Northern California Forest Yield Cooperative
Department of Forestry and Resource Management
University of California, Berkeley, CA 94720

Research Note No. 29 (revised) August 13, 1990

PERMCHECK

A permanent plot data checking program

Version 2.0

by

Pamela D. Swartz, Greg S. Biging, and Timothy A. Robards

ABSTRACT

PERMCHECK is a minimally interactive computer program designed to help the forest manager determine reasonable 5-year growth changes for trees in mixed conifer stands in Northern California. The program, written in Standard Fortran 77, is structured to operate with permanent plot data, such as that used by the Northern California Forest Yield Cooperative at the University of California, Berkeley.

Permcheck compares the values of DBH, total height, height-to-crown base and other plot and tree characteristics to a set of acceptable limits. The growth limits and tree measurement ratios in the program are results of extensive hand-editing of tree data on permanent plots as well as results from stem analysis research.

The authors are, respectively, Laboratory Assistant, Associate Professor, and Assistant Specialist, with the Department of Forestry and Resource Management, University of California, Berkeley, 94720. This research was supported in part by the Northern California Forest Yield Cooperative and McIntire-Stennis Projects 3679-MS and 3815-MS. We also wish to acknowledge the contributions of Dr. Lee Wensel and the cooperators in helping to define the specifications for edit checking.

TABLE OF CONTENTS

I INTRODUCTION

Permcheck is a computer program designed to help the forest manager determine reasonable 5-year growth changes for trees in mixed conifer stands in Northern California. The program, written in Standard Fortran 77, is structured to analyze the permanent plot data collected by the Northern California Forest Yield Cooperative at the University of California, Berkeley and requires only minimal interaction to use. For more information on the field measurement and plot establishment techniques, refer to the attached permanent plot establishment instructions and remeasurement plot field sheet, dated January 10, 1979, (Appendix F).

Permcheck compares the values of DBH, total height, height-to-crown base and other plot and tree characteristics to a set of acceptable limits. It also examines growth values to see if changes in tree characteristics are within reasonable ranges for specific height and DBH classes for a given Dunning crown class. Other consistency tests are performed to insure, for example, that species, Dunning classification, and plot assignment do not change over the measurement interval. The growth limits and tree measurement ratios in the program are derived from extensive hand-editing of tree data on permanent plots, as well as from experience with stem analysis. Our comparisons show that Permcheck quickly identifies the same trees for field verification that a careful office review by a well-reasoned forester would uncover.

Measurement error may be caused by transcription error, systematic error, random error, or damage to the tree in the intervening time since its first measurement. In this program, systematic and random errors are unlikely to be detected unless they are large enough to cause the tree to be considered unusual (such as in comparison to a height-diameter relationship). Transcription errors are often detected since transposing a DBH from 16 to 61 either places it out-of-range or significantly changes its height-diameter ratio. If a tree has incurred damage since its first measurement, such as a broken or dying top, Permcheck will recognize this fact by changing the tolerance of acceptable values for growth and will ignore the check on the height-diameter relationship. Thus, while Permcheck will not detect all possible errors, it identifies measurements that are sufficiently atypical to warrant further investigation.

The data acquisition and checking process has several phases. First, data are obtained by measuring field plots. The tree and plot measurements are put into electronic form and are usually edited upon entry. Permcheck is then used to examine the initial and subsequent permanent plot measurements.

Questionable tree and plot values are identified by Permcheck for further investigation. These trees are revisited, where appropriate, to determine the legitimacy of their recorded values. The process of re-entering and re-editing the data and using Permcheck can be continued until the manager is satisfied with the reasonableness of the collected data.

To run Permcheck, the user must input two tree files (Section III.B); with each tree file containing measurements from the same trees and any ingrowth trees. The tree file representing the first measurement period (t=0), is TREE1.DAT. The tree file representing the second measurement period (t=5), is TREE2.DAT. Permcheck compares the data in TREE1.DAT to the data in TREE2.DAT, plot by plot; tree by tree, and creates two output files: a verification file (TREE.VER) and a change in status file (TREE.STA). These output files supply the user with information about the validity of the initial and remeasurement data, as well as alert the user to possible transcription and data entry errors (Section III.3).

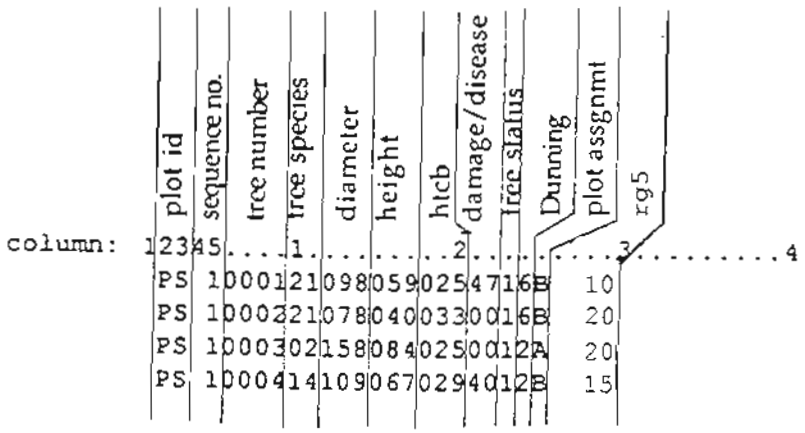
II. PROGRAM DESCRIPTION

The criteria used in Permcheck for comparing individual trees listed in TREE1.DAT and TREE2.DAT are valid for young-growth mixed conifer stands, measured 4-6 years apart[1]. This section is a description of Permcheck's criteria for checking trees and gives reasons for listing individual trees in the verification file (TREE.VER) and in the change in status file (TREE.STA).

A. Checks on data format and accepted values

In order for Permcheck to use individual tree data, the data must be entered into the computer in the appropriate format, as well as include variables within acceptable values. The initial verification checks run on the tree data select out incorrect formatting and inappropriate data values. Table 1 is an example of a tree file. The format is correct and there are no unacceptable values.

Table 1. Tree File Example



1. Tree Number

Each tree is listed in TREE1.DAT and TREE2.DAT with a 4-digit number (columns 6-9). If the tree numbers are not identical in both tree files (e.g. TREE1.DAT lists tree number forty as '0040'; TREE2.DAT lists the same tree as '_ _40'), Permcheck will treat each entry as a separate tree. Tree '0040' in TREE1.DAT will appear in the verification file (TREE.VER) as not remeasured, and tree '_ _ 40' in TREE2.DAT will be listed as ingrowth in the TREE.VER file. This is an example of a data entry error discovered by Permcheck.

---

[1] Permcheck was written to analyze data from five year remasurements on permanent plots. Therefore, this program is most accurate when measurements are as close as possible to this cycle. However, the period lenght is adjustable within the program.

2. Tree Species Code

Each tree is listed with a 2-digit species code (columns 10-11) in each tree file. Since each tree species is assigned a code, only the codes listed in Table 2 are valid. Also, because a tree does not change species during a 5-year growth cycle, a tree's species code is assumed to remain the same from one measurement sequence to the next. If a species code has changed, it is usually due to encoding errors.

Table 2. Species Codes

Species Code	Species
01	Ponderosa Pine
02	Sugar Pine
03	Lodgepole Pine
04	White Pine
05	Jeffery Pine
12	Incense Cedar
14	Douglas-Fir
21	White Fir
22	Red Fir
39	Hardwood, Misc.
42	Chinquapin
46	Black Oak
47	Tan Oak
50	Conifer, Misc.

Permcheck will list a tree with a '**verify species code**' message in the verification file (TREE.VER) for the following reasons:

1. Species $Code_1$ is not equal to Species $Code_2$
2. The species code is missing for the tree in either TREE1.DAT or TREE2.DAT file
3. The species code listed is not valid (Table 2).

A manager may use a different set of species codes by changing the Parameter statement in the TREEPROC subroutine in the source code. The program then would need to be recompiled and linked to form the new executable named "**permchek**".

3. Dunning Classification

A 1-digit Dunning classification code is entered for each tree in both tree data files. As with tree species code, only acceptable values are allowed. Table 3 lists the 1-digit Dunning classification codes (column 24), along with a brief description, typical age and DBH ranges, and top and bark characteristics.

Table 3. Dunning Classification codes (taken from J. R. Dilworth, 1987. Log scaling and timber cruising. O.S.U. Book Stores, Inc. Corvallis, Oregon.)

Dunning Code	Tree Description	Age (years)	DBH (inches)	Top	Bark
1	Immature, dominant	60-150	< 30	Pointed	Dark
2	Immature, codominant	60-150	< 24	Pointed	Dark
3	Mature, dominant	150-300	18-40	Rounded	Lt. brown or yellow
4	Mature, codominant	150-300	---	Rounded	Lt. brown or yellow
5	Overmature, dominant	> 300	12-15	Flat	Lt. yellow
6	Immature, intermediate or suppressed	60-150	---	Pointed	Dark

Permcheck will list a tree with a '**verify Dunning Classification**' message in the verification file (TREE.VER) for the following reasons:

1. Dunning Classification$_1$ does not equal Dunning Classification$_2$. (This may be legitimate, but in general we expect no change in a 5-year period)
2. The Dunning Classification is missing for the tree in either file TREE1.DAT or TREE2.DAT
3. The Dunning Classification listed does not meet the limits of DBH as shown in Table 3.

4. Damage and Disease Codes

Most trees incur some type of damage or disease over their lifespan. Therefore, it is necessary to denote damage and disease characteristics for each tree listed in the data files. Permcheck identifies the trees with out-of-range damage and/or disease codes. Table 4 lists the 2-digit damage/disease codes (columns 21 and 22) used in each tree list. Since there are two columns for codes there can be two damage/disease codes for each tree.

Table 4. Acceptable Damage and Disease Codes used in Permcheck

Damage/Disease Code	Source of Damage
1	Insect (crown)
2	Insect (bole)
3	Conks
4	Mistletoe
5	Fire
6	Bole Scar
7	Broken or Dying Top
8	Other Crown Damage (Note)
9	Other Bole Damage (Note)

Permcheck will list a tree with a '**verify Damage/Disease Code**' message in the verification file (TREE.VER) for the following reasons:

1. The Damage/Disease code listed is not an accepted value (Table 4)
2. The tree is listed with a damage/disease code of 7 and/or 8 (crown damage) and change in height is greater than 4 feet.

5. Plot Assignments

The 1-digit Plot Assignment codes (column 25) used in each tree list are A, B, and C.

Table 5. Plot Assignment Codes

Typical User-Specified Plot Sizes	Typical Minimum Diameter Measured on Plot or Subplot	Type of Plot	Diameter Limits
A (0.2 acre)	11.1 "	Main plot	11.1 - 40 "
B (0.1 acre)	6.1 "	Growth plot	6.1 - 40 "
C (0.05 acre)	2.0 "	Reproduction plot	2.0 - 40 "

The plot size is the smallest plot or subplot (A, B, or C) in which the tree is located. For example, a 20" tree growing in the reproduction plot (C) has plot size C. If it is not in the reproduction plot, but is in the growth subplot (B), it has plot size B. If it is in neither subplot, it is in the main plot (A). Permcheck will list a tree with a '**verify Plot Assignment**' message in the verification file (TREE.VER) for the following reasons:

1. Plot Assignment at time 1 does not equal Plot Assignment at time 2;
2. The Plot Assignment is missing for the tree in either TREE1.DAT or TREE2.DAT;
3. The Plot Assignment listed is not an accepted value (A, B, or C)
4. The diameter of the tree listed is not within the plot diameter limits for the Plot Assignment (Table 5 and Section III.1). If this is true, a **'verify diameter'** message is also listed. Both plot assignment and diameter are listed for verification because it is not known which measurement may be in error.

B. Diameter, height, and height-to-crown base checks

The diameter, height, and height-to-crown base measurement checks are separated into 2 categories:

1. Absolute value checks; and
2. Checks on growth values.

1. Absolute value checks

For diameter, height, height-diameter relationships, and height-to-crown base measurements, a minimum or a maximum value has been established for change over a five year period. Tree values that have been entered (in either tree file) which fall outside the acceptable bounds are listed in the verification file.

a. Diameter

All trees, regardless of species, must have a diameter between 0-40". This assumes that a diameter value is entered for each tree, in both tree files, and that the listed trees are intended for logging before reaching 40" in diameter.

b. Height

Hardwoods are the only tree species checked for absolute height values. Hardwood heights greater than 50 feet result in a **'verify total height'** message in the TREE.VER listing.

c. Height-Diameter Relationships

For all species, except hardwoods, a relationship between height and diameter exists, based upon the tree's species and its diameter value. These relationships are summarized in Table 6.

Table 6. Height/Diameter Relationships - Absolute Value Checks

Species	Diameter	Upper Height Limit	Lower Height Limit
All species, excluding Hardwoods	< 6"	4 + (6 DBH)	3 + (2 DBH)
Douglas-Fir *	> 6"	25 $\sqrt{DBH}$	10 $\sqrt{DBH}$
All other species, * excluding Hardwoods and Douglas-Fir	> 6"	31 $\sqrt{DBH}$	10 $\sqrt{DBH}$

* The stem analysis data base was used to estimate height as a function of diameter. Upper and lower bounds were modelled as $H_U = b_1 \sqrt{DBH}$ and $H_L = b_2 \sqrt{DBH}$.

If a tree's total height does not fall between the diameter-based upper and lower height limits, a '**verify total height and diameter**' message will be listed for the tree in the verification file (TREE.VER). Both the diameter and total height are listed for verification because it is not known which measurement needs validation, since a relationship is assumed to exist between these two measurements.

NOTE: Trees listed with damaged crowns (code 7 or 8 in columns 21 and/or 22) are not subjected to the height/diameter check.

d Height-to-crown base

The height-to-crown base is the distance from the ground surface to the base of the tree crown. The crown length is the distance from the base of the tree crown to the top of the tree.

For all species, Permcheck will list a tree with a '**verify Height to Crown Base**' message in the

verification file (TREE.VER) for the following reasons based upon experience from editing the data:

1. The height-to-crown base measurement is missing for the tree in either TREE1.DAT or TREE2.DAT;
2. The height-to-crown base measurement is greater than the tree's total height;
3. The crown length [Total Height - (height-to-crown base)] is less than or equal to 2 feet;
4. The height-to-crown base measurement is less than 15 feet for a tree greater than 40 feet in total height;
5. The height-to-crown base measurement is less than 4 feet for a tree less than 40 feet in total height.

2. Checks on Growth Changes

Since there is a 4-6 year growth increment between the tree measurement periods, it is important for Permcheck to verify the possible changes due to growth and mortality that can and do occur in a forest. The changes in a tree's diameter, height, and height-to-crown base from one measurement period to the next are assumed to be from mortality, logging, and tree growth. In particular, tree growth is related to site quality and tree competition. Since site quality is relatively constant for all trees on a given plot, the tree's Dunning classification becomes an important tool for determining reasonable growth changes over a 5-year period. Consequently, the allowable growth changes in Permcheck are directly related to the tree's Dunning classification. These guides were derived from extensive experience gained in office editing the remeasurement data.

a. Diameter, height, and height-to-crown base

Permcheck requires changes of equal or reasonable magnitude between diameter, height, and height-to-crown base. Table 7 shows the required height change for a given diameter change.

Table 7. Required height changes for given diameter changes

Dunning Class	Required height change	when diameter change is:
1,2,3	10.0-12.0 ft	2.0-2.5 in
1,2,3	6.0-10.0 ft	1.0-1.9 in
1,2,3	4.0-7.0 ft	0.5-0.9 in [2]
4,5,6	4.0-7.0 ft	0.5-1.2 in
4,5,6	0.0-3.0 ft	0.0-0.4 in

Table 8 shows the required growth changes for trees with damaged crowns.

Table 8. Required Height Growth Changes for Trees with Damaged Crowns All Species.

Dunning Class	Required height change	when diameter change is:
1,2,3	-5.0 - +5.0 ft	0.5-2.5 in [2]
4,5,6	-5.0 - +5.0 ft	0.0-1.2 in

* Note that trees with damaged crowns are not screened with the height-diameter relationships specified in Table 6.

Table 9 shows the maximum allowable growth changes for all species and all Dunning classes.

Table 9. Maximum Allowable Growth Changes from Measurement 1 to Measurement 2 - all Dunning classes and all species

Variable	Maximum Change
Change in Diameter	2.5 inches
Change in Height	12.0 feet
Change in Height-to-crown base	-5.0 to +15.0 feet

Trees listed with missing measurement data in either TREE1.DAT or TREE2.DAT are omitted from these screening processes, and are subsequently listed in TREE.VER with the appropriate '**verify "missing measurement"**' message.

[2] Notice that a tree which grows 0 - 0.49 inches in diameter will not be flagged.

If **corrections** were made to the previous measurements (Section III.B), the corrected values are used (instead of the values listed in TREE1.DAT) for determining allowable growth changes according to the criteria above.

b. Ingrowth

If a tree is listed in TREE2.DAT but is not listed in TREE1.DAT, Permcheck assumes this tree is ingrowth, and lists it with an '**ingrowth**' message in TREE.VER.

c. Status

The codes for tree status are listed in column 23 of the tree file.

1 = alive

2 = dead from natural mortality factors

3 = logged/harvested.

Trees entered in TREE2.DAT with a change of status, either 2 (dead) or 3 (logged), are listed in the second output file, the change in tree status file, (TREE.STA), but are not checked for validity of tree dimensions and growth values. Trees are listed by plot identification and tree number. The change in status file, TREE.STA, supplies the user with a summary list of trees whose status has changed since the first measurement (Appendix E).

III. HOW TO RUN PERMCHECK

A. Running the Program

After loading Permcheck.exe. the 2 input tree files (TREE1.DAT and TREE2.DAT), and any configuration file you wish to use, type '**Permcheck**' at the prompt (C:\ if on a hard disk system). You are first given the option of entering the configuration routine. If you wish to load your own configuration file, change the default configuration, or save a configuration file then type 'y'. Next supply the names of the tree files (eg TREE1.DAT and TREE2.DAT). Supply the names of the verification file (eg. TREE.VER) and the name of the status file (eg. TREE.STA). As Permcheck analyzes each plot, the plot identification code is listed on the computer screen. When the analysis is successfully completed, the following message appears: **'NORMAL PROGRAM COMPLETION"**.

B. Input Files Format

Table 10 shows an example using the proper format for each input tree file.

Table 10(a). Proper Format for TREE1.DAT Tree File

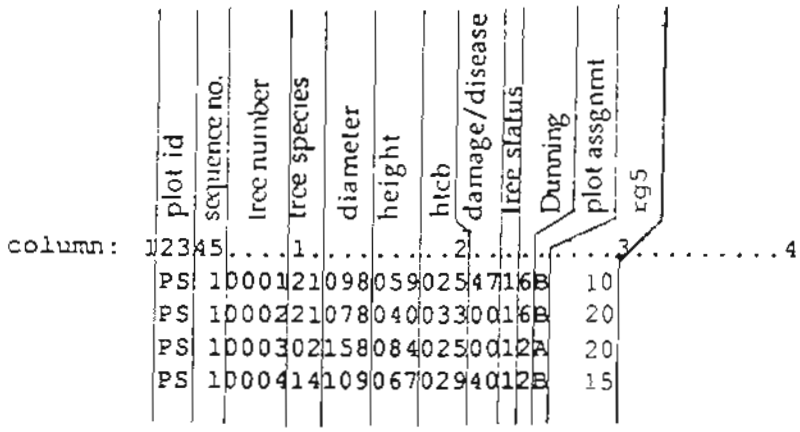


Table 10(b). Proper Format for TREE2.DAT Tree File

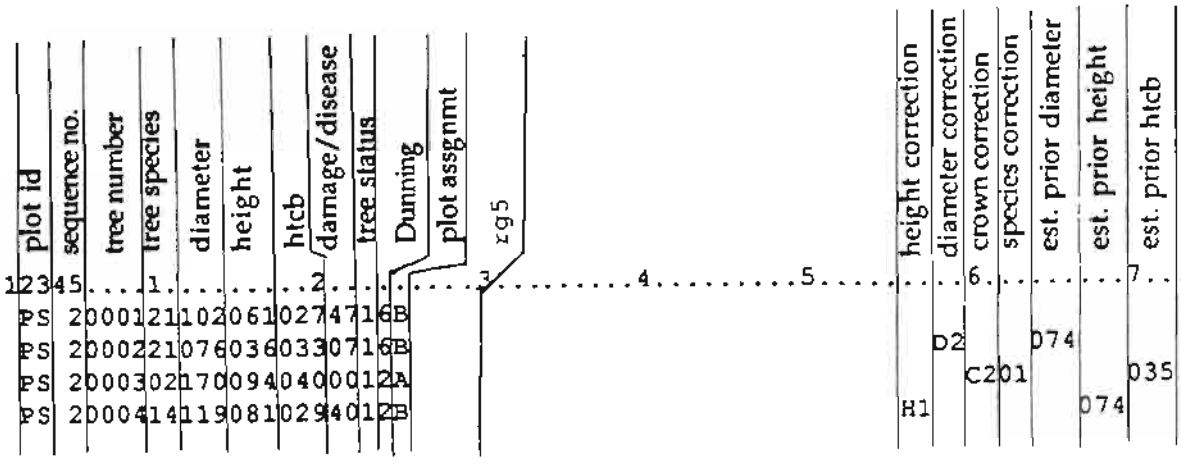


Table 11 lists the column number and variable description for the tree files listed in Table 10.

Table 11. Tree File Description

Column	Variable	Example
1	Blank space	
2-3	Plot identification code	PS
4	Blank space	
5	Measurement sequence number	2 (second measurement)
6-9	Tree number	0001
10-11	Tree species code	21 (white fir)
12-14	Tree diameter (DBH * 10)	102 (10.2")
15-17	Tree total height	061 (61')
18-20	Tree height-to-crown base	027 (27')
21-22	Damage/disease codes	47 (4 = mistletoe) (7 = broken top)
23	Tree status	1 (alive)
24	Dunning classification	6 (suppressed)
25	Plot assignment	B
26	Blank space	
27-29	5-year radial increment	025

ERROR CODES These may be listed for some trees - ONLY IN SECOND MEASUREMENT

Column	TREE FILE (TREE2.DAT) Variable	Example
56-57	Height error correction code	H1 (transcription error likely)
58-59	Diameter error correction code	D2 (no evident reason)
60-61	Height-to-crown base error correction code	C2 (no evident reason)
62-63	New species code	01 (Ponderosa pine)
64-66	Estimated prior diameter (DBH * 10)	074 (7.4")
67-69	Estimated prior total height	074 (74')
70-72	Estimated prior height-to-crown base	035 (35')

Columns 2-3: Plot Identification Code

The plot identification code may be any 2-digit combination of characters (e.g. integer and/or letter). Do not replicate plot identification codes within the same tree file: i.e. do not assign the identical identification code to 2 or more plots. The identification code assigned to a specific plot must be identical in both TREE1.DAT and TREE2.DAT. This includes upper and lower case characters. If a plot is identified in TREE1.DAT as Plot "AB" and identified in TREE2.DAT as Plot "Ab", Permcheck will assume Plots "AB" and "Ab" are separate plots.

Column 5: Measurement Sequence Number

The measurement sequence number identifies the measurement period of the input tree file. Each tree listed in the first measurement tree file (TREE1.DAT) must have a '1' entered in column 5. Each tree listed in the second measurement tree file (TREE2.DAT) must have a '2' entered in column 5. However, after 4 measurement periods, 4 tree files will exist, each containing 5-year growth measurements for the same plots. Consequently, the tree files will be:

TREE1.DAT [initial measurement period $_{(t = 0)}$, column 5 = 1],
TREE2.DAT [first remeasurement period $_{(t = 5)}$, column 5 = 2],
TREE3.DAT [second remeasurement period $_{(t = 10)}$, column 5 = 3], and
TREE4.DAT [third remeasurement period $_{(t = 15)}$, column 5 = 4].

To run Permcheck, it is necessary to enter the names of the 'old' and 'new' tree files. The 'old' tree file's measurement sequence number must be less than the 'new' tree file's measurement sequence number. Thus, to compare TREE3.DAT to TREE4.DAT using Permcheck, enter TREE3.DAT as the "old" tree file and TREE4.DAT as the "new" tree file. Even though TREE2.DAT's measurement sequence number (2) is less than TREE4.DAT's (4) measurement sequence number, it is not possible to compare TREE2.DAT to TREE4.DAT (representing a 10-year growth change), because Permcheck is only valid for approximately 5-year growth changes.

Columns 6-9: Tree Number

The tree number identifies each tree within each plot of the input tree files. Like the plot identification code, the tree number must be the same for a specific tree in both tree lists. If the tree numbers are not identical in both tree files (e.g. TREE1.DAT lists tree number forty as '0040'; TREE2.DAT lists the same tree as '_ _40'), Permcheck will treat each entry as a separate tree. Tree '0040' in TREE1.DAT will appear in the verification file (TREE.VER) as not remeasured, and tree '_ _40' in TREE2.DAT will be listed as ingrowth in the TREE.VER file.

Columns 10-11: Tree Species Code

The tree species code identifies the species for trees listed in the tree files. Table 2 lists the legitimate 2-digit tree species codes. These may be altered in the source code.

Columns 12-14: Tree Diameter

The tree diameter is measured and entered to the nearest tenth of an inch. The diameter is entered in both tree files without a decimal point, and is 3 digits (right justified). Therefore, a diameter of 9.8" is entered as '098.' A diameter of 19.0" is entered as '190.' During analysis, Permcheck will convert the entered diameter (without the decimal) to decimal form.

Columns 15-17: Tree Total Height

The tree total height is measured and entered to the nearest foot. It is entered as 3 digits right justified. Therefore, a total height of 45' is entered as '045.' A total height of 103' is entered as '103.'

Columns 18-20: Tree Height-to-Crown Base

The tree height-to-crown base is measured and entered to the nearest foot. It is entered as 3 digits right justified. Therefore, a height-to-crown base of 15' is entered as '015.' A height-to-crown base of 100' is entered as '100.'

Columns 21-22: Damage/Disease Codes

The damage/disease codes supply supplemental information about the health and vigor of an individual tree. Table 4 lists the legitimate 2-digit damage/disease codes.

Column 23: Tree Status

The codes for tree status are:

1 = alive
2 = dead from natural mortality factors
3 = logged/harvested.

Column 24: Dunning Classification

Table 3 lists the valid Dunning classification codes.

Column 25: Plot Assignment

The plot assignment codes are A, B, and C. These may be altered in the configuration routine.

Columns 27-29: 5-year radial increment

The tree radial increment is measured and entered to the nearest tenth of an inch. The tree radial increment is entered in both tree files without a decimal point, and is 3 digits (right justified). Therefore, an increment of 1.5" is entered '015'. This information is optional as Permcheck performs no check with this data, but a check may be coded in by the user.

Columns 56-72: Corrections to Previous Measurement

The descriptions for columns 1-25 are identical for TREE1.DAT and TREE2.DAT. However, columns 56-72 are different. For TREE1.DAT, columns 56-72 are blank. For TREE2.DAT, these columns may contain corrections to the previous tree measurements. If the comparison is between say TREE3.DAT and TREE4.DAT, the presence of data in columns 56-72 of TREE3.DAT will be ignored.

During remeasurement, errors in the previous tree measurements (diameter, total height, height-to-crown base, or species code) may have been detected. These errors may be results of transcription errors, or inaccurate measurements because of tree deformation (e.g. logging damage to the bole at breast height, thus decreasing the actual tree diameter). Consequently, for trees with errors in the first measurement, error correction codes may be listed in the remeasurement tree file, accompanied with an estimated prior value (an estimate of the actual measurement value during the prior measurement period). For more information, refer to the attached "Instructions for Remeasurement of the Coop Permanent Plots," dated 5/29/85 (Appendix G).

Table 12 lists the error correction codes used in the second tree list.

Table 12 - Error Correction Codes

HEIGHT ERROR CODE		DIAMETER ERROR CODE		CROWN BASE ERROR CODE	
Code	Reason for error	Code	Reason for error	Code	Reason for error
H1	transcription error	D1	transcription error	C1	transcription error
H2	no evident reason	D2	no evident reason	C2	no evident reason
H3	broken top	D3	logging damage	C3	branch loss from logging
H4	snow damage	D4	fire damage	C4	density induced branch loss
H5	top die-back	D5	missing tree tag	C5	crown not balanced on prior measurement
H6	other: describe	D6	other: describe	C6	other: describe

C. Debugging Input Files

Following is a list of common errors in the tree input files, which will result in an unsuccessful analysis by Permcheck.

Table 13. Common Errors in Tree Input Files

1. Duplicate *plot identification codes* in the same tree list.
2. Duplicate *tree numbers* within the same plot, in either tree list.
3. Nonidentical *plot identification codes* used in both tree lists.
4. Nonidentical *tree numbers* within the same plot, used in both tree lists.
5. Unequal *number of plots* between both tree lists.
6. A *blank line* in either tree list.
7. *Data entered* in the incorrect columns and/or incorrect format, in either tree list.

D. Description of Permcheck's Output Files

Permcheck creates 2 output files: a verification file (TREE.VER) and a change in status file (TREE.STA).

TABLE 14. Verification File Example

PLOT ID: EM

```
TR#  SPP DBH   THT   HTC  DD1 DD2 STS DUN PSZ DEC HEC CEC  NDB   NHT   NHC VERIFICATION MESSAGES
-------------------------------------------------------------------------------------------------
0020 12  3.5  12.0  7.0   0   0   1   6   C              0.0   0.0   0.0 ***** OLD DATA *****
0020 12  3.8  13.0 11.0   0   0   1   6   C              0.0   0.0   0.0 ***** NEW DATA *****

                                                                  VERIFY HT TO CR BASE
-------------------------------------------------------------------------------------------------
0023 12  4.6  17.0  8.0   0   0   1   6   C              0.0   0.0   0.0 ***** OLD DATA *****
0023 12  4.9  25.0 12.0   0   0   1   6   C              0.0   0.0   0.0 ***** NEW DATA *****

                                                                  VERIFY DIAMETER   TOTAL HEIGHT
-------------------------------------------------------------------------------------------------
0039  1 17.3 104.0 49.0   0   0   1   2   A              0.0   0.0   0.0 ***** OLD DATA *****
0039  1 18.6  97.0 51.0   0   0   1   2   A         H2   0.0  92.0   0.0 ***** NEW DATA *****

                                                                  VERIFY DIAMETER   TOTAL HEIGHT
                                                                  VERIFY HT CORRECTION
-------------------------------------------------------------------------------------------------
```

Table 15 explains the column headings used in the verification file.

Table 15. Verification File Headings

Heading	Explanation
TR#	Tree number
SPP	Tree species code
DBH	Tree diameter (inches)
THT	Tree total height (feet)
HTC	Tree height-to-crown base (feet)
DD1	The first damage/disease code
DD2	The second damage/disease code
STS	Tree status
DUN	Dunning classification
PSZ	Plot assignment
DEC	Diameter error correction code
HEC	Height error correction code
CEC	Height-to-crown base error correction code
NDB	Estimated prior diameter (0.0 = not estimated)
NHT	Estimated prior total height (0.0 = not estimated)
NHC	Estimated prior height-to-crown base (0.0 = not estimated)
VERIFICATION MESSAGES	Verification messages listed for tree

The tree data listed on the 'OLD DATA' line in the verification file (TREE.VER) refers to the first measurement. The data listed on the 'NEW DATA' line refers to the second measurement.

The change in status file, TREE.STA, lists the trees whose status has changed since the first measurement. The trees are listed by plot identification, tree number, and their new status as listed in TREE2.DAT (Appendix E).

IV. APPENDICIES

A. Permcheck Sample Runstream

Boldface indicates user entry

```
C:\: Permcheck
```

Welcome To
PERMCHECK

This program is a product of the Northern California Forest Yield Cooperative.
See Research Note No. 28 for detailed information.

Do you wish to enter the configuration routine? (y/n):**n**

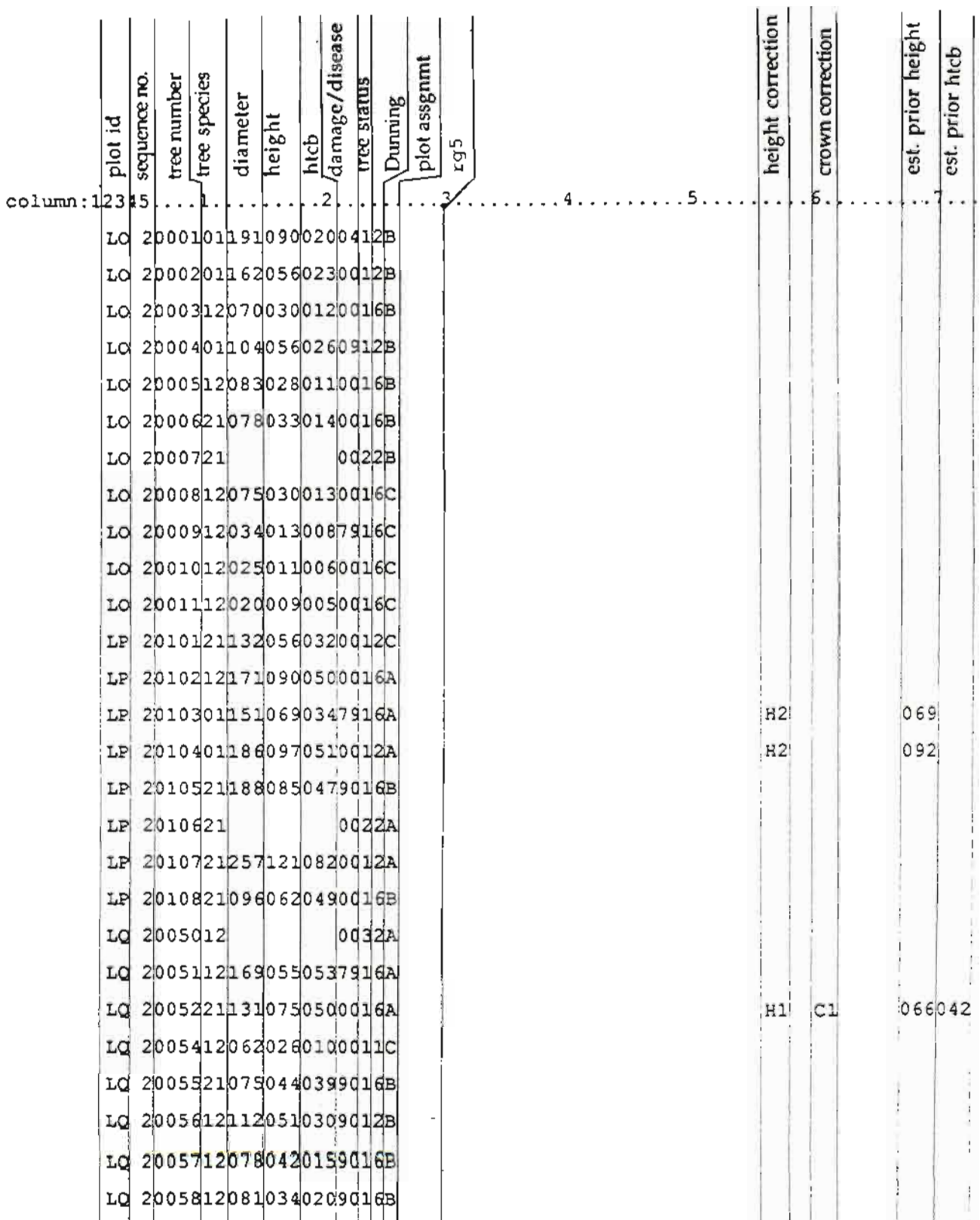
```
Enter OLD tree data file name:  tree1.dat

Enter NEW tree data file name:  tree2.dat

Enter treelist output file name:  tree.ver

Enter status file name:  tree.sta


UCID:  LO
UCID:  LP
UCID:  LQ
NORMAL PROGRAM COMPLETION

C:\:
```

B. First Measurement Tree List (Tree1.Dat)

column: 12345....1.........2.........3..........4

plot id	sequence no.	tree number	tree species	diameter	height	htcb	damage/disease	tree status	Dunning	plot assgnmt	rg5
LO	1	0001	01	188	086	020	00	1	2	B	
LO	1	0002	01	151	050	028	00	1	1	B	
LO	1	0003	12	066	024	006	00	1	6	B	15
LO	1	0004	01	095	047	020	00	1	2	B	40
LO	1	0005	12	077	023	011	00	1	6	B	20
LO	1	0006	21	065	022	009	00	1	6	B	40
LO	1	0007	21	115	034	006	00	1	2	B	55
LO	1	0008	12	068	024	006	00	1	6	C	35
LO	1	0009	12	031	012	009	09	1	6	C	5
LO	1	0010	12	025	008	006	00	1	6	C	5
LP	1	0101	21	118	046	017	00	1	2	C	
LP	1	0102	12	162	090	045	00	1	6	A	
LP	1	0103	01	148	092	045	00	1	6	A	
LP	1	0104	01	173	104	049	00	1	2	A	
LP	1	0105	21	178	081	038	00	1	6	B	
LP	1	0106	21	278	136	083	00	1	2	A	
LP	1	0107	21	245	120	086	00	1	2	A	
LP	1	0108	21	096	045	031	00	1	6	B	
LQ	1	0050	12	322	116	071	00	1	2	A	
LQ	1	0051	12	167	057	048	00	1	6	A	
LQ	1	0052	21	130	086	062	00	1	6	A	
LQ	1	0053	12	145	050	017	01	1	1	C	
LQ	1	0054	12	044	016	007	00	1	6	C	60
LQ	1	0055	21	070	042	020	00	1	6	B	15
LQ	1	0056	12	095	050	020	00	1	2	B	30
LQ	1	0057	12	068	037	018	00	1	6	B	30
LQ	1	0058	12	075	029	010	09	1	6	B	30

C. Second Measurement Tree List (Tree2.Dat)



column: 12345	plot id	sequence no.	tree number	tree species	diameter	height	htcb	damage/disease	tree status	Dunning	plot assgnmt	rg5	height correction	crown correction	est. prior height	est. prior htcb
	LQ	20001	01	19	10	90	02	00	41	2B						
	LQ	20002	01	16	20	56	02	30	01	2B						
	LQ	20003	12	07	00	30	01	20	01	6B						
	LQ	20004	01	10	40	56	02	60	91	2B						
	LQ	20005	12	08	30	28	01	10	01	6B						
	LQ	20006	21	07	80	33	01	40	01	6B						
	LQ	20007	21					00	22	2B						
	LQ	20008	12	07	50	30	01	30	01	6C						
	LQ	20009	12	03	40	13	00	87	91	6C						
	LQ	20010	12	02	50	11	00	60	01	6C						
	LQ	20011	12	02	00	09	00	50	01	6C						
	LP	20101	21	13	20	56	03	20	01	2C						
	LP	20102	12	17	10	90	05	00	01	6A						
	LP	20103	01	15	10	69	03	47	91	6A			H2		069	
	LP	20104	01	18	60	97	05	10	01	2A			H2		092	
	LP	20105	21	18	80	85	04	79	01	6B						
	LP	20106	21					00	22	2A						
	LP	20107	21	25	71	21	08	20	01	2A						
	LP	20108	21	09	60	62	04	90	01	6B						
	LQ	20050	12					00	32	2A						
	LQ	20051	12	16	90	55	05	37	91	6A						
	LQ	20052	21	13	10	75	05	00	01	6A			H1	C1	066	042
	LQ	20054	12	06	20	28	01	00	01	1C						
	LQ	20055	21	07	50	44	03	99	01	6B						
	LQ	20056	12	11	20	51	03	09	01	2B						
	LQ	20057	12	07	80	42	01	59	01	6B						
	LQ	20058	12	08	10	34	02	09	01	6B						

D. Verification File (Tree.Ver)

```
PLOT ID: LO

 TR#   SPP DBH   THT   HTC   DD1 DD2 STS DUN PSZ DEC HEC CEC     NDB    NHT    NHC VERIFICATION MESSAGES
-------------------------------------------------------------------------------------------------------
0002    1 15.1    50    28     0   0   1   1   B                .0      0      0 ***** OLD DATA *****
0002    1 16.2    56    23     0   0   1   2   B                .0      0      0 ***** NEW DATA *****

                                                                              VERIFY DUNNING CLASS

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

0003   12  6.6    24     6     0   0   1   6   B                .0      0      0 ***** OLD DATA *****
0003   12  7.0    30    12     0   0   1   6   B                .0      0      0 ***** NEW DATA *****

                                                                  VERIFY CHANGE IN TOTAL HEIGHT

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

0004    1  9.5    47    20     0   0   1   2   B                .0      0      0 ***** OLD DATA *****
0004    1 10.4    56    26     0   9   1   2   B                .0      0      0 ***** NEW DATA *****

                                                                  VERIFY CHANGE IN TOTAL HEIGHT

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

0005   12  7.7    23    11     0   0   1   6   B                .0      0      0 ***** OLD DATA *****
0005   12  8.3    28    11     0   0   1   6   B                .0      0      0 ***** NEW DATA *****

                                                              VERIFY TOTAL HEIGHT AND DIAMETER

-------------------------------------------------------------------------------------------------------
```

```
0006  21  6.5   22    9    0   0   1   6   B                .0      0      0 ***** OLD DATA *****
0006  21  7.8   33   14    0   0   1   6   B                .0      0      0 ***** NEW DATA *****

                                                          VERIFY TOTAL HEIGHT AND DIAMETER

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

********** TREE 0011 IS INGROWTH **********
0011  12  2.0    9    5    0   0   1   6   C                .0      0      0 ***** NEW DATA *****

-------------------------------------------------------------------------------------------------
```

PLOT ID: LP

TR#	SPP	DBH	THT	HTC	DD1	DD2	STS	DUN	PSZ	DEC	HEC	CEC	NDB	NHT	NHC	VERIFICATION MESSAGES
0102	12	16.2	90	45	0	0	1	6	A				.0	0	0	***** OLD DATA *****
0102	12	17.1	90	50	0	0	1	6	A				.0	0	0	***** NEW DATA *****
																VERIFY CHANGE IN TOTAL HEIGHT
0103	1	14.8	92	45	0	0	1	6	A				.0	0	0	***** OLD DATA *****
0103	1	15.1	69	34	7	9	1	6	A		H2		.0	69	0	***** NEW DATA *****
																VERIFY CHANGE IN HT-TO-CR BASE
0104	1	17.3	104	49	0	0	1	2	A				.0	0	0	***** OLD DATA *****
0104	1	18.6	97	51	0	0	1	2	A		H2		.0	92	0	***** NEW DATA *****
																VERIFY CHANGE IN TOTAL HEIGHT
0107	21	24.3	120	86	0	0	1	2	A				.0	0	0	***** OLD DATA *****
0107	21	25.7	121	82	0	0	1	2	A				.0	0	0	***** NEW DATA *****
																VERIFY DUNNING CLASS
																VERIFY CHANGE IN TOTAL HEIGHT

```
0108  21  9.6   45   31    0   0   1   6   B                .0     0     0 ***** OLD DATA *****
0108  21  9.6   62   49    0   0   1   6   B                .0     0     0 ***** NEW DATA *****
```

VERIFY CHANGE IN TOTAL HEIGHT

VERIFY CHANGE IN HT-TO-CR BASE

PLOT ID: LQ

TR#	SPP	DBH	THT	HTC	DD1	DD2	STS	DUN	PSZ	DEC	HEC	CEC	NDB	NHT	NHC	VERIFICATION MESSAGES
0051	12	16.7	57	48	0	0	1	6	A				.0	0	0	***** OLD DATA *****
0051	12	16.9	55	53	7	9	1	6	A				.0	0	0	***** NEW DATA *****
																VERIFY CHANGE IN TOTAL HEIGHT
0052	21	13.0	86	62	0	0	1	6	A				.0	0	0	***** OLD DATA *****
0052	21	13.1	75	50	0	0	1	6	A		B1	C1	.0	66	42	***** NEW DATA *****
																VERIFY CHANGE IN TOTAL HEIGHT
********** TREE 0053 IS NOT REMEASURED **********																
0053	12	14.5	50	17	0	1	1	1	C				.0	0	0	***** OLD DATA *****
0054	12	4.4	16	7	0	0	1	6	C				.0	0	0	***** OLD DATA *****
0054	12	6.2	26	10	0	0	1	1	C				.0	0	0	***** NEW DATA *****
																VERIFY DUNNING CLASS

```
0055  21  7.0   42   20    0   0   1   6   B                .0      0      0 ***** OLD DATA *****
0055  21  7.5   44   39    9   0   1   6   B                .0      0      0 ***** NEW DATA *****

                                                          VERIFY CHANGE IN TOTAL HEIGHT
                                                          VERIFY CHANGE IN HT-TO-CR BASE

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

0056  12  9.5   50   20    0   0   1   2   B                .0      0      0 ***** OLD DATA *****
0056  12 11.2   51   30    9   0   1   2   B                .0      0      0 ***** NEW DATA *****

                                                          VERIFY CHANGE IN TOTAL HEIGHT

-------------------------------------------------------------------------------------------------
```

E. Status File (Tree.Sta)

PLOT ID	TREE NUMBER	OLD STATUS	NEW STATUS
LO	0007	1	2
LP	0106	1	2
LQ	0050	1	3

F. Permanent Plot Establishment and Permanent Plot Field Sheet January 10, 1979

MINIMAL REQUIREMENTS FOR PERMANENT PLOT DATA TO BE USED IN PERMCHECK

I. Plot Information

a) Plot size, month/day/year of measurements

b) Township, range, section

c) Aspect

d) Slope percent

e) Elevation

f) Logging history; either

i) uncut

ii) cutover and calendar dates of logging during the last 20 years

g) Ground cover (visual estimates)

h) Site trees

i) Selection: Choose 6 trees, 3 of which are dominants of the most abundant species and 3 of which are dominants of the second most abundant species. If only one species is mainly present, ignore the second set of three site trees. Anything less than three trees of a given species is insufficient. go outside the plot boundaries if necessary to find suitable dominants. If at all possible, choose all young growth trees.

ii) Measurements: The following items should be recorded for each site tree.

- Species
- Diameter
- Total height
- Breast high age

II. Minimal Diameters

Trees should be measured down to 2" DBH. If necessary, a small subplot can be located within plot boundaries (1/20th of an acre) and trees from 2" to the minimum DBH currently used on the major plot can be measured.

III. Harvests

If possible, plots should be measured immediately prior to and immediately after logging.

T|_|_| R|_|_| S|_|_| 40|_|_| Plot#|_|_|_| Date|_|_|/|_|_|/|_|_|

Elev(ft)|_|_|_| Aspect(deg)|_|_|_| Slope(%)|_|_|

Brush Cover(%)|_|_| Brush Ht(ft)|_|_| Site Index|_|

Plot Size(ac): Main Plot(A) .|_|_| Subplot(B) .|_|_| Repro Plot(C) .|_|_|_|

Min.Diam. Measured: Main Plot(A)|_|_|.|_| Subplot(B)|_|.|_| Repro(C)|_|.|_|

Tree No.	Sp	DBH	Height-ft		Damage/ Disease	Status	Dunning Crown Class	*Plot Size	Radial Growth	
			Tot.	Crown					5yr	10yr

Notes:

*The Plot Size is the smallest plot or subplot (A, B, or C) in which the tree is located. For example, a tree growing in the Repro plot(C) has Plot Size C. If it is not in the Repro plot, but is in Subplot(B) has Plot Size B. And if it is in neither subplot, but is in the Main plot(A), record the Plot Size as A.

Site Trees										
Tree No.	Sp	DBH	Total Ht.	BH Age	Ht. Growth			Radial Growth		
					5yr	10yr	15yr	5yr	10yr	15yr

Logging History: Cutting Date(M/Y)[ ][ ]/[ ][ ] Intensity(%)[ ][ ]
Other Information:

Bearing Tree Data		Species	DBH	Bearing	Distance
	1				
	2				
	3				

The plot is _____ Chains, azimuth ____° **FROM** the ____ corner of the section, from _____.

Species Codes

Code	Species	Code	Species
01	Ponderosa Pine	21	White Fir
02	sugar Pine	22	Red Fir
03	Lodgepole Pine	39	Hardwoods Misc.
04	White Pine	42	Chinquapin
05	Jeffrey Pine	46	Black Oak
12	Cedar Misc.	47	Tan Oak
14	Douglas Fir	50	Conifers Misc.

Damage/Disease Codes

Code	Source of Damage	Code	Source of Damage
1	Insect (Crown)	6	Bole Scar
2	Insect (Bole)	7	Broken or Dying Top
3	Conks	8	Other Crown Damage (Note)
4	Mistletoe	9	Other Bole Damage (Note)
5	Fire		

Status Codes

Code	Status
1	Live Tree
2	Dead Tree
3	Harvested Tree

Site Index Codes

Code	Old Growth Site Index
1	A-200
2	I-175
3	II-150
4	III-125
5	IV-100 or poorer

G. Instructions for Remeasurement of the Coop Permanent Plots

This revised document supercedes the handout given at Blodgett May 30,1985. It includes new instructions on formatting error codes and estimates of prior values of height, diameter or height to the crown base into data files to be sent to Berkeley.

The remeasurement data from the permanent plots will be completed this year for most cooperators. We are planning to acquire the remeasurement data for use in updating our predictive equations for CACTOS and for use in estimating mortality and ingrowth. A copy of the plot forms should be sent to us at Berkeley. For those of you without computer facilities, we will encode the data into the permanent plot data base directly from the field forms.

For those of you who will have the data on a computer system we are requesting that you format the data into two files (a plot identifier file and a tree list file) and send it to us on a $5^{1/4}$ inch floppy disk. Of course, we also need a copy of the field forms. The format of the data should be as follows:

PLOT IDENTIFIER FILE

VARIABLE	COLUMNS	[FORMAT]	EXAMPLE
(FIRST LINE)			
township	6-8	[A3]	38N
range	9-11	[A3]	03W
section	12-13	[A2]	02
40th acre (see research note #5 for definition)	14-15	[A2]	12
company plot number	16-19	[A4]	0001
elevation (feet)	26-29	[I4]	2800
aspect (degrees)	30-32	[I3]	156
slope (percent)	33-35	[I3]	020
brush cover (percent)	36-37	[I2]	40
average brush height (ft)	38-39	[I2]	04
main plot size [A] (percent of acre)	41-42	[I2]	20 (1/5 AC)
middle plot size [B] (percent of acre)	43-44	[I2]	10 (1/10 AC)
small plot size [C] (percent of acre)	45-47	[I3]	025 (1/40 AC)
minimum diameter for plot A (diameter*10)	48-50	[I3]	111 (11.1")
minimum diameter for plot B (diameter*10)	51-52	[I2]	61 (6.1")
minimum diameter for plot C (diameter*10)	53-54	[I2]	21 (2.1")
logging history (mm yy)	61-64	[I4]	0770 (JULY, 1970)
intensity of cut (percent)	65-66	[I2]	70 (70%)
(SECOND LINE)			
date of measurement (mm dd yy)	11-16	[I6]	082985

TREE LIST FILE

[with corrections to prior measurements where appropriate]

VARIABLE	COLUMNS	[FORMAT]	EXAMPLE
(ONE LINE PER TREE)			
Company plot number	1-4	[A4]	0055
measurement sequence number	5	[I1]	2 (second measurement)
tree number	6-9	[A4]	0001
species (university codes)	10-11	[I2]	14 (DF)
DBH (measured to 0.1" multiplied times 10)	12-14	[I3]	094 (9.4")
total height (nearest foot)	15-17	[I3]	059
height to crown base (nearest foot)	18-20	[I3]	025
damage codes (up to two codes, 1 digit each)	21-22	[A2]	17 [1=insect;7=broken top]
status	23	[I1]	1 [1=alive]
Dunning crown class	24	[I1]	4
occurence on main, middle or small plot	25	[A1]	C [40th acre plot]
IF PRIOR MEASUREMENT(S) IN ERROR			
height error code	56-57	[A2]	H1
diameter error code	58-59	[A2]	D2
crown base error code	60-61	[A2]	C6
new species code	62-63	[I2]	01
estimated prior DBH (o.b.)	64-66	[I3]	084 (8.4")
(measured to 0.1" multiplied times 10)			
[Note: prior diameter is estimated from			
a 5-year radial increment(o.b.) and bark thickness - See Formula 1 below]			
estimated prior total height (nearest foot)	67-69	[I3]	055
estimated prior height to the crown base (1')	70-72	[I3]	020
(if possible to estimate)			

Formula 1. DBH (o.b.) past = DBH (o.b.)present -(2 x (5-year radial increment)/ K)

where K = the average bark factor = $\Sigma dib / \Sigma dob$ For the mixed conifer species the values of K are approximately:

Species	K
PP	0.84
SP	0.86
DF	0.82
WF	0.89
RF	0.87
IC	0.81

If K values other than those above are used, indicate the values used on the plot sheets.

H. Minimizing Measurement Error During Remeasurement of Permanent Plots

Over 700 permanent plots were established by the cooperative in 1979 and 1980. Summary statistics from these plots are presented in Research Note #5 entitled "Summary of the Coop's databases". These plots are scheduled for their first remeasurement in the latter part of 1984 and 1985. This paper is presented to help resolve several types of errors in measurement which may occur.

Minimization of measurement errors

One common source of measurement error in tree height and height to the crown base occurs when a tree is measured from different locations. This can happen because of varying distances or changes in the ability to sight or locate the tree's top and base. Thus we suggest that you record azimuth and distance from the tree to the observer on the plot forms. Then in future measurements you will always return to the same location to measure height, and thus, eliminate the source of error associated with location. We have included columns for this information on the permanent plot record forms. A discussion of reduction of measurement errors for height, diameter and height to crown base follow the cases outlined below.

Case 1 : The most recent tree measurement is less than or equal to the prior measurement or if in your professional judgement the measured change is too little. [e.g. for total height, this type of error could be manifested when the current measurement is less than or equal to the prior height, or it could happen when a modest height growth is measured, but it is evident that the tree has been growing faster than measured.]

For this case, first check that you have measured the correct tree. For height and height to crown base, recheck your distance and clinometer readings two or three times to assure that your current measurements are correct. For height to the crown base remember to visually balance the crown as shown in the following diagram. In balancing, ignore minor trailing branches. For diameter, if there is no nail and tag on the tree to indicate where to measure DBH, locate breast height and retag the tree. Recheck your diameter readings two or three times. If after multiple checks, the current measurement is still inconsistent with the prior measurement, check for physical damage that could explain the differences (e.g., such as a broken top, die back or snow damage for heights; recent fire or logging damage for diameter; or crown damage for height to the crown base). If physical causes do not explain the inconsistency, then check for some simple transcription error (e.g., a previous height recorded as 121 when 112 is more likely; a diameter

recorded as 12.1 when 11.2 is more likely; or height to the crown base recorded as 67 feet when it likely was 76 feet). If after these procedures there are still discrepencies, then record your current measurement and make your best estimate of what the prior measurement should have been (see guide presented below entitled **"Estimating what the prior measurement should have been"**). In all cases where there was a discrepency record the reason for the discrepency (according to the codes provided).

Case 2 : The most recent tree measurement is much greater than the prior measurement or the measured change is greater than indicated by your professional judgement.

Since there is no exact criterion for determining when there is too much height growth, diameter growth or change in the crown base some professional judgment must be applied. Site index curves can be used to calculate a reasonable upper bound on 5-year height growth. However, individual trees could legitimately be growing faster than the site curves indicate since site curves represent the average height growth of dominant and co-dominant trees. For diameter growth there are no good guidelines, but as an example no trees in the stem analysis data-base grew more than 4.5 inches in diameter in 5 years, and the vast majority grew under 2.5 inches in 5 years.

As in the prior case, the first thing to check is that you have measured the correct tree. For height and height to crown base, recheck your distance and clinometer readings two or three times. For diameter, if there is no nail and tag on the tree to indicate where to measure DBH, locate breast height and retag the tree. Recheck your diameter readings two or three times. If after multiple checks, the current measurement is still inconsistent with the prior measurement, then check for some simple transcription error (e.g., previous measurements of height, diameter and height to the crown base recorded as 112', 11.2" and 67' when it likely that the measurements should have been 121', 12.1" and 76', respectively). If after these procedures there are still discrepencies, then record your current measurement and make your best estimate of what the prior measurement should have been [see section below].

Estimating what the prior measurement should have been

Height

Record your current estimate of height and estimate the past 5 year's height growth by counting down 5 whorls (a pair of binoculars is essential) and use the clinometer to estimate the height 5 years ago. Enter both the current height estimate and your estimate of the height 5 years ago. Record the height error code. The error codes are:

H1 transcription error likely
H2 no evident reason
H3 broken top
H4 snow damage
H5 top die-back
H6 other: _____

A copy of a guide to recognizing annual whorls (from the stem analysis procedures) is attached.

Diameter

Record your current estimate of diameter (o.b.) and core the tree, measure and record the most recent 5-year radial increment (i.b.) and bark thickness. If the tree is out-of-round take the increment from the minor axis (shortest axis). Record the diameter error code. The error codes are:

D1 transcription error likely
D2 no evident reason
D3 logging damage
D4 fire damage
D5 tree missing tag
D6 other: _____

cedar.

5. Sugar pine: Although not observed in this sample, Sugar pine is like ponderosa pine in that there generally is no internodal branching.