

TREE FAILURES AND ACCIDENTS IN RECREATION AREAS :

A Guide to Data Management
for Hazard Control

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PACIFIC
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A data management system has been developed for storage and retrieval of tree failure and hazard data, with provision for computer analyses and presentation of results in useful tables. This system emphasizes important relationships between tree characteristics, environmental factors, and the resulting hazard. The analysis programs permit easy selection of subsets of data for examination of individual species, sites, and other categories of information. Use of this system allows site managers to control hazard at lower cost to both the site and the budget.

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INTRODUCTION

To managers of wooded recreation areas, the safety of the public and protection of site and property are major concerns. Injuries, fatalities, and high property losses occur each year as a result of tree failures on such sites. Complete prevention of accidents is usually not possible without sacrifice of the recreational values of such a site, but an acceptable level of safety can be achieved by modifying the expected losses associated with public occupancy. Hazard reduction can limit such losses to predefined levels consistent with site values and public welfare. Lack of permanent records, however, combined with misunderstanding of the influence of hazard components, has made effective hazard control very costly in the past. Today we have enough data on tree failures to permit most individual agencies to control hazard with predictable results at lower cost.

For a number of years, State and Federal agencies have been recording the details of failures and accidents within their jurisdiction. Many have used this information in their own planning and management, and have also provided copies of it for use in a nationwide research program undertaken by the U.S. Forest Service. The failure reports on which data have been submitted are patterned on U.S. Forest Service Form PSW 4600-3 (*fig. 1*). Generally, tree failures are reported only if they were large enough to inflict injury or property damage. Most of the terms used here have been defined previously,¹ but one or two should be emphasized.

A *tree failure* is the uprooting or breakage of any significant part of a tree, when the failure was not directly caused by logging or construction work.

Hazard, in this context, is the expected dollar loss that will result from mechanical failure of a particular tree during a specific time, such as one year. It depends, in part, on the probability that the tree will fail during a given period, and on the contingent probability that a target will be struck by the tree if it fails. Hazard can only exist, then, if there is a target of value which may be damaged by the failure. The targets under consideration are usually people, fixed or movable property, and agency site improvements.

Loss from damage to the natural site or to the tree itself is not considered in this context.

Because all trees would fail in time, reduction of hazard must be effected by (1) removing part or all of the tree before failure, (2) excluding recreationists or limiting exposure (especially during high-risk periods), or (3) a reasonable combination of these actions. Managers have become increasingly aware of these control options and of the critical factors noted on the report form. Our analyses by species and locality have already begun to concentrate attention on the more dangerous situations. One result has been a consistent annual decrease in the proportion of failures which cause accidents.

In the course of our research on hazard, we have developed a group of computer programs for retrieval and analysis of desired information from the data submitted by cooperating agencies. This user's guide to the programs, in conjunction with the program tape, the coding manual, and the user's own data, will provide a manager with analyses that will greatly assist in identifying problems and in achieving economical control of hazard. During the past years, we have been able to prepare only a limited number of analyses for cooperating agencies. Now, almost any administrator or manager with access to a large computer can carry out his own analyses as needed.

Analyses produced with the data management system described in this manual will provide a manager with information on the relative frequency of failures and accidents, by species; the types of accidents and dollar losses; the classes of failure that have occurred most often; the defects that have most frequently led to failure; and the environmental factors that have triggered failures. In addition, data on diameter classes, time of day, month, site, elevation, and other factors normally recorded can be analyzed to determine their influence. Relations between class of failure, defect, and environmental factors are also available. Because this information can be related to specific areas, the hazard inspector can localize problems and allocate his time and priorities more effectively. The administrator, with a review of statistics for the over-all area, can recommend intensification of efforts where needed and can budget funds to meet defined goals. The site planner can identify those sites with high-risk species or size classes and advise managers to avoid or modify them before making heavy investments on inappropriate locations.

¹ Paine, Lee A. 1971. *Accident hazard evaluation and control decisions on forested recreation sites*. USDA Forest Serv. Res. Paper PSW-68, 10 p., illus. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

REPORT OF TREE FAILURE ^①
(Mechanical break, collapse, or uprooting)

REPORTING AGENCY: _____ UNIT: _____

(A) Tree and stand

Species: _____
Approximate dbh of tree: _____ inches
Approximate age of tree: _____ years
Forest type: _____
Stand age class: ☐ Overmature
 ☐ Mature
 ☐ Young-growth
 ☐ All-age
Elevation of site: _____

(B) Class of mechanical failure

☐ Upper bole (top half)
☐ Lower bole
☐ Butt (lower 6 feet)
☐ Limb
☐ Root, including uprooting

(C) Tree defect or fault leading to failure ^②

☐ Rot (trunk, limb, or root)
☐ Sweep
☐ Tree dead - snag
☐ Fire wound
☐ Leaning
☐ Lightning wound
☐ Mechanical wound
☐ Cracks or splits
☐ Fork or multiple top
☐ Twin bole or basal fork
☐ Dead top or branch
☐ Widow-maker or hang-up
☐ Canker, rust
☐ Canker, mistletoe
☐ Other: _____
☐ Unknown or none

(D) Contributing factors

☐ Wind	☐ Stream bank erosion
☐ Snow	☐ Shallow rooting
☐ Erosion	☐ Tree striking tree
☐ Soil - saturation	☐ Other: _____
	☐ Unknown or none

(E) Time and location of incident

Approximate hour: _____
Month, year: _____
County: _____
State: _____
Site open for public use: Yes ☐ No ☐

(F) Land ownership

☐ Federal
☐ State
☐ Other public: _____
☐ Private
☐ Public utility

(G) Site category

☐ Established camp or picnic ground
☐ Other established public use site ^③
☐ Volunteer site ^④
☐ Marked trail
☐ Special use site ^⑤
☐ Roadside
☐ Residence site ^⑥
☐ Other: ^⑦ _____
☐ Urban

(H) Property or person directly affected

☐ Agency
☐ Recreationist
☐ Forest industry
☐ Permittee-Concessionaire
☐ Other: _____
☐ Contractor
☐ Public utility

(I) Consequences

☐ Clean-up work required
☐ Property damaged: _____
☐ Property loss estimate: \$ _____ (Do not give tree values)
☐ Injuries
☐ Medical attention required
☐ Fatalities

(J) Name of site: ^⑧

Comments: _____

Only failures of a size capable of inflicting some damage or injury should be reported. Minor limb failures should not be reported unless they were potentially dangerous. Do not report simple death of a tree or part of a tree unless it resulted in mechanical failure. Trees removed prior to failure should not be reported.

Forest Service Form PSW-4600-3 (Rev 6/75)

Figure 1—For data management, reports of tree failures and accidents are submitted on a form patterned after the U.S. Forest Service Form PSW-4600-3.

- ① A report should be made for:
- (1) each tree failure involving property damage or bodily injury;
 - (2) each failure adjacent to permanent recreation facilities, home sites, or other locations where failures are a threat to property, and;
 - (3) each failure on recreation sites and other high use locations during the season of public use, whether or not the failure causes damage or injury.
- ② Check only those defects and contributing factors which lead to the actual failure.
- ③ Other established public use site: Winter sports, beaches, viewpoints, visitor centers, historical buildings, etc.
- ④ Volunteer site: Undeveloped site with concentrated public use.
- ⑤ Special use site: Resorts, service facilities, etc.
- ⑥ Residence site: Agency, private, or permittee-lessor.
- ⑦ Other: Wilderness area sites, open forest, etc.
- ⑧ Published analyses will not indicate the source of specific incidents.
-

If many failures occur in your area, reports may be limited to managed sites normally subject to inspection and hazard control. Where information is available, however, reports from volunteer and other noninspected sites will be of value.

NOTE: A SEPARATE FORM SHOULD BE COMPLETED FOR EACH INDIVIDUAL FAILURE. Inclusion of more than one failure on a report prevents correlation of data unless all details are identical.

Additional forms may be obtained from your headquarters or by writing to the following address:

Return to: Lee A. Paine
U.S.D.A. Forest Service
P.O. Box 245
Berkeley, California 94701

Commercial Phone: (415) 486-3158
FTS Phone: 449-3158

Thus, this data control system is a means of planning and monitoring hazard management programs. It delineates program modifications dictated by problem areas, species, or conditions, assists in selection of new recreation sites, and serves as a useful record in legal actions when accidents occur. Specifically, the data processing programs facilitate storage, editing, and retrieval of tree failure and accident data (species, class of failure, target, loss, etc.), and execution of analyses useful in hazard control management.

The programs and instructions are intended for recreation site managers and administrators with local or remote access to computers. Although a basic understanding of data coding and retrieval is assumed, use of the programs does not require specialized knowledge of computer programming or operation. The illustrations of program control cards, sample data cards, and sample output are given as they would be used on a Control Data 6600 computer² under a Scope operating system. A programmer or systems analyst should be able to modify them easily for use with other available equipment. Once the programs are made compatible with the local data processing system, the procedure for management of the data and use of the programs is essentially as described here.

Three of the programs in the system are available on tape; the fourth is listed in this guide and is available on cards. To obtain the programs, send a magnetic tape (1200- or 2400-foot reel) to Director, Pacific Southwest Forest and Range Experiment Station, P.O. Box 245, Berkeley, California 94701, Attention: Statistical Services. If your agency has previously submitted data to this Station, send a second tape and request a copy of the data.

In addition to the programs and the already existing data files, the coding manual³ is needed so that new data files from the failure report forms can be established. Staff members of agencies and organizations which have not previously received a printout of the coding manual should request that it be included with the program tapes.

² Trade names and commercial enterprises or products are mentioned solely for information. No endorsement by the U.S. Department of Agriculture is implied.

³ Paine, Lee A. *Coding hazardous tree failures for a data management system*. Gen. Tech. Rep. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif. Manuscript in preparation.

The basic procedure for use of these programs requires the following steps:

1. Pertinent data must have been collected (as in *fig. 1*).
2. Data must have been coded and punched on standard 80-column data cards as indicated in the coding manual.
3. Cards should be subjected to the ERROR CHECK program for detection of illegal punches.
4. Following any necessary corrections, the data must be added to any earlier data on a computer tape, using the WRITE program.
5. Accumulated data on the tape can then be subjected to selective analyses using the FAILURE programs. These programs provide summaries in one of seven standard tables. The FAILURE programs are flexible; groups of tree failures associated with specified environmental, geographic, organizational, and species characteristics may be studied as easily as a single group encompassing all reported failures for an agency.

6. As an option, data cards or listings of selected incidents may be re-created from the data tape using the PUNCH program. Cards produced by PUNCH may be used for editing and resubmission to a data tape, for special analyses, or for transmittal of data to other offices.

In this guide to the ERROR CHECK, WRITE, FAILURE and PUNCH programs, the basic element is the "control card format" for each program. Control card listings not enclosed in brackets give the actual command required by the Scope operating system. For use with other computers, an interpretation of the command is given. Comments enclosed in brackets < > are descriptive or explanatory. They merely represent actual cards which must be prepared without brackets or comments. For example, <7-8-9 card> requires a card with a multiple 7-8-9 punch in the first column; it represents an end of logical record.

Following the control card format, notes are provided which explain the preparation or use of the cards and any necessary cautions or restrictions that should be kept in mind. Such matters as computer storage procedures and estimates of storage requirements are also discussed. Finally, where appropriate, sample listings of the control cards and data cards are given.

PREPARING DATA CARDS

Data relating to failures of individual trees are submitted on the "Report of Tree Failure" (fig. 1). As the reports are received at the coding office, each is given an accession number and entries are interpreted and coded in accordance with the code

manual. The codes are then punched in specified locations on standard 80-column data processing cards. Two cards are required to record relevant data for each failure. A listing of the cards will look like the following example:

162721503	10	050	18	2	093	5	01	1	2	87654	63	99	0276	06010	1	1	1	1	0	0	09
1627220				0	0	0	0			1	WARNER CG										9
162781803	48	125	09	2	000	1	09	1		87654	63	19	0976	01039	1	2	4	1	0	0	09
1627820				0	0	0	0			1	INTERP TRAIL										9
162791001	36	100	02	4	003	2	01 03	9		87654	63	22	1076	01008	1	2	1	2	1	0	00
1627921	CAMPR	200	0	0	0	0	7000	7000	1	XXXXX											0
162831572	10	999	01	2	000	3	01 05	9		87654	63	99	0976	01023	1	2	1	1	0	0	09
1628320				0	0	0	0			1	CAMPSITE 94										9
162851510	28	999	02	1	010	3	01	9		87654	63	04	1076	01044	1	2	4	1	1	0	00
1628521	FENCE	90	0	0	0	0	90	90	1	30 FT SW OF SANTA CLARA TREE											0
162861505	24	040	20	2	000	4	08 09	1		87654	63	18	0876	01023	1	2	1	1	0	0	09
1628620				0	0	0	0			1	WAYSIDE CG SITE 18										9
162871803	64	200	20	2	020	4	01	9		87654	63	99	0976	01042	1	1	1	1	0	0	09
1628720				0	0	0	0			1	DAVEY BROWN CG										9
162881824	37	120	17	2	007	5	01	1 6		87654	63	10	1076	20061	1	1	1	1	0	0	09
1628820				0	0	0	0			1	MARBLE CREEK CG										9
162891820	18	999	20	2	026	3	01	1		87654	63	20	1076	01019	1	1	1	1	0	0	09
1628920				0	0	0	0			1	HOEGEE'S TRAIL CAMP										9
162901301	18	120	13	2	080	5	01	1 2		87654	63	99	0476	06008	2	1	1	1	0	0	09
1629020				0	0	0	0			1	OLD FOLKS FLAT CG										9

ERROR CHECK PROGRAM

After data have been punched on cards, following the coding manual format, the cards should be checked to insure that no errors have been introduced during the process of coding and punching. The ERROR CHECK program detects illegal code numbers (those not valid for the specific field), lists them, and identifies the detected errors. (The program cannot, for the most part, detect incorrect assignment of valid code numbers.)

By modifying the "standard" error check parameter cards, which are listed in the next section, the user can change the range of illegal code numbers as needed for most data fields. Detection of certain occurrences, such as the illogical combination of failure classes and associated defects, is part of the pro-

gram and is not easily changed. But the range of illegal species, for example, can easily be restricted or expanded to accept only those species normally reported to a particular agency.

Sample error check test cards are provided for use with the program. Submitting these data to the ERROR CHECK program, either separately or after valid data cards, yields examples of various potential errors. The value of the test cards is to illustrate the manner in which certain errors are indicated by the program, and to verify proper operation of the program should all new data cards be submitted without errors. A listing of the error check test cards is given at the end of this section.

ERROR CHECK Program Control Card Format

< JOB CARD >	
RUN(S)	Compile program
COPYCR(INPUT,CHECKER)	Copy ERROR CHECK cards to file checker
REWIND(CHECKER)	Rewind the file checker
LINK(F=LGO,X)	Load and execute the program
< 7-8-9 CARD >	End of record
< ERROR CHECK PROGRAM DECK >	
< 7-8-9 CARD >	End of record
< A. BLANK CHECK CARDS (2) >	
< B. NUMERIC CHECK CARDS (2) >	
< C. FIELD CHECK CARDS (ANY NUMBER) >	
< 9 CARD (COLUMN 1) >	End of field check cards
< 7-8-9 CARD >	End of record
< ERROR CHECK TEST CARDS - OPTIONAL >	
< DATA CARDS TO BE CHECKED >	
< 6-7-8-9 CARD >	End of job

Notes on ERROR CHECK Program

The listing in the following section shows a “standard” set of the three different types of ERROR CHECK control cards. These “blank,” “numeric,” and “field” check cards may be used as shown, may be limited to parameters of a specific agency, or may be expanded to accommodate additional species. Normally, an agency would restrict the range of all checks to the limits of agency data. For example, if no site lies above 3900 feet elevation, the illegal parameters on the appropriate field check card (see printout, following location card 12325) would be changed to three blanks followed by ,040-998\$.

In the listing, the cards with X’s are blank check and numeric check cards. The remainder are field check cards. If different cards are desired, they should be prepared as described here, using the code manual as needed. Note that the code manual requires that the record of each failure begin on one card and end on another, so that each failure is represented by a pair of cards, rather than a single one.

Blank Check Cards

There are two blank check cards, one for each data card of a pair. For each unused column on data cards, a corresponding column on the blank check cards must be blank. For each non-blank data column, enter an X in the corresponding column of the blank check cards.

Numeric Check Cards

There are also two numeric check cards, one for each data card of a pair. For each non-alpha column (blank or numeric) on data cards, the corresponding columns on the numeric check cards must be blank. For all alpha or alpha-plus-numeric fields on data

cards, enter X in the corresponding columns of the numeric check cards.

Field Check Cards

This part of the deck may contain any number of field check cards for identified fields. Each data field to be checked requires a location card and one or more parameter cards.

Location card locates a field as follows: Column 1—punch the number of the card containing the specified field (1 or 2 of a two-card data set). Columns 2 and 3—punch first column of field, right justified. Columns 4 and 5—punch last column of field, right justified. (For 1-column fields, columns 4 and 5 will be the same as columns 2 and 3.)

Parameter cards follow each location card, and specify values that are illegal for the field defined in the location card. The number of digits punched for each value should correspond with the code manual and the defined length of the particular field. Parameters begin in column 1 with leading zeros as necessary to match the defined field length. When blanks are illegal, the parameter card starts with the appropriate number of blanks followed by a comma or a dollar sign.

Parameters may be either a single illegal value or a series of individual values and/or ranges. Individual parameters are separated by commas. For ranges, the first and last illegal values are separated by a dash and followed by a comma. The last parameter on a card is followed by an asterisk. The last parameter on the final parameter card for each location card is followed by a dollar sign in place of an asterisk. Additional sets of location cards and parameter cards are used as necessary to define all fields to be checked and the illegal values for such fields.

Listing of Blank Check, Numeric Check, and Field Check Cards

```

XXXXXXXXXX XX XXX XX X XXX X XX XX XX X X X XXXXX XX XX XXXX XXXXX X X X X X X XX
XXXXXXXXX XXXXXXXXXXXX X X X XXXXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX X
      X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X
10709 XXXXXX X X X X X XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      ,000,003,004,008,009,017-020,037-099,108-199,203-209,213-219,222-229,233-269*
272-299,307-349,354-399,404-449,456-459,510-511,515,522,523,532-535,543,549-551*
554,555,558,559,565,569,576,577,580-581,591,595,601,606,607,610,611,619,622,623*
626,627,630,631,642,643,648,649,657,663,667,671,675,682,683,690,691,695,701,707*
717,724,728,729,733,738,743,748,749,761,765,769,773,773779,782,783,788,789*
795-799,819,830-948,950-999$
11112
      ,99$
11416
      $
11819
      ,00,21-98$
12121
      ,0,5-8$
12325
      ,200-998$
12727
      ,0,6-9$
12930
      ,00,17-99$
13233
01,16-99$
13536
01,02,16-99$
13838
      ,0$
14040
1,9$
14242
1-2,9$
14448
      ,00000,01117-01199,01216-01299,01314-01399,01411,01419-01499,01519-01599*
01620-01699,01704-01799,01837-01899,01916-01999,02000-02099,02114-02116,02118*
02123,02125-02130,02141,02147-02199,02201-02210,02212-02299*
02301,02303,02305,02307,02309*
02311,02313,02316-02319,02321-02399,02420-02999*
03001-03100,03102-03201,03203-03306,03308-03406,03408-03510,03512-03612*
03614-03707,03709-03820,03822-03899,04001-04099,04106,04107,04110-04199*
04201-04205,04208,04212-04214,04218-04299,04301-04311,04315-04317,04320-04399*
04401-04422,04425-04499,04501-04599,04601-04620,04622-40099,41001-41099*
41106-41199,41207,41208,41210-41999,42001-42099,42104-42199,42205-42299*
42307-50999,51001-51199,51201-51299,51301-51399,51401-51499,51501-51599*

```

***Listing of Blank Check,
Numeric Check, and
Field Check Cards
(continued)***

51601-51699,51910-51999,52001-52099,52123-52199,52231-52232,52234-52299*
52333-52399*
52436-52499,52528-52599,52620-52999,53001-53099,53101-53999,54001-54004*
54006-54099,54150-54199,54240-54299,54347-54399,54425-54499,54527-54599*
54636-54999,55001-55999,56001-56099,56125-56199,56237-56299,56367-56399*
56430-56499,56520-56999,57801-59999,61001-61509,61511-61999,62001-62999*
63001-63999,66000-69999,70507-70999,72300-73099,73101-73399,73401-73499*
73501-73599,73601-73999,74001-75099,77001-79999,80001-80029,80031-80099*
80102-80199,80201-80299,80301-80399,80407-80499,80501-80599,80601-80699*
80702-99999,03901-03904,03906-03999\$

15051
 ,85-99\$
15354
 ,00,25-98\$
15657
 ,00,13-98\$
15859
 ,00-50,76-99\$
16162
 ,00,51-99\$
16365
 ,253-999\$
16767
 ,0,3-9\$
16969
 ,0,6-9\$
17171
 ,0,9\$
17373
 ,0,8,9\$
17575
0,2-9\$
18080
0-8\$
20707
0,2-9\$
22020
3-9\$
22424
3-9\$
22626
 ,3-9\$
24042
 , 0\$
28080
0-8\$

Listing of ERROR CHECK Test Cards

000021001	10	300	27	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000220					0	0	0 1	1	1 FOREST TYPE ERROR + CLEANUP
000031001	10	300	18	5	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000320					0	0	0 1	1	1 STAND AGE CLASS ERROR TIMBER TYPE 9
000041001	10	300	08	1	005	1		1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000420					0	0	0 0	1	1 DEFECT COL BLANK 9
000051001	10	300	08	1	005	1	05 05	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000520					0	0	0 2	1	1 DEFECT IS REPEATED TWICE 9
000061001	10	300	08	1	005	5	01	4 4	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000620					0	0	0 3	1	1 CON FACTORS REPEATED TWICE 9
000071001	10	300	08	1	005	5	01	2	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000720					0	0	0 0	1	1 COL 38 BLANK (CONTRIBUTING FACTOR) 9
000081001	10	300	08	1	005	5	01 11	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000820					0	0	0 1	1	1 DEFECT CONFLICT WITH CLASS OF FAIL 9
000091001	10	300	08	1	005	4	01	3	01101 01 20 0769 01010 1 1 1 1 0 0 09
0000920					0	0	0 2	1	1 CON. FACTOR CONFLICT CLASS OF FAIL 9
000101001	10	300	08	1	005	1	01	1	05001 01 20 0769 01010 1 1 1 1 0 0 09
0001020					0	0	0 2	1	1 AGENCY CODE ERROR 9
000111001	10	300	08	1	005	1	01	1	01101 01 27 0769 01010 1 1 1 1 0 0 09
0001120					0	0	0 3	1	1 HOUR ERROR 9
000121001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 9 1 0 0 09
0001320					0	0	0	1	1 LAND OWNERSHIP ERROR 9
000141001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 3 1 1 0
0001421 CAR					5	1	1 0 0	1	1 INJURY--PERSON AFFECTED REC. 9
000161001	10	300	08	1	005	1	17	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0001620					0	0	0 0	1	1 DEFECT ERROR (NO SUCH DEFECT) 9
000171001	1	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0001720					0	0	0 0	1	1 DBH ERROR COL 12 BLANK 9
000201001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 2 0 0
0002021 CAR					5	0	0 0 0	1	1 2 IN COL 75
000221888	10	926	82	7	005	6	18 05 02 9 2 3	1	01101 01 20 1369 51010 1 1 1 1 2 0 0
0002222 CAR					5	0	0 0 0	1	1 2 IN COL 75 AND 2/7 + MULTIPLES 9
000231	36	250	06	4	055	2	16	1 2	01517 04 99 0174 01031 2 1 1 1 0 0 09
0002320					0	0	0 0	1	1 COLUMN 7-9 (NO SPECIES) 9
000321 88		888	21	0	978	8	20 03 03 2 1	1	66 09 0077 09444 322 2 2 3 3 39
0003220					0	0	0 0	1	1 MULTIPLE ERROR TESTER 9
000351001	10	300	08	1	005	2	01 051	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0003520					0	0	0 0	1	1 COL 34 SHOULD BE BLANK 9
000371701	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0003820					0	0	0 0	1	1 CLASS OF FAIL ERROR (NO SUCH CLASS) 9
000391001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 2 1 3 3
0003921					5	2	3 2 0	1	1 CHECK ON MULTIPLE INJ + FAT
000401001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 0
0004020					0	0	0 0	1	1 NO 9 IN COL 80 ON CARDS 1 OR 2
000411001	10	300	08	1	005	5	04 01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0004120					0	0	0 0	1	1 DEFECTS OUT OF ORDER 9
000431001	10	300	08	1	005	1	01	1	01101 01 20 0769 01010 1 1 1 1 0 0 09
0004310					0	0	0 0	1	1 2 CARD HAS 1 IN COL. 6 9

WRITE PROGRAM

Using the cards that have been checked for errors and corrected, the WRITE program creates data tapes to be used with the FAILURE programs. The WRITE

program also edits and deletes data, and makes additions to existing data on tape.

WRITE Program Control Card Format

< JOB CARD >	
RUN(S)	Compile Program
COPYCR(INPUT,TAPE3)	Copy the data deck to the disk file TAPE3
REWIND(TAPE3)	Rewind the file TAPE3
REQUEST(TAPE2)27604	Mount the current data tape as file TAPE2
LINK(F=LG0,X)	Load and execute the program
UNLOAD(TAPE2)	Release the tape drive
REQUEST(NEW,W)27605	Mount the new data tape
REWIND(TAPE1)	TAPE1 is a disk file containing the new data
COPY(TAPE1,NEW)	Copy TAPE1 to the tape file, NEW
UNLOAD(NEW)	Release the tape drive
REQUEST(BACK,W)10407	Mount another tape and copy the
REWIND(TAPE1)	contents of TAPE1 to it for a
COPY(TAPE1,BACK)	back-up of the reel 27605
< 7-8-9 CARD >	
< WRITE PROGRAM DECK >	
< 7-8-9 CARD >	
LISTA < OR LIST >	See Notes
< 1LINE (OPTIONAL) >	
EDIT < OR DATA >	See Notes
< NEW DATA CARDS >	
END	End of data cards
< 6-7-8-9 CARD >	

Notes on WRITE Program

For WRITE, the new data cards, or the cards to edit existing data, or both together, should be put in sequential order, with card 1 of each pair immediately preceding card 2, before they are added to the data tape.

The control card format as shown provides for a method—not required, but convenient—whereby three data tapes, one of which is a backup, are used. During the process of adding or editing data, records from the current tape (27604) are copied to the new tape (27605), except that those records to be edited are replaced by the input data cards. When all old data are copied or edited, any new data sets remaining in the card deck are also added to the new tape (27605). Subsequently, the same file is written to the backup tape (10407).

In this process, 27605 has become the “new” or current data tape. In the next revision, 27605 will be called first and the edited data will be written back onto 27604. Thus, the two data tapes are alternately assigned as the new tape. Backup 10407 is always a copy of the most recent of the two data tapes. (The tape numbers actually assigned to tapes will vary depending on the applicable tape numbering system.)

LISTA

Precedes EDIT or DATA card. LISTA provides a listing of the entire new tape.

LIST

Precedes EDIT or DATA card. May be used in place of LISTA. LIST provides a listing only from first new or first edited data item to the end of all data.

1LINE

If one-line printed output without comments and other non-numeric information is also desired, insert 1LINE after LISTA or LIST and before EDIT card. LISTA or LIST may be omitted to suppress the two-card image listing.

EDIT

Must always be used when one or more data records in the old data file are to be replaced with new data, or new data are being added. The new data cards follow the EDIT card and are followed by an END card. Revised data cards used with EDIT delete the old records and replace them with the new data bearing the same accession numbers.

Special Note: To delete data for a pair of cards without an immediate replacement, prepare only card 1 of the pair, with an asterisk (*) in column 6 after the accession number. Place the card in numerical sequence with the other data cards to be edited or added to the data tape.

DATA

Must be used to build a new data tape the first time data for a user's agency or specific unit are recorded on tape. It is used in place of EDIT. Data are written from cards to fresh tape. LIST or LISTA card must precede DATA card.

END

Must be the next-to-last card in the deck immediately after data cards and is followed only by an “end of job” card.

FAILURE PROGRAM

The FAILURE program provides for retrieval from the data tape of selected classes or groups of data as required. The selected data are summarized and presented in one of seven tables according to the type of analysis and format desired.

The seven FAILURE tables are produced by four programs. (These originally formed a single program, but turn-around time was excessive. Rather than re-design the program to use overlays, we separated the

table functions by making four copies of the program. We removed from each copy all but the selected table summaries, thus obtaining four smaller programs which would use less central memory for any given problem.) Separate programs (FAIL3, FAIL6, and FAIL7) produce each of the three largest tables. The remaining program (FAIL15) produces tables 1, 2, 4, and 5.

FAILURE Program Control Card Format

< JOB CARD >	
REQUEST(FAIL)40972	Mount tape containing appropriate FAIL program
REQUEST(TAPE1)27605	Mount current data tape
LINK(F=FAIL,X)	Load and execute the FAIL program
< 7-8-9 CARD >	End of record
< TABLES CARD >	See notes
< LEVEL SELECTOR CARDS >	See notes
< BLANK CARD >	End of level selector cards
< 6-7-8-9 CARD >	End of job

Notes on FAILURE Program

1. TABLES card shows the word TABLES in column 1-6 and the number of the table desired (1-7) in column 8.

2. For all tables, level selector card sets for species must be last in series if species are to be individually identified and analyzed. Each level must include all data required from subsequent levels (with higher level numbers). (See explanation of level selector cards below.)

Table 1 always requires a level selector card set for species (even when data for all species are desired). Species card sets must be last in series.

3. Table 6 will contain fewer data than other tables because on some failure reports, hour or month information is missing. Table 6 does not include "hour=99" or "month=99" (unknown) data (see coding manual).

FAILURE Tables

This summary of the tables indicates their content: they are listed here in order of utility. (The terms 1-way, 2-way, and 3-way refer to the number of interrelations analyzed in the table.)

Table 7: 1-way, three parts

Failures, accidents, and losses by (A) class of failure, (B) defects, and (C) environmental factors.⁴ (No direct interrelations are shown between A, B, and C.)

Table 1: 1-way

Frequency of failures by species code number.

Table 5: 2-way, two parts

Frequency of failures by (A) class of failure by defect, and (B) class of failure by environmental factor.

Table 4: 3-way, one table for each class of failure

Frequency of failures by class of failure, by defect by environmental factor.

Table 6: 3-way, one group of tables for each factor, one table for each class of failure

Frequency of failures by selected environmental

factor (wind, unknown/none, other), by class of failure, by month by hour of the day.

Table 2: 3-way, one table for each defect

Frequency of failures by defect, by environmental factor by class of failure.

Table 3: 3-way, two parts, one table for each defect, and one table for each factor

Frequency of failures (A) by defect, by species by class of failure; and (B) by environmental factor, by species by class of failure.

Examples of the tables given in a later section illustrate their general form. (Because of their length, it is not feasible to show complete examples of all formats.)

Restriction of the data to produce the desired tables is accomplished in the programs by means of level selector cards. The preparation of these cards, according to the coding manual, is explained below. Temporary storage file requirements of the various levels must be provided for in advance; instructions for this are also given in a later section.

Use of Level Selector Cards in FAILURE Program

To obtain the desired analysis, once the TABLES card has specified the table format, the level selector card must be entered to specify the part of the data to be included. There are 28 selector field names which can be used with FAILURE. The list of names includes an explanation of the name and the location of the entry for that name on the data card (either card 1 or card 2 of the two-card set for each failure

record). Note: The list includes four names to cover levels of U.S. Forest Service administration—AGENCY, REGION, FOREST, and DISTRICT. These can be used to cover similar levels of administration in other organizations. State or Federal parks are given code numbers under FOREST (see code manual).

⁴ The terms "environmental factor" and "contributing factor" are used interchangeably in the programs.

28 Selector Field Names for FAILURE Program

See coding manual for related code numbers. Far right column gives location of information on data card.

Selector field name	Meaning	Card number and column
NUMBER	Accession or incident number (e.g., 5R12345)	1/1-5 (2/1-5)
SPECIE	Tree species	1/7-9
DBH	Diameter at 4.5 feet	1/11-12
AGE	Age of tree	1/11-12
TIMBER	Forest type	1/18-19
STAND	Stand age class	1/21
ELEV	Elevation divided by 100	1/23-25
DEFECT	Causal defect	1/29-30
FACTOR	Causal environmental factor	1/38
AGENCY	Agency designation, 1st level	1/44-45
REGION	Agency designation, 2nd level	1/46
FOREST	Forest or park designation, 3rd level	1/47-48
DISTR	District designation, 4th level	1/50-51
HOUR	Time of failure	1/53-54
MONTH	Month of failure	1/56-57
YEAR	Year of failure	1/58-59
STATE	State in which failure occurred	1/61-62
COUNTY	County in which failure occurred	1/63-65
SEASON	Whether in season for public use	1/67
OWNER	Land ownership	1/69
SITE	Site category	1/71
TARGET	Property or person affected	1/73
IFPROP	Property accident	(1/75) 2/7
INJURY	Number of injuries	(1/77) 2/20
MEDATT	Number requiring medical attention	2/22
FATAL	Number of fatalities	(1/79) 2/24
CLAIM	Failure category—normal, catastrophe, or urban	2/26
CLEAN	Cleanup required	(1/80) 2/80

Preparing Selector Cards

The selector names chosen for a specific table must be numbered in sequence; these are the *levels* of the analysis. (The number of levels is limited as explained below.) A series of level selector card sets is prepared, with reference to the code manual, in the manner described here.

Card 1 of a set

Card 1 defines the data field to be searched. In column 2 of the card, the level number (the sequence number for the field names) is entered. Repetitions of a particular selector field name (to cover more than one range in the field) retain the same level number. (In the example of selector card sets see level "3 FOREST" and level "4 YEAR.")

In columns 4 through 9, the selector field name is entered in the required form shown in the list.

In columns 11 through 13, a "total" number is entered (right justified), that tells how many separate code numbers are to be searched in that repetition of the level. (The actual code numbers are given on card 2.) However, if the code numbers embrace a continuous series with no omissions, no entry is made in columns 11 to 13.

The title of the field starts in column 15 and may be continued through column 44 at most, except that for table 3 the title must terminate by column 32. Any desired informative title may be used.

Card 2 and following of a set

The second card contains the codes for the desired items for that repetition within the designated selector field. The card begins in column 1, with 5-digit fields for each code number. Numbers are entered in sequence, with zeros preceding each as necessary to make each number 5 digits long. For example, if the desired code numbers are 3, 7, and 9, they would be written 000030000700009. If more than 16 individual code numbers are needed for SPECIE, they are entered continuously in fields of five on subsequent cards. If the code numbers form an unbroken series, only the first and final numbers are written. For example, 1 through 9 is written 0000100009. (Note, however, that if card 1 shows a 2 in column 13, the program would select only code 1 and code 9, ignoring 2 through 8.)

Coding of certain items on selector card sets may differ from that on data card sets. In the coding manual and on data cards, code numbers vary in length from one to five digits depending on the items. On data cards, moreover, most code fields are separated by blanks. Exceptions to this rule are certain groups of field names: the accession number, card number, and tree species which occur in an unbroken series; the month and year; the state and county; and the agency, region, and forest. In the last group, only the first two digits of the five-digit combination refer to the selector AGENCY. The third digit is the code for REGION, and the last two positions define the selector FOREST. In the selector card sets, a separate level is required for each selector name in a group. For example, on data cards, Los Padres Forest in Region 5 of the U.S. Forest Service is coded 01507. On the selector card set, however, to retrieve specific information for the Los Padres, the selector AGENCY is written 00001 on card 2, REGION is 00005, and FOREST is 00007. These would be levels 1, 2, and 3.

In FAILURE, a maximum of 10 levels (10 different selector names) may be used in one run. A maximum of 100 selector title cards (100 levels and repetitions combined), may be used in each execution. For each repetition of the selector name SPECIE there is a limit of 200 individual specifications within the repetition. For each repetition of any other selector, there is a limit of 10 individual specifications within the repetition. For example, within FOREST only 10 individual forests can be specified for each repetition; for DBH only 10 individual inch measurements can be specified for each DBH repetition. A continuous range is not subject to this restriction, however.

For discontinuous code numbers, then, with a maximum of 16 code numbers per card, there can be 12 ½ cards for a SPECIE repetition. There can only be one card, with at most 10 specifications, within any single repetition of a selector other than SPECIE.

The number of tables that will be produced is equal to the product of the repetitions per level. The following example would create 1 X 1 X 2 X 4 X 1 or 8 tables.

Example of Selector Card Sets

```

< 7-8-9 CARD >
TABLES 7
1 AGENCY      1 CALIFORNIA STATE PARKS + REC
00052
2 REGION      1 DISTRICT 4
00004
3 FOREST      ALL PARKS IN DISTRICT
0000100035
3 FOREST      1 BLANK STATE PARK
00001
4 YEAR        ALL YEARS
0003800076
4 YEAR        1 1976
00076
4 YEAR        1 1977
00077
4 YEAR        1 1978
00078
5 SPECIE      41 MINOR HARDWOODS
00502005040050800509005110051300514005150051600517005180051900520005210052200523
00524005250052600527005280052900530005310053200533005340053500536005370053800539
005400054100542005430054400545005460054700548
< BLANK CARD >
< 6-7-8-9 CARD >

```

Computer Storage Requirements

The FAILURE program requires a maximum of 10 temporary files on a magnetic disk, or drum. The files, called scratch files, are used by the program to store the subset of data required at each level of the summary, according to the table selected by the user, and the selector field names chosen. The first scratch file contains the data selected at the first level, the second scratch file contains the data selected for the second level, and so on. Thus, the number of files to be used is predictable. The size of each file is not so easily known, however. This depends on the degree of restriction represented by the user's choice of table format, selector fields, and selector codes, to fit his particular problem. The first scratch file may be small, or may be nearly as large as the data set itself. The other scratch files will grade downward at some rate peculiar to the problem. If the user's computer system requires a special request for scratch storage

space, he will need to make some trials with the programs before he can estimate exactly what is necessary.

As many as nine levels may be written to scratch files—one less than the number of levels needed for the job. TAPE1 is the file name for the data tape itself; the scratch file names are TAPE2 through TAPE10. (TAPE11 is also used, but it is a storage file for a table of species selectors. See coding manual.)

Central memory or core requirements are as follows:

<i>File</i>	<i>Name</i>	<i>Core</i>
1	FAIL7	60000
2	FAIL15	64000
3	FAIL3	137000
4	FAIL6	63000

Examples of Failure Analysis Tables

General note: The sample data shown in the tables given here are incomplete, and are drawn from only one state. Also, for convenience, parts of long tables or wide-page tables have been omitted, as indicated by the jagged lines.

Table 7

To produce this example of the output for Table 7, the following steps have been taken:

1. A data tape has been established in the computer through proper coding and punching of data cards and use of the ERROR CHECK and WRITE programs as described.

2. The proper control card format for the FAILURE program, for table 7, has been followed.

3. Three levels of selector names have been chosen: AGENCY, REGION, and CLAIM. Selector card sets have been properly prepared, using the coding manual for the information desired at each level, and these have been entered in the program, preceded by the TABLES 7 card, and followed by a blank card. The result is a table 7 format analysis of all non-catastrophe failures which have been recorded for the specified regions of the selected agencies.

Other Tables

These tables have been produced in a manner similar to that used for table 7. Selector card sets have been prepared for the information desired at each level.

SELECTOR INDEXES AND TITLES =====

1. SELECTED AGENCIES

2. SPECIFIED REGIONS

3. NONCATASTROPHE

TABLE 7A -- TOTAL NUMBER OF ACCIDENT FAILURES
BY CLASS OF FAILURE FOR ALL SPECIES (001-999)

CLASS OF FAILURE	PROP DAMAGE	INJURY	FATALITY	ACCIDENT FAILURES	TOTAL FAILURES	PERCENT FAILURES	PROP LOSS	MED ATTN REQUIRED
LIMB	76	7	1	78	311	.25080	20750	4
UPPER BOLE	91	3	3	94	653	.14395	37070	2
LOWER BOLE	104	5	5	105	601	.17471	100696	5
BUTT	95	13	3	100	619	.16155	69078	11
ROOT	197	14	11	201	1831	.10978	133903	14
=====								
* TOTAL *	563	42	23	578	4015	.14396	361497	36
=====								

TABLE 7B -- TOTAL NUMBER OF ACCIDENT FAILURES
BY DEFECTS/FAULTS FOR ALL SPECIES (001-999)

DEFECTS/ FAULTS	PROP DAMAGE	INJURY	FATALITY	ACCIDENT FAILURES	TOTAL FAILURES	PERCENT FAILURES	PROP LOSS	MED ATTN REQUIRED
ROT	271	19	4	274	1817	.15080	177318	15
SWEEP	1	0	0	1	15	.06667	100	0
TREE DEAD	59	10	5	62	385	.16104	29000	9
FIRE WOUND	20	2	4	20	100	.20000	25990	2
LEANING	57	9	5	60	394	.15228	31833	9
LIGHTNING	6	2	1	7	60	.11667	2200	1
MECH WOUND	11	0	0	11	112	.09821	710	0
CRACK/SPLIT	14	1	1	15	100	.15000	6985	1
FORK TOP	24	2	2	25	87	.28736	16535	1
TWIN BOLE	9	3	3	10	50	.20000	11730	3
DEAD TOP/BR	23	3	0	23	133	.17293	2717	0
WIDOW-MAKER	2	0	0	2	23	.08696	1722	0
CANKER,RUST	5	0	0	5	22	.22727	5915	0
CANKER,MIST	9	0	0	9	15	.60000	3585	0
OTHER	8	1	1	8	53	.15094	20437	0
UNKNOWN/NONE	165	8	7	170	1279	.13292	107217	8

TABLE 7C -- TOTAL NUMBER OF ACCIDENT FAILURES
BY CONTRIBUTING FACTORS FOR ALL SPECIES (001-999)

CONTRIB FACTORS	PROP DAMAGE	INJURY	FATALITY	ACCIDENT FAILURES	TOTAL FAILURES	PERCENT FAILURES	PROP LOSS	MED ATTN REQUIRED
WIND	403	25	19	413	3015	.13698	288813	21
SNOW	109	1	0	109	731	.14911	56547	1
EROSION	7	0	1	7	54	.12963	3580	0
SOIL SATUR	57	3	5	57	383	.14883	54178	3
STREAM EROS	13	5	1	13	147	.08844	8775	5
SHALLOW ROOT	38	0	0	38	316	.12025	24805	0
TREE X TREE	3	2	2	3	70	.04286	2640	2
OTHER	11	1	0	11	94	.11702	2545	0
UNKNOWN/NONE	86	11	2	91	572	.15909	26731	9

TABLE 1	
TOTAL NUMBER OF TREE FAILURES BY INDIVIDUAL SPECIES	
SPECIES	TOTAL
1	1194
2	9
5	859
824	7
826	6
ALL SPECIES	7830

TABLE 5A -- TOTAL NUMBER OF TREE FAILURES BY DEFECT/FAULT
AND CONTRIBUTING FACTOR FOR ALL SPECIES

CLASS OF FAILURE	TOTAL CLEAN		ROT	SWEEP	SNAG	FIRE	LEAN	CONTRIBUTING FACTORS					UNK. OR NONE
	IN	UP						WID- DEAD TOP	CAN- OW- MAKER	CAN- KER, RUST	CAN- KER, MIST	OTH.	
UP BOLE	857	746	185	5	62	13	72	32	6	5	12	6	451
LOW BOLE	1089	977	296	4	88	24	84	0	0	1	8	8	652
ALL BOLE*	1946	1723	481	9	150	37	156	32	6	6	20	14	1103
BUTT	1319	1194	995	5	81	41	728	0	1	1	0	16	167
LIMB	2027	1866	223	0	9	5	1	68	17	1	9	20	1651
ROOT	2538	2275	518	9	100	45	324	0	1	0	0	19	1734
* TOTAL *	7830	7058	2217	23	340	128	1209	100	25	8	29	69	4655

CLASS OF FAILURE	CONTRIBUTING FACTORS								UNK. OR NONE
	WIND	SNOW	SION	SAT.	STR. ERO- SION	SHA- LOW	TREE STK.	OTHER	
UP BOLE	342	440	0	1	0	0	32	12	106
LOW BOLE	374	615	0	0	0	0	24	11	132
ALL BOLE*	716	1055	0	1	0	0	56	23	238
BUTT	403	745	0	0	0	0	34	10	176
LIMB	268	1613	0	0	0	0	6	14	174
ROOT	1083	810	73	898	314	240	107	37	124
* TOTAL *	2470	4223	73	899	314	240	203	84	712

TABLE 5B -- PERCENTAGE OF TREE FAILURES BY DEFECT/FAULT
AND CONTRIBUTING FACTOR FOR ALL SPECIES

CLASS OF FAILURE		TOTAL	CLEAN							WID- OW-	CAN- KER,	CAN- KER,	UNK. OR
		GROUP	UP	ROT	SWEEP	SNAG	FIRE	LEAN		MAKER	RUST	MIST	OTH. NONE
UP	BOLE	1.00	.87	.22	.01	.07	.02	.08		.01	.01	.01	.53
LOW	BOLE	1.00	.90	.27	.00	.08	.02	.08		0.	.00	.01	.60
ALL	BOLE*	1.00	.89	.25	.00	.08	.02	.08		.00	.00	.01	.57
BUTT		1.00	.91	.75	.00	.06	.03	.55		.00	.00	0.	.13
LIMB		1.00	.92	.11	0.	.00	.00	.00		.01	.00	.00	.81
ROOT		1.00	.90	.20	.00	.04	.02	.13		.00	0.	0.	.68
* TOTAL *		1.00	.90	.28	.00	.04	.02	.15		.00	.00	.00	.59

TABLE 4 -- FREQUENCY OF ASSOCIATION OF DEFECTS/FAULTS
WITH CONTRIBUTING FACTORS FOR ALL SPECIES

CLASS OF FAILURE -- UP BOLE					
DEFECT/FAULT	WIND	SNOW	EROSION	OTHER	UNK/NONE
ROT	126	32	0	0	48
SWEEP	4	0	0	0	1
TREE DEAD	31	2	0	0	30
FIRE WOUND	11	8	0	0	2
LEANING	28	25	0	5	19
LIGHTNING	2	0	0	0	9

TABLE 4 -- FREQUENCY OF ASSOCIATION OF DEFECTS/FAULTS
WITH CONTRIBUTING FACTORS FOR ALL SPECIES

CLASS OF FAILURE -- * TOTAL *

DEFECT/FAULT	WIND	SNOW	EROSION	OTHER	UNK/NONE
ROT	1001	794	16	23	418
SWEEP	16	0	1	0	4
TREE DEAD	170	19	3	6	134
FIRE WOUND	75	18	3	2	43
LEANING	338	702	25	15	117
LIGHTNING	5	1	0	0	11

TABLE 6A -- TOTAL NUMBER OF TREE FAILURES BY MONTH AND HOUR
DUE TO WIND FOR ALL SPECIES

CLASS OF FAILURE -- UPPER BOLE

MONTH	1	2	3	4	5	6	7	8	9	20	21	22	23	24
JAN	4 .12	2 .06	2 .06	4 .12	4 .12	1 .03	2 .06	1 .03	2 .06	1 .03	0 0.	0 0.	3 .09	2 .06
FEB	2 .12	0 0.	0 0.	4 .24	0 0.	0 0.	1 .06	0 0.	0 0.	1 .06	0 0.	3 .18	1 .06	1 .06
MAR	0 0.	0 0.	1 .10	1 .10	0 0.	0 0.	0 0.	0 0.	0 0.	1 .10	1 .10	1 .10	0 0.	0 0.
APR	0 0.	0 0.	0 0.	1 .20	0 0.	0 0.	1 .20	0 0.	0 0.	0 0.	0 0.	0 0.	0 0.	0 0.
DEC	0 0.	14 .22	2 .03	24 .38	3 .05	0 0.	0 0.	0 0.	4 .06	5 .08	0 0.	1 .02	2 .03	0 0.
YEAR	8 .04	20 .10	6 .03	34 .16	7 .03	4 .02	6 .03	4 .02	8 .04	8 .04	4 .02	6 .03	11 .05	15 .07

Tables 6B and 6C provide data for "unknown/none"
or "other" as environmental factor.

TABLE 2A -- FREQUENCY OF ASSOCIATION OF DEFECTS/FAULTS WITH
CONTRIBUTING FACTORS BY CLASS OF FAILURE
TOTAL TREE FAILURES FOR ALL SPECIES

FACTORS		TOTAL	ROOT	UPPER BOLE	LIMB
ROT	- WIND	1001	311	126	117
ROT	- SNOW	794	54	32	41
ROT	- EROSION	16	16	0	0
ROT	- SOIL SATURTN	213	213	0	0
GRAND - TOTAL		11395	4027	1111	2162

Table 2B provides data corresponding to 2A, in percentages; see table 5B.

TABLE 3A -- TOTAL NUMBER OF TREE FAILURES
ASSOCIATED WITH ROT

SPECIES	UPPER BOLE	LOWER BOLE	SUBTOTAL	LIMB	TOTAL
11	3 .05000	16 .26667	19 .31667	0 0.	60
12	6 .11765	13 .25490	19 .37255	2 .03922	51
15	3 .04839	18 .29032	21 .33871	1 .01613	62
24	0 0.	11 .42308	11 .42308	1 .03846	26
25	23 .23469	13 .13265	36 .36735	6 .06122	98
5 CALIF. PINES	35 .11785	71 .23906	106 .35690	10 .03367	297

TABLE 38 -- TOTAL NUMBER OF TREE FAILURES

ASSOCIATED WITH WIND

SPECIES	UPPER BOLE	LOWER BOLE	SUBTOTAL	LIMB	TOTAL
11	41 .27152	35 .23179	76 .50331	4 .02649	151
12	19 .18812	21 .20792	40 .39604	9 .08911	101
15	15 .10274	33 .22603	48 .32877	1 .00685	146
24	3 .08108	15 .40541	18 .48649	1 .02703	37
25	39 .15918	21 .08571	60 .24490	13 .05306	245
5 CALIF. PINES	117 .17206	125 .18382	242 .35588	28 .04118	680

PUNCH PROGRAM

The PUNCH program is designed to create quasi-original data cards from a data tape, and also to provide subsets of data as listings or tapes. The program allows selection of any desired data card sets from the data tape. Selector names for any data fields can be specified and the range within fields can be restricted as needed. Using this procedure, one may, for example, request all data for a given species, for a limited diameter range, for only certain types of sites within one district of a forest of the U.S. Forest Service in the state of Montana. A single run will produce either or both of two forms of data card listing and/or quasi-original punched cards that may be treated as originals for subsequent computer analyses. One form of listing (1LINE) provides all the numeric data available in a single line for each

numbered incident. The other listing shows both alpha and numeric data as they would appear on each data card pair, whether or not punched cards are actually produced as desired output. The PUNCH program can also be used to create a new tape containing a subset of data from an existing tape. This new tape can thereafter be treated as an original data tape and subjected to FAILURE analyses or even to subsequent PUNCH programs.

The control card format for PUNCH, given in the next section, includes the complete program listing. Because PUNCH is a short program, it has been provided here rather than on the tape available on request. Therefore, each time the program is used, the program cards shown must be submitted to the computer.

PUNCH Program (Complete Listing)

```
< JOB CARD >
RUN(S)                                (COMPILE PROGRAM)
REQUEST(TAPE1)27604                  (MOUNT CURRENT DATA TAPE)
LINK(F=LGO,X)                        (LOAD AND EXECUTE THE PROGRAM)
REWIND(PUNCH)                        (REWIND PUNCH FILE)
COPYSBF(PUNCH,OUTPUT)                (PRINT AND DELETE PUNCH FILE)
< 7-8-9 CARD >                       (END OF RECORD)
PROGRAM DATAOUT(PUNCH=7001,OUTPUT=7001,TAPE1=3001,INPUT)
INTEGER SPECIE, DBH, AGE, TIMBER, STAND, ELEV, CLASS, DEFECT(3),
$ FACTOR(3), AGENCY, REGION, FOREST, DISTRT, HOUR, YEAR,
$ STATE, COUNTY, SEASON, OWNER, SITE, TARGET, FATAL, CLAIM,
$ CDOLLAR, SETTLE, SDOLLAR, TREES, CLEAN
COMMON BUFFER, IDATA
INTEGER PUNCH, IDATA(45), BUFFER(5000)
LOGICAL READB
EQUIVALENCE
$ (IDATA( 1),NUMBER ), (IDATA( 2),SPECIE ), (IDATA( 3),DBH ),
$ (IDATA( 4),AGE ), (IDATA( 5),TIMBER ), (IDATA( 6),STAND ),
$ (IDATA( 7),ELEV ), (IDATA( 8),CLASS ), (IDATA( 9),DEFECT ),
$ (IDATA(12),FACTOR ), (IDATA(15),AGENCY ), (IDATA(16),REGION ),
$ (IDATA(17),FOREST ), (IDATA(18),DISTRT ), (IDATA(19),HOUR ),
$ (IDATA(20),MONTH ), (IDATA(21),YEAR ), (IDATA(22),STATE ),
$ (IDATA(23),COUNTY ), (IDATA(24),SEASON ), (IDATA(25),OWNER ),
$ (IDATA(26),SITE ), (IDATA(27),TARGET ), (IDATA(28),IFPROP ),
$ (IDATA(29),LOSS ), (IDATA(30),INJURY ), (IDATA(31),MEDATT ),
$ (IDATA(32),FATAL ), (IDATA(33),CLAIM ), (IDATA(34),CDOLLAR),
$ (IDATA(35),SETTLE ), (IDATA(36),SDOLLAR), (IDATA(37),TREES ),
$ (IDATA(38),CLEAN )
CALL FET(5LTAPE1,2000 0000 0000 0000 0000B,8*64)
MT=1
ASSIGN 1000 TO NOPUNCH
ASSIGN 2000 TO PUNCH
READ 10,LIST
10 FORMAT(A5)
IF(LIST.NE.5H1LINE) GO TO 1000
KOUNT = 0
PRINT 9000
PRINT 9001
```

PUNCH Program (Complete Listing) ***(continued)***

```

1000 READ(1) IDATA
      DO 50 I=1,38
        IDATA(I)=-IDATA(I)
50    CONTINUE
      IF(IDATA(1).EQ.5REND ) STOP
      IF(IDATA(1).EQ.5RDATA ) GO TO 1000

<    INSERT 'IF' STATEMENT SELECTOR CARDS HERE BEFORE RUN.    >

2000 IF(LIST.NE.5H1LINE) GO TO 2025
      IF ( KOUNT .LT. 50 ) GO TO 2025
      PRINT 9002
      PRINT 9001
      KOUNT = 0
2025 CONTINUE
      DO 2026 I=1, 38
        IF ( IDATA(I) .EQ. 0 ) IDATA(I) = 0
2026 CONTINUE
      IF(LIST.EQ.5H1LINE)PRINT 9003,(IDATA(I),I=1,38)
      PUNCH 9004,(IDATA(I),I=1,27),IDATA(1),IDATA(28),IDATA(39),
1    (IDATA(I),I=29,37),(IDATA(I),I=40,45),IDATA(38)
      KOUNT = KOUNT + 1
      GO TO 1000
9000 FORMAT(1H1,41X,31H*** LISTING OF PUNCHED DATA *** // )
9001 FORMAT ( 1X, 111(1H=) / 1X,111H ID SP DBH AGE TT S ELE F DEFE
      $CT/F CONTR AG R FO DI HR MO YR ST CO S O S P D LOSS I M F C CLAIM
      $$ SAMT NUM C / 1X, 110(1H=) // )
9002 FORMAT(1H1,35X,43H*** LISTING OF PUNCHED DATA (CONTINUED) ***//)
9003 FORMAT(1X,R5,I5,I3,I4,I3,I2,I4,I2,3I3,3I2,I3,I2,7I3,5I2,I5,4I2,I6,
      $ I2,I5,I4,I2)
9004 FORMAT(R5,1H1,I3,I3,I4,I3,I2,I4,I2,3I3,3I2,I3,I1,I2,3I3,I2,2I3,4I2
      $ /R5,1H2,I1,1X,A5,I5,4I2,I5,I1,I6,I4,1X,5A6,A5,1X,I1)
      END
< 7-8-9 CARD > (END OF RECORD)
1LINE
< 6-7-8-9 CARD > (END OF JOB)

```

Specifying Form of Output

The control card format as shown will produce a two-card image listing and a 1LINE (numeric data) listing as well as punched card output. To obtain alternative combinations of output, cards may be added or omitted as follows:

To suppress two-card image listing, remove:
 REWIND(PUNCH)
 COPYSBF(PUNCH,OUTPUT)

To suppress 1LINE listing, remove after END card:
 7-8-9
 1LINE

To suppress punched card output, insert:

REWIND(PUNCH)
 WRITEF(PUNCH)

after

REWIND(PUNCH)

and

COPYSBF (PUNCH,OUTPUT)

or in place of these two cards if the two-card image listing is not needed.

Preparing Statement Cards to Specify Selector Fields and to Restrict Data

Statement cards are inserted in the PUNCH program at the point shown in the program listing. Any field or combination of 38 named selector fields may be searched. Restriction of data within a field is made by conventional FORTRAN IF statements. Code

numbers are specified which are either equal to, not equal to, less than, or greater than the numbers representing the desired characteristics selected for punching. Relationships between fields may be additive or restrictive.

As many statement cards specifying selectors may be used as needed. When selector fields are restrictive, there should be only one IF statement for each selector field. The IF statements must be capable of only two possible interpretations—true or false. The computer must “know” whether to “punch” or not. Examples of suitable statements are given in a later section.

Statement cards begin in column 7 with IF and (, or open parenthesis. Card must end, or be continued to another card, with column 72. The first card remains blank in column 6. When a statement continues on a following card, the following card(s) must have a character other than a zero punched in column 6. The dollar sign (\$) has been used in this program for continuation. Spaces have no significance in these statements. The last statement card must end with a close parenthesis, followed by either GO TO NOPUNCH or GO TO PUNCH. If it ends with GO TO PUNCH it must be followed by a separate GO TO NOPUNCH card. Unlike the IF statement cards, the separate GO TO NOPUNCH card is punched starting

in column seven. If GO TO NOPUNCH concludes the last of the statement cards, omit separate GO TO NOPUNCH card.

Note: When DEFECT or FACTOR is a chosen selector, the order of selection desired must be specified (see examples of IF statements). This is because the coding manual provides that up to three of each of these items can be punched, in separate locations. If all occurrences of any one defect or factor are to be selected, the defect or factor must be searched for in all three locations. Exceptions are the defects “rot” and “unknown,” and the factors “wind” and “unknown,” which are always in the first location of the appropriate field (see coding manual).

When NUMBER is a selector, the desired five-digit accession numbers must each be preceded by 5R (e.g., 5R12345).

Blanks and zeros should be assumed equivalent in all columns which are used for data.

Redundancy—to improve accuracy in coding, columns 75, 77, 79, and 80 on card 1 are duplicated in columns 7, 20, 24, and 80 on card 2.

38 Selector Field Names for PUNCH Program

See coding manual for related code numbers. Next-to-last column gives location of information on

data cards. Last column gives abbreviated forms that will appear as headings on 1LINE output.

Selector field name	Meaning	Card number and column	1LINE Title
NUMBER	Accession or incident number (e.g., 5R12345)	1/1-5 (2/1-5)	ID
SPECIE	Tree species	1/7-9	SP
DBH	Diameter at 4.5 feet	1/11-12	DBH
AGE	Age of tree	1/14-16	AGE
TIMBER	Forest type	1/18-19	TT
STAND	Stand age class	1/21	S
ELEV	Elevation divided by 100	1/23-25	ELE
CLASS	Class of failure	1/27	F
DEFECT (1)	Causal defect	1/29-30	DEFECT/F
DEFECT (2)	Causal defect	1/32-33	DEFECT/F
DEFECT (3)	Causal defect	1/35-36	DEFECT/F
FACTOR (1)	Causal environmental factor	1/38	CONTR
FACTOR (2)	Causal environmental factor	1/40	CONTR
FACTOR (3)	Causal environmental factor	1/42	CONTR
AGENCY	1st level agency designation	1/44-45	AG

38 Selector Field Names for PUNCH Program (continued)

REGION	2nd level agency designation	1/46	R
FOREST	3rd level Forest or park	1/47-48	FO
DISTR	4th level District	1/50-51	DI
HOUR	Time of failure	1/53-54	HR
MONTH	Month of failure	1/56-57	MO
YEAR	Year of failure	1/58-59	YR
STATE	State in which failure occurred	1/61-62	ST
COUNTY	County in which failure occurred	1/63-65	CO
SEASON	Whether in season for public use	1/67	S
OWNER	Land ownership	1/69	O
SITE	Site category	1/71	S
TARGET	Property or person affected	1/73	P
IFPROP	Property accident	(1/75) 2/7	D
LOSS	Dollar property loss	2/14-18	LOSS
INJURY	Number of injuries	(1/77) 2/20	I
MEDATT	Number requiring medical attention	2/22	M
FATAL	Number of fatalities	(1/79) 2/24	F
	Failure category—normal, catastrophe or urban	2/26	C
CDOLLAR	Value of property	2/27-31	CLAIM
SETTLE	Data field open for use	2/32	S
SDOLLAR	Total value including injuries, fatalities	2/33-38	SAMT
TREES	Uncoded failures associated with report + 1	2/40-42	NUM
CLEAN	Cleanup required	(1/80) 2/80	C

Examples of IF Statements

Some of the conventions used in IF statements are illustrated below. Only one of the IF statements shown here would normally be used in any one run of the PUNCH program. In these statements, .EQ. is "equal to," .NE. is "not equal to," .GT. is "greater than," .LT. is "less than," .GE. is "greater than or equal to," and .LE. is "less than or equal to." These

examples illustrate both the inclusive GO TO PUNCH directive as well as the exclusive GO TO NOPUNCH when the directive is part of the IF statement. When GO TO NOPUNCH is used in the IF statement, all other than the designated items are selected. Multiple restrictions are illustrated in the last five statements. Note that nesting parentheses are used for clarity.

IF (SPECIE .EQ. 001) GO TO PUNCH GO TO NOPUNCH	Selects only data for species 001
IF (SPECIE .NE. 001) GO TO NOPUNCH	Selects only data for species 001
IF (SPECIE .GT. 002) GO TO NOPUNCH	Selects data for species 002 and below
IF (SPECIE .LT. 003) GO TO PUNCH GO TO NOPUNCH	Selects data for species 002 and below
IF (SPECIE .GE. 003) GO TO NOPUNCH	Selects data for species 002 and below
IF (SPECIE .LE. 002) GO TO PUNCH GO TO NOPUNCH	Selects data for species 002 and below
IF (AGENCY .EQ. 01 .AND. REGION .EQ. 5 .AND. FOREST .EQ. 02) GO \$TO PUNCH GO TO NOPUNCH	Selects data for forest, within region, within agency specified
IF (SPECIE .LT. 800 .OR. SPECIE .GT. 826) GO TO NOPUNCH	Selects data for species 800 thru 826
IF (SPECIE .EQ. 801 .AND. CLEAN .EQ. 9 .AND. CLAIM .EQ. 1) GO TO \$PUNCH GO TO NOPUNCH	Selects only California black oak catastrophe failures which did not cause accidents
IF ((SPECIE .EQ. 801 .OR. SPECIE .EQ. 804) .AND. (YEAR .EQ. 40)) \$GO TO PUNCH GO TO NOPUNCH	Selects data for species 801 and 804 failures which occurred in 1940
IF ((DEFECT(1) .EQ. 01) .AND. (DEFECT(2) .EQ. 03 .OR. DEFECT(3) \$.EQ. 03)) GO TO PUNCH GO TO NOPUNCH	Selects only data for failures when trees were both dead and decayed