

A SYSTEM FOR HANDLING AND PRELIMINARY ANALYSIS OF VEGETATION PLOT DATA

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ABSTRACT

A system has been developed for the efficient collection, keypunching, verification and analysis of vegetation plot data. It includes field forms on write-in-the-rain paper which are designed to be easily keypunched. A program has been written to facilitate cleaning the keypunched data. Other routines enable: 1) conversion of the data into positional format for entry into most classification and ordination routines, 2) construction of species cover and stand tables, 3) estimation of tree height and age (when necessary on large diameter trees), and 4) estimation of soil water-holding capacity.

INTRODUCTION

Much similar ecological data has been collected by scientists in Corvallis associated with the USDA Forest Service and Oregon State University. In the absence of standardized procedures methods of data collection and analysis have varied between investigators. With the establishment of a data bank as part of the Coniferous Forest Biome in Corvallis, data collection procedures and computer formats have now been documented for many studies. This led several investigators to use one general set of procedures and data formats for taking similar types of data.

Obvious benefits accrue from having data sets well documented in a data bank. First, the data is available to future researchers with complete documentation even after the original investigator leaves. Second, data collected by different people on different studies can be easily analysed together or compared.

This paper describes use of a vegetation data set design and programs for making preliminary summaries and calculating simple indices. The data bank includes other large data sets, for instance those on logs and snags, used by several researchers.

THE DATA SET

The desire of researchers to use uniform methods and formats resulted in the formation of a data set which evolved through several stages to the current TP56 data set, described here. The unpublished Vegetation Survey Crew Manual (Hawk et al. 1979) coevolved with TP56 and became the primary vehicle for standardizing field procedures and formats. Write-in-the-rain forms for collecting vegetation data in the field are one of the keys to this system because they eliminate transcribing (a common source of introduced errors) prior to keypunching.

Seven different types of data can be recorded on the TP56 data set. Each type can be recorded on its own field form or portion thereof and card type.

Codes for data deck (TP56), card type, study, plot and a sequence number are punched in the first 16 columns of each card so it is uniquely labeled. Card type is punched at the beginning so a deck can be scanned quickly by computer and only the desired cards need be read in detail.

Several features of this data set make it flexible enough to be used by different investigators. Only the desired data need be recorded. Thus, most people do not use all the field forms or card types. The standardized formats for general site, general vegetation, and soil pit data leave extra space for data unique to a particular study. When there is insufficient room on field forms for data on species cover, and tree tally, age, height, or conditions and growth, recording can be continued on a second form. New field forms and corresponding formats can be designed as needed. TP56 is used for different plot types and sizes.

The general site, general vegetation, and species cover data are all on the same field form. The types of data collected are as follows:

General Site Physical Data.--This data, punched on card type 1, consists of area code, date, plot type code, plot area, elevation, slope, aspect, landform code, and habitat or community type code.

General Vegetation Data.--Data which can be recorded on card type 2 are the percent ground covered by: bedrock, loose rock, mineral soil, coarse litter, fine litter, moss, and lichens, as well as the number of species and total cover of trees, tall shrubs, low shrubs, herbs, mosses, and lichens.

Species Cover.--A seven-character species alpha code (Garrison et al. 1976) and percent cover may be recorded on the field form for all species of interest. This data is punched on card type 3 in a non-positional format as species, cover, etc., seven species per card. Additional cards are used as needed for the number of species to be recorded. The sequence number can be used to distinguish species cover on different subplots when necessary.

Tree Tally.--Trees can be tallied by 10 cm diameter classes up to 120 cm d.b.h., and diameters greater than 120 cm can be recorded individually on card type 4. Trees shorter than 137 cm can be tallied on subplots, the area of which is also recorded. Tallied trees can be separated by species, rooting material (soil or rotten wood), or vitality (live or dead).

Tree Age and Height.--This field form and format are used when taking data to determine site index. In addition to tree age and height, the following can be recorded on card type 5: month and year, tree tag number, species alpha code, d.b.h., diameter at core height, and core height. Bark thickness, core length, growth rate at the inner end of the core in rings/centimeter, angle from the core tip to the pith, and core age, can be recorded so age at core height can be estimated by computer on trees too large to reach the center with an increment core. The angle to the tree top, angle to a bottom target, height of the bottom target, slope distance to the tree base, and eye height of the observer can be recorded so height can be calculated. Since height can be calculated by computer, sightings can be taken at any convenient location and the slope distance measured afterwards. The card type 5 and 6 data are usually recorded on the same form.

Tree Conditions and Growth.--Month and year, tree tag number, species, and d.b.h. can be recorded on card type 6. Codes for the following can also be recorded: canopy class, overall vigor, conditions of crown, bole and rooting, and types of scars present. In addition, the following data on diameter growth can be taken on two increment cores: bark thickness, current growth rate in rings/centimeter, and sapwood thickness. Lastly, basal area around the tree measured with an angle gauge and expressed as either square feet per acre or square meters per hectare can be recorded.

Soil Pit Description.--The soil pit field form has structured data fields at the top for keypunching into the standardized format and unstructured space below for recording other data pertinent to a particular investigation. Card type 7 allows digitization of: depth to bedrock, pit depth, and litter thickness codes for characterizing topography, coarse fragments, and bedrock. Thickness, a code for texture, and percent coarse fragments can be recorded for three horizons. Similar data on four more horizons, or other data, may be recorded in the columns beyond the standardized format.

COMPUTER PROGRAMS

Most of these computer programs were developed in conjunction with a study of Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) on dry sites in western Oregon (Means 1981). All are written in Fortran and run on the CDC Cyber computer at Oregon State University.

Cleaning Key punched Data.--Whenever data is keypunched, it must be verified (i.e. proofread). This job is facilitated for TP56 by program CKTP56 which reads in all data, performs some simple checks, and prints it out in a form similar to the field form (figure 1). This last feature increases the speed and accuracy of verifying the data with the field forms from which it was punched. Program SPPCK compares all species alpha codes in a deck with a list provided by the investigator and lists all codes not common to both. In large data sets SPPCK usually catches errors not caught when species codes are checked by eye.

Converting Species Cover Data to Positional Format.--SIMDAT2 converts the species cover data on card type 3 to a positional format, which is required by many ordination and classification programs. The species to be output and their order can be specified if desired. Species codes may be lumped and called by one name which causes their covers to be added on each plot. This allows grouping taxa believed to have similar ecological requirements or which are difficult to distinguish in the field. SIMDAT2 was written by Alfred T. Brown when he was data bank manager. It includes non-standard Fortran statements (ENCODE and DECODE).

Species Cover Table.--Plots and species can be selected, ordered, and plant cover displayed in a table by program ORDER3 (figure 2). It requires data in a format such as that produced by SIMDAT2. ORDER3 is based on program ORDER of Volland and Connelly (1978). Average cover can be calculated for all plots or for plots in which the species occurs. Percent constancy and an importance value are also calculated. Arrays are dimensioned with variables in the subroutines so it is easy to modify the program for different data matrix and machine sizes. Several different, perhaps overlapping, groups of plots may be processed in one run.

Stand Tables.--Program STANTAB produces stand tables (figure 3) from the tree tallies on card type 4. Using slope and plot area in the general site data, it corrects plot area for slope and converts the tallies to a per hectare basis. STANTAB also calculates basal areas. Output is broken down by species, vitality (live versus dead trees), and rooting medium (soil versus rotten wood). The general site data is printed as a heading for each plot. Lastly, summary tables of average values and standard errors are produced for each group of plots. Several different, perhaps overlapping, groups of plots may be processed in one run.

TSUGA MERIENSISIANA / VACCINIUM SCOPARIUM

PLOTS	5	6	7	8	10	11	12	29	30	32	COVI	CONS	OCUR	IMFO
1 5ABAM		0	.5		3	.1	1	.6	.1	3	.5	20.	6.	6.
2 5ABLA					.2		0	5	.1	3	.9	30.	3.	5.
3 5ABPR			.1	0						1	.0	10.	1.	0.
4 5PICO						0	0	1	2		.4	40.	4.	4.
5 5PIEN			.2	1	1	.5	.1	0	.7	1	.2	20.	2.	2.
6 5PIMO	1	.1						7	.1	1	.5	90.	9.	7.
7 5TSME	34	35	29	59	30	30	0+	7	.7	40	44.8	100.	10.	67.
8 4VAME							.1				.0	10.	1.	0.
9 4VASC	10	10	1	.1	5	8	13	6	.6	50	10.9	100.	10.	33.
10 3LUCA									.1		.0	10.	1.	0.
11 3PYSE					3						0.0	0.	0.	0.
12 2CAFO									.1		.0	10.	1.	0.
PLOTS	5	6	7	8	10	11	12	29	30	32	COVI	CONS	OCUR	IMFO

Figure 2. Species cover table produced by program ORDER3.

DECK ID TP5b 1 STUDY ID DRYO PLOT 19 AREA IU 00ET ESTABLISHMENT DATE 770725																				
PLOT TYPE HS PLOT AREA (SQ M) 500.0 ELEVATION (M) 1249 SLOPE (%) 43. ASPECT 225																				
LANDFORM MEDDVC HABITAT THCC																				
SLOPE CORRECTION FACTOR 1.08853 PLOT SIZE CONVERSION FACTOR 20.00000 BOTH CONV. FACTORS COMBINED = 21.7706																				
SPP ALPHA CODE	CODES	REPRO	LT	137CM	0.1-10	20	30	40	50	60	70	80	90	100	110	120	***TREES GT 120CM DBH***	NUM /HA	TOTAL STEMS GT10CM /HA	TOTAL BASAL AREA M2/HA
PSME	L M	50	0	0	0	0	44	22	44	44	44	44	44	44	44	44	0	0	152	22
TSHE	L M	50	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACGL	L M	50	0	0	87	0	0	0	0	0	0	0	0	0	0	0	0	0	65	2
CACH	L M	50	0	1742	348	218	0	0	0	0	0	0	0	0	0	0	0	0	501	23
PRUNU	L M	50	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0	44	1
LIVE TOTALS	50	8	1742	457	327	261	87	44	44	0	0	0	0	0	0	0	0	0	762	49
PSME	D M	50	0	0	0	0	0	0	22	0	0	44	0	0	22	44	0	0	131	87
CACH	D M	50	0	0	65	65	0	0	0	0	0	0	0	0	0	0	0	0	65	2

Figure 3. Stand table produced by program STANTAB. The general site description data is used as a heading. This data is on a per hectare basis and corrected for slope.

Ages and Heights.--Program AGEHT calculates tree ages and heights when not already present. It currently uses data on card types 5 and 6. Age is calculated when extrapolation beyond the end of the core is necessary. AGEHT assumes the pith is at the geometric center of the tree and that ring width decreases linearly with increasing age from the pith outward. Two estimates of number of rings beyond the core tip are made using different subsets of the increment core data. The average is added to core age to estimate age at core height. Ring width is generally thought to decrease exponentially with age (Fritts 1976), but this function was not used for several reasons. It is more difficult to solve, comparisons with the current method indicated that differences between the two methods were small, and usually only a small portion of the age at core height must be estimated.

Different formulas are used to calculate height depending on the elevation of the observer relative to the base and top of the tree, whether or not a bottom target is used, and eye height of the observer relative to the height of the bottom target when used.

Effective Soil Depth and Available Water-holding Capacity.--Program SH20 calculates effective thickness and available water-holding capacity for each soil horizon, to pit depth, to a selected depth, and to bedrock (if known) (figure 4). It uses the data on card type 7. Effective thickness is the horizon thickness minus the proportion of coarse fragments. Horizon water-holding capacity is effective thickness times the available water capacity for that textural class (Soil Conservation Service 1971). Horizon values are then summed to different depths. Output is generated on the printer and on a computer file ready for analysis.

Using the System.--Immediately after keypunching, all card types can be grouped together in one deck. Programs are then run on this complete deck, keying on the card type codes to pick out only the data needed. Most programs use the data from only one or two card types. Computer time could be saved if the card types were separated and only needed card types read, but the present system is used because of the convenience of having all the data from one plot together in a deck which contains data from all the plots in one study.

Programs and data files are generally stored on magnetic tape at the Oregon State University computer center and on cards in the investigator's office. They are put on disk files for use.

PLOT	PIT	BEDRKDEP	PI10EP	RKFRAG	BEDROCK	LITTER	TOFO	BA(M2)
59	2	165.0	165.0	R4 03	R4 4 3	4.0	VV	73.5

HORIZONS	THICK	TEXT	CCARGE PARTIC	EFFECT THICK	WATER CA FAC
F FLOCF	4.0	0.	0.0	4.0	1.2
FIRST	47.0	6.	21.0	37.1	7.4
SECONC	54.0	10.	12.0	47.5	9.5
THIFD	64.0	4.	75.0	16.0	2.7

DEPTHS

PIT	165.0	39.0	100.7	20.9
BEDROCK	165.0	39.0	100.7	20.9
SELECT	100.0	16.2	83.8	18.0

Figure 4. Output from program SH20. Depths, thicknesses, and water capacity are in centimeters.

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