CMDL

Guide for accessing permanent sample plot data in the FPDS database.

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Introduction

Forest Productivity and Decision Support section of Research Branch has accumulated a large permanent sample plot (PSP) database from a variety of sources and for a wide range of species and stand conditions. Over 9000 permanent sample plots comprised of almost 31,000 measurements currently resides in the system. The purpose of this document is to briefly discuss the steps taken to summarize the data and provide the information necessary for individuals to access the data as the need arises.

The data from many of the sources were obtained for the single purpose of the calibration of the Tree and Stand Simulator (TASS) so that reliable managed stand yield tables could be generated. Many of the agencies regard their data as proprietary. Use of proprietary data for purposes other than TASS calibration will have to be arranged with the agency who provided the data unless it is allowed in the specific data sharing agreement. Notification of use is certainly warranted in every case. Do not release any data to individuals outside our group without written permission from management and/or outside agency who supplied the data.

Data Sources

Tables 1a and 1b list the Coastal and Interior sources in the database, respectively. A total of 14 outside agencies have supplied data (eight coastal and six interior). In addition, data from 15 active coastal and four active interior experiments have been included from the Research Branch database. Data have also been summarized from inactive Ministry experiments and growth-natural plots from Inventory Branch. Note that the source codes and species codes used in Table 1 are consistent throughout this paper with the exception of species code Mx (mixtures) which is categorized in greater detail below.

Preliminary Data Organization and Screening

Each source was received in or converted to the British Columbia version of the standard COSMADS metric format for both the tree detail file (TDF) and the header file (HDR). See Appendix A for descriptions of the COSMADS formats and examples of TDF and HDR files.

No conversion was performed between imperial and metric definitions of breast height, 1.37m and 1.3m above germination, respectively, if the original data was received in imperial measure. Unmeasured trees coded as dead were assigned the DBH and/or height from the previous measurement. Trees materializing after the first measurement were treated as ingrowth.

Table 1a. Existing data in FPDS PSP database - Coastal Regions.

Agency	Source Code	Subdirectory Name[1]	No. of Plots	Species[2]	Type of data[3]
BCFS Forest Science Research Branch[4] (active experiments)	EP 364	EP364	15	Fd	N CT
	EP 365	EP365		Fd	N CT
	EP 368	EP368	49	Fd,Hw,Cw,Ss,Ba,Bg	P PCT
	EP 388	EP388	20	Hw	N CT
	EP 418	EP418	17	Fd	P CCT
	EP 429	EP429	9	Fd,Ba,Cw,Mx	P SP
	EP 469	EP469		Fd	N CCT
	EP 499	EP499		Fd	N CT
	EP 534	EP534	47	Fd	P PCT[5]
	EP 554	EP554	47	Fd	P CCT
	EP 570	EP570	12	Ss	P SP
	EP 571	EP571	151	Fd,Hw,Cw,Ss,Ba,Hm	P SP
	EP 703	EP703	822	Fd,Hw,Mx	N PCT,F,TF
	EP 712	EP712		Ss	P SP
	Schenstrom	SCHENST	6	Fd	N PCT,CT
(Inactive Experiments)	Coast Eps	OLDEP	370	Fd,Hw,Ss,Mx	N Various
MacMillan Bloedel	MB	MB	811	Various	N Various
Western Forest Products	WFP	WFP	359	Hw,Cw,Ss,Mx	N
University of B.C.	UBC	UBC	29	Fd,Cw,Mx	P SP
Washington State Dept. of Natural Resources	DNR	DNRCOOP	32	Hw,Mx	N
ITT Rayonier	Deep Creek	DEEPCRK	5	Fd	P
	ITT	ITTCOOP	183	Hw	N PCT,F,TF
	ITT CFI	ITTCFI	226	Hw,Mx	N CFI
University of Washington	U of W	UWCOOP	1504	Hw,Mx	N PCT,F,TF
U.S. Forest Service	USFS	USFSCOOP	8	Hw	N PCT
Weyerhaeuser Co. (U.S.)	Weyco	WEYCOOP	246	Hw,Mx	N PCT,F,TF

[1] Subdirectory name below \USR\SEG\PSP\ where TDF and HDR files reside during summary process.

[2]
Fd = Douglas-fir
Hw = western hemlock
Ss = Sitka spruce
Cw = western redcedar
Ba = amabilis fir
Bg = grand fir
Mx = mixtures

[3]
P = plantation
N = natural regeneration

SP = espacement trial
PCT = precommercial spacing
CT = commercial thinning
F = fertilized
TF = thinned and fertilized
CCT = correlated curve trend
CFI = continuous forest inventory

[4] Only Fd plots summarized for EP 429. EPs 365,469,499 and 712 not yet completed.

[5] PCT on EP 534 was accidental.

Table 1b. Existing data in FPDS PSP database - Interior Regions.

Agency	Source Code	Subdirectory Name[1]	No. of Plots	Species[2]	Type of data[3]
BCFS Forest Science Research Branch (Active Experiments)	EP 537	EP537	12	Sw	P SP
	EP 549	EP549	18	Sw	P SP
	EP 660	EP660	60	Pl,Sw,Fdi	P SP
	EP 671	EP671	24	Pl	P SP
(Inactive Experiments)	Inter. Eps	OLDEP	134	Pl,Sw,Fdi,Py,Mx	N Various
BCFS Inventory Branch (growth natural plots)	Inv. Br.	BCFSGN	81	Fdi	N
Alberta Forest Service	AFS	AFS	1524	Pl,Sw,Sb,Mx	N
Forestry Canada (NFC)	For. Can.	GREGBURN	30	Pl	N PCT
Weldwood, Canada (Hinton, Alberta)	Weldwood	WELDWOOD	3079	Pl,Sw,Sb,Mx	N CFI
University of Idaho	U of I	UOFI	270	Fdi	P PCT,F
Ontario Ministry of Natural Resources	OMNR	OMNR	10	Sw	P SP
Forestry Canada (PNFI)	PNFI	PETAWAWA	14	Sw	P SP

[1] Subdirectory name below \USR\SEG\PSP\ where TDF and HDR files reside during summary process.

[2]
Pl = lodgepole pine
Sw = white spruce
Sb = black spruce
Fdi= interior Douglas-fir
Ba = balsam fir
Py = ponderosa pine
Mx = mixtures

[3]
P = plantation
N = natural regeneration
SP = espacement trial
PCT = precommercial spacing
CT = commercial thinning
F = fertilized
TF = thinned and fertilized
CFI = continuous forest inventory

The data sets were split into smaller files convenient for processing in the PC DOS environment using SPLIT.EXE program written by Ken Polsson. The number of plots in each file ranged between 1 and 20, depending on plot size and number of measurements for a particular group. The normal naming convention for tree detail and header files is:

TDF: scdTDF.fsn
HDR: scdHDR.fsn

where scd is a one-to-three character source code (e.g. "AFS" for Alberta Forest Service and "364" for EP 364) and fsn is a file sequence number which ranges from "001" to the number of files to be processed from a particular source (leading zeros included). Each TDF file was compressed for purposes of space efficiency using PKZIP software into a file named: scdfsn.ZIP.

Formal experiments and unique plots were preliminarily screened for data errors by passing the TDF files through a SAS edit program developed for the purpose (EDITDF.SAS). Errors such as declining height and/or DBH growth, missing codes, and disappearing trees are detected by the program. Preliminary graphs of DBH vs. previous DBH and height vs. DBH for each plot-measurement are also produced to graphically detect abnormal entries. If available, original field sheets were usually consulted to determine keypunch or interpretation errors. Occasionally, subjective adjustments of DBH irregularities are necessary and suspect height entries are eliminated to be later predicted by height-DBH regressions.

In some cases, DBH backdating or interpolation was performed so that all plots in a source had a similar number of measurements. In other cases, interpolation of DBH for specific trees was necessary since some trees were not found in one field visit but located in the next.

The larger, wild-stand data sets were not preliminarily screened for errors because original field sheets were not available. Instead, data anomalies were detected after summarization through graphical evaluation of important variables. Plots with irregular trajectories were investigated in detail and re-summarized when errors were uncovered.

The Weldwood wild-stand database has a particularly difficult structure because the minimum DBH specification changed from 6 inches in the 1950's to 2 inches today (15.2 cm to 5.1 cm). The DBH of trees which materialized due to the changing merchantability standards are backdated to previous measurements. A relationship between DBH growth and DBH was generated on a for each plot and backdated diameters are designated by an "8" in column 58 of the TDF file. The consistency of summary trajectories was greatly enhanced but mortality is still

underestimated since trees which died prior to attaining a particular DBH limit were never recorded.

Height-DBH Relationships

Most sources required the fitting of height-DBH relationships since only a subsample of trees were measured for height. Highly variable data structures were encountered and many potential regression models were investigated. In most cases, the number of height measurements changed across the sequence of measurements for a plot in response to changes in information needs, minimum DBH standards or available remeasurement budget. The height-DBH model that most consistently performed well across measurements was a modification of the non-linear Moness model used by Omule and Macdonald (1991):

$$HT_{im} = 1.3 + (b_0(1/DBH_{im}-1/DTOP_m) + (1/(b_1 AGE_m^{b_2}-1.3))^{1/3})^{(-3)} + RESID_i \quad (1)$$

where: HT_{im} = total height
DBH_{im} = diameter at breast height
$DTOP_m$ = average diameter of the top height trees (largest 100/ha where $DTOP_m \geq DTOP_{m-1}$)
AGE_m = total age or breast height age
b_0-b_2 = regression coefficients (b_2=1 for non-remeasured plots)
$RESID_i$ = average residual per tree
i = i^{th} tree
m = m^{th} measurement

The model is simultaneously fit across all measurements of a plot using the derivative-free (DUD) option in the non-linear procedure in SAS. "Global" coefficients for all species combined on the plot is used for species which have less than 11 height observations across measurements. Species-specific coefficients are used for species with 11 or more height-DBH observations. The measure DTOP is calculated for each measurement but conditioned to be non-declining if mortality from above causes it to decrease in value. This compensated for irregular solutions which commonly occurs in such cases. Coefficients from nearby plots with similar AGE and DTOP are occasionally substituted for plots which have too few heights for any fits to occur.

The average residual for each tree (RESID) is included in the prediction for those trees which are measured for height only in a portion of the measurements for the plot. In some datasets, no tree heights were recorded for a particular measurement. RESID essentially acts as an interpolation and/or extrapolation adjustment for those trees and makes height predictions more consistent across measurements. This is particularly important for trees in the top height cohort on small plots. Trees never

measured for height were of course assigned the height predicted from the base regression (RESID=0).

Equation 1 performed very robustly across most plots which had fewer than about 7 measurements. The model performed less well for plots established in young stands and monitored for long periods. The coefficient b_0 was sometimes made a power function of AGE to increase model flexibility for plots with more numerous measurements. The variable AGE and coefficient b_2 were removed and b_0 and b_1 were fit independently by measurement for plots which had adequate height samples across measurements and had more than about 10 measurements.

Coefficient files for each tree detail file were produced and saved. The power relationship $b_1 AGE_m^{b_2}$ was solved for each plot-species-measurement combination (renamed HTOP) creating three parameters (b_0, DTOP and HTOP). HTOP can be interpreted as the height predicted at DBH=DTOP since the model is conditioned to pass through the point (DTOP,HTOP). The naming convention for the coefficient files is scdCOE.fsn where scd and fsn are as defined for TDF and HDR files. See Appendix D for the format of such coefficient files. Appendix D also includes the listing of a portion of an example coefficient file 364COE.001. (Other aspects of EP 364-001 summarization process will be used as further examples below).

Summary Process and File Organization

File generation and program execution.

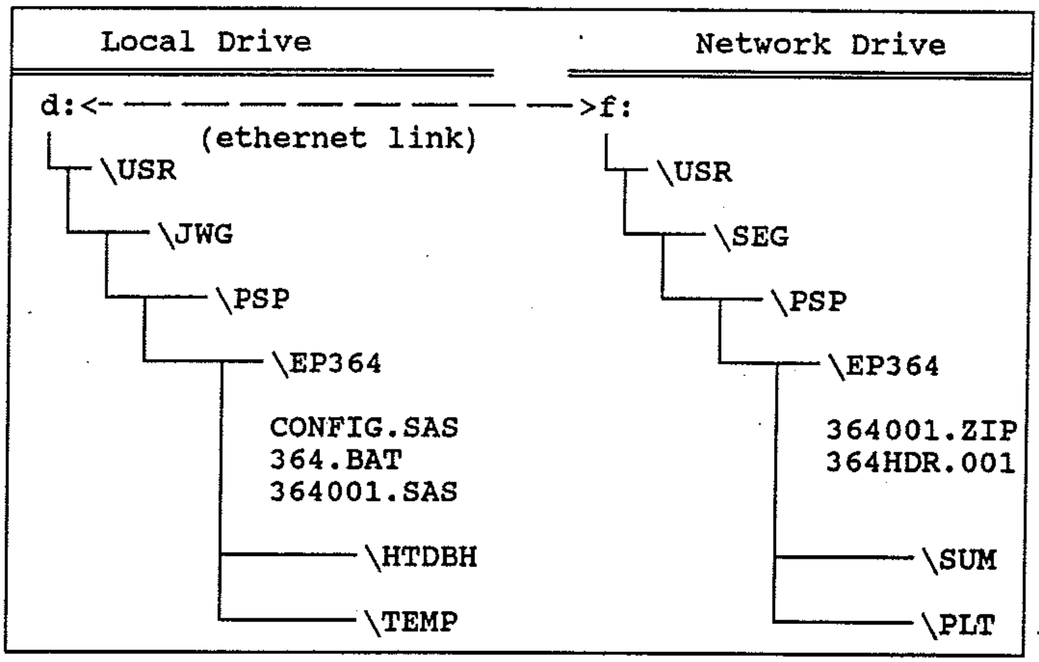
A true basic program called EPGEN.EXE was written to produce a DOS batch file called scd.BAT and a variable number of small batch SAS files named scdfsn.SAS (scd and fsn defined as above). The DOS batch file, which is usually run at times of low demands on the network, controls the execution of the summary programs. One scdfsn.SAS file is generated for each TDF file processed.

EPGEN.EXE is located on the network VOL1:\USR\SEG\PSP directory and upon execution, prompts for the information required (see Appendix B for screen prints of the program). A directory named ?:\USR\JWG\PSP\dirname must be created on the LOCAL disk drive of the PC to be used for the summarization (? = local disk drive designation). Two subdirectories, TEMP and HTDBH which are used to store temporary SAS datasets must also be created "below" this directory. The dirname assigned to the local subdirectory must match the subdirectory name on the network where the TDF and HDR files are stored. EPGEN.EXE should be run from the local drive so that the .BAT and .SAS files will be written to the local disk drive. It is also a recommended that a version of the CONFIG.SAS file be copied into the dirname subdirectory and have it point necessary SAS work space to the LOCAL drive to enhance input-output efficiency (see Appendix C

for an example). At least 20 megabytes of free space should be available on the local drive to assure that most files will be processed without running out of space.

All TDF and HDR files to be processed are located in subdirectories of \USR\SEG\PSP\ on VOL1 of the network. For example, EP 364 files reside in \USR\SEG\PSP\EP364. Two network subdirectories below each source subdirectory named SUM and PLT are also required (e.g. \USR\SEG\PSP\EP364\SUM and \USR\SEG\PSP\EP364\PLT). Figure 1 illustrates the directories, subdirectories and file types which should exist after running EPGEN.EXE. The first file (001) for EP364 is used as an example PSP source and d: and f: for local and network disk drive designations, respectively. Letter designations for the local and network hard drives vary from machine to machine.

Figure 1. Illustration of the files and subdirectories required to process PSP data using EP 364 file 001 as an example.



The DOS batch file first returns the TDF to ASCII format by executing the PKUNZIP software, and then executes the first .SAS file in the sequence. The scdfsn.SAS file specifies three input

and five output file names (see Figure 2). It "includes" a larger summary program called \USR\SEG\PSP\MONESUM.SAS which:

1) reads the TDF, HDR and Kozak (1988) volume coefficients;
2) performs the height-DBH regressions;
3) writes the scdCOE.fsn file (discussed above);
4) predicts necessary heights
5) writes an additional TDF file with predicted heights included (naming convention: scdTDFO.fsn); and
6) generates per ha summaries (discussed below).

After completion of the first scdfsn.SAS job, the scd.BAT file compresses the output TDFO into a new file designated as scdOfsn.ZIP, compresses the scdfsn.LOG and scdfsn.LST files from the SAS job into LOGfsn.ZIP and LSTfsn.ZIP, respectively, and then deletes the following five ASCII files:

scdfsn.SAS
scdfsn.LST
scdfsn.LOG
scdTDF.fsn
scdTDFO.fsn.

The scd.BAT file then processes the next file in the sequence. Figure 2 also shows the contents of example files 364.BAT and 364001.SAS from the example above.

Figure 2. Example .BAT and .SAS files generated by EPGEN.EXE which are necessary to process PSP data.

File: 364.BAT

```
PKUNZIP -o f:\usr\seg\psp\ep364\364001 f:\usr\seg\psp\ep364\
SAS 364001
PKZIP f:\usr\seg\psp\ep364\3640001 f:\usr\seg\psp\ep364\364TDFO.001
PKZIP f:\usr\seg\psp\ep364\LST001 364001.LST
PKZIP f:\usr\seg\psp\ep364\LOG001 364001.LOG
DEL f:\usr\seg\psp\ep364\364TDF.001
DEL f:\usr\seg\psp\ep364\364TDFO.001
TIME
```

File: 364001.SAS

```
LIBNAME HTDBH 'd:\usr\jwg\psp\ep364\HTDBH';
LIBNAME TEMP 'd:\usr\jwg\psp\ep364\TEMP';
FILENAME HEADER 'f:\usr\seg\psp\ep364\364HDR.001';
FILENAME TDF    'f:\usr\seg\psp\ep364\364TDF.001';
FILENAME KOZAKMAT 'f:\usr\seg\psp\KOZAK\KOZAKA.MAT';
FILENAME KOZAKIMM 'f:\usr\seg\psp\KOZAK\KOZAK.IMM';
FILENAME OUTCOEF'f:\usr\seg\psp\ep364\364COE.001';
FILENAME TDFOUT 'f:\usr\seg\psp\ep364\364TDFO.001';
FILENAME OUTSUM  'f:\usr\seg\psp\ep364\SUM\364001.SUM';
FILENAME OUTSTAND 'f:\usr\seg\psp\ep364\SUM\364001.STD';
FILENAME OUTSTOCK 'f:\usr\seg\psp\ep364\SUM\364001.STK';
FILENAME SASIN 'f:\usr\seg\psp\monesum.sas';
%LET dsn=364-001;
%INCLUDE SASIN ;
```

Note that the SAS scdfsn.LOG is retained in zipped form for the purpose of tracing errors that may have occurred in the processing and the SAS scdfsn.LST file is retained for a permanent record of the height-DBH solutions and graphs. The LST file is usually printed out and stored in binders for formal experiments or unique plots but only as needed for large wild-stand data sources.

Plot Summaries.

Plot summaries are generated after DBH-height regressions have been fit and each non-height tree is assigned a height from the relationship shown in equation 1. Young trees below breast height are assigned a zero DBH rather than a missing value and thus are included in calculations of average DBH.

Trees are categorized and summaries produced for the

following six summary types:

MORTALITY	- trees dying in previous time interval;
PRE-THIN	- all live trees prior to thinning (only calculated if some trees thinned);
THINNINGS	- all trees removed in a thinning;
INGROWTH	- trees materializing after measurement 1;
SUPPRESSED	- all trees classified as suppressed crown class;
STANDING	- all live trees.

The volume equations of Kozak (1988) and the unpublished update produced in 1990 are used to predict total and merchantable volumes for all species. Some "mapping" was necessary for species encountered that did not have available coefficients. A top DIB of 10 cm and stump height of 30 cm is used for merchantable volume calculations.

A summary record is produced for each species, measurement and tree category combination and for the entire plot. The STANDING record type for the entire plot also contains percentages of total volume by species. The same number of records are written to two additional files for stand table and merchantable-volume stock table summaries (by 5-cm DBH classes). The naming convention for the three output summary files is:

Summary file	:	scdfsn.SUM
Stand table	:	scdfsn.STD
Stock table	:	scdfsn.STK

where "scd" and "fsn" are defined as above. See Appendix D for description and format of the variables included in the output data files. Figure 3 shows the files existing after executing the system on the example EP364.001 file.

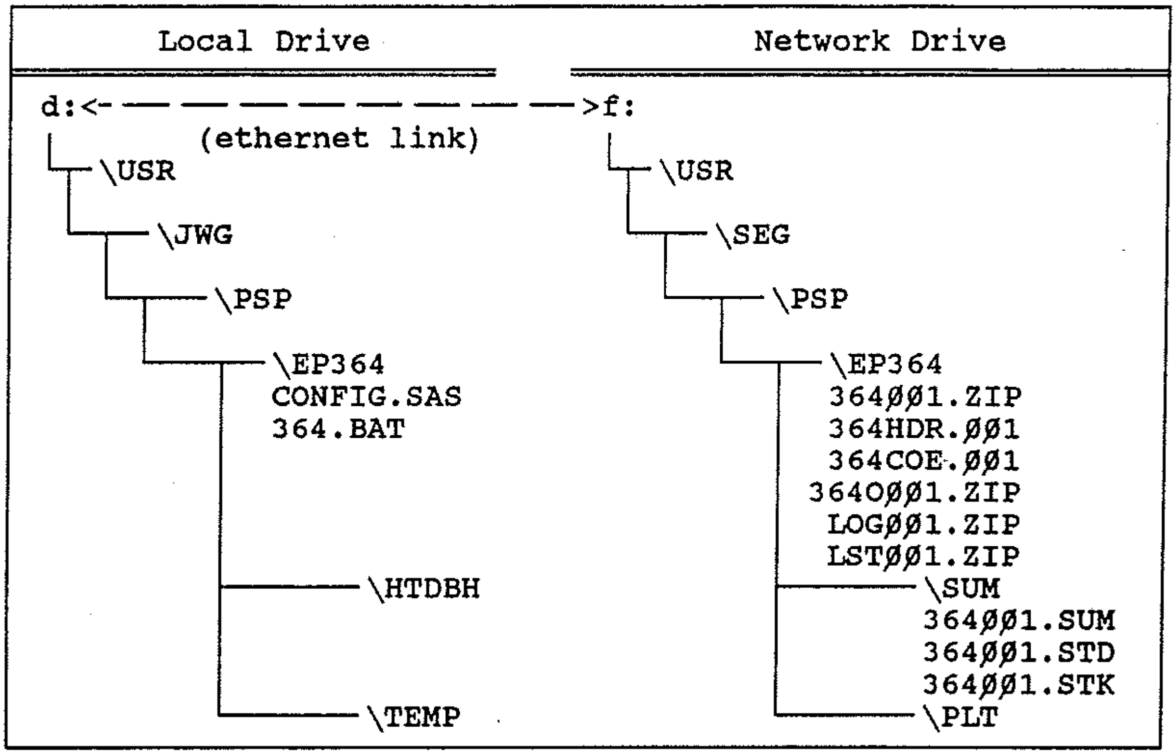
Plot Classification

All the .SUM files from a particular source in the \USR\SEG\PSP\dirname\SUM subdirectory are concatenated together into one overall summary file after they are processed. This is usually done by the use of a standard DOS copy command. For example, EP 364 is split into two TDFs and the resulting summaries were concatenated using the DOS command:

```
COPY 364001.SUM+364002.SUM EP364.SUM.
```

Larger datasets required the use of an editor to create a .BAT file containing a collection of COPY commands to perform this requirement in several steps. Intermediate temporary files were created, concatenated into an overall file and then deleted.

Figure 3. Illustration of the files and subdirectories existing after an example PSP file is processed.



Another SAS program (PSPCLASS.SAS) is used to classify each PSP in the concatenated summary file based on the sum of total volume across measurements by species. Treatments are used to further classify the plots. The only treatments considered were "control", thinning and/or fertilization. Note that the control designation implies only that the plot has not been thinned or fertilized. Other treatments such as planting or cleaning may have occurred on control plots. The following species composition criteria were used for classification purposes:

Softwood = ≥80 % total volume in coniferous species.
    Species specific = ≥75% total volume in one coniferous species.

Hardwood = ≥80 % total volume in hardwood species.
    Species specific = ≥75% total volume in one hardwood species.

Mixedwood = neither hardwood nor coniferous species comprise 80% of the total volume.

PSPCLASS.SAS created new classified summary files consisting of just the STANDING and, if a thinning had occurred, PRE-THIN type of summaries from the overall plot statistics. Individual species statistics were not included except for percent total volume in each

measurement. These are written to the network subdirectory \USR\SEG\PSP\dirname\PLT which was previously created. The naming convention is straightforward for the "pure" species-specific files (≥75% of total volume). The filename consists of the three-character source code, followed by the two-letter species code (e.g. FD for Douglas-fir), and then by a treatment codes "t" and/or "f" if the plot had been thinned and/or fertilized. For example, the EP 364 experiment had two "pure" Douglas-fir categories of plots, a control and thinned. The corresponding filenames for the classified plots are: 364FD.SUM and 364FDt.SUM. Appendix E specifies the potential species codes.

The naming convention for mixed-species plots shown in Table 2 is more complex. Recall that "scd" indicates the three-character source code. Each source created one or more classified files. For example, EP 364 created the two pure FD files mentioned above and one file in the mixedwood category. Figure 4 shows the files existing in the EP364 directories after the classification procedure.

Table 2. Naming conventions for summary files that are not classified as pure.

Plot Type	Treatment	Filename
Softwood	Control	scdSOFT.SUM
	Thinned	scdSOFTt.SUM
	Fertilized	scdSOFTf.SUM
	Thinned&Fertilized	scdSOFft.SUM
Hardwood	Control	scdHARD.SUM
	Thinned	scdHARDt.SUM
	Fertilized	scdHARDf.SUM
	Thinned&Fertilized	scdHARft.SUM
Mixedwood	Control	scdMIXED.SUM
	Thinned	scdMIXt.SUM
	Fertilized	scdMIXf.SUM
	Thinned&Fertilized	scdMIXft.SUM

Post-summary checks.

The following five graphs are customarily produced using GRAFLEX software developed in FPDS for each classified summary file to ensure that reasonable results are being achieved:

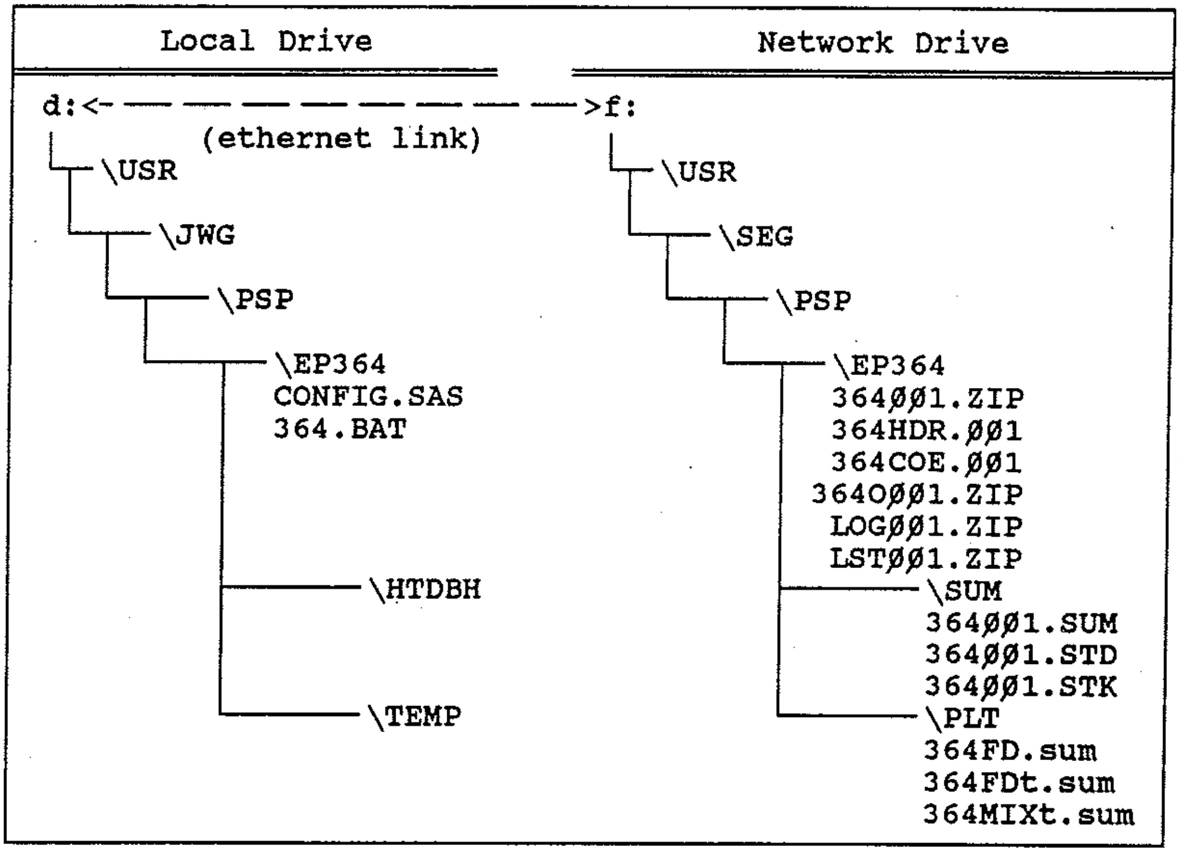
1) Top height vs. breast height or total age (with site curves if available);
2) Total volume vs. top height;
3) Number of live stems vs. top height;
4) Basal area vs. top height;
5) Quadratic mean DBH vs. top height.

Graphs are compared to others from the source and to other sources that had produced the same category of plot. Anomalous trajectories are investigated and corrections are made when possible. The most common problems revolve around irregular height predictions and top height trajectories. If problems are observed, TDFs are checked in detail, other height/DBH models are investigated or coefficients from nearby similar plots are substituted. Another summary program named RESUM.SAS, which is a subset of MONESUM.SAS, is used if the latter strategy is taken. It reads an existing but modified height/DBH coefficient file and generates new heights and outputs new TDFO and summary files. Very occasionally plots are deleted from the database due to unresolved problems.

File compression and backups.

The network subdirectories containing the input and output files are backed up on to 3.5-inch diskettes using the FASTBACK software after all problems are resolved. The source-specific back-ups are stored in Research Branch. The TDF, TDFO, LST and LOG files are deleted from the network so that space is available for other work. The summary, stand table and stock table files in the \SUM subdirectory are compressed together into common ZIP files named SUM.ZIP, STD.ZIP and STK.ZIP, respectively. Sometimes the header and height/DBH coefficient files are also compressed into common ZIP files if a large number exists for a particular PSP source (normally named HDR.ZIP and COE.ZIP). Figure 5 shows the typical contents of the example directories after the summary, classification, compression, back-up and deletion steps are completed. Other files may exist in the directories as needs arise for each source.

Figure 4. Illustration of the files and subdirectories existing after an example source of PSPs is processed and classified.



Species-treatment subdirectories.

The final step is to create species-treatment subdirectories where all sources of a particular species-treatment combination are stored together. Figure 6 shows the hierarchy of the species-treatment subdirectories on the network. Note that "below" each of the species subdirectories are one or more of the following treatment subdirectories :\CONTROL, \THINNED, \FERT, and \THINFERT corresponding to the four treatments. These are created as required. The summary files reside in these subdirectories.

Access has been restricted to read-only for these subdirectories to ensure that files do not get inadvertently changed or erased. If a file is of interest, copy it into your area, investigate or graph it, and then remove from your area when done to avoid unnecessary proliferation of copies which can be a problem in terms of both space and security.

Figure 5. Illustration of the files and subdirectories existing after an example source of PSPs is processed, classified and backed up.

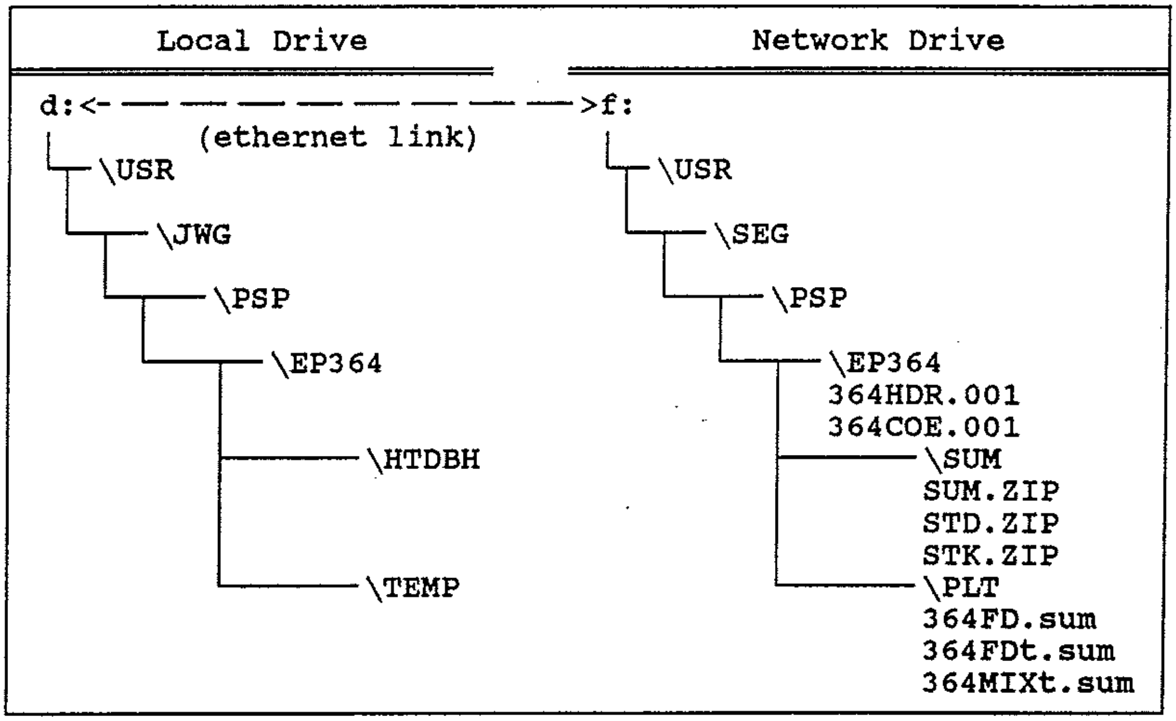
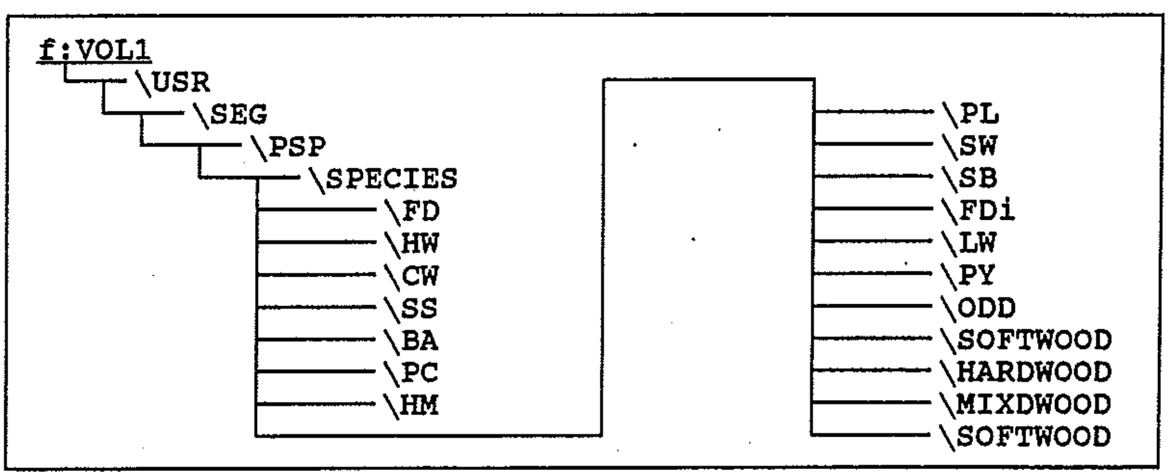


Figure 6. Illustration of the species-treatment subdirectories on the network.



Appendix F displays the subdirectory contents and summary statistics for each source and for the entire subdirectory. Note that summary files from both the coastal and interior sources are present for some species such as \BA, \SOFTWOOD, \HARDWOOD and \MIXDWOOD. In these cases, an "i" has been added to the filename to indicate an interior source (see for example, \USR\SEG\PSP\SPECIES\BA\AFSBAi.SUM). Enough sources of interior Douglas-fir data existed to warrant a separate species designation and subdirectory, FDi. Note that no indicator of the "leading" species is retained for mixed stands in the file naming convention. However, these can be determined from percentages retained on each "STANDING" summary record (see Appendix D for the format).

Appendix G summarizes the number of plots and mean and range of important variables by region (coast and interior), species and treatments, and for the entire database. A total of 3767 plots have been summarized from coastal sources and 5256 from the interior (east of the Cascades to Ontario).

Appendix H presents the same information but organized by source. Important notes concerning each source appear below the statistics.

Currently, only the per hectare summaries have been classified into species and treatment files. Future work will produce categorized stand, stock and merchantable volume files which will correspond to the .SUM files. If a source or type of file appears to be of interest, please conduct some background information review prior to using the data. Refer to the information contained in the appendix, the EP file at headquarters (if it is a Research Branch EP), and appropriate publications so that knowledgable use is ensured. The original detailed summary, stand and stock tables are readily available in other subdirectories if needed. An obvious example would be the individual species summaries and diameter distributions for mixed-species stands.

The need to protect the proprietary data as well as Ministry data can not be more strongly emphasized. Any published use or distribution of these data must be approved by management and/or the source of the data.

Please pass on any suggestions you may have for improvement of the database organization to Shelley Grout or Jim Goudie, Research Branch, Forest Productivity and Decision Support Section.

Literature Cited

Kozak, A. 1988. A variable-exponent taper equation. Can. J. For. Res. 18:1363-1368.

Omule, S.A.Y. and R.N.Macdonald. 1991. Simultaneous curve fitting for repeated height-diameter measurements. Can. J. For. Res. 21:1418-1422.

Appendix A. British Columbia metric COSMADS format for tree detail files and plot header files.

Table A.1. Tree detail file format.

Columns	Format[1]	Description	Units/entries
1-3	I3	Installation number	
4-7	I4	Plot number	
8	I1	Sector (usually means subplot)	
9-12	I4	Tree Number	
13-14	A2	Species code	
15-17	I3	Age Years	
18-22	F5.2	X - coordinate	m
23-27	F5.2	Y - coordiate	m
28-29	I2	Measurement number	
30-33	F4.1	Diameter at breast height	cm
34-37	F4.1	Diameter at 1/3 height	cm
38-40	F3.1	Total height	m
41	I1	Height code	1=measured in field 2=measured from air 3=predicted from height/DBH Eq. 4=suspect ground (estimated) 5=suspect air 6=suspect other (check) 7=ocular estimate 9=corrected
42	I1	Crown Class	1=dominant 2=codominant 3=intermediate 4=suppressed 5=understorey 6=overstorey 7=off plot
43-45	F3.1	Height to crown base	m
46-48	F3.1	Maximum crown width	m

Table A.1. Tree detail file format (cont.).

Columns	Format[1]	Description	Units/entries
49-51	F3.1	Height at maximum crown width	m
52-54	F3.1	Mid-crown width	m
55-57	F3.1	Height to mid crown	m
58	I1	Tree condition	0=live 1=cut ⇒ thinned 2=dead 3=ingrowth 4=not found 5=not measured 6=extra tree 7=both site&crop tree 8=DBH backdated 9=ingrowth (dead)
59	I1	Tree damage	0=no damage 1=unspecified unhealthy 2=mechanical 3=chemical treated 4=disease 5=insects 6=animal 7=weather 8=suppression 9=replacement
60[2]	I1	Lean or sweep code	1=lean 2=sweep 3=broken top 4=twin 5=forked (above BH) 6=scar or stump of felled 7=crooked tree 8=poor top
61-62	I2	Browse code	10=grouse 11=leader browsed 12=top bud eaten

Table A.1. Tree detail file format (cont.).

Columns	Format[1]	Description	Units/entries
63	I1	Leader code	1=dead 2=new leader 3=multiple leaders
64	I1	Leader flush code	1=leader flush 2=side shoot flush
65	I1	Stem scar code	1=stem scar to 0.05 m^2 2=stem scar 0.05-0.1m^2 3=stem scar 0.1-0.2m^2 4=stem scar 0.2m^2+
66	I1	Root scar code	1=root scar to 0.05 m^2 2=root scar 0.05-0.1m^2 3=root scar 0.1-0.2m^2 4=root scar 0.2m^2+
67	I1	Dying code	1=windthrow 2=roots cut 3=woodpecker holes
68	I1	Injury code	1=gum 2=one-sided crown 3=old blaze scar
74-80		Blank	

[1] all decimals implied.
[2] codes in columns 60-73 can vary by source.

Table A.3. Cosmads header file format.

Card type 1 - Plot description.

Columns	Format[1]	Description	Units/entry
1-2	I2	Record type	1
3	I1	Record sequence	0
4-6	I3	Installation number	1-999
7-10	I4	Plot number	1-9999
11	A1	Status	A=active D=discontinued X=destroyed
12	I1	Comment record flag	
13-15	I3	Breast height age @ establ.	years
16-18	I3	Total age @ establishment	years
19-21	I3	Site index	m
22	A1	Site index source	e.g. B=BCFS M=McArdle
23-26	F4.4	Plot area	ha
27	A1	Plot shape	C=circular R=rectangular S=square
28	A1	Stem map indicator	Y=yes,N=no
29	A1	Stand origin	N=natural P=planted S=seeded
30-31	A2	Species code-major timber type	e.g. FD=Douglas-fir
32-33	A2	Species code-minor timber type	e.g. DR=red alder
34-35	A2	Region	
36-38	I3	Compartment number	
39	A1	Compartment letter	
40-41	A2	Zone	
42-43	A2	Productivity zone	
44-46	A3	Cruise number	
47-48	A2	Province or state	e.g. BC=B.C.
49-51	I3	Elevation	m
52-54	I3	Aspect	degrees
55-57	I3	Slope	%
58	I1	Slope position	1=ridge top 2=upper 1/3 3=middle 1/3 4=lower 1/3 5=bottom 6=flat
59-62	A4	Organization	e.g. BCFS
63-66	A4	Project	e.g. 0364
67-70	A4	Installation identification	e.g. E001
71-72	I2	Block number	
73-80		Blank	

[1] decimals implied

Table A.3. Cosmads header file format (cont.).

Card type 2 - measurement dates.

Columns	Format[1]	Description	Units/entry
1-2	I2	Card type	2
3-10		Same as card type 1	
11-16	3I2	Date of 1st measurement (year, month, day)	e.g. 360910
17-22	3I2	Date of 2nd measurement (year, month, day)	e.g. 411015
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
71-76	3I2	Date of 11th measurement (year, month, day)	e.g. 861105

[1] decimals implied
Note: Additional card type 2s permitted for plots with greater than 11 measurements (card sequence (col. 3) = 1,2,etc)

Card type 3 - thinning dates and type.

Columns	Format[1]	Description	Units/entry
1-2	I2	Card type	3
3-10		Same as card type 1	
11-12	I2	Treatment code.	
13-18	3I2	Treatment date (year, month, day)	e.g. 411015
19-20	I2	Treatment type	
21-24	I4	Treatment intensity	
25-27	F3.3	Treatment d/D ratio	

[1] decimals implied
Note: Additional card type 3s permitted for plots with greater than 1 treatments (card sequence (col. 3) = 1,2, etc.).

Card type 4 - Fertilization dates and type.

Columns	Format[1]	Description	Units/entry
1-2	I2	Card type	4
3-10		Same as card type 1	
11-12	I2	Treatment code.	e.g. F1
14-19	3I2	Treatment date (year, month, day)	e.g. 711015
20-21	I2	Method of N application	
22-23	I2	Type of N	
25-27	I4	Amount of N	kg/ha
28-29	I2	Method of P application	
30-31	I2	Type of P	
32-35	I4	Amount of P	kg/ha
36-37	I2	Method of K application	
38-39	I2	Type of K	
40-43	I4	Amount of K	kg/ha
44-45	A2	Nutrient code	
46-47	I2	Method of application	
48-49	I2	Type of fertilizer	kg/ha
50-53	I4	Amount of fertilizer	kg/ha
54-80		Blank	

[1] decimals implied
Note: Additional card type 4s permitted for plots with greater than 1 treatments (card sequence (col. 3) = 1,2, etc.).

Card types 5-8 rarely used - see COSMADS report for description.

Card type 9 - Comment cards.

Columns	Format	Description	Units/entry
1-2	I2	Card type	9
3-10		Same as card type 1	
11-80	70A1	Comment	

Note: Additional card type 9s permitted for plots with greater than 1 treatments (card sequence (col. 3) = 1,2, etc.). The card type (9) is often moved to column 1 and the card sequence is entered in columns 2-3 since more than ten comment cards are usually required.

Appendix B. Screen displays for EPGEN.EXE execution. Bold type designates keyboard input. "<return>" indicates pressing return key.

Appendix C. Example CONFIG.SAS listing and description.

```
-SET SASROOT z:\public\SAS
-FSDEVICE SASXDIVA
                                /* Directory definitions        */
-sashelp    !sasroot\sashelp /*   help file    directory      */
-sasuser    s:sasuser        /*   user profile directory   */
-work       d:\saswork       /*   work directory (SEE NOTE BELOW)*/
-msg        !sasroot\sasmsg  /*   message file directory      */

-ems all
-dms                             /* Display Manager mode         */

-path    !sasroot\sasexe\core /* SAS executable files search order
 */
-path    !sasroot\sasexe\base
-path    !sasroot\sasexe\stat
-path    !sasroot\sasexe\iml
-path    !sasroot\sasexe\af
-path    !sasroot\sasexe\fsp
-path    !sasroot\sasexe\graph

/* -filebuffer  5 512 */          /* Use 5 buffers of 512 bytes to  */
                                  /* decrease disk accesses and  */
                                  /* improve performance           */


/* -filecache  !sasroot\sasexe\core 15 Cache often read only files */
/* -filecache  !sasroot\sasexe\base  5  for improved performance. */
/* -filecache  !sasroot\sasmsg       5                          */
                                   /* Do NOT cache directories that*/
                                   /* may contain SAS data sets or*/
                                   /* SAS catalogs.          */
```

NOTE: Change the d: in the -work line to the local disk of the machine that is running the programs.

Appendix D. Formats and examples of the .SUM, .STD and .STK output files.

Table D.1. Format of the scdCOE.fsn files.

Columns	Format	Variable	Units/	Description
1-3	I3	Installation		
5-8	I4	Plot		
10-11	I2	Species number		(used for sorting)
13-14	I2	Measurement		
17-18	I3	Age		
20-21	I2	Species code		
23-29	F7.4	b_0		
31-38	F8.4	HTOP	m	Predicted height at DBH=DTOP.
40-45	F6.2	DTOP	cm	Average diameter of largest 100/ha trees.
47-53	F7.3	"R^2"		Proportion of variation in height explained by regression.
55-58	I4	N		No. of height measure trees.
62	I1	Fit code		Type of fit. "6"=species specific "8"=overall plot "9"=by measurement
63-68	A6	Model name	Moness	Name of regression model.

Table D.3. Format of the scdfsn.SUM files.

Columns	Format	Variable	Units/ Entries	Description
1-4	I4	Installation		
5-8	I4	Plot		
10-11	I2	Measurement		
13-14	A2	Species		See Appendix E XX=all species combined
16-18	I3	Breast ht. age	years	
20-22	I3	Total age	years	
24-33	A10	Type	MORTALITY	Dead tree summary
			PRE-THIN	Pre thinning summary
			THINNED	Thinned tree summary
			INGROWTH	Ingrowth tree summary
			SUPPRESSED	Suppressed tree summary
			STANDING	Live tree summary
35-38	F4.1	Top height	m	Avg. ht of 100 largest DBH trees/ha
40-43	F4.1	Site height	m	Avg. ht of doms. and codoms. (if available)
45-48	F4.1	Mean height	m	Avg. ht of all trees
50-55	F5.1	Total volume	m^3/ha	All trees - top and stump included.
57-62	I6	Stem count	#/ha	
64-67	F4.1	Mean DBH	cm	Arithmetic average DBH
69-72	F4.1	Quad. mean DBH	cm	Quadratic mean DBH
74-78	F5.1	Basal area	m^2/ha	All trees
80-81	I2	Month		Date of measurement
84-85	I2	Year		" " "
87-92	I5	Merch. volume	m^3/ha	All trees, excluding 30cm stump,10cm top DIB

Table D.3. Format of the scdfsn.SUM files (cont.).

Columns	Format	Variable	Units/ Entries	Description
-------Columns 94-162 for species=XX, type=STANDING only----------				
			Percent total volume by species	
94-96	I3	FDp	%	Douglas-fir
97-99	I3	HWp	%	western hemlock
100-102	I3	HMp	%	mountain hemlock
103-105	I3	CWp	%	western redcedar
106-108	I3	SSp	%	Sitka spruce
109-111	I3	BAp	%	balsam fir
112-114	I3	CYp	%	alaska cedar
115-117	I3	RHp	%	residual hemlock
118-120	I3	RCp	%	residual cedar
121-123	I3	PLp	%	lodgepole pine
124-126	I3	PWp	%	white pine
127-129	I3	PYp	%	yellow pine
130-132	I3	SWp	%	white spruce
133-135	I3	SBp	%	white spruce
136-138	I3	LWp	%	western larch
139-141	I3	psoft	%	softwood
142-144	I3	DRp	%	red alder
145-147	I3	MBp	%	bigleaf maple
148-150	I3	ATp	%	trembling aspen
151-153	I3	ACp	%	black cottonwood
154-156	I3	EAp	%	paper birch
157-159	I3	OTp	%	"other" species
160-162	I3	phard	%	hardwood

Table D.4. Format of the scdfsn.STD files.

Columns	Format	Variable	Description
1-38			Same as *.SUM file
40-45	I6	NTOT	Total number of trees/ha
			Number of trees/ha by 5-cm DBH class
46-51	I6	N0	DBH<2.5
52-57	I6	N5	2.5≤DBH<7.5
58-63	I6	N10	7.5≤DBH<12.5
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
154-159	I6	N90	87.5≤DBH<92.5
160-165	I6	N95	92.5≤DBH<97.5
166-171	I6	N100	97.5≤DBH

Table D.5. Format of the scdfsn.STK files.

Columns	Format	Variable	Description
1-38			Same as *.SUM file
40-45	F6.1	MVTOT	Merchantable volume - all trees (m^3/ha)
			Merchantable volume (m^3/ha) by 5-cm DBH class
46-51	F6.1	MV0	DBH<2.5
52-57	F6.1	MV5	2.5≤DBH<7.5
58-63	F6.1	MV10	7.5≤DBH<12.5
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
154-159	F6.1	MV90	87.5≤DBH<92.5
160-165	F6.1	MV95	92.5≤DBH<97.5
166-171	F6.1	MV100	97.5≤DBH

NOTE: Merchantable volume predicted by Kozak et al. (1988) volume equations. Stump=30cm, minimum top DIB=10cm.