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OVERSEAS DEVELOPMENT ADMINISTRATION

FOREST PLANNING AND MANAGEMENT PROJECT

BELIZE

Project Consultancy Report No. 4.

RE-ANALYSIS OF BROADLEAF FOREST INVENTORIES 1969-1981

TECHNIQUES AND PRELIMINARY RESULTS

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December 1992

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EXECUTIVE SUMMARY

Inventories covering several broadleaf natural forests in Belize were performed with ODA Assistance between 1969 and 1981, including Chiquibul, Columbia River, Maya Mountains, Deep River, Cockscomb Basin, and the former Belize Estates Company land in the Hillbank-Rio Bravo area. With the exception of the Chiquibul inventory, these were never written-up in published form, and results were only available in departmental files as partially corrected drafts. This report describes procedures for the re-analysis of these inventories, and their presentation in a common format. It is an interim report at the mid-point of a six-month consultancy.

Data for Chiquibul, Columbia River, Maya Mountains, and Cockscomb Basin were re-entered from the original cards. For the Deep River and Hillbank inventories, the data was only available from archive magnetic tapes from Oxford University, who performed the original analyses for ODA. Programs were written for data entry and editing, and for building and maintaining a species list. These are documented in the report. Standard data files were created for all data sets except Deep River, which was excluded because of time constraints. All the data was manually checked and cleaned for errors.

A major computer program, called TSIA (Transect Sampling Inventory Analysis) was written to re-process the data. This uses stratified random sampling with variable length transects as its statistical paradigm. Stand tables were produced for all the inventory areas except Deep River, and are included in the report, together with documentation and a listing of program TSIA.

Tree volume equations developed for the original inventories were re-assessed. The raw tree measurements were re-input, and a new set of equations computed that provide pooled functions for the various inventory areas. The data collected was heavily biased towards Chiquibul forest, and insufficient data was available for reliable local volume equations. Examination of the old data suggested low precision of measurement, and collection of data for new equations, based on felled tree mensuration, is recommended.

Procedures were developed for input of data from permanent sample plots, and the production of plot maps via the SYSTAT package. These are detailed in a separate Appendix.

Work was commenced on the use of the Arc/Info GIS system, with the help of the Land Information Centre of the Ministry of Natural Resources. A GIS workstation was set up in the forest management office, and transect locations for all the inventories digitized. During the next consultancy phase, this data will be used in conjunction with vegetation and land system maps now available on GIS to re-stratify the original inventory transects and provide more general and broadly applicable estimates of forest cover and condition.

Some recommendations are made for stock survey and 2% inventory work that should be developed as a component of the forest management system for broadleaf forests.

CONTENTS

1 Introduction

1.1 Terms of Reference

1.1.1 The consultant's terms of reference (TOR) as given in his contract of employment are reproduced in Appendix A. In essence the main emphasis is to spend some six months re-processing data from the various broadleaf forest inventories carried out with ODA assistance between 1969 and 1981 (see table 1, page 2). This re-analysis is intended to provide several benefits:

- Presentation of results presently scattered in a variety of typescripts and reports in a common and accessible format.
- Re-stratification by land system or vegetation type, to permit the possibility of generalizing the data to provides estimates of forest stocking usable at a national level.
- Provision of a standard computer system for inventory analysis that can be used for future management inventories.

1.2 Scope of the report

1.2.1 The present report covers work undertaken during the first three-month period, from 22nd September to 15th December 1992. It is mainly concerned with technical descriptions and documentation of computer programs written for data analysis during this period, and does not attempt to draw any conclusions from the inventory re-analysis, which is only partially completed.

1.2.2 It does however include recommendations for future stock survey and inventory techniques, based on the statistical parameters derived from a review of the older inventories.

1.2.3 It also reports on progress in permanent sample plot data entry, and the integration of Geographical Information Systems (GIS) with the inventory programs to provide forest management information in map form, and to estimate the locations of the earlier inventory transects.

1.3 Forest inventories covered

1.3.1 The forest inventories for which data has either been re-entered, or converted from the Oxford archive format are summarised in relevant technical respects in Table 1. This also shows additional data sets in the Oxford format that could potentially be converted and processed through the systems described in this report. Much of the work in recovering this data is due to J.R. Palmer, who located and re-organized the scattered inventory cards. The Oxford Forestry Institute was also co-operative in retrieving old magnetic tapes and downloading inventory files onto diskettes which were made available to the present author in March 1992 by H.L. Wright. Maps and original write-ups of the inventories, together with a good deal of other relevant reference material, were provided by the Forest Management Specialist (FMS) to the Project, N.M. Bird.

Table 1 : Broadleaf forest inventory data available on computer

Forest	Year of inventory	Current status of data	Summary description of sampling design
Chiquibul main series transects	1969	Re-entered from cards, cleaned, and converted into new format	Block size: 8 km square Transect width: 20 m, 40 m for Mahogany, Cedar, Allspice. Record units 50 m long, diameters above 40 cm recorded, (10 cm for primaries), subsamples every fifth record unit with all trees to 20 cm recorded.
Chiquibul check plots	1970	Re-entered from cards	As above, but only some record units on a few transects re-measured. Used as a quality control check.
Chiquibul mountain series	1972	As above, but data cards for several blocks not located.	5-km square blocks, otherwise as above.
Columbia River/Maya Mountains	1975/76	As above. Data also available in Oxford format, but not so far used.	5-km square blocks, Allspice not included as a 'primary' species, all species recorded down to 40 cm, down to 20 cm on subsamples for most species, 10 cm minimum for Mahogany and Cedar.
Cockscomb	1977	Re-entered from cards, also available in Oxford format	4 x 5 km blocks, each with 2 transects of 4 km. Otherwise as for Columbia River above.
Belize Estates (Hillbank)	1971/74	Converted from Oxford format	Variable sized blocks and transects, subsampling every 10th record unit, record unit IDs lost in Oxford data.
Deep River	1981	Available in Oxford format, not yet converted.	2-km square blocks, transects and sampling as for Columbia River, except Mahogany sampled to 20 cm on main sample.

1.3.2 Although all the inventories are similar, based on two random transects within blocks which cover the whole forest area, there are numerous variations which have greatly complicated the task of writing analytical programs. Each inventory has slight differences in sampling procedure, including the minimum diameter measured, species considered to be primary (usually Mahogany and Cedar, but sometimes including Allspice), frequency of subsampling and intensity. In many cases there are significant variations in transect length, with even block size being variable on the Hillbank inventory.

1.3.3 The original data cards used variable and confusing notation to record regeneration, and it was decided not to include this data in the re-processing exercise. It may in future be potentially of interest for comparison with results of new inventories, but amounts to little more than presence-absence data for a limited set of perhaps twenty identifiable species. Another curious feature of the field cards was the absence of any notation for defect codes. Tables of defect percentages are recorded in all the original write-ups; defect codes are also present in the Oxford data. Where this data was recorded is a mystery, and defect is necessarily excluded from consideration in the re-analysis.

1.4 Reference diskettes

1.4.1 To accompany this report, a set of reference diskettes has been prepared and provided to the project Forest management Specialist. These contain all the data sets, programs, and supplementary files, including this report, in a compressed format created by the Xtree Gold archival system. Appendix B gives a list of all the files on these diskettes with a short summary of their nature.

2 Data entry and error correction procedures

2.1 Entry in original card format

2.1.1 In order to provide an early start to the data entry work, prior to the biometrics consultant's arrival, a format was designed for entering the data on the original field cards using DBASE IV. This format allowed all the various annotations and oddities on the cards to be entered by adopting character values for all fields. This unfortunately simply delayed and complicated the task of data cleaning, and introduced another layer of programming activities into the consultant's overall task. The files created in this format are listed in Table 2 below.

Table 2 : Card format data files

File	Contents
CHIQUIBU.DBF	Chiquibul Main Transects
CHIQCHK.DBF	Chiquibul Check Transects
COLUMINV.DBF	Columbia/Maya Mountains Transects
COCKSCOM.DBF	Cockscomb Transects

2.1.2 These files are very large, comprising mainly empty fields, and have been placed in an archive diskette, using the XTGOLD package archiving option. This is diskette #1 in the set of reference diskettes. The archive file is called CARDFMT.XTG, and contains, in addition to the above files, the dBASE format files CARDS.* which are required to view these files with the dBASE EDIT command.

2.2 Conversion of data to prefix format

2.2.1 The card format files were converted to a format called in this report **prefix** format for purposes of data cleaning and routine analysis. Each reserve area was given a 5-letter prefix name. Two files were created for each inventory area:

(i) **Plot files.** These contain plot-level information extracted from the card-format files. The filename comprises the 5-letter prefix together with the suffix '_P'. The data structure of this file is shown in Appendix C.1.

(ii) **Tree files.** These contain tree species code and diameter, together with a linking field called PLOT which contains the inventory identity, block number, transect number and record-unit number compressed as an 8-digit code. Details are given in Appendix C.2.

2.2.2 The files which resulted from this conversion process are listed below. This list also includes, for completeness, the HILLB_P and HILLB_T files. These files were produced by a different route, from the Oxford data sets, as discussed in section 2.4.2 below. They will be found on reference diskette #2 in the archive file PREFIX.XTG.

Table 3 : Prefix-format data files

Plot	Tree	Inventory area
CHIQU_P	CHIQU_T	Chiquibul Main Series 1969
CHIQM_P	CHIQM_T	Chiquibul Mountain Series 1971
COLUM_P	COLUM_T	Columbia River 1975/76
MAYAM_P	MAYAM_T	Maya Mountains 1975/76
COCKS_P	COCKS_T	Cockscomb 1978
HILLB_P	HILLB_T	Hillbank (Belize Estates) 1975

2.2.3 The conversion process, from card to prefix format, was carried out by a program called DBH_CONV. This can be operated from the dBASE assist screen by first placing the card format file (eg. CHIQUIBU) in use, then

running the DBH_CONV application. This should not be done casually however, as DBH_CONV will erase the contents of the prefix output file before starting to run.

2.2.4 DBH_CONV should not be required in future. It is retained purely for archival and documentation purposes, as all the necessary conversions have been done. The program undertakes the following processes:

(i) It scans each tree data field in the card-format record and looks up the species local name in a file called SPECIES.DBF. If it cannot find it, it also checks a secondary database called SYNONYMS. If there is still no match, the operator is invited either to add the name to the SYNONYMS file as an alternative to another selected name, or to add it to the SPECIES file with a new and unique species code number. This process thus dynamically builds both the SPECIES and SYNONYMS databases.

(ii) The species code thus derived is placed in an new record added to the _T file. The corresponding list of diameters in the card file are decoded from a character-format list into numeric values, and added to the _T file, one record per tree, with the species code being replicated for each record.

(iii) The plot level information, comprising the record unit, transect, and block identity, are added to the _P file, together with the site codes from the card-format file. The plot identity information is synthesised into a unique code number that is added to each corresponding tree record.

2.2.5 The conversion process is quite slow, taking 2-3 hours for each data file. The output files thus obtained can include many types of error resulting either from syntactic oddities in the card-format files, from mistakes in species nomenclature, or errors in plot identification. The latter are potentially serious, as with the one-to-many linkage between the _P and _T files, trees can be assigned to the wrong plots as a result of errors in identity numbers. Duplicated numbers will result in all trees being assigned to the first plot that occurs in the database file.

2.2.6 The basis of the species list, and some consequences of its dynamic build-up in this way, are discussed fully in section 3.

2.3 Data listing, correction, and editing

2.3.1 A short program called PRT_DAT was developed to list the converted data files, together with names for species codes. This program can be run from the dBASE control centre or from the dot prompt. In the latter case type:

```
DO PRT_DAT
```

The program requests the 5-letter file prefix to be listed, and the first and last transect numbers. The latter are preceded by block numbers to uniquely identify them. It then proceeds to print out the data. Wide paper continuous forms are required. The printing process may take 1-2 hours for a full file.

2.3.2 All the data was listed in this way, and checked against the original field cards for mistakes. An editing program called BIDE (Broadleaf Inventory Data Editor) was written to conveniently update the prefix format files. This program provides a browse table[a] of plot-level information. Records can be edited directly to amend site information. Function keys allow plot identification to be altered; this is a more complex process, as all related tree records in the _T file must also be updated.

2.3.3 Tree data is accessed by pressing the F1 key from the plot browse table. The list of trees on the plot is then displayed for editing. The **Ctrl-End** key reverts to the plot-level table with changes to the tree data saved. The **Esc** key reverts without saving edits to the tree data. In the tree table the F1 key can be used to review previously deleted trees, and if necessary restore them.

2.3.4 The BIDE program is listed in Appendix D.1. Its complexity illustrates the difficulty of handling one-to-many relations in dBASE. In other database packages that the author has used, such as PARADOX or R:BASE, these operations are trivial and can be handled within the screen form generator, without any programming being required. Much of the complexity derives from the need to give a reasonably fast user-response. The SET FILTER TO function in dBASE provides an obvious approach to one-to-many access, but it is extremely slow with large files. In BIDE, relevant records are copied to a database called SCRATCH for editing. This database will be found in the directory, but it can be deleted at any time. It will be found to contain the tree records for the last plot edited.

2.3.5 BIDE can also be used to input data directly into the prefix files, without having to go through the card-format files and data conversion process. Moving to the end of the plot table, using **Ctrl-PgDn**, allows a new plot level record to be entered. The plot ID information is carried forward automatically. Associated tree information is added by pressing the F1 key. After entry, the plot will be sorted into its proper position

2.4 Conversion of Oxford format files

2.4.1 The Belize inventories were originally processed in Oxford, using programs written by P.G. Adlard, with volume table analysis by H.L. Wright. The author was provided with copies of the extant data files. These were accompanied by documentation files describing the sampling design for each inventory, block areas and transect lengths, species lists and codes, and volume equations used. Table 4 lists all the Oxford files available. They are archived on reference diskette #4.

---

[a] That is, a table produced by the dBASE BROWSE command, giving data in a tabular, spreadsheet-style format, one line per record.

2.4.2 These files do not correspond precisely with the data on the original inventory cards. Within transects, record unit designations have been lost, and individual species diameters are replaced by 10-cm diameter class codings. It should be noted that each inventory uses its own species list and code numbers, which do not correspond with the codes used in the prefix data files created under this assignment.

2.4.3 The data for the Hillbank-Rio Bravo inventory of 1975 were converted by the following procedures:

(i) An intermediate dBASE file was created to correspond to the columns in the Oxford HILLA1, HILLB1 etc. files. Data from these files was appended to this database (known as HILLBANK.DBF).

(ii) The species codes in the Oxford data were converted using the dBASE UPDATE command, and a temporary file called OLDSPP.DBF that contained the old and new species codes.

(iii) A short program called OXCONV was run to create the prefix files HILLB_P and HILLB_T, separating tree and plot level information.

2.4.4 The same procedure can be used to convert the other data files. About 2-3 days work are required for each conversion, mostly in checking species code numbers and compatibility of nomenclature. It is intended in the next phase of this consultancy to convert the Deep River file, as that is not available on cards. Time has not permitted this to be done within the current 3-month period.

3 Species list development and updating procedures

3.1 Basis of the species list

3.1.1 The species names on the inventory cards were originally entered in text format, as written on the cards, whilst in the Oxford data sets, each inventory has its own species list using different code numbers. A priority for the consultant was therefore to establish the basis for a rational system of common species coding and nomenclature.

3.1.2 As a starting point, the Oxford list for the Columbia River/Maya Mountains inventory was used. This appeared to be the longest and most comprehensive of the several Oxford lists. It was edited from the SHARDWDS.TXT file (see page 8, Table 4) to produce a fixed-format file with four columns: code number, local name, botanical name, and utilization group. This file was then converted into a dBASE file called SPECIES.DBF by creating the structure shown in Appendix C.3, and appending records from the text file with the SDF option.

3.1.3 Two other lists were available at that time: That given by Palmer (1989)[1], and the list produced by Hartshorn et. al. (1984)[2]. During the data conversion of the card format to prefix format files (see 2.2.4), new local

Table 4 : List of data files obtained from Oxford University

File	Description of contents
TO.BEL	Apparently a memorandum covering documents sent to Belize from Oxford. Not directly useful.
HWDKEY.TXT	Description of the data columns in the hardwood inventory files.
SHARDWDS.TXT	Documentation for the Columbia/Maya Mountains inventory, including sampling design, species lists, and volume tables.
SHALEOUT	Columbia/Maya Mountains Shale series transects tree data
LIMEOUT1	- " - , Limestore series.
LIMEOUT2	- " -
LIMEOUT3	- " -
RIVER.TXT	Deep River documentation: sampling design, sepecies lists, volume functions
RIVEROUT	Deep River data file
COCKS.TXT	Cockscomb Basin documentation: sampling design, species list, volume functions
COCKOUT1	Cockscomb Basin transect data
COCKOUT2	- " -
HILLBANK.TXT	Hillbank-Rio Bravo (Belize Estates) inventory documentation: Sampling design, including sizes of all transects and blocks (which were variable), species lists, and volume tables.
HILLA1	Hillbank data, West of Rio Bravo
HILLB1	Hillbank data, East of Rio Bravo
HILLB2	- " -
HILLB3	- " -
PINEKEY.TXT	Description of data file columns for the pine inventories
MACHACA.TXT	Sampling design for Machaca pine inventory
MPR.TXT	Sampling design. Data file noted as lost.
MPROUT	Data for Mountain Pine Ridge inventory update, 1980.

names, not in the Oxford list, were frequently encountered. These were checked against the Palmer and Hartshorn lists to try and establish an existing botanical identity. If this could be done, then the alternate local name was recorded as the synonym for the established local name in the Oxford list.

3.1.4 Many synonyms arising in this way are simply variant spellings, often of an obviously erroneous nature. A database file called SYNONYMS.DBF was built containing all the variant spellings encountered during conversion of all the card-format files. The structure of this file is given in appendix C.4, and a listing sorted by the standard local name in Appendix G. A Word Perfect document called SYNLIST.WPD will be found on reference diskette #3 in the

\DOCS directory which includes the synonyms sorted by code number, standard name, and variant names.

3.2 Cleaning the species list

3.2.1 The species list as constructed needs to be carefully reviewed for three types of error:

(i) **Multiple local names for one species.** There are many local names which have been encountered on the field cards for which no botanical name has been determined. In some cases, these may be unrecognised variants of existing names. These can to some extent be resolved by a working group of forest rangers familiar with Belizean species nomenclature. Where multiple names exist, the alternates should have the notation '# see nnn', where nnn is the code number of the species botanically identified, inserted in the botanical name column of the database.

(ii) **A single name for multiple species.** For example, the name Moho applies to a number of species in different families. The author would suggest that it would achieve little at this stage to go back to the original data cards and try to resolve these discrepancies, by, for example, picking out Red Moho, White Moho, Broadleaf Moho, Narrowleaf Moho, etc. However, for future work, these distinct variations should be kept separate and botanical identifications determined.

(iii) **Regional variations in species name.** The same local name may apply clearly but distinctly to different species in different regions.

3.2.2 A current checklist of tree species in Belize has been supplied to the project by B.W. Miller[3]. This is available on reference diskette #3 as the Word Perfect document TREELIST.WPD, but is not reproduced in this report for copyright reasons. An index has been added with generic and local names to facilitate use of this list. It is suggested that the SPECIES.DBF file be updated to include all botanical names and local names on this list, and that botanical research is undertaken to identify all the local names on the SPECIES file with those on Miller's check list.

3.3 Usage of the species list in programs

3.3.1 The species database file SPECIES.DBF is required by all the documented programs described in this report. It is generally used to look up the species code numbers stored on the data files and present the standard local name on reports or on screen. In order to succeed in this, the programs require also the associated index files, which are SPECIES.MDX for dBASE programs, and various temporary .NTX files for Clipper programs. The Clipper indexes are generated as required and need not be of concern to the user. The dBASE .MDX file is also normally updated properly, but may under some circumstances become corrupted (eg. after power failure). A program called SPIX

is provided to regenerate the dBASE IV index files. It also PACKs (ie. permanently removes) any records in the file marked as deleted.

3.3.2 Correct presentation of results by the programs requires that species codes are not arbitrarily changed. The procedure for changing a species code is as follows:

(i) Use the REPLACE command with each _T file in turn to amend the required species number. For example:

```
USE CHIQU_T ORDER TAG
REPLACE SPP WITH 123 FOR SPP=132
```

will replace all occurrences of species code 132 with 123 in file CHIQU_T.

(ii) Edit the botanical name field of the species with code 132 with the note '#see 123'. The species line can be marked for deletion with the **Ctrl-U** key; it will actually be removed from the file at the next PACK operation. The following commands achieve this from the dot prompt:

```
USE SPECIES ORDER TAG SPP
FIND 132
REPLACE SNAME WITH '#see 123'
DELETE
```

The same result can be achieved interactively via the BROWSE command.

3.3.3 It is important to note that species code numbers should be added sequentially. Do not add numbers such as 999 or 1075. This is because a component of the array space in the inventory programs is determined by the highest species number found; arbitrarily large numbers may cause the programs to fail for lack of sufficient memory, and may require that significant parts of the programs are redesigned.

3.3.4 Examining the species codes in the list in Appendix F will show that only codes of two digits (ie. below 100) have utilization groups assigned; and that the code for **unknown species** is 103. This reflects the origins of the list, as discussed above. Codes below 100 were those species on the Oxford list for Columbia River/Maya Mountains. These all had utilization codes. Numbers above 100 were added dynamically as new species were encountered, with 'unknown' being the third such new species, hence the number 103.

3.4 Species groups

3.4.1 The species groups used in the original inventories were based on wood properties, including colour and density into a combined classification. These have been retained for the presentation of inventory results in this report, as shown in the tables in Appendix E.

3.4.2 Table 5 below lists the group codes and their meanings. This table corresponds to the contents of the file SPGROUPS.DBF which is used by program TSIA and will be found on reference diskette #3 in directory \INV.

3.4.3 However, the inventory program TSIA is indifferent to the meaning of the species groups, and alternate categories can be envisaged: degree of market penetration, botanical family, ecological category, etc. To set up alternative grouping schemes, the following procedure is adopted:

Table 5 : Species group codes

Group	Description
A	Primary species
B	Soft light wood
C	Medium soft wood
D	Medium hard dark wood
E	Medium hard light wood
F	Hard dark wood
G	Hard light wood
H	Very hard dark wood

(i) The dBASE file SPGROUPS is edited via the BROWSE command to include the group codes and descriptions. It should be borne in mind that output of stand tables is based on the alphabetic order of the species group codes, and these should therefore be chosen to present results in a logical sequence. Up to 4 letters can be used to identify the groups.

(ii) The SPECIES file is then edited to add the group codes for each species in the UTIL field. The UTIL field receives its name from its orginal use to hold utilization codes, but can equally be used for any grouping factor. To carry out this process efficiently, the UPDATE command should be used to replace the codes for a list of species. For example, a database may be created called MARKET, having the fields SPP (species code) and GROUP. Into this database the species code numbers and group codes should be entered. MARKET should be indexed on the SPP field, which must of type N3 for compatibility with the SPP field in the SPECIES database.

The commands:

```
SELECT 1
USE MARKET ALIAS MK
INDEX ON SPP TO TAG SPP
SELECT 2
USE SPECIES ORDER TAG SPP
UPDATE ON SPP WITH MK REPLACE UTIL WITH MK->GROUP
```

will then replace the UTIL field with the value of GROUP in the MARKET database for each species code that matches.

4 Inventory analysis procedures

4.1 Statistical basis for analysis

4.1.1 The various inventories listed in Table 1 were all designed on a common principle, which was proposed by H.C. Dawkins in 1958[4]. The forest area was covered by a series of square or rectangular blocks, and within each block, two transects were located at random. The blocks are treated as strata, within a stratified random design; the transects are the sample plots.

4.1.2 The Belize inventories were complicated by a number of factors however. Different transects widths were used for different species. Table 6 shows some of the technical parameters of the inventories. It is derived from a listing of the file INVCODES.DBF. Appendix C gives the formal field names corresponding to the columns in this table. Transect widths were 20 m. for species other than Mahogany and Cedar, and 40 m. for the latter. In the Hillbank and Chquibul inventories, Allspice was also sampled in the 40 m transect. Different minimum diameters applied on the various inventories, and different schemes of sub-sampling. Generally, the transect was divided into 50 m. long record units, or plots. Every fifth record unit was treated as a sub-sample. On the Hillbank inventory, however, every tenth record unit was subsampled. On the subsamples, trees were measured to diameter limits below the minimum diameters given in the columns in Table 6 for primary and secondary species.

Table 6 : Inventory parameters defined in INVCODES database

Inv no.	Card file	Prefix file	Inventory description	Bl. Size km2	Tran. Leng. m.	Primary species	Tr. Width 1y m.	Tr. Width 2y m.	Freq Subs	Min Diam 1y cm	Min Diam 2y cm	RU ln m.
1	chiquibu	chiqu	Chiquibul Main Series 1969	64	8000	1,2,49	20	20	5	10	40	50
2	chiqmnt	chiqm	Chiquibul Mountain Series 1971	25	5000	1,2,49	20	20	5	10	40	50
3	columinv	colum	Columbia River 1975/76	25	5000	1,2	40	20	5	40	40	50
1	chiqchk	chiqc	Chiquibul Check Plots 1969	64	8000	1,2,49	20	20	5	10	40	50
4		mayam	Maya Mountains 1975/76	25	5000	1,2	40	20	5	40	40	50
5	cockscom	cocks	Cockscomb Basin 1977	20	4000	1,2	40	20	5	40	40	50
6		hillb	Hillbank-Rio Bravo (BEC) 1975		Variable	1,2,49	40	20	10	40	40	-

4.1.3 Overlaid on these formal variations were a number of informal ones. The original concept of a random design was partially violated by the fact that some blocks were rejected as too mountainous or as unstocked. In a well-

designed inventory, such unsampled areas should be delineated and mapped before establishing the sampling frame.

4.1.4 The transects, which should have been of equal lengths, were in many cases short, due to obstacles encountered such as limestone karsts. In the Hillbank inventory, block size and transect lengths were variable in the design.

4.1.5 An additional factor that needed to be taken into account for the program design was the fact that the data would be re-stratified by land system or vegetation type, and that in doing so, transects would be broken up into units of highly variable length.

4.1.6 For the development of a standard program to re-analyse all these inventories, it was therefore decided to adopt the following general statistical procedures:

(i) The sample design would be treated as a stratified random sample based on variable-sized transects. Strata would be weighted by stratum area to derive pooled (forest-level) means and variances.

(ii) From this, it followed that the variance of the within-stratum mean for a parameter would be calculated as:

$$var(\bar{x}) = [(n/\Sigma w).(\Sigma wx^2 - (\Sigma wx)^2/\Sigma w)/(n-1)]/n \quad \text{-\{eqn. 1\}}$$

where:

n	is the total number of transects within the stratum;
w	are the individual parameter lengths (weights);
x	is the parameter concerned, such as volume of trees greater than 10 cm in a given species group.
$\bar{x}$	is the within-stratum mean of x.

It will be noticed that this formula simplifies to the conventional expression for variance of a mean if the plot weights are equal, ie. fixed sized plots are used. It also differs from that suggested in Philip (1983)[5] or de Vries (1986)[6] for variable-length transect sampling. They suggest a ratio estimator. The above formula, for a conventional weighted sample, seems to the present author to be perfectly adequate and considerably simpler.

(iii) The within-stratum mean is calculated as:

$$\bar{x} = \Sigma wx/\Sigma w \quad \text{-\{eqn. 2\}}$$

(iv) The pooled, forest-level mean would be calculated as:

$$\bar{\bar{x}} = \Sigma a\bar{x}/\Sigma a \quad \text{-\{eqn. 3\}}$$

where

a	is the stratum area
$\bar{\bar{x}}$	is the pooled mean

(v) The variance of the pooled mean is calculated from:

$$var(\bar{\bar{x}}) = \Sigma[a^2.var(\bar{x})]/(\Sigma a)^2 \qquad \text{-\{eqn. 4\}}$$

4.2 Design of inventory program TSIA

4.2.1 The main analytical program for forest inventories is called TSIA, an acronym for Transect Sampling inventory Analysis. It is written in Clipper 5.0, and is listed in Appendix D. The program comprises some 1100 lines of code, about 30 text pages. The description of its structure given here is necessarily a brief summary.

4.2.2 Figure 1 shows the main stages of program execution. The initialization stage corresponds to the routines **InvSelect, OpenInvf, OpenAreaFile, OpenSpf** in the program listing, as well as some preliminaries in the main program at the start of the listing. These routines provide the user with a menu to select the inventory to be processed, open the corresponding data files, and open the species file.

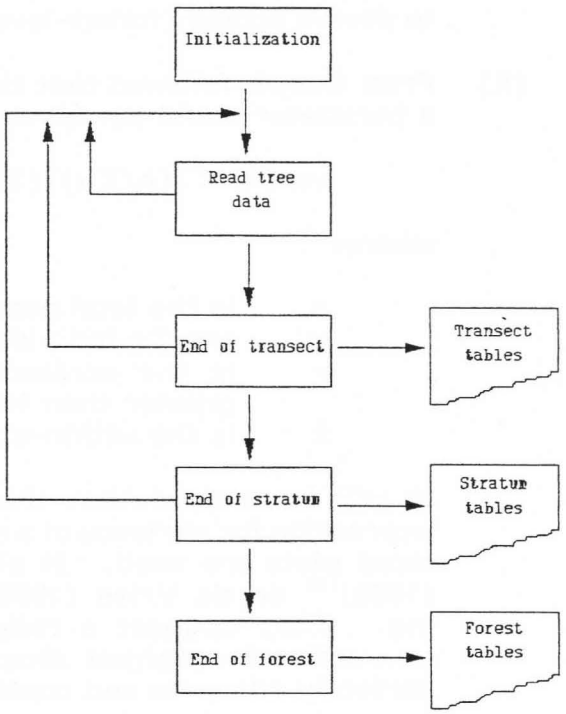

Figure 1 : Outline flowchart of program TSIA

4.2.3 When the species file is opened, the program sets up a series of data structures such as those depicted schematically in Figure 2. These are referred to n-branched arrays. A series of routines (**zfill, AddArray, FnArray**) will be found near the end of the program listing which manipulate these structures. Each array comprises a main array corresponding to the number of species groups. Within each group is a sub-array corresponding to each species in that group, plus one to accumulate group totals. Within each of these, depicted as a rectangle in the figure, is a sub-sub array comprising the diameter classes and cumulative diameter classes for the output tables. Two of the groups, however, are not defined at the species level. These are symbolized in Figure 2 by the horizontal rectangles attached to the main stem of the tree. These are the diameter class arrays for totals and for unclassified species (those not assigned to a specified group).

4.2.4 After initialization, TSIA reads tree data from the prefix_T file. This process is actually done indirectly, by first selecting the next record unit header in the _P file, then selecting the linked trees for that record unit. During this process, TSIA accumulates information on transect length and the number of record units within it. The transects lengths constitute statistical weights, as noted in the preceding section. The tree data is accumulated into two transect level arrays: **stu** and **volu**. These are N-branched structures as described above, which contain, respectively, numbers of trees by diameter classes, converted to a km² basis, and volumes by cumulative diameter classes.

4.2.5 The end of the transect is detected by several alternative mechanisms, depending on the method of stratification defined from the INVOPT program (see below). A **TransectID** variable is constructed from either block number, or Land System code, or Vegetation Type code, combined with the original transect number and the inventory number. This ensures uniqueness of identity even if several inventory data sets are pooled, and the transects 'snipped' into sections as they cross stratum boundaries. At the end of the transect, the **stu** and **volu** arrays are added, with appropriate weighting for transect length, to stratum level totals retained in arrays **sts** and **vols**. This addition process is handled by the routine **AddArray**, which recursively processes each branch of the array until it finds nodal array elements to add. It is also necessary, for variance and sampling error calculation, to add sums of squares of the volume array **volu**. This is done into array **volsq**.

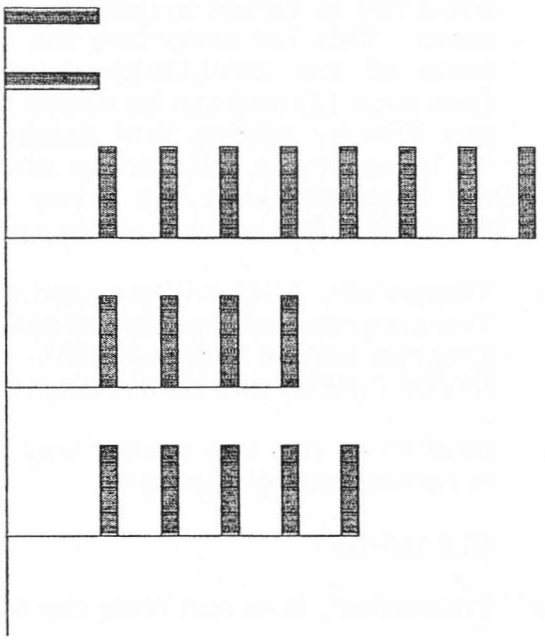

Figure 2 : Schematic representation of N-branched array

4.2.6 When the program detects the end of a stratum, by means of a change in the internally-constructed variable **StratumID**, then end-of-stratum processsing is initiated. The values in arrays **sts** and **vols** are converted from totals to means, by application of equation 2 above. Sums of squares in **volq** are converted to variances using equation 1. These are then weighted by the stratum areas and added to the forest level accumulators **stf**, **volf** and **volfq**. If stratum summaries are required, they are printed at this stage. the routine **EndStratum** in the program listing carries out these operations.

4.2.7 At the end of the data file, the remaining tree data is added to the current transect, the last transect added to the current stratum, end-of-stratum processing completed, and then end-of-forest processing initiated. These stages will be seen at the end of the data input loop in the main program portion of the TSIA listing. The forest

processing is relatively simple, adjusting the means and variances in the arrays **stf**, **volf** and **volfq** for the total area weights using equations 3 and 4, and then printing results. This is done from routine **EndForest**.

4.3 Instructions for program operation

4.3.1 TSIA is run as a .EXE file from the DOS prompt. The source program in Appendix D is called TSIA.PRG. This is converted to a .EXE file by the Clipper compiler. A DOS batch program called CL5.BAT, listed in the text box opposite, carries out the compilation.

CL5 batch file provided on reference diskette #3

```
@echo off
path c:\;c:\dos;c:\cl5;c:\cl5\bin
SET INCLUDE=C:\CL5\INCLUDE
SET LIB=C:\CL5\LIB
SET OBJ=C:\CL5\OBJ
SET PLL=C:\CL5\PLL
clipper %1
if errorlevel 1 goto 1exit
rtlink file %1
:1exit
```

4.3.2 To compile TSIA, type:

CL5 TSIA

from the DOS prompt.

4.3.3 To execute it, simply type:

TSIA

4.3.4 On start up, the program will present a list of forest inventories as a menu. This list comprises the contents of the INVCODES database (see page 12) and can be added to at any time by editing that database. An inventory is selected by moving the highlight with the arrow keys and pressing **Enter** at the required selection. **Esc** will abort the program and return to DOS.

4.3.5 Thereafter, TSIA will proceed with processing of the required inventories. The program has a number of options which can be set by running the INVOPT program before running TSIA. These options are saved on disk in the file INVOPT.MEM, and do not need to be changed between runs unless required.

4.3.6 INVOPT is run in a similar way to TSIA. If the .EXE file is not on disk[a], it is recompiled by typing:

CL5 INVOPT

4.3.7 Thereafter, it is run from the DOS prompt by typing:

INVOPT

4.3.8 The program will load the file INVOPT.MEM if it can be found; otherwise it will display a series of default options. Starting the program with the switch /D

---

[a] .EXE files have not been saved on the reference disks, and must initially be recreated as described, but thereafter, the programs do not need to be recompiled.

will force a reversion to the default options, over-riding any that have been saved to disk.

4.3.9 The options that the user can set are as follows:

(i) **Diameter classes:** A list of diameter class lower bounds can be entered. Note that no check is made that the values entered are sensible, and TSIA may perform in an undefined manner with absurd values. Each successive class should be greater than the preceding one; the lowest should be ≥10, and the highest ≤200 cm. Not more than 10 classes or less than 3 should be entered.

(ii) **Cumulative diameter classes:** A list of one to three cumulative diameter classes can be entered. The program will operate with more than three classes, but wide paper will be required for the printout. The cumulative class boundaries should coincide with diameter classes or results will be difficult to interpret.

(iii) **Printer set-up codes:** These are ASCII values required to set the printer. It is recommended that code 15 be entered for most Epson or IBM proprinter compatible printers to put them into condensed mode printing. If the printer is not in condensed mode when the tables are output, they will not print properly.

(iv) **Stratification method:** A value of 1 to 3 should be entered to select stratification by block, land system or vegetation type. It should be noted that TSIA has no knowledge of land systems or vegetation types, and simply uses the code values in the LANDSYS or VEGTYP files of the selected inventory _P file to perform stratification. Whether the results are sensible or not will depend entirely on how the data has been set up.

(v) **Page length:** A value of 58 should be used for American standard (8.5" x 11") paper. In landscape mode, a value of 43 should be used. Some lines are used for margins by most sheet feeders, and the actual setting that works best may depend on the printer. The printer setup codes can be used to set up 0.125" line spacing, which allows more lines per page.

(vi) **Transect summaries:** If requested, a set of tables will be printed for every transect. The output will be voluminous, as each transect will need 4-6 pages.

(vii) **Stratum summaries:** Summary tables will be produced for every stratum. This may not be required when stratifying by artifical factors such as sampling blocks.

(viii) **File output:** If requested, the output tables will be sent to a file with the prefix name of the inventory, and the extension .PRN, for example CHIQU.PRN. This is recommended as it greatly speeds up program execution. The resultant file can be printed from DOS with the PRINT command, when the output becomes a background operation that does

not hinder other work. If **No** is entered here, output is directed to the printer on LPT1: and is not saved to file.

4.4 Preliminary results for forest inventories

4.4.1 Results have been recalculated for all the for inventories listed in Table 1 with the exception of Deep River Reserve. Time did not permit the conversion of the latter data set from the Oxford format. These results represent only one of many styles of presentation that are possible with TSIA. During the next phase of consultancy, it is proposed to explore more fully the best ways to stratify the data and present the species groupings.

4.4.2 Each set of outputs comprises a stand table of trees per km², and a table of mean volumes above given size limits. For the tables of mean volumes, sampling statistics are presented, including the coefficient of variation of the mean, and the reliable minimum estimates (RME), or lower confidence limits at the 95% probability level. In some cases the RME is blank, indicating that if calculated it would give a negative value. This reflects the unsatisfactory nature of confidence limits based on normal distribution assumptions for small samples. Where there are less than 30 plots or transects, RME figures are likely to be underestimates[a]. For planning purposes **mean volumes should always be used.** These represent the most likely and least biased estimate of stand volume. The RME is a useful indicator where the sample size is greater than 30, and can then be used to define lower limits for the resource.

4.4.3 The following describes the stratification methods applied to produce the tables shown:

(i) **Chiquibul main series:** Stratified by sample block.

(ii) **Chiquibul mountain series:** Data for blocks 1 to 8 were available, and were stratified by block. One transect from block 11 was ignored.

(iii) **Columbia River Forest Reserve:** Divided into two strata, Conservation forest and Production forest. Codes CONSV and PRODN were edited into the LANDSYS field of the COLUM_P file for the following blocks:

Conservation: Blocks 16, 23, 28, 29
Production: Blocks 21,34, 35,36,37,39

Area weights were set in file COLUM_AL artificially to reflect the number of blocks in each stratum, with 100 km² in Conservation, and 150 km² in Production. TSIA was run with the stratification method set to 2, ie. by the LANDSYS field.

(iv) **Maya Mountains Reserve:** Stratified by sample block.

(v) **Cockscomb Basin Reserve:** Stratified by sample block.

---

[a] This criterion should ne be applied to plantation inventories. Because of the rare nature of individual species on plots in natural forest, the sample distribution is grossly skewed.

(vi) **Hillbank-Rio Bravo (Belize Estates) inventory:** This uses variable sized blocks. Although TSIA is designed to handle this situation, there is an as yet undetermined program bug which made it impossible to run on a 'stratified by block' basis[a]. The data was therefore treated as two strata, East and West of Booth River, comprising the following blocks:

East: Blocks 54, 56, 58, 60, 63, 65, 67, 68, 71, 73, 81, 86
West: Blocks 13, 15, 16, 22

The area file HILLB_AL was created with the total area of 2020 km² divided on a 16:14 ratio, as suggested in the Oxford documentation file.

4.4.4 For all the print-outs in Appendix E, only the forest summaries are shown. This is necessary to keep the present report to a reasonable size. No attempt is made in this report to discuss the significance of these results in forest management or resource terms. That will form a part of the second phase of consultancy to be undertaken in 1993.

5 Tree volume equations

5.1 Tree volume equations used on original inventories

5.1.1 The original tree volume equations used on the various inventories were all developed on a standard basis. Sample trees along transects were measured by Relascope to record diameter at breast height (1.3 m) or above buttress, at the mid-point of the bole, and at the point of crown break. Height of buttresses and the crown-break point were recorded. These measurements were made on the original field cards used to record other transect data.

5.1.2 Figure 3 shows the numbers sampled on each inventory (CHIQM : Chiquibul Mountain series, CHIQU : Chiquibul Main series, COCK : Cockscomb Basin, MAYA : Columbia River/Maya mountains inventory). It will be seen that the majority of the sample was from the rather atypical, hurricane-damaged areas

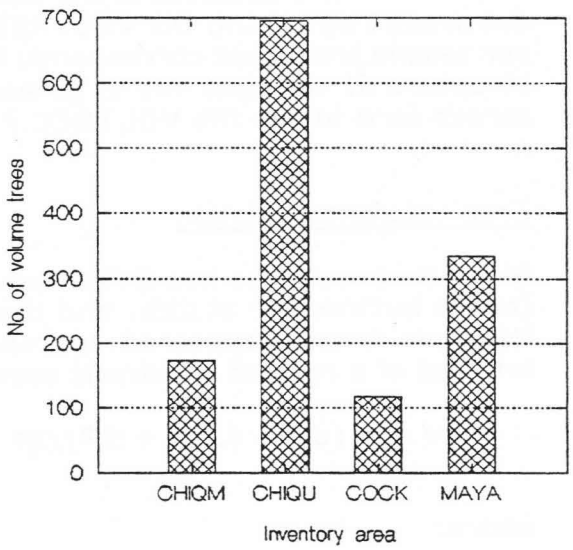

Figure 3 : Numbers of volume sample trees

[a] It is probable that after reading the block size from the file HILLB_BZ, TSIA finds itself unexpectedly in the wrong work area, and locks into an endless loop trying to locate records from another file. This problem will be corrected on the next visit.

atypical, hurricane-damaged areas of Chiquibul Forest Reserve during the 1969-1971 inventories.

5.1.3 The volume equations derived from these data were available both in the original write-ups of the inventory (eg. Johnson & Chaffey, 1973)[7], and in the documentation to the data sets provided by Oxford University. There were two forms of equation used:

$$\log(V) = a + b.\log(D) \qquad \text{-\{eqn. 5\}}$$

and

$$\log(V) = a + b.\log(D) + c.D \qquad \text{-\{eqn. 6\}}$$

where a,b,and c are coefficients fitted by regression analysis, V is bole volume, and D is tree diameter (d.b.h. or above buttress).

5.1.4 It would have been possible to use these equations directly for the re-analysis, but the author was concerned about their precision, and the complexity of applying different equations to each data set. It was desired to examine both the statistical features of the raw observations, and to produce a set of common equations for all reserves.

5.2 Data entry methods

5.2.1 The volume data was entered via a simple screen format program called VOLTREE into a database of the same name. VOLTREE is run from the dBASE dot prompt by typing DO VOLTREE. It brings up a simple screen, one form per sample tree, that corresponds to the entries on the field data cards. The structure of the data file is given in Appendix C.9. The program uses a screen form in the file VOLTREE.FMT.

5.3 Tree volume calculation

5.3.1 Given that each tree has three observations, being two end points of the bole (above buttress or at dbh, and that at crown-break), and at the mid-point, Newton's formula appeared appropriate. This calculates the volume as the integral of a rotated quadratic section, using the formula:

$$V = \pi.(d_b^2 + 4.d_m^2 + d_t^2)/24 \qquad \text{-\{eqn. 7\}}$$

where:

- V is bole volume,
- d_b is lower diameter, d.b.h or diameter above buttress,
- d_m is mid-diameter,
- d_t is top diameter, or diameter at the crown-break point.

5.3.2 The program CALCVOL listed in Appendix D operates on the VOLTREE database of tree measurements to carry out these calculations for each tree. It produces as output another dBASE file called COMVOL, whose structure is shown in Appendix C. It contains the bole volume, dbh, crown-break height, and codes for species and forest reserve. This file was designed to be input into SYSTAT for analysis. CALCVOL is run from the dBASE dot prompt by typing DO CALCVOL.

5.4 Revised volume equations

5.4.1 The data was analysed to produce coefficients for the logarithmic volume equation (equation 5 above), but without distinction between reserves, and with a general model for the pooled data that could be used for those species which had not been individually sampled to an adequate level. The COMVOL.DBF file was manually edited within dBASE to replace the species abbreviation by 'Other' for all species with less than 10 observations.

5.4.2 The file was then imported into SYSTAT. The DATA module of SYSTAT was started from the DOS prompt, and the following sequence of commands given:

```
FPATH 'D:'
SAVE COMVOL
IMPORT 'D:COMVOL.DBF' / TYPE=DBASE4
```

5.4.3 This sequence declares a default directory D:, imports the file, and saves it as a SYSTAT file called COMVOL.SYS. The D: directory is a pseudo-drive created from DOS with the SUBST command, and should be the directory containing the COMVOL.DBF files.

5.4.4 Next a number of additional variables were created in the file, for regression and graphical analysis. The appropriate commands were:

```
USE COMVOL
LET FV=0.00007854*DBH^2*HTOP
LET FF=VOL/FV
LET FH=VOL/0.00007854^2*HTOP
LET LOGVOL=LOG(VOL)
LET LOGDBH=LOG(DBH)
RUN
SAVE COMVOL
RUN
```

5.4.5 This creates five additional variables by appropriate transformations, and then saves them back in COMVOL for future analyses. FV is form volume, or the volume of a cylinder with the same height as the bole height HTOP, and the same diameter. The factor 0.00007854 is $0.001 \times (\pi/4)$ and is appropriate where diameter is in cm, height in m, and volume in m^3. FF is form factor, or the ratio of bole volume to form volume. FH is the form height, or the ratio of bole volume to tree basal area. The variables LOGVOL and LOGDBH were

created for the linear regression analysis, and are the natural logarithms of volume and dbh respectively.

5.4.6 The author was interested to examine form height as a possible simplified model. This is very similar to the logarithmic volume equation, but has only a single parameter. Equation 5 can also be expressed as:

$$V = a.D^b \qquad \text{-\{eqn.8\}}$$

where a is e^a, a being as defined in equation 5, e is the natural constant 2.71828...etc. The values of a are typically around 0.0001, and of b around 2. The form height equation is:

$$V = H_f.\ 0.00007854\ D^2 \qquad \text{-\{eqn. 9\}}$$

5.4.7 Figure 4 shows how similar the two functions are in practice. The data is for Nargusta (Terminalia amazonica). The solid line is the fitted form height model, based on an average form height of 9.876 m, and the dashed line is the logarithmic volume equation, with a=0.00036779 and b= 2.158. After examining this and other plots, it was decided, however, that the logarithmic equation was necessary, because the form height model shows bias at the lowest end of the curve. This is particularly important in the present case because trees below 40 cm were not sampled. To prepare volume tables requires therefore a backward extrapolation of the function for smaller trees, and any bias might have a substantial cumulative effect.

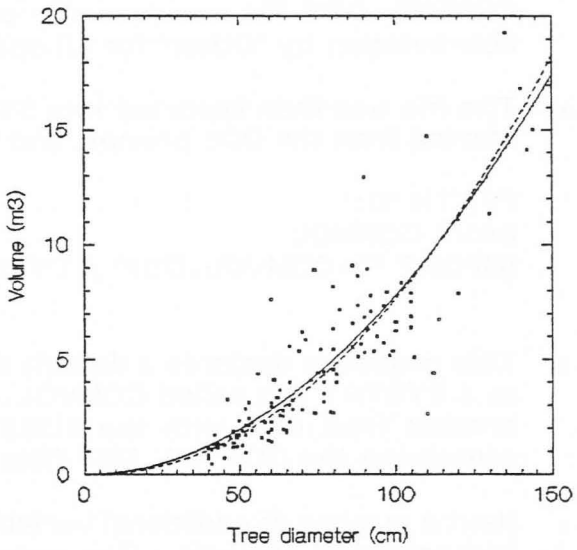

Figure 4 : Volume data for Nargusta with logarithmic (dashed) and form height (solid) models

5.4.8 The commands used to produce Figure 4 are shown below as an example of how more complex graphs are created in SYSTAT. After giving the commands noted in paragraph 5.4.4 above, the user should switch to the SYGRAPH module by typing SYGRAPH, and then enter the FEDIT command editor with:

```
FEDIT NARGVOL.CMD
```

5.4.9 If the files have been retrieved from the reference disks, NARGVOL.CMD may already exist, and will look something like the following:

```
begin
plot vol*dbh / xmin=0,xmax=150,xpip=10,ymin=0,ymax=20,ypip=5,
        xlabel="Tree diameter (cm)", ylabel="Volume (m3)"
plot vol=9.876*(0.00007854*diam*diam) ! xmin=0,xmax=150,ymin=0,ymax=20,
        scales=0,xlabel=" ", ylabel=" ",axes=0
plot vol=0.00036779*diam^2.158 ! xmin=0,xmax=150,ymin=0,ymax=20,
        scales=0,xlabel=" ", ylabel=" ",axes=0, line=10
end
```

5.4.10 These commands are executed by leaving FEDIT with the F10 key, and then submitting this command file with the statement:

SUBMIT NARGVOL

Notice that the .CMD extension must be given explicitly for FEDIT but omitted on the SUBMIT command[a]. The file generates three graphs. The first plots the data, and the second and third plot the form height and logarithmic equations respectively. The BEGIN and END commands bracket these plots so that they will all fall onto a single scale.

5.4.11 The output can be saved in an HPGL[b] file by preceding the SUBMIT command with the command OUTPUT PLOTTER. The resultant output will be in a file called PLOTTER.HGL. This can be read into a Word Perfect graphics box as has been done in this report.

5.4.12 To develop new regression equations, the MGLH module of SYSTAT was used. A linear model of the form:

$$\log(V) = a + a_k + b.\log(D) + b_k.\log(D) \qquad \text{-\{eqn. 10\}}$$

was fitted. In this, a and b are mean coefficient values, and a_k, b_k are species effects. MGLH performs a multiple covariance analysis with this model that generates all the required species coefficients, and also provides an analysis of variance of the species effects. For the 22 species with more than 10 data points, there were significant differences between coefficients, as may be expected. It was not possible in the time available to refine this further by, for example, performing a cluster analysis on the regression coefficients to derive a lesser number of equations for species groups, such that within-group differences were insignificant.

5.4.13 Table 7 below shows the fitted coefficients for each species. It can be seen that the distribution of the sample does not well reflect commercial usage. Sapodilla and Breadnut are both heavily sampled, yet both species are prohibited for logging. Most of the sampling was done in Chiquibul forest reserve during the 1969/1971 inventories (see Figure 3). It was apparent from the analysis that the tree measurements were not to a very high accuracy, as would be expected if using a Relascope for volume table

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a This is one of numerous quirks in SYSTAT that tend to frustrate the user. However it remains a powerful and flexible statistical package.

b HPGL : Hewlett-Packard Graphics Language - a common standard for graph plotting equipment.

construction. Many trees showed form factors greater than one, implying that the upper diameter was larger than the lower diameter, a normally impossible situation. The scatter of points shown in Figure 4 is greater than would normally be expected with tree volume data. The R^2 for equation 10 was 0.712 with 1320 trees; typically values better than 0.9 would be expected.

5.4.14 It can be concluded that the existing volume equations, although obviously of some value, need to be refined, and a programme of tree measurements to collect new data would be desirable. The most suitable way to do this would be for a two-man mensurational team to work with a logging company such as Belize Timbers, measuring trees after felling. A number of diameter measurements along the bole should be taken, at intervals of not more than 2 m apart. Tree dbh should be recorded before felling. Measurements should record both the length of the logs actually extracted, and the total length of the bole.

Table 7 : Volume equation coefficients

Code	Species name	a	b	No.
1	Mahogany	-7.608	2.092	72
2	Cedar	-8.330	2.198	48
4	Cotton (Ceiba)	-6.725	1.909	10
6	Mapola	-9.221	2.404	51
9	Polak (Balsa)	-4.117	1.259	10
13	Hogplum	-12.636	3.315	55
14	Quamwood	-9.978	2.727	10
16	Kaway	-2.731	0.909	21
21	Redwood	-6.756	1.845	11
22	Cramantree	-7.666	2.142	7
23	Banak	-5.604	1.696	19
40	Barba Jolote	-8.780	2.313	25
41	Fiddlewood	-7.796	2.129	25
45	Sillion	-8.720	2.426	17
46	Santa Maria	-8.307	2.295	24
56	White Breadnut	-9.450	2.511	86
57	Nargusta	-7.908	2.158	127
59	Bitterwood	-8.463	2.310	12
60	Male Bullhoof	-6.690	1.839	28
73	Sapodilla	-8.231	2.233	205
78	Mylady	-6.038	1.755	15
79	Ironwood	-8.370	2.308	59
81	Faisan	-6.333	1.688	27
123	Bay Cedar	-4.573	1.260	26
124	Sapotillo	-11.597	3.094	17
	Others			313
	All species	-8.095	2.190	1320

6 Permanent sample plot data entry

6.0.1 A separate paper has been written on permanent sample plot data entry which was used as the basis of training sessions on this topic. It is included verbatim as Appendix H on page 135.

7 Geographical databases and post-stratification methods

7.1 Digitizing of transect locations

7.1.1 For all the inventories described in this report, maps of varying quality were available. For the Chiquibul inventories, original LRD maps of 1:50,000 scale showed the transect locations precisely. For Columbia/Maya Mountains, old dyeline prints were available, together with some 1:50,000 sheet prepared by J.R. Palmer showing transects. The latter unfortunately contained some errors. For the Cockscomb inventory, 1:50,000 maps cut and pasted together showed the transects. For the Hillbank area, a rather faded and torn dyeline print was available at 1:100,000.

7.1.2 From these sources, the transect locations were digitized as accurately as possible, using Arc/Info. The following coverage files have been created and are stored as Arc/Info export files in the reference diskettes:

Coverage	Contents
CHIQU_BL	Block outlines, Chiquibul main inventory
CHIQU_TR	Chiquibul main series transects
CHIQM_BL	Chiquibul Mountain series block outlines
CHIQM_TR	- " -, transects
COLUM_BL	Columbia/Maya Mountains block outlines
COLUM_TR	- " -, transects
COCKS_TR	Cockscomb transects
HILLB_TR	Hillbank transects

7.1.3 These coverages can be used to produce transect maps for reference purposes. Constraints on time have prevented these from being prepared for inclusion in the present report, but in principle, HPGL files output by Arc/Info can be imported to Word Perfect for documentation purposes.

7.2 Further work

7.2.1 During the next phase of this consultancy, these transect coverages will be combined with the Land Systems maps and the Vegetation Types maps, both of which are available as Arc/Info coverages, to slice up the transects into segments and assign them to different strata, comprising major land system or vegetation type units. From this, and from area estimates for these strata provided by the GIS, it should be possible to produce more generalized estimates of forest stocking for the forest reserves.

7.2.2

8 Requirements for management inventory systems

8.1 Sampling parameters for the Broadleaf inventories

8.1.1 During the early part of the present consultancy, the author developed programs to analyse how the sampling error changed with different transect lengths and for species which were more or less common. Earlier conventional wisdom with regard to tropical forest inventories suggested that large plots were necessary in order to reduce the variance between plots. The question is therefore: What is the optimum plot size, and what sampling intensity is required to give different levels of precision ?

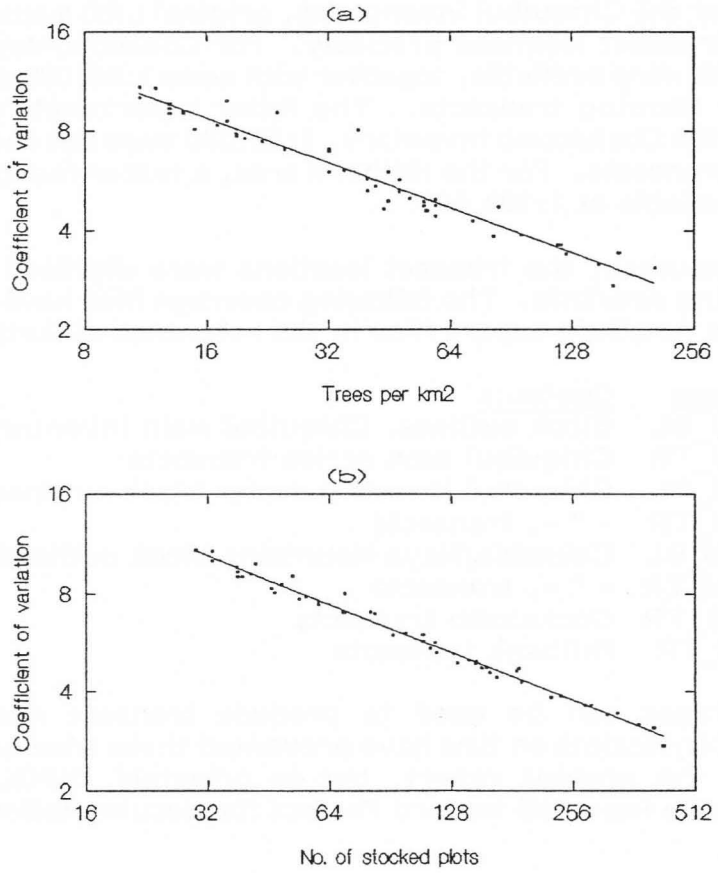


Figure 5 : Effect of species occurrence on coefficient of variation

8.1.2 Figure 5 shows how the cofficient of variation (CV) changes according to the occurrence of a species. The CV is defined here as μ/σ, where μ is the mean number of stems per km² (N/km²) for a species, and σ is the standard deviation of this for a population of 50x20 m record units. The figures shown on the graph are ratios, not percentages. A CV of 4, for example, indicates a standard deviation that is four times the mean. The graph is plotted on

double logarithmic axes, and shows a close straight-line relation between mean stocking for a species, and also for the number of stocked plots.

8.1.3 It can be seen that the more common a species is, the less variable it is. This result can be applied not only to individual species, but to groups. Since a broader group will have a higher total stocking than a narrowly-defined one, it follows that lower sampling intensities will be adequate for broad groups, whereas high intensities are required for individual species.

8.1.4 Figure 6 below shows the results of an analysis in which the data for successive record units was aggregated to simulate the effects of sampling with transects of different lengths. As transect length increases, the coefficient of variation declines, as would be expected. Three species are compared: Nargusta (TRA), Santa Maria (CLB) and Mahogany (SWM). The analysis used the data from the Columbia River/Maya Mountains inventory.

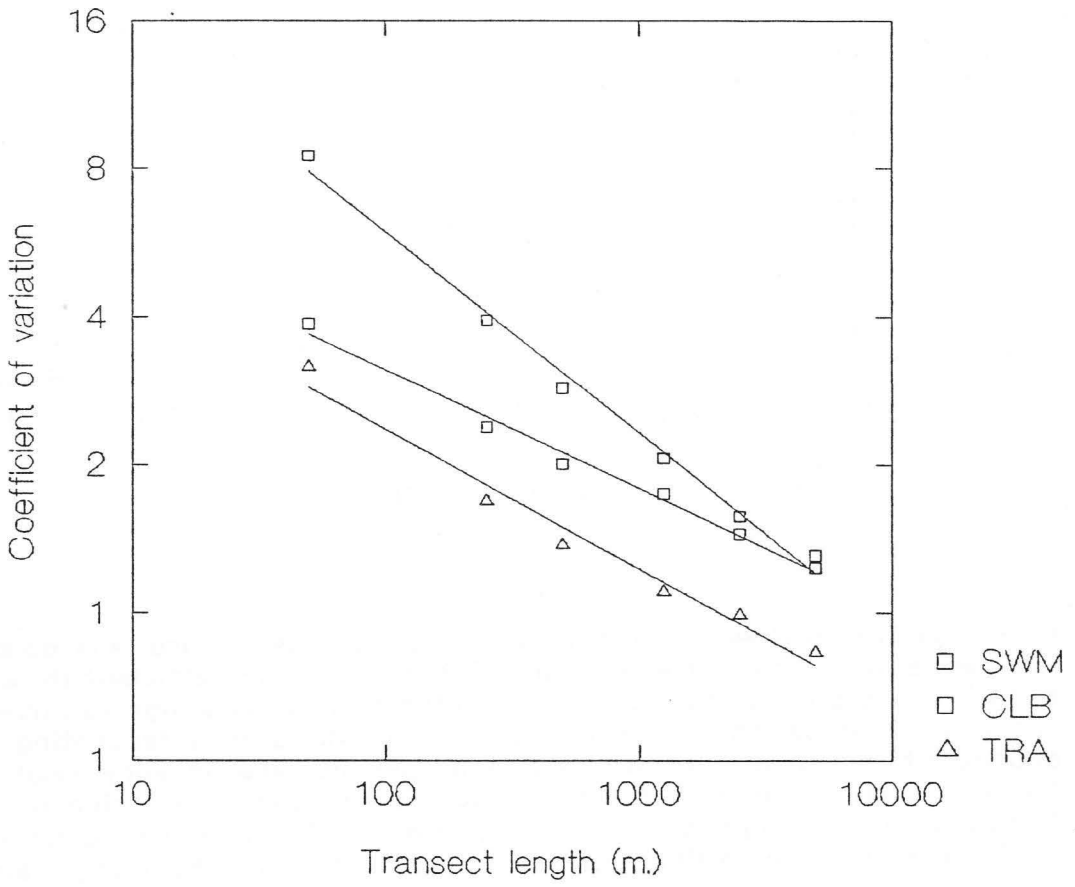
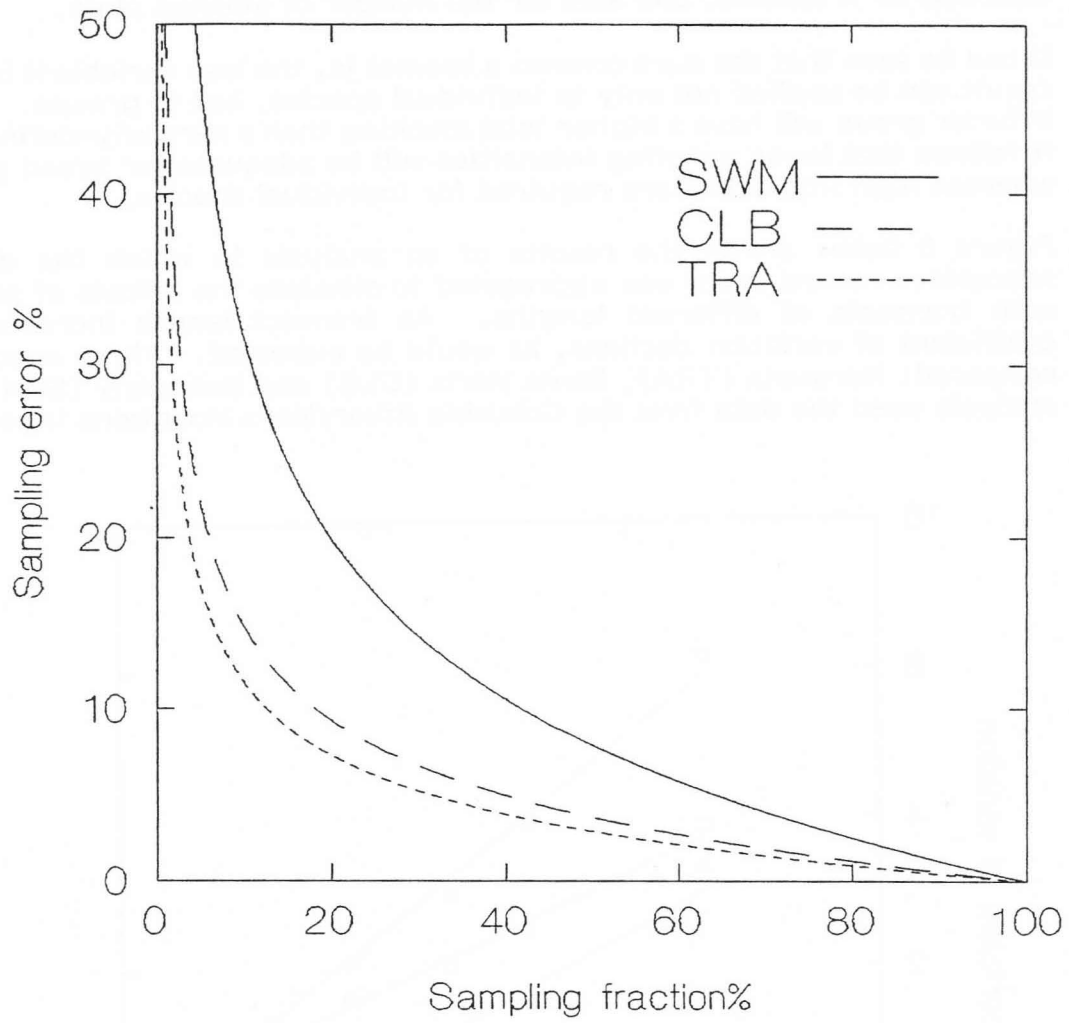


Figure 6 : Effect of transect length on coefficient of variation

8.1.5 The ultimate sampling error varies as a function of $1/\sqrt{n}$ of the number of plots. Analysis does not show any clear optimum in plot size, partly because



to achieve 20% confidence limits for any given species requires a large sample. It appears likely that the smaller the plot size, the more efficient the sample, but with very small plots, access time to the plot becomes high relative to the costs of demarcation. There are also problems of interpreting scale-dependent measures such as basal area per hectare on very small plots. Figure 7 shows that even for the most common species in Columbia River, Nargusta, a sampling fraction of around 10% would be required to achieve 20% confidence limits for small areas. This graph is based on 50 m long transects.

8.1.6 The regressions used to draw the above figures are documented in Table 8 for future reference. They can be used to study further this question of optimal inventory design, once species groups have been defined in terms that are of maximum relevance for forest management, and some knowledge of costs of demarcation and measurement are available.

Table 8 : Regressions of inventory sampling error parameters

Regressions for population coefficient of variation (CV) as a function of the stocking of a species (N) per km² or the number of stocked plots (P). The sample points (see figure 5) are data for different species. These statistics are based on plots of 50 x 20 m.

Species N/km²	log (CV) = 3.415 - 0.450 log(N)
Stocked plots	log (CV) = 4.047 - 0.491 log(P)

Regressions of CV on transect length (L) in metres for three species. Note that for Mahogany transect width is 40 m, whilst for the other species it is 20 m. This may account for the different slope in figure 6.

Mahogany (SWM)	log(CV) = 3.660 - 0.408 log(L)
Santa Maria (CLB)	log(CV) = 2.248 - 0.241 log(L)
Nargusta (TRA)	log(CV) = 2.164 - 0.283 log(L)

8.2 Recommended procedures for management inventories

8.2.1 Time has not permitted the fullest analysis of the implications of the functions described in the preceding section. It does however appear that to exercise effective control over operations at the compartment level, 100% stock survey is necessary. This should include all trees over 40 cm diameter (except palms), and be conducted on 1 km square units. The area should be sampled in 20 m wide strips, with record cards assessing 100 m long units. During the stock survey, trees should have a stock number painted on them. The forest manager can then assign trees for felling by number, allowing for proper road alignments, protection of areas adjacent to water courses, and retention of a suitable coverage of seed trees for valued species.

8.2.2 Stock survey will normally precede logging operations by six months to a year. For planning at the concession level, a sample inventory is required. It is probable that a 2% sample, using 100 x 20 m plots randomly located with 1-km grid units will be suitable. This survey will give the forest manager sufficiently detailed information for five to ten year forward planning, estimation of allowable cut and required logging capacity and machinery, and identify areas requiring special treatment for conservation or production.

8.2.3 The detailed procedures for these inventories will be worked out during the next phase of this consultancy. The concepts concerned have been discussed with the Forest Management Specialist to a sufficient level to allow some pilot operations to be commenced during the 1993 dry season.

8.2.4 The costs of stock survey and 2% inventory should be borne by the timber license holder. These factors, as well as the legal restriction of felling to specified areas and trees designated annually by the Forest Department, need to be written in to all future timber licenses. The Forest Department should encourage concessionaires either to undertake stock survey and inventory themselves, or use contractors approved by the Forestry Department. However, it is reasonable that during the transitional period of the current project, some component of these costs should be borne as a non-recurrent training and development cost by the project itself.

8.3 Data analysis requirements

8.3.1 Data generated by stock surveys, 2% inventories, and research activities require a continuing capability by the Forest Department for data analysis. It is recommended that if possible a Belizean be recruited for this purpose, but failing that, ODA should seek to include such a position in the project. The particular skills and qualifications required are:

(i) Preferably a degree in forestry, with a Masters or higher degree in data processing applications (inventory, mensuration, modelling) in forestry. Failing this, a degree in any numerate science with strong emphasis on statistical methods (eg. mathematical statisics), with background experience in ecology or forestry.

(ii) Good computer programming skills, especially in DBASE.

8.3.2 This person would be responsible for setting up (possibly with the present consultant's assistance) programs to analyse stock surveys and 2% inventories, including plotting of stock maps and integration of these with GIS coverages such as forest management maps, and routine processing of stock survey data. He would also analyse and map the results of 2% inventories. TSIA provides a useful basis for the latter program. A compartment register should be set up and maintained, linking stock surveys, 2% inventories, and returns from felled tree measurements and post-felling inspections.

8.3.3

9 Conclusions

9.0.1 The work described in this report has been completed in a period of just under three months, between 22nd September and 14th December 1992. The data for five major inventories has been re-entered on the computer, checked for errors, and processed to produce the tables given in Appendix E of this report. A computer program was written for this analysis which was able to handle automatically the numerous variations in sampling technique between the inventories. A GIS workstation has been set up in the Forest Department, and map information relating to the inventories digitized. Several ancillary programs have been written for data entry and editing, species list manipulation, and the early production of preliminary results.

9.0.2 At the same time, the author has undertaken a number of field visits to forest areas in Belize for orientation purposes, and has assisted other consultant's and specialists with various matters of experimental design and computer technique.

9.0.3 The present report represents an interim stage in the author's total input to the Belize Forest Planning and Management Project. It aims especially to provide technical documentation and reference material for the work that has been completed. A second three-month period, scheduled for early May 1993, will concentrate in the interpretative aspects of the work, on the evolution of GIS procedures to support forest management planning and the presentation of inventory results, the design of compartment, timber license, and production register databases, and on the design, field procedures, and data processing methods for proposed stock surveys and management inventories.

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Appendix A

Terms of Reference : Biometrician

1. Re-analyze the Belize broadleaf forest inventory data. Define a standard inventory program and data file structures and document them. Add site and record unit level information, including geographical coordinates, to the existing data sets using ordiginal field cards and maps. Prepare an inventory report based on the results of this work.

2. Assist the Forest Management Specialist (FMS) to explore whether the existing data sets, augmented if necessary by new measurements, can be used to estimate forest growth.

3. Create linkages between the inventory data and map data held in the GIS. In liaison with the GIS specialist, program ARC/INFO procedures to produce thematic forest maps. Review site classification and stratification methods to determine the best approach to producing general estimates of growing stock.

4. Review records of volume sampling in broadleaf forest and determine the most practical and efficient set of general volume functions. Compile the volume data into an accessible format available for further mensurational research.

5. In collaboration with the FMS, undertake a systems analysis of the requirements for a control system for forest management and planning, including the design of management inventory, log measurement and accounting procedures, post logging diagnostic checks (for regeneration and damage levels) and linkages to concession management and billing of forest fees.

6. In collaboration with the FMS and silviculturist, design field trials for alternative systems of silviculture, especially uniform and shelterwood systems. This will include detailed experimental design, design of field procedures and forms, and a description of the analytical procedures and methods by which the results may be ultimately analysed.

7. Assist the FMS to establish appropriate methods of sampling forest dynamics for the development of growth models. Set up data entry procedures and data base structures, and prepare programs for the production of plot maps and calculation of tree competition indices.

8. Provide on-the-job training to a research clerk.

Duration: 159 working days (about 6 months) in two three-month periods, the first commencing in September 1992 and the second in late April 1993.

Appendix B : Summary of computer files on reference diskettes

Reference diskette No. 1

This contains the original card format .DBF files shown in Table 2, page 4. They are packed into a file called INVCARDS.ARC.

Reference diskette No. 2

This contains all the _P and _T prefix files shown in Table 6, page 12 in an archive called INVDAT.XTG.

Reference diskette No. 3

This contains miscellaneous files in several archive files, as follows:

Archive	Files	Description
DOCS.XTG	DECREP-A.WPD	This report, main text WordPerfect 5.1 format.
	DECREP-B.WPD	As above, appendices.
	SYNLIST.WPD	List of synonyms, Word Perfect 5.1 format
TREELIST.XTG	TREELIST.WPD	Formatted copy of Bruce Miller's Checklist of Trees of belize, with index to local and generic names added. WP 5.1 format.
VOL.XTG	CALCVOL.PRG	See section 5 of report, page 19 ff.
	COMVOL.DBF	
	NARGVOL.CMD	
	NTREES.CMD	
	VOLEQN.DBF	
	VOLTREE.DBF	
	VOLTREE.FMT	
	VOLTREE.PRG	
SPECIES.XTG	FAMILIES.DBF	List of family names with provisional codes
	GENERA.DBF	List of generic names
	NEWSPL.PRG	(not documented)
	SPCHANGE.DBF	List of old and new numbers.
	SPCHANGE.PRG	Used to renumber species after conversion from Oxford formatS
	SPECIES.DBF	Main species database, as listed in Appendix G.
	SPIX.PRG	Program to reindex species database.
	SPLIST.FRG	File used by SPLIST.PRG
	SPLIST.FRM	-"-
	SPLIST.PRF	-"-
	SPLIST.PRG	Program to print species list (see section 3, page 7 ff.)
	SPNAMES.DBF	Palmer's (1989) species list
	SPNAMES.WPD	Palmer's species list formatted as WP 5.1 document.

MISCDBF.XTG	COLUM_AL.DBF	Columbia Area file for PRODN and CONSV strata (see section 4.4)
	HILLB_AL.DBF	Hillbank stratum area file for EAST and WEST (see section 4.4)
	HILLB_BZ.DBF	Hillbank block sizes.
	INVCODES.DBF	Master file of inventory parameters.
	SPECIES.DBF	See SPECIES.XTG above - another copy.
	SPGROUPS.DBF	Species groups codes and full names.
	VOLEQN.DBF	Volume equation coefficients.
PSPS.XTG	Various files documented in Appendix H.	
PROGS.XTG	BIDE.PRG	Programs documented in this report.
	DBH_CONV.PRG	
	INVOPT.PRG	
	PIX.PRG	
	PRT_DAT2.PRG	(referred to as PRT_DAT in report)
	TSIA.PRG	

Reference diskette No. 4

Contains the files listed in Table 4, page 8 in an archive called OXDAT.XTG.

Reference diskette No. 5

This contains the following ARC/INFO export files. The extension .E00 is omitted for clarity.

CHIQU_TR	Chiquibul main and mountain series transects
CHIQU_BL	- " - sample block outlines
COLUM_TR	Columbia and Maya Mountains transects
COLUM_BL	- " - block outlines
COCKS_TR	Cockscomb Basin transects
COCKS_BL	- " - block outlines
HILLB_TR	Hillbank transects
FRESV	Forest reserve outlines
BEZBORD	Belize borders and coastline, low resolution.
INDEX	Tic points. Note this is an extension of the LIC INDEX file, including addiotnal points for Cockscomb and Hillbank areas.

With the exception of disk No. 5, all files can be viewed and de-archived from Xtree Gold. Insert the diskette and log on to the diskette drive (A: or B:). Select the archive file, and press Alt-F5 to bring up the archive window. A help screen is available.

Appendix C : Database structures

Database structures are given for all files created during the inventory analysis. The first column is the field number. The second is the dBASE field name. The third and fourth columns are field type and length, with number of decimal places in some cases. The fifth column is a description of the field.

C.1 Plots (prefix P)

1	RESV	N 2	Inventory code number (see INVCODES)
2	BNO	N 2	Block number
3	TNO	N 2	Transect number
4	PNO	N 3	Plot (record unit) number
5	UTM_N	N 7	UTM Y (North) coordinate
6	UTM_E	N 7	UTM X (East) coordinate
7	INVYR	N 4	Year of inventory (not used)
8	LANDSYS	C 6	Land system code
9	VEGTYP	C 4	Vegetation type code
10	CF	C 2	Condition of forest
11	CC	C 2	Canopy class
12	UG	C 2	Undergrowth class
13	SP	C 2	Slope position
14	SG	C 2	Slope class
15	AS	C 2	Aspect class
16	DR	C 2	Drainage class

C.2 Trees (prefix T)

1	PLOT	N 9	Plot index, constructed as 1000000*RESV+100000*BNO+1000*TNO+PNO
2	SPP	N 3	Species code number
3	DBH	N 3	Tree diameter, cm.

C.3 Species

1	SPP	N 3	Species code number
2	LNAME	C24	Local name
3	SNAME	C42	Scientific name
4	UTIL	C 4	Utilization (or other) group code

C.4 Synonyms

1	SPP	N 3	Species code number
2	SYNONYM	C24	Alternate species name

C.5 Spgroups

1	GROUP	C 4	Species group (corresponds to UTIL in SPECIES)
2	GNAME	C25	Species group name

C.6 Voleqn

1	SPP	N 3	Species code number
2	A	N 9.5	A coefficient
3	B	N 9.5	B coefficient

C.7 Invcodes

1	RESV	N 2	Inventory number
2	FRFILE	C 8	Card-format file
3	PREFIX	C 5	Prefix-format file
4	INVENTORY	C50	Inventory title
5	BLOCK_KM2	N 3	Block size, km² (zero if variable)
6	TRAN_LEN	N 5	Transect length, m (zero if variable in design)
7	PYSPP	C 6	List of species code numbers for primary species
8	WIDTH_1Y	N 2	Transect width for primary species, m.
9	WIDTH_2Y	N 2	Transect width for secondary species, m.
10	FREQ_SUBP	N 2	Frequency of subsample plots. Eg. 5 means 1 in 5 record units.
11	DMIN_1Y	N 2	Minimum diameter on main plots for primary species
12	DMIN_2Y	N 2	Minimum diameter on main plots for secondary species
13	PLENGTH	N 4	Plot (record unit) length, m. Zero if variable.

C.8 Stratum areas (prefix AL)

1	STRATUM	C 6	Stratum short code. must correspond to entry in LANDSYS or VEGTYP fields.
2	ST_AREA	N 6	Stratum area, km².

C.9 Voltree

1	INVNO	N 2 1	Inventory code number (see INVCODES)
2	BNO	N 2 2	Block number
3	TNO	N 2 3	Transect number
4	PNO	N 3 4	Plot (record unit) number
5	SPP	N 3	Species code number
6	VDIST	N 5.1	Distance from tree, m.
7	DBH	N 5.1	Diameter at 1.3 m or above buttress, cm.
8	HBASE	N 5.1	Height to base of tree, m.
9	HTOP	N 5.1	Height to point of crown break, m.
10	HTOT	N 5.1	Total tree height, m.
11	MDIAM	N 5.1	Diameter at mid-point on stem. cm.
12	TDIAM	N 5.1	Diameter at crown-break point, cm.
13	HBUTT	N 5.1	Buttress height, m.

C.10 Comvol

1	INVNO	N 2	Inventory code number
2	SPP	N 3	Species code number
3	GENSPP	C 7	First three letter of Genus and species name, eg. 'Swi mac' for Swietenia macrophylla.
4	DBH	N 6.1	Tree diameter, cm.
5	HTOP	N 6.1	Height to crown-break point, m.
6	VOL	N 7.3	Bole volume, m3.

C.11 PSPs

This data structure is described in Appendix H.

Appendix D : Principle computer programs

The computer programs listed below are included in this appendix. They will all be found on reference diskette #3 with the file extension .PRG.

Programs marked * are written in Clipper 5.0; other programs are written in dBASE 4. INVOPT will run in either system. Clipper is used where program speed or array handling facilities are of paramount importance. The language is similar to dBASE and derived from it, but includes a number of extensions. dBASE files are freely transferable between the two systems, but the index files are different. The Clipper programs generate their own indexes, which will appear in the directory with extension .NTX, as needed. dBASE indexes have the extension .MDX.

D.1 BIDE : Broadleaf Inventory Data Editor

This program is run from within dBASE by typing DO BIDE at the dot prompt. It provides a screen editor for the linked plot and tree files in prefix format.

```
* Broadleaf Inventory for Belize : Editor
* edits PLOT:TREE linked data files via two browse tables
set talk off
set status off
set deleted on
set safety off
set confirm on
set near on
Esc=27
CtrlEnd=Chr(23)
@ 0,0 clear
@ 0,0 say "Broadleaf Inventory Data Editor"
@ 1,0 to 1,79 double
prefix=space(5)
@ 3,0 say "File prefix : " get prefix
read
@ 3,0
if lastkey()=Esc
  * quit program
  set status on
  set talk off
  return
endif
close databases
select 1
use (prefix+"_P") order tag plots alias plots
select 2
use (prefix+"_T") order tag plot alias trees
select 3
use c:\belize\species\species order tag spp alias species
define window plot from 3,0 to 20,76 double
define window tree from 5,40 to 22,79
on key label F1 do ExitPedit
on key label F2 do FindPlot
on key label F3 do ChangePlot
on key label F10 do ExitProg
more=.T.
do while more
  select 1
  @ 24,0 say "F1 show trees   F2 find plot  F3 change plot ID  F10 exit program " color w+/bg
  browse nomenu noclear compress window plot fields RESV/R,BNO/R,TNO/R,;
        PNO/R,UTM_N,UTM_E,LANDSYS,VEGTYP,CF,CC,UG,SP,SG,AS,DR
  if lastkey()<>Esc
    do ShowTree
  endif
enddo
```

```
set status on
clear typeahead
close databases
set talk on
return

procedure ExitProg
  more=.F.
  keyboard Chr(Esc)+Chr(Esc)
return

procedure ExitPEdit
* saves the current cursor row and exits from the plot level browse table
* using Ctrl_End
public plot_row
plot_row=row()+3
keyboard CtrlEnd
return

procedure ShowTree
* displays trees in a browse box.  To speed up the program with large files,
* relevant trees are copied to a scratch file.  Changes are copied back
* after Ctrl-End but not Esc.
* disable plot level function key labels
on key label F1 do del_toggle
on key label F2 ?? chr(7)
on key label F3  ?? chr(7)
@ plot_row,0 say ">" color w+*/r
@ 24,0 clear
@ 24,0 say "F1  Show deleted trees" color w+/bg
plotid=RESV*10000000+BNO*100000+TNO*1000+PNO
select trees
set deleted off
seek plotid
if found()
  copy to scratch while PLOT=plotid
else
  copy structure to scratch
endif
select 4
use scratch alias scratch
count to ndel for deleted()
if reccount()=0 .or. ndel>=reccount()
  append blank
endif
delfil=.T.
set filter to .not. deleted()
goto top
browse nomenu compress window tree fields SPP,name=;
      lookup(species->LNAME,SPP,species->SPP), DBH
set filter to
if readkey()>256
```

```
  * save changes back to original file
  goto top
  select trees
  seek plotid
  if found()
    scan while PLOT=plotid
      if .not. deleted([scratch])
        replace SPP with scratch->SPP,DBH with scratch->DBH
      else
        delete
      endif
      skip 1 in scratch
    endscan
  endif
  * see if there are any additional records in scratch
  do while .not. eof([scratch])
    append blank
    replace PLOT with plotid, SPP with scratch->SPP, DBH with scratch->DBH
    skip 1 in scratch
  enddo
endif
select scratch
use
set deleted on
* re-enable function key labels
select plots
on key label F1 do ExitPedit
on key label F2 do FindPlot
on key label F3 do ChangePlot
return

procedure Del_toggle
* toggles deleted flag on/off during tree editing
activate screen
if .not. delfil
  @ 24,0 say "F1  Hide deleted trees" color w+/bg
  set filter to
  goto top
  delfil=.T.
else
  @ 24,0 say "F1  Show deleted trees" color w+/bg
  set filter to .not. deleted()
  goto top
  delfil=.F.
endif
activate window tree
return

procedure FindPlot
* position pointer at specified plot (or nearest)
on key label F1
on key label F2  ?? chr(7)
```

```
on key label F3  ?? chr(7)
define window FindWin from 8,25 to 16,55 double
activate window FindWin
select plots
f_resv=RESV
f_bno=BNO
f_tno=TNO
f_pno=PNO
@ 0,0 say "Find plot"
@ 2,0 say "Reserve code  : " get f_resv
@ 3,0 say "Block no.     : " get f_bno
@ 4,0 say "Transect no.  : " get f_tno
@ 5,0 say "Plot no.      : " get f_pno
read
if lastkey()<>Esc
  plotid=f_resv*10000000+f_bno*100000+f_tno*1000+f_pno
  seek plotid
endif
deactivate window FindWin
on key label F1 do ExitPedit
on key label F2 do FindPlot
on key label F3 do ChangePlot
return

procedure ChangePlot
* Change plot ID, and update corresponding PLOT values in tree file
on key label F1
on key label F2  ?? chr(7)
on key label F3  ?? chr(7)
define window ChWin from 8,25 to 13,55 double
activate window ChWin
select plots
c_resv=RESV
c_bno=BNO
c_tno=TNO
c_pno=PNO
k=14
@ 0,k say              "FR BN TN PLT"
@ 1,0 say "New plot ID : ##-##-##-### "
@ 1,k get c_resv picture "99"
@ 1,k+3 get c_bno picture "99"
@ 1,k+6 get c_tno picture "99"
@ 1,k+9 get c_pno picture "999"
read
* don't process if Esc pressed.
if lastkey()<>Esc
  * get old and new ID's
  oldid=RESV*10000000+BNO*100000+TNO*1000+PNO
  newid=c_resv*10000000+c_bno*100000+c_tno*1000+c_pno
  * new ID must be unique
  seek newid
  if found()
```

```
    * display error message and wait for a key
    @ 3,0 say "New ID not unique" color w+/r
    clear typeahead
    do while inkey()=0
    enddo
  else
    * change ID fields in plots file
    seek oldid
    replace RESV with c_resv,BNO with c_bno,TNO with c_tno,PNO with c_pno
    * find and change PLOT field of corresponding trees
    select trees
    seek oldid
    replace PLOT with newid while PLOT=oldid
  endif
endif
deactivate window ChWin
on key label F1 do ExitPedit
on key label F2 do FindPlot
on key label F3 do ChangePlot
return
```

D.2 PIX : Re-index prefix inventory data files

This program is run from the dBASE dot prompt by typing DO PIX. It requests the name of a file to re-index, and then regenerates the _P and _T .MDX files, after first packing each database to remove records marked for deletion. It is used only when the index file has been deleted or corrupted, or if the data files have been edited from the Clipper DBU program (which will not maintain dBASE 4 indexes).

```
* Plot and tree indexing
set talk off
set safety off
set status on
@ 0,0 clear
@ 0,0 say "Re-index plot and tree files"
@ 1,0 to 1,79 double
prefix=space(5)
@ 3,0 say "File prefix : " get prefix
read
@ 3,0
if lastkey()=27
  * quit program
  set talk on
  return
endif
set talk on
use (prefix+"_P")
pack
index on RESV*10000000+BNO*100000+TNO*1000+PNO tag plots
use (prefix+"_T")
pack
index on PLOT tag plot
set talk on
return
```

D.3 SPLIST : Prints species list sorted in various ways

This program is run from within dBASE 4 by typing DO SPLIST at the dot prompt. A menu will appear specifying the required sort order. The printer should be switched on and ready before running the program. If it is not, a dBASE dialog box will appear; reset the prointer and make sure it is online, then select the **Retry** button in this box.

The program provides examples of simple menu construction and wondow usage in dBASE 4.

```
* lists SPECIES.DBF file in columnar small character format
set talk off
set status off
define menu spord
clear
use species
define pad spno of spord prompt  "Code number  " at 2,0
define pad lname of spord prompt "Local name" at 3,0
define pad sname of spord prompt "Botanical name" at 4,0
define pad pquit of spord prompt "Exit" at 5,0
define window spord_w from 5,30 to 12,50 double
on selection pad spno of spord do setspno
on selection pad lname of spord do setlname
on selection pad sname of spord do setsname
on selection pad pquit of spord do pquit
activate window spord_w
@ 0,0 say "Species print order"
activate menu spord
deactivate window spord_w
use
set talk on
set status on
return

procedure pr_splist
@ 2,0 say " Make sure printer " color g+/n
@ 3,0 say "  is on and ready  "   color g+/n
@ 5,0 say "Now printing..." color r+/b
_ploffset=10
_ppitch="elite"
_plength=60
report form splist noeject to printer
@ 2,0 clear
return

procedure setspno
set order to tag spp
do pr_splist
return
```

```
procedure setlname
set order to tag lname
do pr_splist
return

procedure setsname
set order to tag sname
do pr_splist
return

procedure pquit
deactivate menu
return
```

D.4 VOLTREE : Editor for volume tree data input

This program needs to be run only if the SPECIES.MDX index file has become lost or corrupted. It re-creates it, and also permanently removes deleted records from the SPECIES database. It is run from the dBASE dot prompt by typing DO SPIX.

```
set talk off
set confirm on
set deleted on
close databases
use voltree
select 2
use species order tag spp alias sp
select 1
set format to voltree
goto bottom
set status on
edit nomenu
set format to
close databases
set talk on
return
```

Voltree.fmt - This file must be available in the same directory for Voltree.prg to work.

```
@ 0,21 TO 18,48 DOUBLE
@ 1,23 SAY "Volume tree data entry"
@ 2,22 SAY "_____"
@ 3,23 SAY "Inventory no.       "
@ 3,43 GET Invno PICTURE "99"
@ 4,23 SAY "Block no            "
@ 4,43 GET Bno PICTURE "99"
@ 5,23 SAY "Transect no.        "
@ 5,43 GET Tno PICTURE "99"
@ 6,23 SAY "Plot no.            "
@ 6,43 GET Pno PICTURE "999"
@ 7,23 SAY "Species             "
@ 7,43 GET Spp PICTURE "999"
@ 8,23 SAY lookup(sp->lname,spp,sp->spp) func-
tion "S25" color w+/b
@ 10,23 SAY "Viewing distance    "
@ 10,43 GET Vdist PICTURE "999.9"
@ 11,23 SAY "Tree DBH            "
@ 11,43 GET Dbh PICTURE "999.9"
@ 12,23 SAY "Height to base      "
@ 12,43 GET Hbase PICTURE "999.9"
@ 13,23 SAY "Height to top       "
@ 13,43 GET Htop PICTURE "999.9"
@ 14,23 SAY "Total height        "
@ 14,43 GET Htot PICTURE "999.9"
@ 15,23 SAY "Diam Mid-Ht         "
@ 15,43 GET Mdiam PICTURE "999.9"
@ 16,23 SAY "Diam Top-Ht         "
@ 16,43 GET Tdiam PICTURE "999.9"
@ 17,23 SAY "Buttress Ht         "
@ 17,43 GET Hbutt PICTURE "999.9"
```

D.5 CALCVOL : Calculate tree volumes and produce output file

CALCVOL is run from within dBASE by typing DO CALCVOL at the dot prompt. It calculates tree volumes for the data in the VOLTREE database, using Newton's formula, and generates an output file with the format shown in section C.10, page 38. This is designed to be imported into SYSTAT for analysis.

```
* CALCVOL : Calculates tree volumes using Newton's formula from raw
* data file VOLTREE, putting computed values in COMVOL.  Also adds
* a GenSpp abbreviation for use in SYSTAT.
set talk off
set safety off
clear
@ 0,0 say "Tree Volume Calculation"
@ 1,0 to 1,79 double
select 1
use voltree alias vt
select 2
use comvol alias cv
zap
select 3
use species order tag spp alias sp
select 1
@ 3,0 say "Tree .... of "+str(reccount(),4)
scan
  @ 3,5 say recno() picture [9999]
  botname=lookup(sp->SNAME,SPP,sp->SPP)
  k=at([ ],botname)
  xgenspp=left(botname,3)+" "+left(ltrim(substr(botname,k)),3)
  * Newtons formula
  xvol=0.00007854*(HTOP-iif(HBUTT=0,HBASE,HBUTT));
               *(DBH^2+4*MDIAM^2+TDIAM^2)/6
  select 2
  append blank
  replace INVNO with vt->INVNO,SPP with vt->SPP,GENSPP with xgenspp,;
         DBH with vt->DBH, HTOP with vt->HTOP, VOL with xvol
  select 1
endscan
set talk on
set status on
return
```

D.6 STANDTAB : Simple stand table program

This program was originally written as a precursor to TSIA. It produces simple stand tables of stem numbers by diameter classes and cumulative diameter classes. However, it has the capability of listing explicitly all species, and of sorting them by frequency, whereas TSIA only lists species for which a species group code is defined. STANDTAB does not calculate volumes or sampling errors.

It is a Clipper program and must be compiled before execution. See the notes on page 39.

```
* simple stand table program
* written by Denis Alder, November 1992.
set confirm on
set deleted on
set softseek on
clear
@ 0,0 say "Stand Table Compilation"
@ 1,0 to 1,79 double
prefix="     "
@ 3,0 say "Forest reserve prefix " get prefix picture "AAAAA"
read
if lastkey()=27
  return
endif
* try to find parameter file
mprefix=prefix+".mem"
if file(mprefix)
  restore from (prefix) additive
else
  * set default values (Columbia/Cockscomb values)
  pspp1=1
  pspp2=2
  pspp3=0
  p_width=40
  p_diam=40
  p_subd=10
  s_width=20
  s_diam=40
  s_subd=20
  subf1=1
  subf2=5
  title="Stand table of Columbia/Maya Mountains                    "
  trin_b1=1
  trin_t1=1
  trin_b2=99
  trin_t2=2
  rex=.T.
  rare=10
endif
* parameter screen
```

```
@ 5,0 say "Title" get title
@ 7,0 say "Primary species codes  " get pspp1 picture "999"
@ 7,col()+2 get pspp2 picture "999"
@ 7,col()+2 get pspp3 picture "999"
@ 8,0 say "Transect width (m)     " get p_width picture "99"
@ 9,0 say "Min. diam, main sample " get p_diam picture "99"
@ 10,0 say "Min. diam, sub-sample  " get p_subd picture "99"
@ 12,0 say "Secondary species"
@ 13,0 say "Transect width (m)     " get s_width picture "99"
@ 14,0 say "Min. diam, main sample " get s_diam picture "99"
@ 15,0 say "Min. diam, sub-sample  " get s_subd picture "99"
@ 17,0 say "Sub-sample " get subf1 picture [9]
@ 17,col()+2 say "in" get subf2 picture [9]
@ 19,0 say "Include transects from " get trin_b1 picture [99]
@ 19,col()+1 say "-" get trin_t1 picture [9]
@ 19,col()+2 say "to" get trin_b2 picture [99]
@ 19,col()+1 say "-" get trin_t2 picture [9]
@ 21,0 say "Reindex data files ?   " get rex picture [Y]
@ 22,0 say "Group species rarer than " get rare picture [@R 99/km²]
read
if lastkey()=27
  return
endif
save all except prefix to (prefix)
* define diameter classes and stand table array
dc={20,30,40,50,60,70,80,90,100,999}
cdc={20,30,40,50}
ndc=len(dc)-1
ncdc=len(cdc)
msp=400
st=zfill(array(msp+1,ndc+ncdc))
* open data files
plotf=prefix+"_P"
treef=prefix+"_T"
use (plotf) alias plots new
use (treef) alias trees new
use species alias species new
if rex
  * create new clipper index files
  @ 21,40 say "Reindexing..."
  select plots
  index on RESV*10000000+BNO*100000+TNO*1000+PNO to (plotf)
  select trees
  index on PLOT to (treef)
  select species
  index on SPP to spno
else
  * use existing index files
  select plots
  set index to (plotf)
  select trees
  set index to (treef)
```

```
  select species
  set index to spno
endif
* find first record unit to process
select plots
goto top
first_ru=pix(RESV,trin_b1,trin_t1,0)
last_ru=pix(RESV,trin_b2,trin_t2,999)
seek first_ru
nru=0
* set area weights (based on 50 m long record units)
areawt_pm=10000/(50*p_width)
areawt_sm=10000/(50*s_width)
areawt_ps=areawt_pm*(subf2/subf1)
areawt_ss=areawt_sm*(subf2/subf1)
* scan through plots to accumulate stand table
@ 7,0 clear
@ 7,0 say "Block     Transect     Total RUs"
do while (thisp:=pix(RESV,BNO,TNO,PNO))<=last_ru .and. .not. eof()
  @ 7,6 say BNO
  @ 7,19 say TNO
  @ 7,33 say nru
  * get trees for this plot
  select trees
  seek thisp
  do while PLOT=thisp
    * ignore undersized trees
    if DBH>=dc[1]
      * verify species code - if out of range, add to row (msp+1)
      j=if(SPP>=1 .and. SPP<=msp, SPP, msp+1)
      * check diameter class k and cumulative class kc
      for k=1 to ndc
        if DBH>=dc[k] .and. DBH<dc[k+1]
          exit
        endif
      next
      for kc=ncdc to 1 step -1
        if DBH>=cdc[kc]
          exit
        endif
      next
      * check if primary or secondary species
      py= SPP=pspp1 .or. SPP=pspp2 .or. SPP=pspp3
      * determine area weight factor for this stem
      if py
        if DBH<p_diam
          * primary subplot
          awt=areawt_ps
        else
          awt=areawt_pm
        endif
      else
```

```
      if DBH<s_diam
        * secodnary subplot
        awt=areawt_ss
      else
        awt=areawt_sm
      endif
    endif
    * add tree to stand table
    st[j][k]+=awt
    if DBH>=cdc[1]
      for k=ndc+kc to ndc+1 step -1
        st[j][k]+=awt
      next
    endif
  endif
  * get next tree record
  skip
 enddo
 * increment plot counter, get next plot record
 select plots
 nru++
 skip
enddo
* divide by total number of record units and convert to km²
af=100/nru
for j=1 to msp+1
 for k=1 to ndc+ncdc
  st[j][k]*=af
 next
next
* create index by frequency in second cumulative class
ix=array(msp+1)
for j=1 to msp+1
 ix[j]=j
next
ks=ndc+ncdc
asort(ix,,,{|m,n| st[m][ks]>st[n][ks]})
* generate a sorted table that pools results for species code 103 (unknown)
* species rarer than the threshold value 'rare', and line msp+1 (erroneous
* codes)
* first count the lines greater than 'rare'.
ncom=0
kc=ndc+1
for j=1 to msp
 if st[j][kc]>=rare .and. j<>103
  ncom++
 endif
next
* dimension sorted and compressed array
sst=zfill(array(ncom+2,ndc+ncdc))
spref=array(ncom+2,2)
* copy array in sorted order.  Add rare species to line ncom+1,
```

```
* totals to ncom+2
js=1
nc=ndc+ncdc
und=ncom+1
tot=ncom+2
mspl=msp+1
for i=1 to msp
  j=ix[i]
  if st[j][kc]>=rare .and. j<>103 .and. j<>mspl
    spref[js][1]=j
    sst[js++]=st[j]
  else
    for k=1 to nc
      sst[und][k]+=st[j][k]
    next k
  endif
  for k=1 to nc
    sst[tot][k]+=st[j][k]
  next k
next
* add species names to the reference array
select species
for j=1 to ncom
  seek spref[j][1]
  if found()
    spref[j][2]=LNAME
  else
    spref[j][2]="***"
  endif
next
spref[und][2]="Rare or unknown spp.  "
spref[tot][2]="Total (all species)   "
* output stand table
set device to print
lmargin=10
tmargin=3
pageno=0
plength=50
pwidth=27+nc*7
do prt_hdr
lc=1
for j=1 to tot
  if lc>plength
    @ prow()+2,lmargin+pwidth-10 say "(over ../..)"
    do prt_hdr
    lc=1
  endif
  if j>=und
    @ prow()+1,0 say " "
    lc++
  endif
  do prt_line with spref[j],sst[j]
```

```
  lc++
next
@ prow()+1,lmargin+0 say replicate("=",pwidth)
eject
return

procedure prt_hdr
* prints a stand table heading
* eject paper if not page zero
if pageno>0
  eject
endif
pageno++
@ 0,0 say chr(15)
@ tmargin+0,lmargin+0 say "Stand table for "+title
@ tmargin+0,lmargin+pwidth-8 say "Page "+str(pageno,3)
@ tmargin+2,lmargin+0 say "Sample size : "
@ tmargin+2,pcol() say nru
@ tmargin+2,pcol()+1 say "plots     "
@ tmargin+2,pcol() say nru*50 picture "999,999"
@ tmargin+2,pcol() say " m. transect line"
* general headings
h1=4
h2=h1+1
h3=h2+1
@ tmargin+h1,lmargin+0 say "Spp. Species Local Name    "
hdr1=" N/km² by cm diameter classes "
w1=nc*7
n1=(w1-len(hdr1)-2)/2
hdr1x="<"+repl("-",n1)+hdr1+repl("-",n1)+">"
@ tmargin+h1,pcol() say hdr1x
@ tmargin+h2,lmargin+0 say "code                      "
for k=1 to ndc-1
  dhdr=ltrim(str(dc[k],3))+"-"+ltrim(str(dc[k+1],3))
  dhdr=space(7-len(dhdr))+dhdr
  @ tmargin+h2,pcol() say dhdr
next
dhdr="≥"+ltrim(str(dc[ndc],3))
dhdr=space(7-len(dhdr))+dhdr
@ tmargin+h2,pcol() say dhdr
for k=1 to ncdc
  dhdr="≥"+ltrim(str(cdc[k],3))
  dhdr=space(7-len(dhdr))+dhdr
  @ tmargin+h2,pcol() say dhdr
next
@ tmargin+h3,lmargin+0 say replicate( "-", 25+w1)
return
```

```
procedure prt_line
parameters spid,sn
* prints a line of the stand table.  'spid' is a row from 'spref'.
* 'sn' is a row from 'sst'.
pl=prow()+1
@ pl,lmargin+0 say spid[1] picture "@BZ 9999"
@ pl,lmargin+5 say spid[2] picture replicate("X",20)
for k=1 to nc
  @ pl,pcol() say sn[k] picture "@Z 9999999"
next k
return

function zfill(a)
* fills a two dimensional array with zeroes
for i=1 to len(a)
  for j=1 to len(a[i])
    a[i][j]=0
  next
next
return a

function pix(rn,bn,tn,pn)
* calculates plot index function from reserve, block, transect & plot no's
return (rn*10000000+bn*100000+tn*1000+pn)
```

D.7 INVOPT : Set options for program TSIA

This program provides a screen display that allows various options for the TSIA inventory program to be set. These include diameter class and cumulative diameter class bounds, printer setup codes and page length, the stratification method, and whether print-outs are to be produced for transect and strata; a forest-level print-out will always be produced.

The program is written in Clipper and must be compiled before use. The present version will also run from the dBASE 4 dot prompt by typing DO INVOPT, but this compatibility arises by chance and may not be maintained in future. See the Clipper notes on page 39.

```
* INVOPT : Sets Broadleaf Inventory Program options
* written in Clipper 5 by Denis Alder, November 1992
parameters options
@ 0,0 clear
@ 0,0 say "Broadleaf Inventory Program Options"
@ 1,0 to 1,79 double
* a /D on the DOS command line restores the default parameters
Dopt:= if(empty(options),.F.,upper(options)="/D")
* recall options from disk or use defaults
if file("invopt.mem") .and. .not. Dopt
  restore from invopt
else
  * default parameters
  dctxt=   "10,20,30,40,50,60,70,80,90,100      "
  cdctxt=  "10,30,50      "
  pr_setup="15                                  "
  rex=.Y.
  fstratum=1
  PrtEveryTr=.Y.
  PrtEverySt=.Y.
  PageLen=55
  PrtFile=  .N.
endif

@ 3,0 say "Diameter class lower bounds, cm " get dctxt
@ 5,0 say "Cumulative diameter classes, cm " get cdctxt
@ 7,0 say "Printer setup codes             " get pr_setup
@ 9,0 say "Re-index data files             " get rex picture [Y]
@ 9,40 say "Page length (lines)      " get PageLen picture '99'
@ 11,0 say "Stratify on  (1) Block no.      " get fstratum picture [9] range 1,3
@ 12,0 say "             (2) LANDSYS field  "
@ 13,0 say "             (3) VEGTYP field   "
@ 11,40 say "Print Transect Tables ? " get PrtEveryTr picture [Y]
@ 13,40 say "Print Stratum Tables ?  " get PrtEverySt picture [Y]
@ 15,40 say "Send output to file ?   " get PrtFile picture [Y]
@ 21,0 say "Press Ctrl-End to save, Esc to cancel"
read
```

```
if lastkey()=27
  @ 23,0 say "Program cancelled by ESC : current settings not changed"
  @ 24,0 say " "
  return
endif
save all to invopt
@ 23,0 say "Inventory parameters updated on disk"
@ 24,0 say " "
return
```

D.8 TSIA : Variable-length transect stratified sample inventory

This program produces the stand tables shown in Appendix E on page 86. It is simple to run once the prerequisite files have been established. Its use is discussed in the text in section ?, page ?. It is similar to STANDTAB, but runs to some 30 pages of code as against 7 for the former; the extra complexity reflects the difficulties associated with species grouping and calculation of sampling errors.

The program is written in Clipper 5.0. It contains examples of peculiarly Clipper features such as code blocks, browse objects, and tree structures (n-branched arrays).

```
*0************************ TSIA MAIN PROGRAM *****************************
clear
text
```

```
                Belize Forest Planning and Management Project

                TSIA : Transect Sampling Inventory Analysis

This program processes inventory data for broadleaved forests based on
a sampling design using variable length transects randomly located
within strata.  The strata may be blocks, land system, or other factor.

Output comprises stand tables of tree numbers per km² by diameter
classes and species, and volume tables by cumulative diameter and
species.  Sampling errors and reliable minimum estimates are given for
volume.

For information on program operation, refer to the user documentation.

                Programmed by Denis Alder, November 1992
                        Written in Clipper 5.0
```

```
endtext
* hold text on screen for one minute or a keystroke
delay=inkey(60)
* general program status settings
set confirm on
set deleted on
set softseek on
* public variables initialized in subroutines.  Assignments here set type.
public StratumID:="", TransectID:="", ntrs:=0, trls:=0, trlsq:=0
public VarTrLen:=0,PageNo:=0, nru:=0, trlf:=0, ntrf:=0
public ast:=0,astq:=0,nfu:=0,nfs:=0
* set up initial screen display
clear
```

```
@ 0,0 say "TSIA : Transect Sampling Inventory Analysis"
@ 1,0 to 1,79 double
* read standard options defined by INVOPT program
filecheck("invopt.mem")
restore from invopt additive
* convert options text to arrays of diameter class values
dc=&("{"+dctxt+",999}")
cdc=&("{"+cdctxt+"}")
ndc=len(dc)-1
ncdc=len(cdc)
mdc=ndc+ncdc
* select inventory area to process
frno=invselect()
@ 3,0 clear
@ 3,0 say "Analysis of "+INVENTORY
openinvf()
* open species files and create initial accumulator arrays
openspf()
* initialize volume equations
InitVolEqn()
* open stratum area file
OpenAreaFile()
* get printer ready
PrinterSetup()
*  initialize arrays for the first stratum, sum and sum of squares of
* stratum weights
select plots
initStratum()
public forestwt:=0
public forestwtq:=0
* initialize arrays for the first transect
initTransect()
* begin scan through sample plots
goto top
do while .not. eof()
  * count record units
  nru++
  @ 9,17 say nru picture "9999 :"
  * get trees for this plot
  thisp=pix(RESV,BNO,TNO,PNO)
  select trees
  seek thisp
  * tree loop
  nt=0
  do while PLOT=thisp
    @ 9,24 say nt++
    * accumulate data for current tree
    addtree()
    * get next tree record
    skip
  enddo
  * increment plot counter, get next plot record
```

```
  select plots
  skip
  * test for end of file
  if eof()
    exit
  endif
  * test for end of transect
  if NewTransect()
    * end-of-transect processing
    EndTransect()
    * re-initialize transect
    InitTransect()
  endif
  if NewStratum()
    * end-of-stratum processing
    EndStratum()
    * re-initialize stratum
    InitStratum()
  endif
enddo
* end of forest processing
EndTransect()
EndStratum()
EndForest()
@ 24,0 clear
@ 24,0 say "Program TSIA finished OK"
return


*1************ INVENTORY PARAMETER AND SPECIES INPUT FUNCTIONS **************

procedure invselect
* Puts a browse table on the screen with inventory titles shown
* Returns the record number in INVCODES selected for processing
* check file available
filecheck("invcodes.dbf")
use invcodes alias inv new
index on RESV to invcodes
* set up simple browse table
invtable=TbrowseDB(5,15, 15,65)
@ 20,15 say "Select inventory using "+chr(24)+" "+chr(25)+" keys" color "bg+/b"
@ 21,15 say "Press "+chr(17)+"J to select, Esc to quit" color "bg+/b"
invtable:headSep="-"
invtable:addColumn(TBcolumnNew("Forest Inventories",{|| INVENTORY}))
ok=.F.
* display table and wait for Up, Down, Enter or Esc keys
do while .not. ok
  * stabilize table on display
  invtable:stabilize()
  k=inkey()
  do case
  case k=5
```

```
    * up arrow key
    invtable:up()
  case k=24
    * down arrow key
    invtable:down()
  case k=13
    * enter key - leave table
    ok=.T.
  case k=27
    * esc key - see if program to be cancelled
    esc_key()
  endcase
enddo
* record no. of selected inventory in INVCODES file
return recno()

procedure openinvf
* open inventory data files
select inv
goto frno
plotf=PREFIX+"_P"
treef=PREFIX+"_T"
filecheck(plotf+".dbf")
filecheck(plotf+".dbf")
use (plotf) alias plots new
use (treef) alias trees new
if rex
  * create new clipper index files
  @ 24,0 say "Creating Clipper index files for plot and tree data ..."
  select plots
  do case
  case fstratum=1
    * stratification by blocks
    index on RESV*10000000+BNO*100000+TNO*1000+PNO to (plotf+"1")
  case fstratum=2
    * stratify by LANDSYS field
    index on LANDSYS+str(RESV,2)+str(BNO,2)+str(TNO,2) to (plotf+"2")
  case fstratum=3
    * stratify by VEGTYP field
    index on VEGTYP+str(RESV,2)+str(BNO,2)+str(TNO,2) to (plotf+"3")
  endcase
  select trees
  index on PLOT to (treef)
  @ 24,0 clear
else
  * use existing index files
  select plots
  filecheck(plotf+str(fstratum,1)+".NTX")
  set index to (plotf+str(fstratum,1))
  select trees
  filecheck(treef+".NTX")
  set index to (treef)
```

```
endif
return

procedure OpenAreaFile
* opens file of stratum areas, unless stratification is by blocks
do case
case fstratum=2
  AreaFl=inv->PREFIX+"_AL"
case fstratum=3
  AreaFl=inv->PREFIX+"_AV"
otherwise
  * blocks - don't try to open file
  return
endcase
filecheck(AreaFl+".dbf")
use (AreaFl) alias strata new
index on STRATUM to AreaFl
return

procedure openspf
* opens the species files, creates and initializes arrays using species
* or species group data or dimensions
filecheck("species.dbf")
filecheck("spgroups.dbf")
use species alias species new
index on UTIL+LNAME to prtorder
use spgroups alias groups new
index on GROUP to spgroup
* check no of species groups
public nspg :=groups->(lastrec())
* allow two more rows: unclassified species, and grand totals
public uncl :=nspg+1
public tot  :=nspg+2
* find the highest species code number, and declare the hash table
* ..g is group, ..s is position within group, ..v is vol. eqn. lookup
public sppmax :=0
species->(dbeval({|| sppmax:=if(sppmax<SPP,SPP,sppmax)}))
public sphashg :=afill(array(sppmax),0)
public sphashs :=afill(array(sppmax),0)
public sphashv :=afill(array(sppmax),0)
* define main accumulator arrays
* st is the stand table (n/km2 by diameter classes).  Suffixes denote:
* ..u within sample unit (transect) totals, ..s within stratum totals
* ..f grand (forest) totals.
public stu  :=array(tot)
public sts  :=array(tot)
public stf  :=array(tot)
stu[uncl]   :=afill(array(mdc),0)
stu[tot]    := afill(array(mdc),0)
sts[uncl]   :=afill(array(mdc),0)
sts[tot]    := afill(array(mdc),0)
stf[uncl]   :=afill(array(mdc),0)
```

```
stf[tot]    := afill(array(mdc),0)
* array spid contains group and species names of each entry in stand table
public spid  :=afill(array(tot),{})
spid[uncl]="Unclassified species"
spid[tot]="Total (all species)"
* volume arrays.  These accumulate volume of all trees by cumulative
* size classes.  Suffix ..q denotes Σx² accumulator, and ..h denotes
* Σw.x accumulator, where w is transect weight (length or area).
* ..u, ..s, ..f suffixes are for sample unit, stratum, and forest totals
public volu  :=array(tot)
volu[uncl]   :=afill(array(ncdc),0)
volu[tot]    :=afill(array(ncdc),0)
public vols  :=array(tot)
vols[uncl]   :=afill(array(ncdc),0)
vols[tot]    :=afill(array(ncdc),0)
public volf  :=array(tot)
volf[uncl]   :=afill(array(ncdc),0)
volf[tot]    :=afill(array(ncdc),0)
public volsq :=array(tot)
volsq[uncl]  :=afill(array(ncdc),0)
volsq[tot]   :=afill(array(ncdc),0)
public volfq :=array(tot)
volfq[uncl]  :=afill(array(ncdc),0)
volfq[tot]   :=afill(array(ncdc),0)
* find species in each group, create accumulator arrays, and fill
* reference values in species hash tables
select species
* find first non-blank group (. comes after blank and before A)
seek "."
ng=0
do while .not. eof()
  fg=UTIL
  ns=0
  ng++
  if ng>nspg
    @ 24,0 say "Error : More species groups in SPECIES than in SPGROUPS"
    altd()
    quit
  endif
  do while fg=UTIL
    ns++
    sphashs[SPP]=ns
    sphashg[SPP]=ng
    skip
  enddo
  * allow one extra slot for group totals
  ns1=ns+1
  * add sub-branches for each species to accumulator arrays
  stu[ng]  =array(ns1)
  sts[ng]  =array(ns1)
  stf[ng]  =array(ns1)
  volu[ng] =array(ns1)
```

```
  vols[ng] =array(ns1)
  volf[ng] =array(ns1)
  volsq[ng]=array(ns1)
  volfq[ng]=array(ns1)
  * add diameter class rows for each species
  for i=1 to ns1
    stu[ng][i]=    afill(array(mdc),0)
    sts[ng][i]=    afill(array(mdc),0)
    stf[ng][i]=    afill(array(mdc),0)
    volu[ng][i]=  afill(array(ncdc),0)
    vols[ng][i]=  afill(array(ncdc),0)
    volf[ng][i]=  afill(array(ncdc),0)
    volsq[ng][i]= afill(array(ncdc),0)
    volfq[ng][i]= afill(array(ncdc),0)
  next
  * add species group names
  spid[ng] =afill(array(ns1),"")
  select groups
  seek fg
  spid[ng][1]=GNAME
  * add species names
  select species
  sp=1
  seek fg
  do while fg=UTIL
    sp++
    spid[ng][sp]=LNAME
    skip
  enddo
enddo
* check final number of groups consistent with SPGROUPS list
if ng<nspg
  @ 24,0 say "Error : Groups in SPGROUPS are absent from species list"
  if inkey(0)=27
    esc_key()
  endif
endif
return

*
```

```
*2***************** TREE-LEVEL STATISTICAL ROUTINES **********************

procedure addtree
* adds the current tree line to the 'stu' and 'volu' accumulators
* ignore undersized trees
if DBH>=dc[1]
  * screen out odd species codes as 103 (unknown)
  if SPP<1
    replace SPP with 103
  endif
  * look species up in hash table
  ng=sphashg[SPP]
  if ng=0
    * not in species list - use 'unclassified' group
    ng=uncl
  endif
  ns=sphashs[SPP]
  * find diameter class k
  for k=1 to ndc
    if DBH>=dc[k] .and. DBH<dc[k+1]
      exit
    endif
  next
  * find cumulative class kc
  for kc=ncdc to 1 step -1
    if DBH>=cdc[kc]
      exit
    endif
  next
  * check if primary or secondary species
  py=ascan(pysplist,SPP)>0
  * determine area weight factor for this stem
  if py
    if DBH<inv->DMIN_1Y
      * primary species on subplot
      awt=afs1
    else
      * primary species on main plot
      awt=afp1
    endif
  else
    if DBH<inv->DMIN_2Y
      * secondary species on subplot
      awt=afs2
    else
      * secondary species on main plot
      awt=afp2
    endif
  endif
  * get tree volume
  tvol=voleqn(DBH,SPP)*awt
```

```
  * add tree to individual species rows (except for unclassified species)
  if ng<>uncl
    * species rows are offset by 1, row 1 is group totals
    ns1=ns+1
    stu[ng][ns1][k]+=awt
    * group total
    stu[ng][1][k]+=awt
    * add to all cumulative classes below size
    if DBH>=cdc[1]
      for j=ndc+kc to ndc+1 step -1
        stu[ng][ns1][j]+=awt
        volu[ng][ns1][j-ndc]+=tvol
        * group totals
        stu[ng][1][j]+=awt
        volu[ng][1][j-ndc]+=tvol
      next
    endif
  else
    * unclassified species - middle dimension not used
    stu[uncl][k]+=awt
    * add to all cumulative classes below size
    if DBH>=cdc[1]
      for j=ndc+kc to ndc+1 step -1
        stu[uncl][j]+=awt
        volu[uncl][j-ndc]+=tvol
      next
    endif
  endif
  * do totals rows
  stu[tot][k]+=awt
  * add to all cumulative classes below size
  if DBH>=cdc[1]
    for j=ndc+kc to ndc+1 step -1
      stu[tot][j]+=awt
      volu[tot][j-ndc]+=tvol
    next
  endif
endif
return

*
```

```
*3****************** TRANSECT-LEVEL STATISTICAL ROUTINES ******************

procedure InitTransect
* resets the transect-level accumulators to zeroes
* set current transect id, based on stratification type
do case
case fstratum=1
  TransectID= str(RESV,2)+str(BNO,2)+str(TNO,2)
case fstratum=2
  TransectID= LANDSYS+str(RESV,2)+str(BNO,2)+str(TNO,2)
case fstratum=3
  TransectID= VEGTYP+str(RESV,2)+str(BNO,2)+str(TNO,2)
endcase
* update display status
@ 7,0 say "Transect       : "+TransectID
@ 9,0 say "Record Unit    :           "
* reset transect level accumulators
zfill(stu)
zfill(volu)
* reset record-unit counter
nru=0
* reset area weight factors (which may vary according to design for
* each RESV number)
inv->(equalsize(RESV))
* if a non-subdivided transect, set variable transect length
if inv->PLENGTH=0
  VarTrLen=plots->(TLEN)
endif
return

procedure EqualSize (invno)
* calculates plot (..p) and subplot (..s) weights for primary (..1) and
* secondary species (..2), such that all occurrences of a stem on one
* sample unit are added to accumulators as 1 tree/km². Called at the
* beginning of each transect to allow different data sets to be run together.
*
* set primary species list
seek invno
public afp1,afp2,afs1,afs2
public pysplist :=&("{"+PYSPP+"}")
afp1=1000000/(WIDTH_1Y*if(PLENGTH>0,PLENGTH,plots->TLEN))
afp2=1000000/(WIDTH_2Y*if(PLENGTH>0,PLENGTH,plots->TLEN))
afs1=afp1*FREQ_SUBP
afs2=afp2*FREQ_SUBP
return

function NewTransect
* Tests if the current record-unit (plot) is the same as that in TransectID.
* Returns .T. if they differ, ie. a new transect has been encountered.
local NewID
do case
```

```
case fstratum=1
  NewID= str(RESV,2)+str(BNO,2)+str(TNO,2)
case fstratum=2
  NewID= LANDSYS+str(RESV,2)+str(BNO,2)+str(TNO,2)
case fstratum=3
  NewID= VEGTYP+str(RESV,2)+str(BNO,2)+str(TNO,2)
endcase
return NewID <> TransectID

procedure EndTransect
* Does end-of-transect processing.  This involves adding the transect
* accumulators to the stratum accumulators.  If the 'PrtEveryTr' flag
* is set, also prints out every transect.
@ 9,17 clear to 9,79
@ 9,17 say "** EOT **"
if inv->PLENGTH>0
  * transect length is no. record units x length of each unit
  TrLen=nru*inv->PLENGTH
else
  * no. record units - use variable transect length set by InitTransect
  TrLen=VarTrLen
endif
* transect count
ntrs++
* sum of transect lengths
trls+=TrLen
* convert 'stu' and 'volu' to means
FnArray(stu,{|x| x/nru})
FnArray(volu,{|x| x/nru})
* sum of mean N/km² weighted by transect length
AddArray(sts,stu,{|x| x*TrLen})
* sum of volume m3/km²
AddArray(vols,volu,{|x| x*TrLen})
* sum of squares of volumes
AddArray(volsq,volu,{|x| x*x*TrLen})
* if parameter PrtEveryTr set by INVOPT, then print transect summary
if PrtEveryTr
  PrtTransect()
endif
return

*
```

```
*4****************** STRATUM-LEVEL STATISTICAL ROUTINES ******************

procedure InitStratum
* resets the stratum-level accumulators to zeroes
* set current stratum id, based on stratification type
do case
case fstratum=1
  * stratification by blocks
  StratumID= str(RESV,2)+str(BNO,2)
  * BlockNo used in variable block size processing - see VarBlkSz()
  public BlockNo:=RESV*100+BNO
case fstratum=2
  * stratify by LANDSYS field
  StratumID= LANDSYS
case fstratum=3
  * stratify by VEGTYP field
  StratumID= VEGTYP
endcase
* update display status
@ 5,0 say "Stratum        : "+StratumID
* reset stratum level accumulators
zfill(sts)
zfill(vols)
zfill(volsq)
* reset transect counter and length, length squared totals
ntrs=0
trls=0
trlsq=0
return

procedure NewStratum()
* Tests if the current record-unit (plot) is the same as that in StratumID.
* Returns .T. if they differ, ie. a new transect has been encountered.
local NewID
do case
case fstratum=1
  NewID= str(RESV,2)+str(BNO,2)
case fstratum=2
  NewID= LANDSYS
case fstratum=3
  NewID= VEGTYP
endcase
return NewID <> StratumID

procedure EndStratum()
* Does end-of-stratum processing.  The stratum sums are converted to
* means, and their weighted values added to forest-level accumulators.
* Sums of squares and products with transect length are used to compute
* stratum variance using the formula for variable length transects.
* Weighted stratum variance is added to forest-level variance accumulators.
* If required, stratum results are printed, with variances being reduced to
```

```
* standard errors.
local f,ng,sp,d
public ast:=0,astq:=0
@ 7,17 clear to 7,79
@ 7,17 say "** EOS **"
* get stratum area from STRATA file, or from nominal block size
if fstratum=1
  ast=inv->BLOCK_KM2
  if ast=0
    if select("bz")=0
      * check block size file opened yet
      OpenBzFile(BlockNo)
    endif
    ast=bz->(VarBlkSz(BlockNo))
  endif
else
  select strata
  seek StratumID
  if .not. found()
    @ 24,0 say "Error : Stratum "+upper(StratumID)+" not in "+dbf()
    altd()
    return
  else
    ast=ST_AREA
  endif
  select plots
endif
* check more than one transect in stratum
if ntrs<=1
  @ 24,0 say "Warning : Stratum "+upper(StratumID)+" - only 1 transect : Ignored"
  return
endif
* convert stand table totals to means per km²
FnArray(sts,{|x| x/trls})
* derive stratum variance for volume and convert volume total to mean
f=ntrs/trls
ndf=ntrs-1
for ng=1 to tot
  if ng<=nspg
    * individual species rows
    sp=1
    do while sp<=len(vols[ng])
      for d=1 to ncdc
        volsq[ng][sp][d]=(f*(volsq[ng][sp][d]-(vols[ng][sp][d])^2/trls)/ndf)/ntrs
        vols[ng][sp][d]/=trls
      next
      sp++
    enddo
  else
    * unclassifieds and totals
    for d=1 to ncdc
      volsq[ng][d]= f*(volsq[ng][d]-vols[ng][d]^2/trls)/ndf
```

```
      vols[ng][d]/=trls
    next
  endif
next
* add stratum means weighted by stratum area to forest accumulator
AddArray(stf,sts,{|x| x*ast})
* add weighted variances of mean
AddArray(volf,vols,{|x| x*ast})
public astq:=ast^2
AddArray(volfq,volsq,{|x| x*astq})
* add forest stratum weights
forestwt+=ast
forestwtq+=astq
* add up forest level statistics on transects
trlf+=trls
ntrf+=ntrs
nfu+=ntrs
nfs++
* print stratum summary if required
if PrtEverySt
  PrtStratum()
endif
return

procedure OpenBzFile(BlockNo)
* opens block size file
local n,bzfile
n=select()
bzfile=inv->PREFIX+"_BZ"
filecheck(bzfile+".dbf")
use (bzfile) alias bz new
index on RBNO to bz
select (n)
return

function VarBlkSz(BlockNo)
* looks up a block size in file BlkSz - used where block size varies
* requires a file 'Prefix_BZ' containing block numbers and areas in km².
seek BlockNo
if .not. found()
  @ 24,0 clear
  @ 24,0 say "Can't find block ID "+str(BlockNo,4)+" in file "+dbf()
  altd()
  quit
endif
return BL_AREA

*
```

```
*5****************** FOREST-LEVEL STATISTICAL ROUTINES ******************

Procedure EndForest()
* calculates forest means and sampling errors and prints them
* convert weighted totals to means
@ 5,17 clear
@ 5,17 say "Printing forest summary...."
FnArray(stf,{|x| x/forestwt})
FnArray(volf,{|x| x/forestwt})
public fwsq:=forestwt^2
FnArray(volfq,{|x| x/fwsq})
PrtForest()
@ 4,0 clear
return


*
```

```
*6************************  OUTPUT ROUTINES ******************************

procedure PrinterSetup
* initializes constants used for printer control by all output routines
* converts code list from INVOPT into a setup string
local i
public pageno:=0
public lmargin:=10
public tmargin:=3
public PgLen:=PageLen-10
public MaxWidth:=123
* convert setup codes from INVOPT to string format
pr_ch=&("{"+pr_setup+"}")
public pr_setupS:=""
for i=1 to len(pr_ch)
  pr_setupS+=chr(pr_ch[i])
next
* printer uses prefix file name with extension .PRN if file output requested
set printer to (if(PrtFile,inv->PREFIX+".PRN","LPT1"))
return

procedure PrtTransect
* output stand table
local hdr
@ 9,27 say "Printing Transect Summary ..."
set device to print
* code block with heading procedures, N/km²
hdr={|| PrtHdrTop(), PrtTrInfo(), PrtHdrSt()}
eval(hdr)
PrtSt(stu,hdr )
* volumes by cum. dia. class with sampling errors
hdr={|| PrtHdrTop(), PrtTrInfo(), PrtHdrVol()}
eval(hdr)
PrtVol(volu,volsq,0,hdr )
set device to screen
@ 9,17 clear to 9,79
return

procedure PrtStratum
* output stand tables for stratum
local hdr
@ 7,27 say "Printing Stratum Summary ..."
set device to print
* stand table of N/km²
* code block with heading procedures
hdr={|| PrtHdrTop(), PrtStInfo(), PrtHdrSt()}
eval(hdr)
PrtSt(sts,hdr )
* volumes by cum. dia. class with sampling errors
hdr={|| PrtHdrTop(), PrtStInfo(), PrtHdrVol()}
eval(hdr)
```

```
PrtVol(vols,volsq,ntrs-1,hdr )
set device to screen
@ 7,17 clear to 7,79
return

procedure PrtForest
* output stand tables for forest
set device to print
* stand table of N/km²
* code block with heading procedures
hdr={|| PrtHdrTop(), PrtFoInfo(), PrtHdrSt()}
eval(hdr)
PrtSt(stf,hdr)
* volumes by cum. dia. class with sampling errors
hdr={|| PrtHdrTop(), PrtFoInfo(), PrtHdrVol()}
eval(hdr)
PrtVol(volf,volfq,nfu-nfs-1,hdr )
set device to screen
@ 7,17 clear to 7,79
return

procedure PrtSt(st,hdrfn)
* prints main body of a stand table at transect, stratum or forest level
* 'st' is the stand table to be printed, 'corrfn' is a function applied
* to each element before printing to reduce figures to a correctly-weighted
* per km² basis, and 'hdrfn' is called at the end of each page to throw
* paper and print headings for a new page.
local ng,sp,lc
lc=1
for ng=1 to nspg
  * test if there are species in this group
  if present(st[ng][1])
    * have at least 5 lines free before starting group
    CondEop(StTic,5,hdrfn,@lc)
    * print a blank line before group
    TicLine(StTic,{"╟","│","╢"}," ")
    lc++
    nsp=len(st[ng])
    * print line by line
    for sp=2 to nsp
      if present(st[ng][sp])
        lc++
        CondEop(StTic,1,hdrfn,@lc)
        PrtLineSt(spid[ng][sp],st[ng][sp])
      endif
    next
    * print group summary
    TicLine(StTic,{"╟","┼","╢"},"-")
    lc++
    CondEop(StTic,2,hdrfn,@lc)
    PrtLineSt(spid[ng][1],st[ng][1])
    TicLine(StTic,{"╟","┼","╢"},"-")
```

```
    lc+=2
  endif
next
* print unclassified and totals groups
CondEop(StTic,4,hdrfn,@lc)
PrtLineSt(spid[uncl],st[uncl])
TicLine(StTic,{"╠","╪","╣"},"=")
PrtLineSt(spid[tot],st[tot])
TicLine(StTic,{"╚","╧","╝"},"=")
return

function present(sprow)
* tests for presence of non-zero values in a species row
local i, nz
nz=.F.
for i=1 to len(sprow)
  if sprow[i]>0
    nz=.T.
    exit
  endif
next
return nz

procedure CondEop(tics,lfree,hdrfn,lc)
* tests if there are 'lfree' lines left on page.  If not, does a new
* page with headings defined by code block 'hdrfn' and resets line count 'lc'
lt=len(tics)
if lc>PgLen-lfree
  * new page needed
  @ prow()+2,lmargin+tics[lt]-10 say "(.../...)"
  eval(hdrfn)
  pl=prow()+1
  * show ellipsis at top of table
  @ pl,lmargin+tics[1] say "╟"
  @ pl,pcol() say " (.../...)"
  for t=2 to lt-1
    @ pl,lmargin+tics[t] say "┼"
  next
  @ pl,lmargin+tics[lt] say "╢"
  lc=1
endif
return

procedure PrtLineSt(spn,nkm2)
* prints a species or group summary line from the stand table.  'spn' is
* an element of the 'spid' species names array. 'nkm2' is a row of diameter
* class mean stockings for the species.
local pl,k
pl=prow()+1
@ pl,lmargin+StTic[1] say "╟"
@ pl,pcol() say spn
@ pl,lmargin+StTic[2] say "┼"
```

```
for k=1 to ndc
  @ pl,pcol() say nkm2[k] picture "@Z 999,999"
next
@ pl,lmargin+StTic[3] say "|"
for k=ndc+1 to mdc
  @ pl,pcol() say nkm2[k] picture "@Z 999,999"
next
@ pl,lmargin+StTic[4] say "||"
return

procedure PrtHdrTop
* outputs top line common to all tables, including setup string, date,
* time and pageno.  Increments page number before printing, does an eject
* if not page zero
if pageno>0
  eject
endif
pageno++
@ 0,0 say Pr_SetupS
@ 1,lmargin+1 say "TSIA : Transect Sample Inventory Analysis output produced on "
dt=date()
@ 1,pcol() say cdow(dt)+", "+str(day(dt),2)+" "+cmonth(dt)+str(year(dt),5)
@ 1,pcol() say " at "+left(time(),5)
@ 1,lmargin+MaxWidth-8 say "page "+str(pageno,3)
return

procedure PrtTrInfo
* prints transect heading info common to stand and volume tables
bl=left(right(TransectID,4),2)
tr=right(TransectID,2)
@ tmargin,lmargin+1 say "Transect Summary for Block "+bl+" Transect "+tr
invz=alltrim(inv->INVENTORY)
@ tmargin,lmargin+(MaxWidth-len(invz)-12) say "Inventory : "+invz
@ tmargin+1,lmargin+1 say "Length :"+str(TrLen,6)+ " m."
@ tmargin+1,pcol()+5 say "Width (1y/2y) : "+str(inv->WIDTH_1Y,2)+"/" ;
                       + str(inv->WIDTH_2Y,2)+ " m."
@ tmargin+1,lmargin+(MaxWidth-21) say "No. record units "+str(nru,4)
return

procedure PrtStInfo
* prints stratum heading info common to stand and volume tables
local trid
if fstratum=1
  stid="Block "+right(StratumID,2)
else
  stid=StratumID
endif
@ tmargin,lmargin+1 say "Stratum summary : "+stid
invz=alltrim(inv->INVENTORY)
@ tmargin,lmargin+(MaxWidth-len(invz)-12) say "Inventory : "+invz
@ tmargin+1,lmargin+1 say "Total transect length :"+str(trls,6)+ " m."
@ tmargin+1,pcol()+5 say "No. of transects : "+str(ntrs,3)
```

```
@ tmargin+1,lmargin+(MaxWidth-25) say "Stratum area :";
                                    +transform(ast,"999,999")+" km²"
return

procedure PrtFoInfo
* prints forest-level heading info common to stand and volume tables
local trid
@ tmargin,lmargin+1 say "Forest summary, weighted by stratum areas"
invz=alltrim(inv->INVENTORY)
@ tmargin,lmargin+(MaxWidth-len(invz)-12) say "Inventory : "+invz
@ tmargin+1,lmargin+1 say "Total transect length :"+str(trlf,6)+ " m."
@ tmargin+1,pcol()+5 say "No. of transects : "+str(ntrf,3)
@ tmargin+1,pcol()+5 say "No. of strata : "+str(nfs,3)
@ tmargin+1,lmargin+(MaxWidth-21) say "Total area :"+str(forestwt,5)+" km²"
return

procedure PrtHdrSt
* prints column headings for a stand table
* heading lines
local pr,nkm,cum,sph
@ prow()+1,0 say " "
* tic positions
tic1=1
tic2=27
tic3=tic2+ndc*7+2
tic4=tic3+ncdc*7+2
public StTic:={tic1,tic2,tic3,tic4}
TicLine(StTic,{"╔","╤","╗"},"=")
pr= prow()+1
@ pr,lmargin+tic1 say "╟"
@ pr,lmargin+tic2 say "┤"
PrCentre(pr,tic2,tic3,"Trees per km² by cm diameter classes")
@ pr,lmargin+tic3 say "├"
PrCentre(pr,tic3,tic4,if(ncdc>=3,"Cumulative N/km²","N/km²"))
@ pr,lmargin+tic4 say "╢"
pr++
@ pr,lmargin+tic1 say "╟"
PrCentre(pr,tic1,tic2,"Species name")
@ pr,lmargin+tic2 say "┤"
for k=1 to ndc-1
  dhdr=ltrim(str(dc[k],3))+"-"+ltrim(str(dc[k+1],3))
  dhdr=space(7-len(dhdr))+dhdr
  @ pr,pcol() say dhdr
next
dhdr="≥"+ltrim(str(dc[ndc],3))
dhdr=space(7-len(dhdr))+dhdr
@ pr,pcol() say dhdr
@ pr,lmargin+tic3 say "├"
for k=1 to ncdc
  dhdr="≥"+ltrim(str(cdc[k],3))
  dhdr=space(7-len(dhdr))+dhdr
  @ pr,pcol() say dhdr
```

```
next
@ pr,lmargin+tic4 say "╢"
TicLine(StTic,{"╟","┼","╢"},"-")
return

procedure PrCentre(pr,a,b,title)
* prints a title centred between columns a and b on row pr
@ pr,lmargin+a+(b-a-len(title))/2 say title
return

procedure TicLine(Tics,Ch,Spc)
* draws a line with tics across the page for column intersections
* Tics is an array of column positions
* Ch is an array of 3 characters to be used: first tic, middle ones, last tic
* Spc is the spacer character to be used between tics
local k,ntic,pr
ntic=1
pr=prow()+1
col=1
do while ntic<=len(tics)
  if col=tics[ntic]
    do case
    case ntic=1
      c=Ch[1]
    case ntic=len(tics)
      c=Ch[3]
    otherwise
      c=Ch[2]
    endcase
    @ pr,lmargin+col say c
    ntic++
  else
    @ pr,lmargin+col say Spc
  endif
  col++
enddo
return

procedure PrtHdrVol
* prints column headings for table of volumes
local k,kw,d
@ prow()+2,0 say " "
kw=29
* build vtic array
public vTic:={1,27}
k=27
for d=1 to ncdc
  k+=kw
  aadd(vtic,k)
next d
* top of frame
TicLine(vtic,{"╒","╤","╕"},"=")
```

```
Vsubhdr("","Trees ≥# cm diameter",cdc)
Vsubhdr("","Bole    CV of     RME",{})
Vsubhdr("Species name"," volume    mean   (P=.95)",{})
Vsubhdr("","  m3/km²     %      m3/km²",{})
TicLine(vTic,{"╟","┼","╢"},"-")
return

procedure VsubHdr(SideText,ColText,Diams)
* prints column headings for PrtHdrVol routine
local pr,d,j,dtext
pr= prow()+1
@ pr,lmargin+vtic[1] say "║"
if len(SideText)>0
  PrCentre(pr,vtic[1],vtic[2],SideText)
endif
@ pr,lmargin+vtic[2] say "|"
dtext=ColText
for d=1 to ncdc
  if len(Diams)>0
    j=at("#",ColText)
    dText=left(Coltext,j-1)+ltrim(str(diams[d],3))+substr(Coltext,j+1)
  endif
  PrCentre(pr,vtic[d+1],vtic[d+2],dText)
  if d=ncdc
    @ pr,lmargin+vtic[d+2] say "║"
  else
    @ pr,lmargin+vtic[d+2] say "|"
  endif
next
return

Procedure PrtVol(va,vse,ndf,hdrfn)
* prints main body of table of volumes by cum. dia. classes..
* 'va' is the array of volumes, converted to means per km².
* 'vse' is the array of volume standard errors, in m3/km².
* 'ndf' is the degrees of freedom associated with the standard error.
* 'hdrfn' is a code block executed at the top of each new page.
* if 'vse' is not supplied or 'ndf' is zero, statistical columns are
* left blank.
local ng,sp,lc
lc=1
for ng=1 to nspg
  * test if there are species in this group
  if present(va[ng][1])
    CondEop(vTic,5,hdrfn,@lc)
    nsp=len(va[ng])
    * print a blank line before group
    TicLine(vTic,{"║","|","║"}," ")
    lc++
    * print line by line
    for sp=2 to nsp
      if present(va[ng][sp])
```

```
        lc++
        CondEop(vTic,1,hdrfn,@lc)
        PrtLineVol(spid[ng][sp],va[ng][sp],vse[ng][sp],ndf)
      endif
    next
    * print group summary
    TicLine(VTic,{"╟","┼","╢"},"-")
    lc++
    CondEop(vTic,2,hdrfn,@lc)
    PrtLineVol(spid[ng][1],va[ng][1],vse[ng][1],ndf)
    TicLine(vTic,{"╟","┼","╢"},"-")
    lc+=2
  endif
next
* print unclassified and totals groups
CondEop(vTic,4,hdrfn,@lc)
PrtLineVol(spid[uncl],va[uncl],vse[uncl],ndf)
TicLine(vTic,{"╠","╪","╣"},"=")
PrtLineVol(spid[tot],va[tot],vse[tot],ndf)
TicLine(vTic,{"╚","╧","╝"},"=")
return

procedure PrtLineVol(spn,vm,vse,ndf)
* prints a single line in the table of volumes by cum. diam.
local pl,k
pl=prow()+1
@ pl,lmargin+vTic[1] say "║"
@ pl,pcol() say spn
@ pl,lmargin+vTic[2] say "│"
for k=1 to ncdc
  @ pl,pcol() say vm[k] picture "@Z  99,999.9"
  if ndf>0
    se=sqrt(vse[k])
    cv=se/vm[k]*100
    rme=vm[k]-se*tp95(ndf)
    @ pl,pcol() say cv picture "@Z  99,999.9"
    rme=if(rme>0,rme,0)
    @ pl,pcol() say rme picture "@Z  99,999.9"
  endif
  * move print position to next column separator
  if k<ncdc
    @ pl,lmargin+vTic[k+2] say "│"
  else
    @ pl,lmargin+vTic[k+2] say "║"
  endif
next
return

*
```

```
*7********************* VOLUME EQUATION ROUTINES ************************

procedure InitVoleqn
* initializes the array VolEqnC with coefficients for each species code.
* sets corresponding entry lines in 'sphashv'
local neqn,j,i
filecheck("voleqn.dbf")
use voleqn new
neqn=lastrec()
public VolEqnC:=array(2)
VolEqnC[1]:=array(neqn)
VolEqnC[2]:=array(neqn)
for j=1 to neqn
  VolEqnC[1][j]:=A
  VolEqnC[2][j]:=B
  if SPP=0
    * species code zero is for those with no separate equation.
    for i=1 to len(sphashv)
      if sphashv[i]=0
        sphashv[i]=j
      endif
    next
  else
    sphashv[SPP]=j
  endif
  skip
next
* file no longer required - close it
use
return

function voleqn(dbh,spp)
* volume equation function
local j
j=sphashv[spp]
v=exp(VolEqnC[1][j]+VolEqnC[2][j]*log(dbh))
return v

*
```

```
*8********************* N-BRANCH ARRAY OPERATIONS ************************

procedure zfill(a)
* Fills an n-branched array with zeroes or null strings.
* Works by recursive calls at each sub-array until a scalar element is
* met. 'a' is the array to initialize.
local i,eltype,la
la=len(a)
for i=1 to la
  eltype=valtype(a[i])
  do case
  case eltype="A"
    zfill(a[i])
  case eltype="N"
    a[i]=0
  case eltype="C"
    a[i]=""
  endcase
next
return

procedure AddArray(a,b,c)
* Adds n-branched array b to a, executing code block c for each element.
local i,atype,btype,la
la=len(a)
for i=1 to la
  atype=valtype(a[i])
  btype=valtype(b[i])
  do case
  case atype<>btype
    * program bugs may result in non-conformable arrays
    @ 24,0 say "*** Error : Arrays not conformable for addition"
    altd()
    quit
  case atype="A"
    * this element is a sub-array : call AddArray recursively
    AddArray(a[i],b[i],c)
  case atype="N"
    * add element of B to A performing function C
    a[i]+=eval(c,b[i])
  otherwise
    * could come here if there are program bugs
    @ 24,0 say "*** Error : Element of array not numeric in AddArray"
  endcase
next
return

procedure FnArray(a,fn)
* Scans n-branched array 'a', executing code block 'fn' for each element
* and replacing a[i] with result.
local i,atype,la
```

```
la=len(a)
for i=1 to la
  atype=valtype(a[i])
  do case
  case atype="A"
    * this element is a sub-array : call FnArray recursively
    FnArray(a[i],fn)
  case atype="N"
    * perform 'fn' on a[i]
    a[i]:=eval(fn,a[i])
  otherwise
    * could come here if there are program bugs
    @ 24,0 say "*** Error : Element in FnArray of type "+atype
  endcase
next
return


*9****************** MISCELLANEOUS UTILITY ROUTINES **********************

function pix(rn,bn,tn,pn)
* calculates plot index function from reserve, block, transect & plot no's
return (rn*10000000+bn*100000+tn*1000+pn)

procedure filecheck(fln)
* checks for availability of required file 'fln' and aborts program
* with a message if not found
if .not. file(fln)
  * not found - abort program
  @ 24,0 clear
  @ 24,0 say "File "+upper(fln)+" needed but not in current directory."
  errorlevel(1)
  quit
endif
return

procedure esc_key
* checks if abort required following esc key
@ 24,0 clear
abort=.F.
@ 24,0 say "ESC : Cancel program ? " get abort picture [Y]
read
if abort
  quit
endif
@ 24,0 clear
return
```

```
function tp95(ndf)
* returns value of Student's T from lookup tables at P=0.95
* with 'ndf' degrees of freedom.  Returns NIL if 'ndf'=0.
local t
df_1_19={12.71,4.30,3.18,2.78,2.57,2.45,2.36,2.31,2.26,2.23,2.20,2.18, ;
        2.16,2.14,2.13,2.12,2.11,2.10,2.09}
df_20_50={2.06,2.03,2.02}
df_50_100=2.00
df_inf=1.96
do case
case ndf<=0
  t=NIL
case ndf>=1 .and. ndf<=19
  t=df_1_19[ndf]
case ndf>=20 .and. ndf<50
  t=df_20_50[int(ndf/10)-1]
case ndf>=50 .and. ndf<100
  t=df_50_100
otherwise
  t=df_inf
endcase
return t
```

Appendix E : Stand tables for inventories

The stand tables on the following pages were produced by program TSIA. Each set of tables is the forest summary for one inventory, according to the list below:

It should be noted that pagination at the top right of these computer outputs reflects the original reports from which they were extracted. Correct pagination is given at the bottom right of each page.

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar	87	21	11	4	3	2	2	1		2	133	25	10
Mahogany	72	13	7	4	2	1	1	1	0	0	102	17	6
Primary species	160	35	18	8	5	4	3	1	0	2	236	41	15
Cotton		7	1	2		1	1	1		2	14	7	4
Fig		25	7	3	1	1	0	0		1	37	13	3
Mapola	3	57	48	33	36	32	26	14	8	8	264	204	123
Moho		283	40	4	1	0	0				328	46	2
Polak (Balsa)							0				0	0	0
Soft light wood	3	371	96	42	38	33	28	15	8	10	643	270	132
Candlewood		3					0				3	0	0
Hogplum		115	42	29	20	7	3	1			215	101	30
Kaway		18	10	9	5	4	2	1	1	1	52	34	15
Negrito		7	7	3	1	0					17	10	1
Quamwood		4	7	1	1	1	0				13	9	2
Red Gombolimbo		70	26	10	2	1					110	39	3
Salmwood		76	16	3	1	0					95	19	1
White Tamarind		1									1		
Medium soft wood		293	107	55	29	13	5	2	1	1	507	214	52
Banak										0	0	0	0
Cramantree		14	7	1	1	1	0				24	9	2
Red Wood		56	22	8	2	1					89	33	3
Timbersweet (Laurel)		42	23	4	1	1	1				72	30	2
Wild Pear (Aguacatillo)		14	8	2	1	0	0				25	11	1
Medium hard dark wood		126	60	14	5	2	2			0	209	83	9
Female Bullhoof		1	4	1	0						6	5	0
San Juan Macho				1	1	0	0	1			3	3	2
White Gombolimbo	1	99	46	11	4						160	60	4
Yemeri				1	0						1	1	0
Medium hard light wood	1	100	49	13	5	0	0	1			170	69	6

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Barba Jolote		8	5	4	5	4	4	2	2	2	36	28	19
Bastard Mahogany		34	7	2	2	1	1	1	1		46	12	4
Bastard Redwood		7		1							8	1	
Cortez		16	7	4	3	1	1				30	15	5
Fiddlewood		40	35	29	26	19	12	7	3	2	173	133	69
John Crow Wood		8	5	3	3	2	1	0		0	21	13	5
Oak		66	34	10	2	1					113	47	3
Santa Maria		31	8	3	3	1	1				47	16	4
Sillion		89	57	15	5	2	0	0			169	80	8
Waika Chewstick		1		0		0	1				2	1	1
Wild Grape		23	16	8	4	1	1	1	0		53	30	7
Wild Mammee			1	0		0					2	2	0
Wild Orange		5	1		0						7	2	0
Hard dark wood		327	176	80	52	31	20	11	6	4	707	380	124
Bitterwood		13	4	3	2	1	1			0	24	11	4
Cherry		186	25	3	1						215	28	1
Cojotone		68	43	5	1	0					117	49	1
Cornstick (Aceituna)		8	8	1							17	9	
Glassywood		86	43	9	2	1					141	55	3
Male Bullhoof		103	56	18	7	1	0				185	83	9
Mayflower		12	3	4	1			0			19	7	1
Nargusta		51	33	25	20	22	21	18	11	16	215	165	107
Red Breadnut		12	5	2	1	1	0				21	9	2
Toadskin		72	39	10	4	1	1				127	55	6
White Breadnut		296	275	118	54	19	8	3	0	0	772	477	84
Wild Guava		81	31	7	2	1	0	1	0		122	42	4
Hard light wood		986	564	204	94	45	31	21	11	17	1,974	989	220
Allspice	1,064	592	177	7	0						1,840	184	0
Axemaster		39	7	0							46	7	
Balsam		27	5	5	2	1					39	12	2
Bastard Rosewood		22	22	17	8	1	1	1			71	49	10
Billy Webb		20	14	2	0						36	17	0
Black Cabbage Bark		33	18	11	4	1	1	0			67	35	6
Black Poisonwood		20	12	4	1						35	16	1
Black maya			3	2	0						4	4	0
Carbon		3			0	0					3	1	1
Faisan		48	31	14	8	1	1	1			103	55	10
Granadilo		44	18	5	2	1	0				70	26	3
Ironwood	1	79	57	29	12	8	3	1	0		191	110	23

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Mamey ciruela		246	59	8	2	0					314	68	2
Monkey Apple				0							0	0	
Mylady		79	40	8	1	1					130	50	2
Palo Mulatto		96	34	7	2	0					140	43	2
Pigeon plum		18	7	3	0	0		0			28	10	1
Rosewood		4	3	1			0				8	4	0
Sapodilla	3	246	158	104	59	41	18	11	7	4	650	401	140
White Cabbage Bark		7		1		0					8	1	0
White Poisonwood		73	25	2	1						101	28	1
Very hard dark wood	1,068	1,697	689	229	100	55	24	14	7	4	3,886	1,122	204
Unclassified species	3	2,333	704	170	70	28	10	4	3	4	3,330	995	120
Total (all species)	1,234	6,268	2,463	815	399	212	123	70	36	42	11,663	4,161	882

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	55.8	19.7	31.6	43.8	24.8	19.9	33.6	30.2	11.3
Mahogany	46.5	22.5	23.5	33.4	30.0	11.4	22.8	39.8	2.8
Primary species	102.3	17.6	62.8	77.2	23.6	37.2	56.3	30.0	19.2
Cotton	42.0	28.3	15.9	38.4	31.3	11.9	34.2	33.2	9.2
Fig	26.4	22.2	13.5	19.0	25.4	8.4	10.1	32.9	2.8
Mapola	453.9	8.2	371.6	440.6	8.4	358.7	385.9	8.4	314.5
Moho	120.9	14.1	83.3	33.4	25.7	14.5	3.6	42.5	0.2
Polak (Balsa)	0.9	100.0		0.9	100.0		0.9	100.0	
Soft light wood	644.1	7.3	540.6	532.3	7.1	448.6	434.7	7.2	365.7
Candlewood	1.7	71.7		1.0	100.0		1.0	100.0	
Hogplum	134.0	13.9	92.9	120.6	14.8	81.3	76.6	18.6	45.2
Kaway	100.8	14.4	68.9	79.5	17.7	48.5	45.9	21.0	24.7
Negrito	11.9	31.3	3.7	9.8	36.2	2.0	2.6	64.3	
Quamwood	13.9	42.6	0.9	12.9	44.0	0.4	6.1	89.7	
Red Gombolimbo	56.5	20.5	31.1	35.1	19.6	20.0	5.8	22.8	2.9
Salmwood	36.8	12.2	26.9	15.3	15.9	10.0	1.7	60.3	
White Tamarind	0.3	100.0							
Medium soft wood	356.0	6.4	306.1	274.3	8.0	225.9	139.6	12.6	100.8
Banak	2.6	100.0		2.6	100.0		2.6	100.0	
Cramantree	20.8	30.8	6.7	13.7	40.1	1.6	6.9	54.1	
Red Wood	55.7	20.9	30.1	32.7	27.3	13.1	5.5	40.3	0.6
Timbersweet (Laurel)	42.7	18.6	25.2	28.4	23.4	13.8	6.9	26.9	2.8
Wild Pear (Aguacatillo)	15.3	28.5	5.7	10.7	34.4	2.6	3.3	47.4	
Medium hard dark wood	137.0	12.0	100.9	88.1	15.4	58.2	25.1	29.1	9.0
Female Bullhoof	4.1	55.4		3.8	55.8		0.5	100.0	
San Juan Macho	7.6	100.0		7.6	100.0		6.3	100.0	
White Gombolimbo	82.2	10.2	63.8	50.3	13.6	35.2	7.2	22.0	3.7
Yemeri	1.3	50.8		1.3	50.8		0.4	100.0	
Medium hard light wood	95.4	14.0	65.9	63.1	18.6	37.3	14.5	45.0	0.2

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Barba Jolote	84.9	12.6	61.5	83.4	12.6	60.3	76.1	13.9	52.8
Bastard Mahogany	30.3	28.0	11.6	19.2	30.4	6.4	12.8	39.4	1.7
Bastard Redwood	3.4	25.5	1.5	1.2	3.6	1.1			
Cortez	26.0	16.7	16.5	20.9	21.0	11.2	11.3	19.2	6.5
Fiddlewood	309.1	7.6	257.1	294.1	7.1	247.9	228.8	7.5	191.1
John Crow Wood	24.6	21.2	13.1	21.7	20.2	12.0	14.8	32.3	4.3
Oak	62.6	20.8	33.9	40.4	14.4	27.6	6.0	9.0	4.8
Santa Maria	38.0	17.1	23.7	26.1	21.0	14.0	14.2	26.9	5.8
Sillion	128.9	12.2	94.3	96.6	12.2	70.7	25.2	19.8	14.2
Waika Chewstick	4.1	45.9		4.0	46.3		3.6	50.1	
Wild Grape	46.1	31.0	14.6	38.3	33.2	10.3	17.0	41.8	1.4
Wild Mammee	1.8	49.6		1.8	49.6		0.6	100.0	
Wild Orange	2.9	58.3		1.2	100.0		0.5	100.0	
Hard dark wood	762.6	3.3	707.4	648.9	4.1	590.5	411.0	5.4	361.7
Bitterwood	24.8	24.8	11.3	20.5	31.4	6.3	13.3	37.7	2.3
Cherry	75.1	13.7	52.5	20.9	21.7	10.9	1.7	70.7	
Cojotone	61.4	8.7	49.7	38.8	11.2	29.2	2.1	51.0	
Cornstick (Aceituna)	8.4	30.2	2.8	5.9	30.2	2.0			
Glassywood	74.3	15.3	49.3	45.0	14.2	31.0	5.4	25.2	2.4
Male Bullhoof	132.8	14.3	91.1	86.4	15.9	56.2	17.3	36.1	3.6
Mayflower	13.9	24.4	6.5	9.3	24.4	4.3	2.6	63.8	
Nargusta	608.0	9.4	482.8	589.1	9.4	466.8	529.5	9.8	415.2
Red Breadnut	13.4	39.3	1.8	9.8	49.7		3.9	90.0	
Toadskin	74.6	20.5	41.0	51.5	19.3	29.6	12.8	33.3	3.4
White Breadnut	643.9	18.7	378.6	571.2	21.0	307.6	288.4	36.2	58.7
Wild Guava	65.5	22.3	33.5	39.4	25.1	17.6	10.5	47.3	
Hard light wood	1,796.3	5.9	1,564.2	1,488.0	7.0	1,257.7	887.6	10.4	683.5
Allspice	425.6	8.2	349.0	123.4	11.3	92.7	0.5	100.0	
Axemaster	17.0	37.5	3.0	4.5	54.2				
Balsam	22.2	16.5	14.1	13.1	18.8	7.6	4.1	38.7	0.6
Bastard Rosewood	67.3	18.3	40.2	59.0	18.9	34.5	21.0	22.1	10.8
Billy Webb	18.8	64.0		12.8	49.4		0.5	100.0	
Black Cabbage Bark	51.6	14.4	35.3	40.4	16.5	25.8	14.9	20.1	8.3
Black Poisonwood	20.3	33.8	5.2	14.0	37.2	2.5	1.1	100.0	
Black maya	4.2	37.8	0.7	4.2	37.8	0.7	0.6	100.0	
Carbon	1.8	86.1		1.2	100.0		1.2	100.0	
Faisan	71.7	21.4	37.9	52.1	21.4	27.6	16.9	24.1	8.0
Granadilo	38.7	19.8	21.8	24.6	25.2	11.0	5.9	61.7	
Ironwood	196.0	11.4	146.6	163.5	10.7	124.9	72.2	12.0	53.1

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Main Series 1969
Total transect length :192000 m. No. of transects : 24 No. of strata : 12 Total area : 768 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Mamey ciruela	133.0	11.4	99.6	52.8	14.1	36.4	3.5	34.1	0.9
Monkey Apple	0.3	100.0		0.3	100.0				
Mylady	117.4	18.2	70.5	66.7	20.5	36.7	5.5	36.9	1.0
Palo Mulatto	68.2	13.4	48.1	37.2	13.1	26.5	4.9	25.6	2.1
Pigeon plum	17.4	18.8	10.2	11.0	25.5	4.8	2.5	61.1	
Rosewood	5.1	50.4		4.0	38.0	0.7	0.9	100.0	
Sapodilla	787.7	7.4	660.1	704.8	8.2	577.6	458.2	10.2	355.6
White Cabbage Bark	3.7	44.0	0.1	1.6	71.7		0.6	100.0	
White Poisonwood	43.6	24.6	20.0	21.3	39.5	2.8	1.3	57.9	
Very hard dark wood	2,111.6	4.2	1,916.2	1,412.5	4.7	1,265.7	616.6	7.1	519.8
Unclassified species	1,714.7	5.9	1,493.9	1,005.4	5.8	876.7	324.0	6.4	278.6
Total (all species)	7,720.0	3.3	7,159.7	5,589.7	3.3	5,182.5	2,909.3	4.0	2,655.7

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar	48	25	7	6	3	5	3	3	2	5	106	33	21
Mahogany	64	16	11	11	8	3	1	3	2	1	120	39	18
Primary species	112	41	18	16	11	8	4	6	4	6	226	73	38
Cotton		6	3	2	6	2	2	1	1	4	28	21	16
Fig		6								1	7	1	1
Mapola		19	9	15	12	14	16	13	6	3	107	88	64
Moho		1,785	510	44	11	2					2,352	568	13
Polak (Balsa)				1							1	1	
Soft light wood		1,816	523	63	29	18	18	14	7	8	2,495	679	94
Hogplum		172	88	71	46	22	11	3	1		414	242	83
Kaway		9	6	7	6	3	2	1		1	34	25	12
Negrito		47	22	7	2				1		78	31	3
Quamwood		119	22	4	1	1	2				149	30	4
Red Gombolimbo		19	31	7	3	1					61	42	4
Salmwood		31	13	1	1						46	14	1
Medium soft wood		397	181	98	58	27	14	4	2	1	782	385	106
Banak				1	1	2	1				4	4	3
Cramantree		6	3	3	1	1	1				14	8	2
Red Wood		22		4	1	1					28	6	2
Timbersweet (Laurel)		97	9	5	4		1	1			116	19	5
Wild Pear (Aguacatillo)		6									6		
Medium hard dark wood		131	13	12	6	3	2	1			168	36	12
White Gombolimbo		56	6	2	1						66	9	1
Yemeri		9	6								16	6	
Medium hard light wood		66	13	2	1						81	16	1
Barba Jolote		3	9	3	4	3	4	1	1	1	28	25	13
Bastard Mahogany		16	3	1	1	1		1			22	6	3
Cortez		25	3	3	1	3	1	1			36	11	6
Fiddlewood		16	22	11	18	9	8	5	1	3	91	75	43
John Crow Wood			3	2	1			1			7	7	2

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees per km² by cm diameter classes 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	Cumulative N/km² ≥10	≥30	≥50
(.../...)													
Mammee		3		1		1		1	1	1	6	3	3
Oak		6	16	3	1	1					26	20	1
Santa Maria		6	6	3	1	2		1	1		19	13	4
Sillion		31	19	7	3						60	29	3
Waika Chewstick					1						1	1	1
Wild Grape		38	44	8	3	1	1	1	1		96	59	7
Wild Mammee		3				1					4	1	1
Hard dark wood		147	125	40	33	20	14	10	4	4	397	250	84
Bitterwood		16	31	4	5	2	1	1			61	45	9
Cherry		41		3	1						44	3	1
Cojotone		156	47	4	3	1					211	54	3
Glassywood		16	3								19	3	
Male Bullhoof		6	3		1		1				11	4	1
Mayflower		3	13	3	3	1					23	19	4
Nargusta		44	25	29	23	19	14	12	8	9	182	138	84
Red Breadnut		6	25	7	4	1	1				44	38	6
Toadskin		34	16	7	3	1					60	26	3
White Breadnut		28	13	16	6	1	3		1		67	39	10
Wild Guava		19	9	1	1						30	11	1
Hard light wood		369	184	74	48	25	19	13	9	9	751	382	123
Allspice	131	88	31	5	1						256	37	1
Axemaster		9	3	1							14	4	
Balsam		3			1						4	1	1
Bastard Rosewood		3	3	4	1		1	1			12	9	2
Billy Webb		13	22	4	1						39	26	1
Black Cabbage Bark		13	9	3	4	3					31	19	6
Black Poisonwood				1	1						2	2	1
Black maya		3	6	2		1					12	9	1
Carbon		19	19	7	3				1		48	29	4
Faisan		3		1	2	1		1			8	4	3
Granadilo		3	6	2	2						13	10	2
Ironwood		128	72	36	23	8	6		1		274	146	38
Mamey ciruela		116	44	5	4						168	53	4
Monkey Apple		3	3	2	1	1	2				12	9	4
Mylady		81	16	6	1	1					105	24	2
Palo Mulatto		44	6	5	1		1				57	13	2
Pigeon plum		9	6	1	1	1	1				20	11	3
Sapodilla		38	38	30	21	11	8	4	4	1	153	116	48
White Poisonwood		6									6		
Wild Locust (Beefwood)		3	3							1	7	4	1

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...) Very hard dark wood	131	585	288	116	64	26	19	5	5	2	1,241	524	121
Unclassified species		1,236	391	109	53	34	8	7	6	6	1,850	614	114
Total (all species)	243	4,789	1,736	530	305	160	98	60	36	34	7,991	2,959	693

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	278.0	59.5		268.0	61.5		258.2	63.6	
Mahogany	107.3	28.7	34.6	94.3	31.9	23.3	70.8	37.3	8.4
Primary species	385.3	49.4		362.3	52.2		329.1	56.6	
Cotton	127.4	25.8	49.8	124.5	27.1	45.0	118.0	30.1	34.1
Fig	20.6	96.1		18.7	100.0		18.7	100.0	
Mapola	238.4	20.6	122.3	234.6	20.9	118.6	215.4	20.6	110.7
Moho	987.6	14.0	662.0	403.8	18.3	229.2	25.6	26.8	9.4
Polak (Balsa)	2.3	99.5		2.3	99.5				
Soft light wood	1,376.3	8.5	1,101.7	783.8	9.6	607.2	377.6	18.3	214.5
Hogplum	370.6	5.3	324.6	347.3	6.2	296.4	244.5	6.5	207.0
Kaway	71.1	41.4	1.6	59.0	41.3	1.4	34.6	32.3	8.2
Negrito	46.4	50.3		30.8	51.0		7.6	71.8	
Quamwood	66.6	21.5	32.8	36.5	34.2	7.0	17.6	52.5	
Red Gombolimbo	45.8	24.6	19.2	40.2	26.3	15.2	7.9	43.1	
Salmwood	22.8	39.5	1.6	12.5	45.4		1.3	100.0	
Medium soft wood	623.2	7.8	508.8	526.3	9.2	411.9	313.4	7.7	256.2
Banak	15.0	66.5		15.0	66.5		13.3	73.9	
Cramantree	16.4	69.9		12.8	65.8		6.2	74.8	
Red Wood	18.1	35.3	3.0	8.2	21.8	4.0	3.6	38.2	0.4
Timbersweet (Laurel)	57.0	25.3	23.0	24.4	33.6	5.0	12.2	57.5	
Wild Pear (Aguacatillo)	2.1	70.8							
Medium hard dark wood	108.5	14.5	71.4	60.4	18.2	34.5	35.3	19.7	18.9
White Gombolimbo	28.9	31.4	7.5	9.1	55.9		2.2	71.1	
Yemeri	7.5	66.4		4.8	100.5				
Medium hard light wood	36.5	26.0	14.1	13.9	41.2	0.4	2.2	71.1	
Barba Jolote	49.5	15.7	31.2	48.9	16.3	30.1	41.5	19.8	22.1
Bastard Mahogany	16.1	33.8	3.3	11.3	39.4	0.8	8.1	40.9	0.3
Cortez	31.5	31.2	8.3	22.5	27.3	8.0	16.7	25.1	6.8
Fiddlewood	180.3	22.1	86.3	174.5	22.5	81.7	143.3	27.6	49.8
John Crow Wood	11.3	49.6		11.3	49.6		6.8	71.8	

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Mammee	18.6	91.4		17.7	96.0		17.0	100.0	
Oak	20.3	75.8		18.0	73.1		3.0	74.3	
Santa Maria	29.8	25.4	11.9	27.2	28.4	9.0	17.3	53.7	
Sillion	48.8	28.3	16.2	35.5	25.9	13.8	7.6	35.7	1.2
Waika Chewstick	1.3	99.5		1.3	99.5		1.3	99.5	
Wild Grape	74.3	22.5	34.9	61.4	22.4	28.9	21.4	26.1	8.3
Wild Mammee	2.4	74.2		1.6	100.5		1.6	100.5	
Hard dark wood	484.2	13.4	331.3	431.2	13.7	292.2	285.6	17.4	168.2
Bitterwood	64.9	27.3	23.1	59.1	27.1	21.3	29.5	32.1	7.2
Cherry	15.9	22.9	7.3	4.0	63.1		1.1	100.0	
Cojotone	93.7	9.0	73.8	44.0	12.1	31.4	6.5	54.2	
Glassywood	7.1	28.8	2.3	1.9	100.0				
Male Bullhoof	8.1	37.3	1.0	5.5	60.1		3.2	74.2	
Mayflower	20.0	22.6	9.4	18.7	23.1	8.5	8.1	37.5	0.9
Nargusta	614.1	31.7	154.8	596.4	32.9	133.6	538.8	36.1	79.7
Red Breadnut	43.3	88.1		40.7	89.7		14.7	100.0	
Toadskin	35.3	23.0	16.1	24.8	21.5	12.2	6.8	43.7	
White Breadnut	60.2	29.8	17.9	52.9	31.1	14.1	28.1	35.8	4.4
Wild Guava	14.4	41.0	0.5	8.9	74.6		1.1	100.0	
Hard light wood	977.2	19.8	520.8	857.1	22.8	395.3	637.9	30.2	182.9
Allspice	70.6	30.5	19.8	29.1	29.5	8.9	1.0	100.5	
Axemaster	5.3	75.7		3.0	70.9				
Balsam	2.5	72.2		1.0	100.0		1.0	100.0	
Bastard Rosewood	14.5	53.4		13.4	57.2		6.4	70.9	
Billy Webb	24.4	44.3		20.0	49.8		1.1	100.0	
Black Cabbage Bark	30.6	30.3	8.7	26.3	29.2	8.2	14.1	30.6	3.9
Black Poisonwood	2.7	80.4		2.7	80.4		1.4	100.0	
Black maya	9.6	63.6		8.7	67.9		2.0	100.0	
Carbon	38.7	38.8	3.3	32.2	42.2	0.1	9.5	68.4	
Faisan	8.4	79.4		7.3	77.2		6.1	74.3	
Granadilo	11.6	40.6	0.5	10.7	47.2		3.6	57.9	
Ironwood	278.2	17.5	163.5	227.9	18.4	128.8	118.4	31.3	30.9
Mamey ciruela	80.6	14.0	53.9	41.4	21.4	20.5	7.0	33.3	1.5
Monkey Apple	17.0	39.2	1.3	16.2	40.9	0.5	11.5	65.9	
Mylady	88.3	17.2	52.4	35.9	23.4	16.1	6.1	58.9	
Palo Mulatto	32.6	20.1	17.2	16.0	23.3	7.2	6.2	17.7	3.6
Pigeon plum	15.6	47.5		13.2	57.7		8.5	82.2	
Sapodilla	235.6	9.9	180.5	221.8	10.4	167.2	157.8	12.8	110.2
White Poisonwood	2.0	26.8	0.8						
Wild Locust (Beefwood)	10.7	91.1		9.7	100.0		6.8	100.0	

(.../...)

Forest summary, weighted by stratum areas Inventory : Chiquibul Mountain Series 1971
Total transect length : 79900 m. No. of transects : 16 No. of strata : 8 Total area : 200 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...) Very hard dark wood	979.5	7.0	816.6	736.6	8.9	582.4	368.5	14.7	240.5
Unclassified species	1,135.8	14.5	747.4	733.2	15.3	467.9	318.1	20.0	167.7
Total (all species)	6,106.5	7.8	4,982.9	4,504.9	11.4	3,294.6	2,667.7	17.5	1,568.1

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar	4	5	1	0	0	1	1	1	0	1	14	5	4
Mahogany	48	19	6	1	1		2	0	0	1	78	12	4
Primary species	51	24	8	2	1	1	2	1	1	2	92	17	8
Cotton	13	5			1	1	1		1	8	28	10	10
Fig	73	38	40	22	19	18	13	13	8	15	260	148	86
Mapola	40	46	31	19	13	16	17	9	6	11	208	122	72
Moho	875	308	79	24	8		2	1			1,296	113	10
Polak (Balsa)	18	40	43	16	7	2	1				126	68	9
Soft light wood	1,019	437	194	81	48	36	32	22	15	34	1,918	462	187
Candlewood	120	105	33	31	24	24	11	12	9	3	372	147	83
Hogplum	184	103	55	22	22	12	10	4	1	1	412	125	48
Kaway	43	18	10	13	12	10	7	5	1	3	121	61	38
Negrito	52	8	5	1							66	6	
Quamwood	45	18	13	12	8	8	12	3	2	3	122	59	34
Red Gombolimbo	45	46	20	10	3	3	1		1		128	37	7
Salmwood	26	36	15	7	2			1			86	24	2
Medium soft wood	514	333	152	95	71	56	40	24	13	9	1,306	459	212
Banak	8	8	10	2	4	2	1	1	1	1	36	20	8
Caulote		3									3		
Cramantree	109	86	23	15	12	6	3	4	2	3	262	67	29
Red Wood	141	95	48	28	17	15	9	4	5	2	364	128	51
Timbersweet (Laurel)	393	164	75	26	19	13	2	5	3	3	703	146	45
Wild Pear (Aguacatillo)	33	13	23	7	8	4	2	2			90	45	15
Medium hard dark wood	683	368	180	77	60	39	16	15	11	8	1,456	405	148
Cypress		3	3	2	2	2	1			2	13	10	6
Female Bullhoof	73	20	18	7	3	1	2	1			124	30	6
San Juan Macho	18	13	8	1		1			1		40	9	1
White Gombolimbo	228	279	143	53	22	6	2		1		734	226	31
Yemeri	26	23	8	7	7	3		1			75	26	11

(.../...)

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Medium hard light wood	346	338	178	69	33	11	4	2	2	2	985	301	54
Barba Jolote	10	5	13	3	4	3	2	4	1	6	51	36	20
Bastard Mahogany			5	5	1		1	2	1	1	14	14	5
Cortez	3	5		2	2						11	3	2
Fiddlewood	28	5	5	3	1	3	1	3	2	5	54	21	13
John Crow Wood	36	23	23	10	3	1	1	1	1	1	96	38	5
Mammee	5	13	8	1	1	1	1				28	11	2
Oak	21	5	3	2	1	1	1				33	7	2
Palacio	3										3		
Santa Maria	134	92	31	47	36	19	12	9	5	4	388	162	84
Sillion	331	210	155	100	75	69	36	13	5	4	997	456	202
Softstick	138	59	23	5	3	2	1			1	232	35	7
Waika Chewstick	33	8	3	5	4	1					52	12	5
Wild Grape	167	84	33	19	14	5	3	4	1		330	79	26
Wild Mammee	10	3	5	6	2	3	2		1	1	31	18	8
Wild Orange	460	240	144	34	14	5	1	1	1		898	198	20
Wild Star Apple	135	38	10	4	2	1		1		1	191	18	4
Hard dark wood	1,512	789	459	245	160	111	59	36	15	21	3,408	1,107	403
Bitterwood	10	3	5	3	2	2	1	2			25	13	5
Cherry	770	405	154	41	24	9	5	2		2	1,410	235	41
Cojotone	189	99	33	9	1	1					330	43	1
Cornstick (Aceituna)	76	66	56	38	14	7	4	1		1	264	121	27
Glassywood	49	20	28	6	4			1			107	38	5
Male Bullhoof	100	78	28	23	15	5	4	4	1		257	79	28
Mayflower	3	3		1			1				6	1	1
Nargusta	97	49	34	28	18	18	20	24	16	25	328	183	121
Red Breadnut	171	150	61	35	16	8	6	6	2	1	455	135	38
Toadskin	13	5	3	3	1	1	1				26	8	3
White Breadnut	150	76	56	43	27	23	15	10	7	3	410	183	84
Wild Guava	55	31	5	12	8	4	4	2	3		124	38	20
Hard light wood	1,682	985	462	241	129	77	60	49	29	30	3,743	1,077	374
Allspice	28	23	13	1	2	1					67	16	2
Axemaster	145	59	21	7	2		1				233	30	3
Balsam	10	8	8	3	2	1	1		1	1	32	15	5
Bastard Rosewood					1						1	1	1

(.../...)

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Billy Webb				2	2	1		1		1	5	5	3
Black Cabbage Bark	28	10	20	6	3	2	1	2	1	1	72	34	9
Black Poisonwood	183	116	62	36	5	1	1				404	105	7
Black maya	358	45	5	7	2						417	15	2
Carbon	48	48	50	23	19	12	10	5	4	7	228	131	58
Faisan	13	26	31	12	7	1	1			1	91	52	9
Fustic			3								3	3	
Granadilo				1	2	1					4	4	3
Ironwood	229	142	77	71	52	40	20	11	4	3	649	278	131
Mamey ciruela	304	266	72	24	10	7	5	4	1	1	694	124	29
Monkey Apple	28	15	5	1	4	3	2	1	2	2	61	18	12
Mylady	227	97	61	29	11	4	2				432	107	17
Palo Mulatto	33	45	28	13	8	2	2	2			132	54	13
Parrot	149	72	38	29	24	21	9	9	5	2	357	135	68
Pigeon plum	59	28	5	1	1					1	93	7	1
Rosewood	5		8	1	2						16	11	2
Sapodilla	44	40	8	35	29	26	16	20	11	6	235	151	108
White Cabbage Bark	5	3		1			1				9	1	1
White Poisonwood	114	83	30	11	1	1				1	241	43	2
Wild Locust (Beefwood)	70	42	28	7	2	3	2	1			155	43	7
Very hard dark wood	2,078	1,169	571	320	187	125	71	54	28	23	4,628	1,380	489
Unclassified species	6,678	2,891	821	338	136	68	42	30	17	25	11,045	1,476	318
Total (all species)	14,564	7,335	3,024	1,467	827	524	326	232	130	155	28,582	6,684	2,193

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	50.8	83.2		49.0	85.9		48.3	86.9	
Mahogany	48.5	30.2	17.6	36.1	39.2	6.3	29.7	41.9	3.4
Primary species	99.4	42.1	11.0	85.2	50.0		77.9	54.5	
Cotton	181.0	29.8	67.1	175.8	30.9	61.2	175.8	30.9	61.2
Fig	495.9	13.7	352.2	473.7	13.7	336.6	417.4	14.8	287.1
Mapola	336.4	24.8	160.6	323.6	25.8	147.6	290.9	27.4	122.6
Moho	287.7	17.3	182.7	103.1	22.5	54.2	23.1	36.3	5.4
Polak (Balsa)	161.2	35.4	40.9	114.5	31.9	37.4	24.8	29.0	9.6
Soft light wood	1,462.2	9.9	1,158.0	1,190.8	11.6	899.0	932.0	12.9	677.8
Candlewood	434.7	17.7	272.3	385.8	18.5	235.6	322.8	20.3	184.5
Hogplum	228.9	21.1	126.9	212.7	21.6	115.9	171.2	21.0	95.3
Kaway	209.1	15.4	141.3	158.0	17.2	100.7	115.2	19.5	67.8
Negrito	12.8	60.5		5.7	86.7				
Quamwood	238.0	24.6	114.7	228.1	25.2	106.9	202.1	26.6	88.5
Red Gombolimbo	66.7	30.8	23.3	46.7	37.1	10.2	20.6	44.3	1.3
Salmwood	37.9	32.6	11.8	23.7	38.9	4.3	5.2	59.0	
Medium soft wood	1,228.1	12.0	916.3	1,060.7	12.1	789.1	837.2	12.5	616.3
Banak	76.1	29.8	28.2	67.2	31.6	22.4	49.1	39.0	8.7
Caulote	0.8	99.9							
Cramantree	225.3	32.7	70.0	171.6	34.4	46.9	128.9	35.2	33.3
Red Wood	289.3	17.9	179.9	228.3	22.6	119.6	153.4	29.1	59.3
Timbersweet (Laurel)	340.3	33.5	100.1	244.8	42.9	23.1	161.3	51.4	
Wild Pear (Aguacatillo)	73.6	29.8	27.3	65.4	29.7	24.4	39.3	30.1	14.3
Medium hard dark wood	1,005.5	21.0	559.6	777.3	24.8	369.8	532.1	29.2	204.3
Cypress	32.2	88.0		31.5	87.8		27.9	91.3	
Female Bullhoof	51.6	28.3	20.8	36.8	29.7	13.8	14.5	38.6	2.7
San Juan Macho	17.6	45.2	0.8	11.3	64.8		4.7	77.5	
White Gombolimbo	352.8	17.9	219.7	234.1	20.0	135.5	69.0	21.0	38.5
Yemeri	50.6	36.4	11.8	41.1	43.8	3.1	27.3	40.2	4.2

(.../...)

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Medium hard light wood	504.8	13.7	359.3	354.8	16.4	232.4	143.4	21.9	77.2
Barba Jolote	109.7	23.7	54.9	107.8	24.0	53.2	96.8	24.3	47.1
Bastard Mahogany	43.8	39.2	7.5	43.8	39.2	7.5	34.5	48.3	
Cortez	7.4	47.8		5.5	64.2		3.3	77.3	
Fiddlewood	122.3	28.4	49.0	117.7	28.8	46.2	110.7	29.6	41.6
John Crow Wood	58.2	37.1	12.7	47.6	39.1	8.3	19.7	59.6	
Mammee	17.2	50.4		11.8	45.5	0.5	6.2	57.3	
Oak	13.7	49.0		9.8	50.1		5.4	48.7	
Palacio	0.3	100.5							
Santa Maria	515.8	16.3	337.9	466.2	16.5	304.2	368.8	15.6	247.2
Sillion	1,293.6	24.7	618.2	1,181.6	25.5	546.0	879.2	27.1	376.4
Softstick	73.8	31.5	24.8	41.8	40.7	5.9	20.6	61.9	
Waika Chewstick	22.2	55.4		16.7	64.0		9.6	54.9	
Wild Grape	169.1	21.0	94.0	124.2	21.2	68.5	74.2	25.2	34.7
Wild Mammee	40.9	39.2	7.0	39.1	40.0	6.1	28.5	45.2	1.3
Wild Orange	322.0	17.3	204.5	188.2	20.5	106.9	47.7	24.5	23.0
Wild Star Apple	53.2	37.9	10.7	27.8	50.9		14.9	62.1	
Hard dark wood	2,863.4	12.1	2,134.8	2,429.4	13.4	1,740.9	1,720.1	15.2	1,168.6
Bitterwood	28.0	40.6	4.0	26.2	43.5	2.1	18.9	52.3	
Cherry	493.5	17.7	308.9	276.0	19.7	161.4	119.3	31.8	39.4
Cojotone	87.8	21.8	47.4	35.2	29.0	13.7	2.3	67.4	
Cornstick (Aceituna)	297.1	44.9	15.4	266.8	47.5		179.6	64.7	
Glassywood	50.2	28.6	19.9	37.8	32.4	12.0	10.1	39.9	1.6
Male Bullhoof	180.5	16.5	117.5	128.7	20.9	72.0	73.9	23.3	37.6
Mayflower	4.0	61.4		3.0	78.0		2.2	99.9	
Nargusta	804.1	23.8	400.6	776.5	23.8	385.8	710.5	24.8	339.0
Red Breadnut	277.2	24.0	137.0	209.0	24.4	101.6	121.8	21.8	65.7
Toadskin	16.8	44.7	1.0	13.5	44.8	0.7	9.1	41.9	1.1
White Breadnut	416.7	18.6	252.9	387.6	19.2	230.6	309.1	21.4	169.8
Wild Guava	104.8	35.2	26.9	87.1	40.1	13.3	67.6	43.3	5.8
Hard light wood	2,760.7	6.7	2,368.4	2,247.5	7.4	1,894.5	1,624.3	9.7	1,293.3
Allspice	23.2	33.1	7.0	13.0	39.5	2.2	4.4	45.0	0.2
Axemaster	64.6	32.7	20.1	28.4	39.6	4.7	6.5	48.2	
Balsam	29.4	30.9	10.2	26.4	32.1	8.5	17.9	37.4	3.8
Bastard Rosewood	1.0	96.9		1.0	96.9		1.0	96.9	

(.../...)

Forest summary, weighted by stratum areas Inventory : Columbia River 1975/76
Total transect length : 97750 m. No. of transects : 20 No. of strata : 2 Total area : 250 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Billy Webb	12.3	46.3	0.3	12.3	46.3	0.3	10.4	48.0	
Black Cabbage Bark	60.9	28.6	24.2	54.5	27.9	22.5	31.7	34.7	8.5
Black Poisonwood	158.7	30.4	57.0	99.6	32.0	32.4	14.1	36.6	3.2
Black maya	64.5	30.8	22.7	17.7	38.7	3.2	4.0	75.9	
Carbon	322.8	24.6	155.0	300.6	24.5	145.0	233.8	24.0	115.6
Faisan	67.1	31.1	23.0	54.9	32.7	17.1	20.1	51.6	
Fustic	2.2	98.0		2.2	98.0				
Granadilo	6.9	52.6		6.9	52.6		5.4	57.4	
Ironwood	756.8	11.7	569.6	680.2	12.2	504.4	511.9	14.6	354.2
Mamey ciruela	291.8	25.3	136.3	173.7	30.5	62.0	96.7	33.3	28.7
Monkey Apple	60.9	38.0	12.0	52.1	41.7	6.3	47.0	45.5	1.9
Mylady	294.9	14.0	208.0	175.8	14.7	121.3	50.1	28.3	20.2
Palo Mulatto	89.6	19.8	52.1	70.6	25.3	32.9	35.0	34.9	9.2
Parrot	326.7	28.7	128.8	287.3	28.4	115.3	226.8	30.0	83.0
Pigeon plum	23.2	36.5	5.4	8.5	50.2		5.0	81.5	
Rosewood	10.6	55.0		10.3	53.8		3.9	60.3	
Sapodilla	516.0	37.2	111.1	498.3	37.5	103.9	447.6	38.7	82.6
White Cabbage Bark	3.3	59.3		2.3	76.4		1.7	99.9	
White Poisonwood	80.9	27.8	33.4	40.0	29.3	15.3	8.4	64.0	
Wild Locust (Beefwood)	68.8	28.9	26.8	47.5	32.3	15.1	20.1	35.6	5.0
Very hard dark wood	3,337.2	8.6	2,732.0	2,664.2	9.4	2,133.9	1,803.7	10.9	1,390.4
Unclassified species	4,143.2	22.6	2,165.8	2,422.5	37.3	514.2	1,434.0	52.7	
Total (all species)	17,404.4	15.0	11,902.1	13,232.2	20.1	7,621.5	9,104.7	22.0	4,872.7

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar			2							1	2	2	1
Mahogany	26	12		4	5	2	3	0	1	1	54	16	12
Primary species	26	12	2	4	5	2	3	0	1	2	56	18	12
Cotton	16	5		3	3	2	2	2	2	6	42	21	18
Fig	48	32	34	18	5	11	6	3	2	2	161	81	29
Mapola	33	47	34	22	13	12	13	5	7	1	187	107	52
Moho	941	443	41	5	1	1	1			1	1,434	50	4
Polak (Balsa)	7	41	41	20	11	1		1			121	74	13
Soft light wood	1,045	568	149	69	33	27	23	12	11	10	1,946	333	115
Candlewood	14	19	18	5	1	2		1	1		61	27	5
Hogplum	167	31	39	17	8	9	4	2	1	1	279	81	25
Kaway	37	39	47	14	11	9	5	5	3	1	171	95	34
Negrito	27	6		3							36	3	
Quamwood	59	60	25	7	1	1	1				153	34	3
Red Gombolimbo	113	61	36	4	2	1	1				220	45	5
Salmwood	153	41	19	3							217	22	
White Tamarind					1						1	1	1
Medium soft wood	571	258	183	53	25	22	11	8	5	3	1,137	308	73
Banak	11	12	10	5	3	5		1		1	48	25	10
Cramantree	88	56	38	13	7	6	4	5	3	1	221	77	26
Red Wood	137	100	22	17	5	3	1	1	2	1	289	52	13
Timbersweet (Laurel)	379	142	40	4	2	3	2				574	52	8
Wild Pear (Aguacatillo)	63	7	4	1		1					76	6	1
Medium hard dark wood	678	317	115	40	18	18	7	6	5	3	1,208	213	58
Cypress				1				1			1	1	1
Female Bullhoof	29	52	38	8	4	1					132	51	5
San Juan Macho	4	17	4	1		1	1				26	6	1
White Gombolimbo	88	83	55	14	5	5	1	1			253	81	12
Yemeri	161	64	4	3			2		1		234	10	3
Medium hard light wood	282	216	100	27	9	6	4	2	1		646	149	21

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees per km² by cm diameter classes 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	Cumulative N/km² ≥10	≥30	≥50
(.../...)													
Barba Jolote	7			1	5	6	1	2	3		26	19	18
Bastard Mahogany						1			1		2	2	2
Cortez	7	7	11	2	1			1			28	14	1
Fiddlewood	25	37	24	13	6	6	2	6	2	1	122	60	23
John Crow Wood	69	43	30	19	16	12	8	8	1	1	208	96	47
Mammee	22	10	18	5	4	5	4	3		1	72	40	17
Santa Maria	136	68		16	11	7	7	7	3	1	256	52	36
Sillion	175	134	63	14	13	17	8	2			425	116	39
Softstick	21	4		2	4	2	2	2	1		39	14	12
Waika Chewstick	99	14	28	9	4	2	1	1			155	43	7
Wild Grape	359	107	76	14	8	7	2	1			576	110	20
Wild Mammee	50	29	17	5	2						102	24	2
Wild Orange	168	106	44	5	1		1				326	52	2
Wild Star Apple	11										11		
Hard dark wood	1,149	558	310	106	74	67	37	32	11	4	2,348	642	226
Bitterwood	48	23	15	7	15	6	5	6	1		126	55	33
Cherry	506	246	101	8	4	2		1		1	869	117	8
Cojotone	43	66	29	7	5						149	41	5
Cornstick (Aceituna)	57	56	45	8	11	3	1	1			183	69	16
Glassywood	85	48	14	5	4	1					157	23	4
Male Bullhoof	126	76	75	17	8	5	1				308	106	14
Mayflower	5			2							7	2	
Nargusta	432	139	95	43	43	30	24	17	11	8	840	269	132
Red Breadnut	87	51	7	3	2		1	1	1		153	15	5
Toadskin	55	9	7	2	1						75	11	1
White Breadnut	242	136	80	48	25	19	16	11	5	8	589	211	84
Wild Guava	274	91	51	9	1	1	1				428	63	3
Hard light wood	1,961	940	520	158	119	66	48	37	17	17	3,884	983	304
Allspice	40	44	7	1							92	8	
Axemaster	310	107	11	6	5	1					439	22	5
Balsam	4	4	4	5	3						19	12	3
Bastard Rosewood	36	10		4			1	1			53	6	2
Billy Webb	9	5		4							17	4	
Black Cabbage Bark	4	15			1	1					21	2	2
Black Poisonwood	131	50	17	18	4	1					220	39	5
Black maya	54	30		2							86	2	
Carbon	13	11	16	6	2	1	3	1		1	53	29	7
Faisan	6			1							7	1	
Granadilo					1	1		1			3	3	3

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Ironwood	217	93	66	42	32	17	10	11	4		492	182	74
Mamey ciruela	232	146	93	14	6	3	1				494	116	9
Monkey Apple	4		5	2	1	3	1	1		2	19	15	8
Mylady	279	176	87	26	11	5	3	1			588	133	20
Palo Mulatto	11	15	12	3	4	1					47	21	5
Parrot		4	19	3							26	22	
Pigeon plum	66	77	19	1							164	21	
Rosewood	161	119	5	5	3						292	13	3
Sapodilla	261	174	112	70	46	39	13	16	14	8	752	317	135
White Poisonwood	288	155	32	12	4						489	47	4
Wild Locust (Beefwood)		4			1						4	1	1
Very hard dark wood	2,123	1,238	505	225	121	73	32	33	18	11	4,378	1,017	288
Unclassified species	5,505	1,846	686	175	61	46	25	6	1	9	8,361	1,010	149
Total (all species)	13,339	5,952	2,570	857	466	326	188	137	70	59	23,965	4,673	1,246

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	5.1	171.3		5.1	171.3		3.7	230.6	
Mahogany	62.4	25.4	23.6	54.7	26.4	19.4	49.1	28.8	14.5
Primary species	67.5	27.3	22.4	59.8	28.6	17.8	52.8	31.3	12.3
Cotton	170.8	31.1	40.4	165.6	31.4	38.1	160.1	31.6	36.2
Fig	176.0	10.3	131.5	162.0	10.5	120.4	111.1	14.4	71.8
Mapola	204.0	27.3	67.7	192.9	26.6	67.3	155.6	22.8	68.6
Moho	290.9	23.6	122.9	47.6	30.8	11.7	16.1	54.5	
Polak (Balsa)	169.7	18.0	94.7	130.3	15.1	82.2	33.2	27.1	11.1
Soft light wood	1,011.4	7.6	824.2	698.4	9.5	535.1	476.1	11.7	339.4
Candlewood	42.8	24.1	17.5	35.4	27.8	11.3	16.4	34.2	2.7
Hogplum	147.8	15.3	92.4	140.1	16.1	85.0	108.5	16.8	63.8
Kaway	281.5	10.0	212.9	207.8	9.8	157.8	103.0	21.8	48.0
Negrito	9.0	59.2		3.7	40.7	0.0			
Quamwood	55.5	16.1	33.7	32.8	18.8	17.7	10.9	40.3	0.1
Red Gombolimbo	77.0	30.0	20.4	43.7	40.8	0.0	14.7	44.5	
Salmwood	46.8	43.2		17.8	38.8	0.9			
White Tamarind	1.9	106.5		1.9	106.5		1.9	106.5	
Medium soft wood	662.4	7.8	535.5	483.2	5.4	419.2	255.5	10.1	192.5
Banak	86.1	21.6	40.5	71.5	26.4	25.3	47.6	34.8	7.1
Cramantree	219.7	35.1	30.8	178.3	33.9	30.2	115.3	30.1	30.2
Red Wood	144.6	7.9	116.6	79.3	12.8	54.4	40.6	19.4	21.3
Timbersweet (Laurel)	143.1	5.4	124.3	57.3	18.8	30.9	22.9	56.7	
Wild Pear (Aguacatillo)	14.4	46.3		6.1	77.7		2.2	100.0	
Medium hard dark wood	607.9	14.8	388.0	392.6	18.3	216.6	228.5	15.0	144.6
Cypress	4.0	100.0		4.0	100.0		3.2	100.0	
Female Bullhoof	73.3	16.4	43.9	49.4	23.3	21.2	9.5	48.2	
San Juan Macho	14.1	69.0		7.7	73.5		4.8	72.5	
White Gombolimbo	127.9	10.2	95.9	88.7	15.2	55.6	29.8	31.3	7.0
Yemeri	55.5	40.2	0.9	19.9	57.6		13.3	76.4	
Medium hard light wood	274.8	7.6	223.9	169.7	7.2	139.5	60.6	12.0	42.8

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Barba Jolote	54.5	25.1	21.0	54.2	25.4	20.5	52.7	26.0	19.1
Bastard Mahogany	7.7	82.9		7.7	82.9		7.7	82.9	
Cortez	18.3	52.2		15.3	60.5		4.7	101.5	
Fiddlewood	140.7	11.4	101.3	121.1	14.9	76.7	87.9	17.7	49.8
John Crow Wood	227.9	27.0	76.9	205.8	24.6	81.6	157.6	21.6	74.3
Mammee	85.7	36.0	10.2	79.2	34.4	12.4	60.4	34.8	8.8
Santa Maria	220.2	16.9	129.2	179.9	21.2	86.4	156.6	21.6	73.7
Sillion	303.2	28.5	91.4	233.3	33.8	40.3	154.1	44.2	
Softstick	48.6	39.9	1.1	44.8	42.4		42.4	43.4	
Waika Chewstick	59.9	51.6		46.8	62.0		16.8	83.8	
Wild Grape	198.2	10.9	145.3	127.5	6.6	106.9	52.9	16.4	31.6
Wild Mammee	37.5	33.7	6.6	22.2	47.3		3.6	77.5	
Wild Orange	97.5	16.7	57.6	42.6	18.7	23.1	5.1	100.0	
Wild Star Apple	1.0	71.3							
Hard dark wood	1,500.9	9.8	1,140.7	1,180.3	11.5	848.4	802.2	11.5	576.1
Bitterwood	152.5	11.2	110.5	139.7	12.2	97.9	115.7	14.4	75.0
Cherry	231.4	19.6	120.5	104.1	33.3	19.1	28.4	109.2	
Cojotone	65.5	22.9	28.8	39.1	23.4	16.7	8.7	49.6	
Cornstick (Aceituna)	108.6	52.7		84.1	57.4		39.7	52.2	
Glassywood	48.3	12.3	33.8	24.8	18.0	13.8	8.2	3.2	7.6
Male Bullhoof	168.8	17.8	95.2	114.8	18.8	62.0	31.0	21.3	14.8
Mayflower	2.6	57.7		1.9	74.8				
Nargusta	764.3	11.8	543.0	668.4	10.1	502.9	533.6	10.9	391.0
Red Breadnut	50.1	28.4	15.3	26.3	35.1	3.7	17.3	47.3	
Toadskin	17.6	59.1		9.8	77.3		2.5	81.9	
White Breadnut	606.4	16.6	359.9	556.6	17.9	312.7	457.0	21.0	221.8
Wild Guava	105.8	30.8	25.8	53.4	42.6		7.1	70.6	
Hard light wood	2,321.9	4.6	2,059.1	1,822.8	4.4	1,627.2	1,249.1	6.2	1,060.8
Allspice	27.1	35.8	3.4	6.5	59.9				
Axemaster	92.6	42.6		24.5	46.9		10.9	53.2	
Balsam	17.1	20.3	8.6	15.2	18.1	8.5	5.0	5.8	4.3
Bastard Rosewood	20.1	51.3		13.2	39.6	0.4	8.3	20.5	4.1
Billy Webb	6.9	31.1	1.6	4.5	24.1	1.8			
Black Cabbage Bark	11.6	34.1	1.9	5.7	49.7		5.7	49.7	
Black Poisonwood	70.6	41.6		44.8	51.5		8.8	66.6	
Black maya	19.1	45.9		3.0	34.9	0.4			
Carbon	56.3	16.3	33.9	51.4	15.5	31.9	30.0	40.6	0.2
Faisan	1.3	79.2		0.6	101.5				
Granadilo	10.8	61.3		10.8	61.3		10.8	61.3	

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Ironwood	469.5	5.3	408.5	408.5	4.6	362.8	290.1	20.2	146.7
Mamey ciruela	183.8	17.3	105.8	107.0	23.1	46.6	22.9	56.5	
Monkey Apple	46.8	19.5	24.4	46.4	19.2	24.6	39.2	24.2	15.9
Mylady	397.2	23.3	170.6	210.9	20.9	102.8	67.2	34.7	10.0
Palo Mulatto	31.4	31.2	7.4	24.5	33.8	4.2	11.8	82.5	
Parrot	19.4	25.3	7.4	17.7	26.1	6.4			
Pigeon plum	47.0	68.6		15.2	54.3				
Rosewood	66.7	24.5	26.6	15.2	41.2		6.5	52.8	
Sapodilla	764.0	21.9	353.4	673.6	22.1	308.9	508.7	23.0	221.7
White Poisonwood	124.0	19.4	64.9	43.1	24.6	17.1	7.2	57.9	
Wild Locust (Beefwood)	2.3	16.2	1.4	1.3	98.5		1.3	98.5	
Very hard dark wood	2,485.7	9.6	1,900.6	1,743.7	10.4	1,300.3	1,034.5	13.8	685.6
Unclassified species	2,333.4	10.4	1,738.1	1,199.3	8.6	946.0	528.1	14.2	343.8
Total (all species)	11,265.8	2.6	10,542.6	7,749.9	4.2	6,950.0	4,687.4	5.2	4,094.2

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
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Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar			2							1	2	2	1
Mahogany	26	12		4	5	2	3	0	1	1	54	16	12
Primary species	26	12	2	4	5	2	3	0	1	2	56	18	12
Cotton	16	5		3	3	2	2	2	2	6	42	21	18
Fig	48	32	34	18	5	11	6	3	2	2	161	81	29
Mapola	33	47	34	22	13	12	13	5	7	1	187	107	52
Moho	941	443	41	5	1	1	1			1	1,434	50	4
Polak (Balsa)	7	41	41	20	11	1		1			121	74	13
Soft light wood	1,045	568	149	69	33	27	23	12	11	10	1,946	333	115
Candlewood	14	19	18	5	1	2		1	1		61	27	5
Hogplum	167	31	39	17	8	9	4	2	1	1	279	81	25
Kaway	37	39	47	14	11	9	5	5	3	1	171	95	34
Negrito	27	6		3							36	3	
Quamwood	59	60	25	7	1	1	1				153	34	3
Red Gombolimbo	113	61	36	4	2	1	1				220	45	5
Salmwood	153	41	19	3							217	22	
White Tamarind					1						1	1	1
Medium soft wood	571	258	183	53	25	22	11	8	5	3	1,137	308	73
Banak	11	12	10	5	3	5		1		1	48	25	10
Cramantree	88	56	38	13	7	6	4	5	3	1	221	77	26
Red Wood	137	100	22	17	5	3	1	1	2	1	289	52	13
Timbersweet (Laurel)	379	142	40	4	2	3	2				574	52	8
Wild Pear (Aguacatillo)	63	7	4	1		1					76	6	1
Medium hard dark wood	678	317	115	40	18	18	7	6	5	3	1,208	213	58
Cypress				1				1			1	1	1
Female Bullhoof	29	52	38	8	4	1					132	51	5
San Juan Macho	4	17	4	1		1	1				26	6	1
White Gombolimbo	88	83	55	14	5	5	1	1			253	81	12
Yemeri	161	64	4	3			2		1		234	10	3
Medium hard light wood	282	216	100	27	9	6	4	2	1		646	149	21

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
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Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Barba Jolote	7			1	5	6	1	2	3		26	19	18
Bastard Mahogany						1			1		2	2	2
Cortez	7	7	11	2	1			1			28	14	1
Fiddlewood	25	37	24	13	6	6	2	6	2	1	122	60	23
John Crow Wood	69	43	30	19	16	12	8	8	1	1	208	96	47
Mammee	22	10	18	5	4	5	4	3		1	72	40	17
Santa Maria	136	68		16	11	7	7	7	3	1	256	52	36
Sillion	175	134	63	14	13	17	8	2			425	116	39
Softstick	21	4		2	4	2	2	2	1		39	14	12
Waika Chewstick	99	14	28	9	4	2	1	1			155	43	7
Wild Grape	359	107	76	14	8	7	2	1			576	110	20
Wild Mammee	50	29	17	5	2						102	24	2
Wild Orange	168	106	44	5	1		1				326	52	2
Wild Star Apple	11										11		
Hard dark wood	1,149	558	310	106	74	67	37	32	11	4	2,348	642	226
Bitterwood	48	23	15	7	15	6	5	6	1		126	55	33
Cherry	506	246	101	8	4	2		1		1	869	117	8
Cojotone	43	66	29	7	5						149	41	5
Cornstick (Aceituna)	57	56	45	8	11	3	1	1			183	69	16
Glassywood	85	48	14	5	4	1					157	23	4
Male Bullhoof	126	76	75	17	8	5	1				308	106	14
Mayflower	5			2							7	2	
Nargusta	432	139	95	43	43	30	24	17	11	8	840	269	132
Red Breadnut	87	51	7	3	2		1	1	1		153	15	5
Toadskin	55	9	7	2	1						75	11	1
White Breadnut	242	136	80	48	25	19	16	11	5	8	589	211	84
Wild Guava	274	91	51	9	1	1	1				428	63	3
Hard light wood	1,961	940	520	158	119	66	48	37	17	17	3,884	983	304
Allspice	40	44	7	1							92	8	
Axemaster	310	107	11	6	5	1					439	22	5
Balsam	4	4	4	5	3						19	12	3
Bastard Rosewood	36	10		4			1	1			53	6	2
Billy Webb	9	5		4							17	4	
Black Cabbage Bark	4	15			1	1					21	2	2
Black Poisonwood	131	50	17	18	4	1					220	39	5
Black maya	54	30		2							86	2	
Carbon	13	11	16	6	2	1	3	1		1	53	29	7
Faisan	6			1							7	1	
Granadilo					1	1		1			3	3	3

(.../...)

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	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
Ironwood	217	93	66	42	32	17	10	11	4		492	182	74
Mamey ciruela	232	146	93	14	6	3	1				494	116	9
Monkey Apple	4		5	2	1	3	1	1		2	19	15	8
Mylady	279	176	87	26	11	5	3	1			588	133	20
Palo Mulatto	11	15	12	3	4	1					47	21	5
Parrot		4	19	3							26	22	
Pigeon plum	66	77	19	1							164	21	
Rosewood	161	119	5	5	3						292	13	3
Sapodilla	261	174	112	70	46	39	13	16	14	8	752	317	135
White Poisonwood	288	155	32	12	4						489	47	4
Wild Locust (Beefwood)		4			1						4	1	1
Very hard dark wood	2,123	1,238	505	225	121	73	32	33	18	11	4,378	1,017	288
Unclassified species	5,505	1,846	686	175	61	46	25	6	1	9	8,361	1,010	149
Total (all species)	13,339	5,952	2,570	857	466	326	188	137	70	59	23,965	4,673	1,246

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	5.1	171.3		5.1	171.3		3.7	230.6	
Mahogany	62.4	25.4	23.6	54.7	26.4	19.4	49.1	28.8	14.5
Primary species	67.5	27.3	22.4	59.8	28.6	17.8	52.8	31.3	12.3
Cotton	170.8	31.1	40.4	165.6	31.4	38.1	160.1	31.6	36.2
Fig	176.0	10.3	131.5	162.0	10.5	120.4	111.1	14.4	71.8
Mapola	204.0	27.3	67.7	192.9	26.6	67.3	155.6	22.8	68.6
Moho	290.9	23.6	122.9	47.6	30.8	11.7	16.1	54.5	
Polak (Balsa)	169.7	18.0	94.7	130.3	15.1	82.2	33.2	27.1	11.1
Soft light wood	1,011.4	7.6	824.2	698.4	9.5	535.1	476.1	11.7	339.4
Candlewood	42.8	24.1	17.5	35.4	27.8	11.3	16.4	34.2	2.7
Hogplum	147.8	15.3	92.4	140.1	16.1	85.0	108.5	16.8	63.8
Kaway	281.5	10.0	212.9	207.8	9.8	157.8	103.0	21.8	48.0
Negrito	9.0	59.2		3.7	40.7	0.0			
Quamwood	55.5	16.1	33.7	32.8	18.8	17.7	10.9	40.3	0.1
Red Gombolimbo	77.0	30.0	20.4	43.7	40.8	0.0	14.7	44.5	
Salmwood	46.8	43.2		17.8	38.8	0.9			
White Tamarind	1.9	106.5		1.9	106.5		1.9	106.5	
Medium soft wood	662.4	7.8	535.5	483.2	5.4	419.2	255.5	10.1	192.5
Banak	86.1	21.6	40.5	71.5	26.4	25.3	47.6	34.8	7.1
Cramantree	219.7	35.1	30.8	178.3	33.9	30.2	115.3	30.1	30.2
Red Wood	144.6	7.9	116.6	79.3	12.8	54.4	40.6	19.4	21.3
Timbersweet (Laurel)	143.1	5.4	124.3	57.3	18.8	30.9	22.9	56.7	
Wild Pear (Aguacatillo)	14.4	46.3		6.1	77.7		2.2	100.0	
Medium hard dark wood	607.9	14.8	388.0	392.6	18.3	216.6	228.5	15.0	144.6
Cypress	4.0	100.0		4.0	100.0		3.2	100.0	
Female Bullhoof	73.3	16.4	43.9	49.4	23.3	21.2	9.5	48.2	
San Juan Macho	14.1	69.0		7.7	73.5		4.8	72.5	
White Gombolimbo	127.9	10.2	95.9	88.7	15.2	55.6	29.8	31.3	7.0
Yemeri	55.5	40.2	0.9	19.9	57.6		13.3	76.4	
Medium hard light wood	274.8	7.6	223.9	169.7	7.2	139.5	60.6	12.0	42.8

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Barba Jolote	54.5	25.1	21.0	54.2	25.4	20.5	52.7	26.0	19.1
Bastard Mahogany	7.7	82.9		7.7	82.9		7.7	82.9	
Cortez	18.3	52.2		15.3	60.5		4.7	101.5	
Fiddlewood	140.7	11.4	101.3	121.1	14.9	76.7	87.9	17.7	49.8
John Crow Wood	227.9	27.0	76.9	205.8	24.6	81.6	157.6	21.6	74.3
Mammee	85.7	36.0	10.2	79.2	34.4	12.4	60.4	34.8	8.8
Santa Maria	220.2	16.9	129.2	179.9	21.2	86.4	156.6	21.6	73.7
Sillion	303.2	28.5	91.4	233.3	33.8	40.3	154.1	44.2	
Softstick	48.6	39.9	1.1	44.8	42.4		42.4	43.4	
Waika Chewstick	59.9	51.6		46.8	62.0		16.8	83.8	
Wild Grape	198.2	10.9	145.3	127.5	6.6	106.9	52.9	16.4	31.6
Wild Mammee	37.5	33.7	6.6	22.2	47.3		3.6	77.5	
Wild Orange	97.5	16.7	57.6	42.6	18.7	23.1	5.1	100.0	
Wild Star Apple	1.0	71.3							
Hard dark wood	1,500.9	9.8	1,140.7	1,180.3	11.5	848.4	802.2	11.5	576.1
Bitterwood	152.5	11.2	110.5	139.7	12.2	97.9	115.7	14.4	75.0
Cherry	231.4	19.6	120.5	104.1	33.3	19.1	28.4	109.2	
Cojotone	65.5	22.9	28.8	39.1	23.4	16.7	8.7	49.6	
Cornstick (Aceituna)	108.6	52.7		84.1	57.4		39.7	52.2	
Glassywood	48.3	12.3	33.8	24.8	18.0	13.8	8.2	3.2	7.6
Male Bullhoof	168.8	17.8	95.2	114.8	18.8	62.0	31.0	21.3	14.8
Mayflower	2.6	57.7		1.9	74.8				
Nargusta	764.3	11.8	543.0	668.4	10.1	502.9	533.6	10.9	391.0
Red Breadnut	50.1	28.4	15.3	26.3	35.1	3.7	17.3	47.3	
Toadskin	17.6	59.1		9.8	77.3		2.5	81.9	
White Breadnut	606.4	16.6	359.9	556.6	17.9	312.7	457.0	21.0	221.8
Wild Guava	105.8	30.8	25.8	53.4	42.6		7.1	70.6	
Hard light wood	2,321.9	4.6	2,059.1	1,822.8	4.4	1,627.2	1,249.1	6.2	1,060.8
Allspice	27.1	35.8	3.4	6.5	59.9				
Axemaster	92.6	42.6		24.5	46.9		10.9	53.2	
Balsam	17.1	20.3	8.6	15.2	18.1	8.5	5.0	5.8	4.3
Bastard Rosewood	20.1	51.3		13.2	39.6	0.4	8.3	20.5	4.1
Billy Webb	6.9	31.1	1.6	4.5	24.1	1.8			
Black Cabbage Bark	11.6	34.1	1.9	5.7	49.7		5.7	49.7	
Black Poisonwood	70.6	41.6		44.8	51.5		8.8	66.6	
Black maya	19.1	45.9		3.0	34.9	0.4			
Carbon	56.3	16.3	33.9	51.4	15.5	31.9	30.0	40.6	0.2
Faisan	1.3	79.2		0.6	101.5				
Granadilo	10.8	61.3		10.8	61.3		10.8	61.3	

(.../...)

Forest summary, weighted by stratum areas Inventory : Maya Mountains 1975/76
Total transect length : 55900 m. No. of transects : 14 No. of strata : 7 Total area : 175 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Ironwood	469.5	5.3	408.5	408.5	4.6	362.8	290.1	20.2	146.7
Mamey ciruela	183.8	17.3	105.8	107.0	23.1	46.6	22.9	56.5	
Monkey Apple	46.8	19.5	24.4	46.4	19.2	24.6	39.2	24.2	15.9
Mylady	397.2	23.3	170.6	210.9	20.9	102.8	67.2	34.7	10.0
Palo Mulatto	31.4	31.2	7.4	24.5	33.8	4.2	11.8	82.5	
Parrot	19.4	25.3	7.4	17.7	26.1	6.4			
Pigeon plum	47.0	68.6		15.2	54.3				
Rosewood	66.7	24.5	26.6	15.2	41.2		6.5	52.8	
Sapodilla	764.0	21.9	353.4	673.6	22.1	308.9	508.7	23.0	221.7
White Poisonwood	124.0	19.4	64.9	43.1	24.6	17.1	7.2	57.9	
Wild Locust (Beefwood)	2.3	16.2	1.4	1.3	98.5		1.3	98.5	
Very hard dark wood	2,485.7	9.6	1,900.6	1,743.7	10.4	1,300.3	1,034.5	13.8	685.6
Unclassified species	2,333.4	10.4	1,738.1	1,199.3	8.6	946.0	528.1	14.2	343.8
Total (all species)	11,265.8	2.6	10,542.6	7,749.9	4.2	6,950.0	4,687.4	5.2	4,094.2

Forest summary, weighted by stratum areas
Total transect length : 92700 m. No. of transects : 24 No. of strata : 12

Inventory : Cockscomb Basin 1977
Total area : 240 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar			4	0							4	4	
Mahogany	7	4	1	1	1	1	0	2	1	2	20	9	7
Primary species	7	4	5	1	1	1	0	2	1	2	24	13	7
Cotton			5	2		1	2	2	1	5	18	18	11
Fig		13	12	1	2		1				28	15	2
Mapola		8									8		
Moho		1,024	368	41	4	4					1,440	416	8
Polak (Balsa)		148	300	96	48	11	2	2	1		606	458	62
Soft light wood		1,193	685	140	54	15	4	3	2	5	2,101	908	83
Hogplum	3	185	122	58	49	26	9	2	2	1	455	267	87
Kaway		31	39	19	15	17	15	5	5	4	149	118	60
Negrito		488	207	8	1	1		1			704	217	2
Quamwood		269	196	34	4	1					503	234	5
Red Gombolimbo		27	20	9	3	2	1	1	1		63	36	8
Salmwood		262	51	6		1					319	57	1
Medium soft wood	3	1,262	634	133	70	46	25	8	8	4	2,193	928	162
Banak		57	34	16	19	18	26	10	8	5	193	136	86
Red Wood		10	5								16	5	
Timbersweet (Laurel)		176	37	5							218	42	
Wild Pear (Aguacatillo)		3	6								9	6	
Medium hard dark wood		246	82	20	19	18	26	10	8	5	435	188	86
Cypress				1		1	1				2	2	1
San Juan Macho					1	1		1			2	2	2
White Gombolimbo		71	63	10	3	1	1			1	148	77	4
Yemeri		219	74	7	4	1	1				306	87	6
Medium hard light wood		290	137	17	8	3	2	1		1	458	168	13
Barba Jolote		13	5	3	4	4	5	1	2	10	47	34	26
Bastard Mahogany		8	3		1	1					12	4	1
Cortez		3	3	2	3	1	2	1		1	13	10	6
Fiddlewood				1			1		1	1	3	3	2

(.../...)

Forest summary, weighted by stratum areas Inventory : Cockscomb Basin 1977
Total transect length : 92700 m. No. of transects : 24 No. of strata : 12 Total area : 240 km²

Species name	Trees per km² by cm diameter classes									Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
(.../...)													
John Crow Wood				1	1						1	1	1
Mammee		6	15	7	9	10	6	6	4	1	64	58	36
Oak					1	1					1	1	1
Santa Maria		29	16	7	8	8	3	3	2		74	45	23
Sillion		5	10	6	11	8	5	5	2	1	53	48	32
Waika Chewstick		5	3								8	3	
Wild Grape		414	42	7	2	1			1		465	52	3
Hard dark wood		483	96	32	38	33	21	15	10	12	741	258	130
Bitterwood		36	11	6	2	4	1	2	1		62	26	10
Cherry		21	8								29	8	
Cojotone		85	26	17	7	3	2				140	54	11
Cornstick (Aceituna)					1						1	1	1
Male Bullhoof				1							1	1	
Mayflower		20	9	4	4	1	1				39	18	6
Nargusta		50	50	16	17	21	20	19	16	30	238	188	123
Red Breadnut		3									3		
Toadskin		3									3		
White Breadnut		34	5	3	1	1	1				44	10	2
Hard light wood		251	109	46	31	30	23	21	16	30	559	307	152
Allspice		3									3		
Balsam		3									3		
Bastard Rosewood		3	5		1						8	6	1
Billy Webb					1						1	1	1
Black Cabbage Bark				3	2	1	1				5	5	3
Black maya		294	132	26	7		1				460	166	7
Ironwood		123	119	46	29	23	13	5	3	1	362	239	74
Mamey ciruela		120	79	15	6	1					221	100	6
Monkey Apple				1							1	1	
Mylady		34	9	5	1						48	14	1
Palo Mulatto					1						1	1	1
Rosewood		3	3								5	3	
Sapodilla				1		1				1	2	2	1
White Poisonwood					1						1	1	1
Very hard dark wood		583	346	97	47	25	14	5	3	2	1,120	537	95
Unclassified species		5,585	1,400	182	105	71	39	27	19	19	7,448	1,862	280
Total (all species)	10	9,898	3,494	668	373	244	153	92	66	81	15,079	5,171	1,009

Forest summary, weighted by stratum areas
Total transect length : 92700 m. No. of transects : 24 No. of strata : 12

Inventory : Cockscomb Basin 1977
Total area : 240 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	2.7	68.2		2.7	68.2				
Mahogany	52.1	22.9	25.9	50.1	23.8	23.8	47.6	26.1	20.2
Primary species	54.9	22.3	28.0	52.8	23.1	26.0	47.6	26.1	20.2
Cotton	111.8	29.2	40.0	111.8	29.2	40.0	102.7	31.4	31.7
Fig	19.3	23.4	9.4	15.1	22.8	7.5	5.3	34.4	1.3
Mapola	1.3	78.3							
Moho	660.7	10.2	513.0	310.0	11.5	231.5	18.0	31.1	5.7
Polak (Balsa)	920.8	23.3	449.4	775.8	22.9	385.1	164.7	20.9	88.9
Soft light wood	1,713.9	15.1	1,144.6	1,212.7	16.5	772.6	290.8	22.0	150.2
Hogplum	380.2	10.8	290.0	356.8	10.9	271.0	253.0	14.2	173.7
Kaway	329.5	9.4	261.4	290.8	11.4	217.6	188.1	18.3	112.3
Negrito	316.6	28.1	121.1	150.7	30.2	50.4	4.8	80.0	
Quamwood	271.1	16.0	175.9	194.6	14.5	132.3	13.2	44.3	0.3
Red Gombolimbo	56.1	17.8	34.1	48.5	23.8	23.1	25.4	35.1	5.8
Salmwood	124.3	17.5	76.3	42.7	18.9	25.0	1.4	100.0	
Medium soft wood	1,477.7	10.4	1,139.3	1,084.1	9.0	869.2	485.9	14.1	334.9
Banak	596.3	12.5	431.7	546.6	13.2	387.8	465.5	14.5	316.7
Red Wood	8.6	60.1		4.0	100.0				
Timbersweet (Laurel)	88.0	24.8	40.1	29.9	32.4	8.6			
Wild Pear (Aguacatillo)	5.7	67.1		4.7	67.8				
Medium hard dark wood	698.7	12.0	513.7	585.1	12.8	420.9	465.5	14.5	316.7
Cypress	3.7	48.1		3.7	48.1		3.1	71.5	
San Juan Macho	5.3	101.3		5.3	101.3		5.3	101.3	
White Gombolimbo	208.2	56.9		182.2	61.7		128.8	83.7	
Yemeri	136.8	15.8	89.1	67.5	16.2	43.5	13.2	38.0	2.2
Medium hard light wood	354.1	33.9	90.4	258.7	43.2	13.1	150.4	71.8	
Barba Jolote	145.7	19.2	84.0	142.6	19.9	80.3	136.9	20.2	76.2
Bastard Mahogany	7.4	22.8	3.7	4.3	36.1	0.9	2.5	79.8	
Cortez	27.8	34.8	6.5	26.7	33.1	7.3	23.5	33.7	6.0
Fiddlewood	14.0	79.5		14.0	79.5		13.3	83.8	

(.../...)

Forest summary, weighted by stratum areas Inventory : Cockscomb Basin 1977
Total transect length : 92700 m. No. of transects : 24 No. of strata : 12 Total area : 240 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
John Crow Wood	1.5	100.0		1.5	100.0		0.9	100.0	
Mammee	152.1	28.8	55.6	149.9	28.9	54.5	132.3	29.7	45.7
Oak	2.6	98.7		2.6	98.7		2.6	98.7	
Santa Maria	128.8	20.5	70.8	116.6	23.2	57.0	91.3	24.4	42.3
Sillion	171.2	25.7	74.6	169.7	25.9	72.9	149.7	31.4	46.4
Waika Chewstick	3.7	61.2		1.8	101.3				
Wild Grape	166.5	24.3	77.5	41.7	28.8	15.3	8.0	35.0	1.8
Hard dark wood	821.3	10.9	624.4	671.5	11.4	503.3	561.1	14.1	386.8
Bitterwood	65.6	26.0	28.1	52.6	27.9	20.3	36.3	32.9	10.0
Cherry	12.0	52.7		5.3	55.1				
Cojotone	96.3	24.6	44.2	65.8	22.9	32.7	26.1	26.7	10.8
Cornstick (Aceituna)	1.0	98.7		1.0	98.7		1.0	98.7	
Male Bullhoof	0.9	111.8		0.9	111.8				
Mayflower	31.4	28.9	11.5	24.5	29.4	8.7	14.6	42.5	0.9
Nargusta	789.8	14.0	547.4	771.9	13.8	537.3	713.5	14.3	488.6
Red Breadnut	0.7	98.7							
Toadskin	0.6	100.0							
White Breadnut	19.4	19.4	11.1	11.3	25.8	4.9	6.1	24.0	2.9
Hard light wood	1,017.8	9.8	799.4	933.2	10.2	723.7	797.7	12.5	579.1
Allspice	0.6	100.0							
Balsam	0.7	100.0							
Bastard Rosewood	5.2	64.1		4.4	60.7		0.9	100.0	
Billy Webb	2.3	70.8		2.3	70.8		2.3	70.8	
Black Cabbage Bark	9.6	36.1	2.0	9.6	36.1	2.0	6.6	51.9	
Black maya	230.7	32.4	66.3	132.9	34.0	33.6	14.6	38.5	2.2
Ironwood	479.9	15.4	316.8	435.3	15.7	284.6	271.2	17.0	170.0
Mamey ciruela	128.8	19.7	73.0	87.0	18.9	50.8	12.0	48.8	
Monkey Apple	1.6	64.4		1.6	64.4				
Mylady	41.9	30.0	14.3	19.4	35.3	4.3	1.5	89.4	
Palo Mulatto	2.0	100.0		2.0	100.0		2.0	100.0	
Rosewood	2.2	74.0		1.5	100.0				
Sapodilla	8.4	100.0		8.4	100.0		7.5	100.0	
White Poisonwood	1.0	100.0		1.0	100.0		1.0	100.0	
Very hard dark wood	914.9	15.1	611.2	705.4	14.5	481.0	319.7	14.4	218.1
Unclassified species	3,902.7	25.3	1,731.9	2,049.9	19.1	1,188.3	861.8	12.0	633.4
Total (all species)	10,955.9	13.9	7,613.7	7,553.4	9.8	5,924.7	3,980.3	9.7	3,129.3

Forest summary, weighted by stratum areas Inventory : Hillbank-Rio Bravo (BEC) 1975
Total transect length :149800 m. No. of transects : 31 No. of strata : 2 Total area : 2027 km²

Species name	Trees per km² by cm diameter classes										Cumulative N/km²		
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	≥10	≥30	≥50
Cedar	52	101	63	5	5	2	2	2		0	232	79	11
Mahogany	1,875	1,000	660	45	36	22	11	7	2	6	3,665	790	85
Primary species	1,927	1,102	723	50	41	24	13	9	2	6	3,897	868	96
Cotton		38	36	18	12	7	3	4	2	0	120	83	29
Fig		55	19	7	7	2	1	1		0	92	37	10
Mapola		85	25	6	2				1		119	34	3
Moho		72	14	2							88	16	
Polak (Balsa)		47	20	2							70	22	
Provision Tree		51	45	7	6	1			0		111	60	8
Soft light wood		346	159	43	27	10	4	5	3	0	598	252	50
Hogplum		179	159	48	22	6					414	235	28
Kaway		17	17	6	3	1	1	1	1		47	30	7
Negrito		88	29	6	1						124	37	1
Quamwood		23	6	9	4	3	0	0			47	23	8
Red Gombolimbo		205	94	39	8	0	1				348	143	10
Salmwood		34									34		
Tubroos				0	0	0		0	0	1	2	2	2
Medium soft wood		545	306	109	40	10	2	2	1	1	1,016	471	56
Red Wood		28	11	0							39	11	
Timbersweet (Laurel)		141	44	9	0	0					196	54	0
Medium hard dark wood		169	55	10	0	0					235	65	0
Prickly Yellow		266	49	8		0					323	57	0
Yemeri		8	2	3	1					0	15	7	1
Medium hard light wood		275	51	11	1	0				0	338	64	2
Bastard Mahogany		40	2	1							43	3	
Cortez		15	2	1	1	0					19	4	1
Fiddlewood		84	113	58	41	23	11	8	2	2	343	259	87
Mammee		2		2	2	1					7	5	3
Santa Maria		143	113	44	25	13	1	1	0	0	342	198	41
Sillion		156	133	63	23	10	3	1			388	232	36

(.../...)

Forest summary, weighted by stratum areas Inventory : Hillbank-Rio Bravo (BEC) 1975
Total transect length :149800 m. No. of transects : 31 No. of strata : 2 Total area : 2027 km²

Species name	Trees per km² by cm diameter classes 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	≥100	Cumulative N/km² ≥10	≥30	≥50
(.../...)													
Wild Mammee		106	30	14	5	2	0				156	50	7
Hard dark wood		547	393	183	96	49	16	10	2	2	1,298	751	175
Bitterwood		80	24	19	7	3		0			133	52	10
Glassywood		89	26	7	3	0					126	37	4
Male Bullhoof		611	206	76	35	7	4	1			940	329	47
Mayflower		22	11	1	0						34	12	0
Nargusta		110	48	20	12	7	2		1	0	200	91	22
Red Breadnut		68	6	1							75	7	
White Breadnut		243	170	101	38	17	4	3	0		576	333	62
Hard light wood		1,223	490	225	96	35	10	4	1	0	2,084	861	145
Allspice	3,364	584	129	2	1	1				1	4,081	134	2
Billy Webb	2	70	36	13	7	3	1	1		0	133	61	12
Black Cabbage Bark		82	15	15	7	3	0				122	41	11
Black Poisonwood		154	69	17	8	2	0				251	97	10
Granadilo		4		0							4	0	
Ironwood		6	4	1	1						13	6	1
Mamey ciruela		980	229	60	15	2					1,287	307	17
Mylady		400	120	23	6	5					554	154	11
Rosewood		46	42	35	23	9	4	0	1	0	159	113	36
Sapodilla		280	193	136	95	50	16	11	8	2	791	511	182
Very hard dark wood	3,366	2,606	838	303	163	76	21	12	8	3	7,396	1,424	283
Unclassified species	2	2,554	699	221	102	58	26	12	4	7	3,685	1,129	209
Total (all species)	5,295	9,367	3,715	1,154	567	263	91	54	21	20	20,547	5,885	1,016

Forest summary, weighted by stratum areas Inventory : Hillbank-Rio Bravo (BEC) 1975
Total transect length :149800 m. No. of transects : 31 No. of strata : 2 Total area : 2027 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
Cedar	104.5	24.3	52.2	70.8	25.9	32.9	27.9	33.8	8.5
Mahogany	1,613.0	13.0	1,182.5	926.8	11.3	711.2	306.1	11.3	234.8
Primary species	1,717.4	11.9	1,295.1	997.5	10.1	789.5	334.0	9.7	267.0
Cotton	201.2	26.8	90.3	180.1	26.0	83.6	111.6	24.0	56.4
Fig	70.1	28.0	29.6	50.9	40.8	8.2	27.4	61.5	
Mapola	45.4	34.1	13.5	26.2	36.0	6.8	7.6	56.5	
Moho	38.2	53.2		13.1	57.7				
Polak (Balsa)	77.1	98.0		32.6	96.6				
Provision Tree	77.3	28.4	32.2	59.5	27.8	25.4	17.2	38.2	3.7
Soft light wood	509.3	23.5	262.2	362.4	21.9	199.3	163.7	25.5	77.8
Hogplum	202.7	29.8	78.4	177.6	33.9	53.7	62.6	29.1	25.1
Kaway	83.1	29.1	33.4	62.6	29.2	24.9	22.0	25.6	10.4
Negrito	62.9	29.8	24.3	32.2	36.2	8.1	2.7	64.8	
Quamwood	53.5	31.0	19.3	46.5	31.5	16.3	27.8	38.4	5.8
Red Gombolimbo	211.7	15.0	146.5	139.7	16.1	93.3	20.6	28.7	8.4
Salmwood	11.9	40.1	2.1						
Tubroos	11.6	45.5	0.7	11.6	45.5	0.7	11.4	46.7	0.4
Medium soft wood	637.5	9.5	512.7	470.3	11.9	355.1	147.0	17.0	95.4
Red Wood	21.6	39.2	4.2	9.3	64.9				
Timbersweet (Laurel)	95.3	18.9	58.2	45.6	26.0	21.2	1.0	59.9	
Medium hard dark wood	116.9	17.8	74.0	54.9	24.9	26.8	1.0	59.9	
Prickly Yellow	139.9	30.7	51.4	46.3	43.9	4.5	0.6	107.9	
Yemeri	12.9	40.8	2.0	9.9	36.2	2.5	4.2	54.2	
Medium hard light wood	152.8	28.2	63.9	56.2	36.4	14.1	4.8	53.4	
Bastard Mahogany	16.4	46.9	0.6	2.4	72.2				
Cortez	10.4	39.8	1.9	5.0	42.6	0.6	2.4	62.3	
Fiddlewood	474.4	9.3	383.6	441.8	9.7	353.8	271.8	10.2	215.0
Mammee	9.5	39.6	1.7	8.7	42.0	1.2	6.8	42.4	0.9
Santa Maria	349.5	18.3	218.0	292.3	19.5	174.8	126.4	19.8	74.9
Sillion	413.8	9.9	329.5	350.9	8.6	288.4	124.5	5.6	110.0

(.../...)

Forest summary, weighted by stratum areas Inventory : Hillbank-Rio Bravo (BEC) 1975
Total transect length :149800 m. No. of transects : 31 No. of strata : 2 Total area : 2027 km²

Species name	Trees ≥10 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥30 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²	Trees ≥50 cm diameter Bole volume m3/km²	CV of mean %	RME (P=.95) m3/km²
(.../...)									
Wild Mammee	92.0	29.6	35.8	54.7	32.9	17.7	15.4	38.7	3.1
Hard dark wood	1,365.9	7.4	1,158.0	1,156.0	7.4	979.2	547.4	7.3	465.0
Bitterwood	99.4	19.1	60.2	70.7	21.2	39.9	26.2	31.4	9.3
Glassywood	67.1	17.4	43.1	35.8	21.2	20.1	7.1	36.4	1.8
Male Bullhoof	669.8	23.5	346.0	387.0	34.5	111.7	106.8	58.4	
Mayflower	17.3	25.7	8.2	9.6	37.3	2.2	0.4	97.9	
Nargusta	168.7	14.3	118.9	126.8	21.4	70.8	61.0	23.3	31.7
Red Breadnut	29.3	27.3	12.8	5.5	47.3	0.1			
White Breadnut	426.8	16.3	283.9	364.8	17.4	234.1	151.7	21.3	85.2
Hard light wood	1,478.4	10.9	1,147.7	1,000.1	14.9	692.4	353.2	22.3	191.3
Allspice	698.2	13.6	503.0	106.9	26.4	48.7	9.2	59.1	
Billy Webb	98.9	17.1	64.1	74.0	19.7	44.0	30.9	25.5	14.6
Black Cabbage Bark	83.7	19.0	50.9	55.0	19.6	32.8	24.6	33.3	7.7
Black Poisonwood	150.4	23.5	77.5	96.3	27.2	42.3	23.3	18.0	14.7
Granadilo	1.8	60.9		0.3	76.0				
Ironwood	10.2	63.2		7.7	56.0		2.5	69.0	
Mamey ciruela	625.9	13.9	446.9	281.4	18.0	177.3	36.2	25.7	17.0
Mylady	495.7	10.7	386.3	224.6	12.9	164.8	34.1	31.6	11.9
Rosewood	182.7	11.5	139.5	166.5	11.7	126.4	91.7	11.5	69.9
Sapodilla	967.6	10.0	767.6	868.9	10.7	677.1	547.0	11.9	413.3
Very hard dark wood	3,315.0	6.9	2,846.8	1,881.6	7.9	1,575.8	799.5	9.5	643.3
Unclassified species	2,306.2	19.3	1,391.4	1,413.8	27.0	627.2	626.4	43.8	61.8
Total (all species)	11,599.5	11.8	8,768.7	7,392.9	15.9	4,970.6	2,977.0	23.3	1,550.1

Appendix F : Standard species list

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
158	Abalo		
299	Accuwux		
169	Achiotillo		
227	Acir		
211	Akayum		
72	Allspice	Pimento dioica	H
130	Almendro		
292	Anal		
215	Asche		
88	Axemaster	Krugiodendron ferreum	H
270	Bacal mam		
291	Baking p. stick		
255	Balam mash		
93	Balsam	Myroxylum balsamum	H
23	Banak	Virola koschynia	D
191	Banana stick		
40	Barba Jolote	Pithecolobum arboreum	F
47	Bastard Mahogany	Carapa guianensis & Mosquitoxylon jamaic.	F
38	Bastard Redwood	Sickingea salvadorensis	F
84	Bastard Rosewood	Swartzia cubensis	H
131	Bastard cedar	# see 123	
164	Bastard coffee		
123	Bay cedar	Guazuma ulmifolia	
218	Beefwood	# see 92	
160	Bek		
80	Billy Webb	Sweetia panamensis	H
279	Bits		
59	Bitterwood	Vatairea lundellii	G
76	Black Cabbage Bark	Lonchocarpus castilloi	H
74	Black Poisonwood	Metopium brownii	H
159	Black berry		
86	Black maya	Miconia spp.	H
155	Blossom berry		
129	Boil cake		
284	Bosh sul		
101	Botan palm		
185	Boy job		
153	Brayberry		
197	Bri bri	Inga edulis	
223	Bullet tree		
143	Bullhoof	# see 60	
285	Bush sul		
122	Cabbage bark	# see 76	
241	Cabbage palm		
242	Caca tee		
221	Cacho venado		
251	Calabash		
154	Canang		
18	Candlewood	Mastichodendron foetidissimum	C

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
116	Cantemo		
193	Capulin		
70	Carbon	Tetragastris stevensonii	H
213	Caseario		
24	Caulote	Guazuma ulmifolia	D
2	Cedar	Cedrela mexicana	A
25	Cedrillo	Guarea tuerckhamii	D
114	Cerbetana		
256	Chan te		
64	Cherry	Pseudomedia spp.	G
303	Chic che		
244	Chichicaste	Poulsenia armata	
272	Chichipato		
286	Cholol		
261	Chu chak che		
226	Chunup	Clusia suborbicularis	
151	Churuch		
162	Cinamon stick		
112	Clusia	# see 106	
236	Coallock		
202	Cockspur		
141	Cohune palm		
66	Cojotone	Stemmadenia obovata	G
257	Conop		
108	Copal		
181	Copalche		
219	Corn stick	# see 63	
63	Cornstick (Aceituna)	Pleuranthodendron mexicana	G
44	Cortez	Tabebuia chrysantha	F
4	Cotton	Ceiba pentandra	B
195	Cowitch		
150	Craboo		
22	Cramantree	Guarea excelsa	D
231	Cross prickle		
308	Cuero de Sapo	# on PSP 1/Q1	
212	Cumche		
278	Cushub che		
34	Cypress	Podocarpus guatamalensis	E
259	De resh mesh		
142	Dragon stick		
111	Ebony?		
296	Ecimte		
81	Faisan	Dipholis stevensonii	H
33	Female Bullhoof	Celtis schippii	E
41	Fiddlewood	Vitex gaumeri	F
8	Fig	Ficus spp.	B
140	Frangi pani		
87	Fustic	Chlorophora tinctoria	H
61	Glassywood	Guettardia combsii	G

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
235	Golla		
83	Granadilo	Platymiscium yucatanum	H
107	Grande betty		
188	Guacamallo		
306	Guama	# see 197	
282	Guanacaste		
170	Guineo		
186	Haasche		
189	Habing		
288	Hawk stick		
243	Hingi hingi	Rehdera penninerva	
13	Hogplum	Spondias mombin	C
132	Hormiga		
273	Hulunte		
269	Huum che		
157	Huyu		
79	Ironwood	Dialium guianense	H
175	Ishinche		
126	Jaboncillo		
238	Jamir		
102	Jobillo	# see 71	
51	John Crow Wood		F
298	Jojorte		
152	Juan pech		
199	Jug		
300	Ka peh che		
262	Kanab		
209	Kanshan		
222	Kara hell		
206	Kascat		
136	Katalox		
16	Kaway	Pterocarpus spp.	C
161	Kinep		
302	Ku nas te		
133	Lagarto		
147	Laurel	Nectandra sanguinea	
125	Legnumvitae		
117	Limoncillo		
301	Lon lon		
148	Lucky bean		
229	Lutch mash		
214	Luwin		
293	Maculis		
120	Madre cacao		
1	Mahogany	Swietenia macrophylla	A
290	Malactee		
60	Male Bullhoof	Drypetes brownii	G
82	Mamey ciruela	Pouteria campechiana	H
42	Mammee	Mammea americana	F
146	Mammee apple	Mammea americana	

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
228	Mangrove		
178	Mano de lion		
6	Mapola	Bernouillia flammea & Bombax ellipticum	B
246	Marucho		
106	Matapalo	Clusia spp.	
104	Matwa		
67	Mayflower	Tabebuia rosea	G
5	Moho	Heliocarpus & Belotia spp.	B
91	Monkey Apple	Licania platypus	H
233	Morucho		
253	Mulacte		
260	Mut ba		
78	Mylady	Aspidospermyum megalocarpon	H
277	Naba cuc		
57	Nargusta	Terminalia amazonica	G
11	Negrito	Simaruba glauca	C
225	Night kiss	Cestrum panamense	
274	Nutmeg		
43	Oak	Quercus spp.	F
190	Ok mal		
182	Oruja de mico		
163	Ouibish		
198	Ouratea		
248	Pachote		
48	Palacio	Zuelania guidonia	F
287	Palmwood		
71	Palo Mulatto	Astronium graveolens	H
89	Parrot	Sloanea schippii	H
263	Pasne		
264	Pat si min		
183	Pata de vaca		
267	Pepperbird		
90	Pigeon plum	Hirtella american	H
200	Pine		
234	Plantain stick		
275	Poite		
9	Polak (Balsa)	Ochroma lagopus	B
280	Polewood		
294	Pomteh		
192	Powder stick	# see 32	
29	Prickly Yellow	Zanthoxylum kellermanii	E
127	Prickly yellow	Zanthoxylum mayanum	
7	Provision Tree	Pachira aquatica	B
139	Pumpkin stick		
239	Pupute		
14	Quamwood	Schizolobium parahybum	C
173	Quisote		
55	Red Breadnut	Trophis racemosa	G
15	Red Gombolimbo	Bursera simaruba	C

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
21	Red Wood	Erythroxylon areclatum	D
115	Red mylady		
309	Rhoble	# on PSP 1/Q1	
210	Rinion		
85	Rosewood	Dalbergia stevensonii	H
304	Roville		
208	Rubber		
118	Saba che		
217	Sackayom		
177	Sacuruch		
149	Sakpa		
184	Sakulche		
12	Salmwood	Cordia alliodora	C
204	Saltemuche		
172	Samwood		
32	San Juan Macho	Ilex belizensis	E
207	San pedrano		
46	Santa Maria	Calophyllum brasiliense	F
73	Sapodilla	Manilkara zapota	H
124	Sapotillo	Pouteria unilocularis	
289	Shununteh		
180	Sibul		
135	Sikiya		
45	Sillion	Pouteria belizensis & p. izabalensis	F
156	Soapseed		
52	Softstick	Tovomita nicaraguensis	F
179	Soome		
58	Southern Bullet Tree	Terminalia spp?	G
247	Star apple		
187	Suffricaya		
230	Sunte		
265	Sup		
250	Susu		
168	Tamarind		
109	Tamay		
134	Tastab		
144	Tatalosh		
194	Teak	Tectona grandis	
307	Tem		
196	Tempiste		
266	Terech max		
28	Timbersweet (Laurel)	Nectandra or Phoebe spp.	D
65	Toadskin	Heisteria media	G
305	Ton-si-min		
283	Tosh nich		
145	Trumpet		
17	Tubroos	Enterolobium cyclocarpon	C
258	Tuchim		
245	Tulmash		

Belize Broadleaved Forest Inventory Species List

Code no.	Local name	Botanical name	Usage group
297	Tumunche		
271	Tun max		
176	Turtlebone	Pithecellobium recordii	
254	Tzam		
138	Tzol		
281	Tzu nun te		
220	Tzu tzni		
252	Ucan		
103	Unknown		
49	Waika Chewstick	Symphonia globulifora	F
171	Waika pinewood		
224	Waika plum	Rheedia intermedia	
119	Waika ribbon	Bernardia interrupta	
105	Walk naked		
201	Wama or beets		
216	Wamul		
165	Warrywood		
56	White Breadnut	Brosimum alicastrum	G
77	White Cabbage Bark	Andira inermis	H
30	White Gombolimbo	Oreopanax capitatus	E
75	White Poisonwood	Cameraria belizensis	H
19	White Tamarind	Acacia spp	C
110	White mylady		
37	Wild Grape	Coccoloba spp.	F
62	Wild Guava	Alibertha edulis	G
92	Wild Locust (Beefwood)	Hymenia conbaril	H
39	Wild Mammee	Alseis yucatanensis	F
50	Wild Orange	Calyptranthes citrina	F
26	Wild Pear (Aguacatillo)	Persea schiedenia	D
53	Wild Star Apple	Chrysophyllum oliviforme	F
240	Wild anatto		
121	Wild c. apple		
276	Wild heinekin		
205	Wild papaw		
167	Wild pear	# see 26	
249	Wild plum		
203	Wild ruda		
232	Wild tobacco		
166	Wormstick		
295	Wuyteh		
268	Xaxmokan		
174	Xinche		
113	Yashosh		
137	Yellow plum		
237	Yellow wood		
31	Yemeri	Vochysia hondurensis	E
128	Zaculche		

(Printed 10/12/92)

Appendix G : Synonyms and variant spellings for local names

List of alternative spellings and synonyms encountered during data entry for Chiquibul and Columbia River forest reserves. The reference local name from the SPECIES data base is in lower case letters. Numbers are species code numbers.

1	MAHOGAHY	Mahogany
1	MAHOGANY	Mahogany
2	CEDAR69	Cedar
4	COTTON 53	Cotton
4	CEIBO	Cotton
4	CEIBA	Cotton
5	MOHOP	Moho
5	NARR. LEAF MOHO	Moho
5	WHITE MOHO	Moho
5	SMALL LEAF MOHO	Moho
5	WIDE LEAF MOHO	Moho
5	RED MOHO	Moho
5	BIG LEAF MOHO	Moho
5	FINE LEAF MOHO	Moho
5	WHITE MOHO	Moho
5	WILD MOHO	Moho
5	BROAD LEAF MOHO	Moho
5	NARROWLEAF MOHO	Moho
5	BROADLEAF MOHO	Moho
6	MAPLOA	Mapola
6	WHITE MAPOLA	Mapola
6	RED MAPOLA	Mapola
6	MAPALO	Mapola
6	MAPOLAN	Mapola
6	MAP[OLA	Mapola
9	RED POLAK	Polak (Balsa)
11	NEGIRTO	Negrito
11	WILD NEGRITO	Negrito
12	SALAM WOOD	Salmwood
12	BOHONG	Salmwood
12	BOHOM	Salmwood
12	W. SALMWOOD	Salmwood
12	WHITE SALMWOOD	Salmwood
13	HOG PLUM	Hogplum
13	HOGLPUM	Hogplum
15	R. GOMBOLIMBO	Red Gombolimbo
15	RED GOMGOLIMBO	Red Gombolimbo
15	GOMBOLIMBO	Red Gombolimbo
15	R.GOMBOLIMBO	Red Gombolimbo
15	RED GOMBILIMBO	Red Gombolimbo
15	BRADNUT	Red Gombolimbo
15	GUMBOLIMBO	Red Gombolimbo
16	SANGRE	Kaway
18	F. CANDLEWOOD	Candlewood
18	CANDLEWOOOD	Candlewood
18	F.CANDLEWOOD	Candlewood
18	CANDLE WOOD	Candlewood
18	WHT.CANDLEWOOD	Candlewood
18	CANDLESTICK	Candlewood
18	MALE CANDLEWOOD	Candlewood
18	WILDCANDLE	Candlewood
21	REDWOOOD	Red Wood
21	REDWOODD	Red Wood
21	REDWOOD`	Red Wood
21	RDWOOD	Red Wood
21	REDWOOD	Red Wood
22	CRAMANTEE	Cramantree
23	BONAK	Banak
26	AQUACATILLO	Aguacatillo
28	TIMBSRSWEET	Timbersweet
28	TIMERSWEET	Timbersweet
28	WATERWOOD	Timbersweet
28	WATER WOOD	Timbersweet
30	W.GOMBOLIMBO	White Gombolimbo
30	W. GOMBOLIMBO	White Gombolimbo
30	W. GOMBOLIMBIO	White Gombolimbo
30	W. GOBOLIMBO	White Gombolimbo
30	W. GOMBOLIMBO	White Gombolimbo
30	W. GOMBOLIMMBO	White Gombolimbo
30	W. GOMBOLIMBO	White Gombolimbo
33	BULLHOOF[FEMALE	Female Bullhoof
34	EREDMASH	Cypress
37	WILG GRAPE	Wild Grape
37	BLACK GRAPE	Wild Grape
37	WILA GRAPE	Wild Grape
37	WHITE GRAPE	Wild Grape
38	BAST. REDWOOD	Bastard Redwood
39	WILD MAMMMEE	Wild Mammee
39	WILAS MAMMEE	Wild Mammee
40	BARBAS JOLTE	Barba Jolote
40	BARBA JOLTE	Barba Jolote
40	BARBAJOLTE	Barba Jolote
40	BERBA JOLOTE	Barba Jolote
41	FIDDLE WOOD	Fiddlewood
41	FIDDLWOOD	Fiddlewood
43	WIDE LEAF OAK	Oak
43	MOUNTAIN OAK	Oak
43	HIGH RIDGE OAK	Oak
45	SILLYYOUNG	Sillion
45	SILLLY YOUNG	Sillion
45	SILIONN	Sillion
45	SILION	Sillion
45	RED SILION	Sillion
45	RED SILON	Sillion
45	WHITE SILION	Sillion
46	LACHE MARIA	Santa Maria
46	]SANTA MARIA	Santa Maria
46	LECHE MARIA	Santa Maria
47	BAST. MAHOGANY	Bastard Mahogany
47	BAST.MAHOGANY	Bastard Mahogany
50	WOLD ORANGE	Wild Orange
50	ORANGE TREE	Wild Orange
51	JOHN CROWWOOD	John Crow Wood
51	JHON CROW WOOD	John Crow Wood
51	HESMO	John Crow Wood
51	JANKAWOOD	John Crow Wood
51	JOHN CROW WOOD	John Crow Wood
51	QUEMA JUSTAN	John Crow Wood

52	SOFT STICK	Softstick
52	SOFTSIICK	Softstick
55	RAMON	Red Breadnut
55	BRFEADNUT	Red Breadnut
55	RED BDEADNUT	Red Breadnut
55	BREDNUT	Red Breadnut
56	WHITE BRAEDNUT	White Breadnut
56	AHITE BREADNUT	White Breadnut
56	W.BREADNUT	White Breadnut
56	WHITE BREANUT	White Breadnut
56	WHITE BRERADNUT	White Breadnut
56	BREADNUT	White Breadnut
56	BREANUT	White Breadnut
56	W. BREADNUT	White Breadnut
56	WHITE BREADNUT	White Breadnut
57	NARGUSTAA	Nargusta
57	NAGUSTA	Nargusta
57	NARGUSTAOD	Nargusta
59	BITTER WOOD	Bitterwood
61	GLASSY WOOD	Glassywood
61	GLASSYWOOOD	Glassywood
62	WAYABILLO	Wild Guava
63	ACIETUNA	Aceituna
64	WILD CHERRY	Cherry
66	CPOJOTONE	Cojotone
66	CAJOTONE	Cojotone
66	HORSE SEED	Cojotone
67	MAYFLLOWER	Mayflower
67	MAY FLOWER	Mayflower
70	RED CARBON	Carbon
70	CORBON	Carbon
71	PALUMULATO	Palo Mulatto
71	PALOMULATO	Palo Mulatto
71	PALO MULATO	Palo Mulatto
72	1LLSPICE	Allspice
72	ALLSPIOCE	Allspice
73	SAPODILLO	Sapodilla
73	SAPODILA	Sapodilla
73	CHIQUIBUL	Sapodilla
73	SPODILLA	Sapodilla
73	SAPODILLA	Sapodilla
73	SAPOTE	Sapodilla
74	B. POSION WOOD	Black Poisonwood
74	B. POISON WOOD	Black Poisonwood
74	BBLACK P. WOOD	Black Poisonwood
74	BLACK P. WOOD	Black Poisonwood
74	B.POISON WOOD	Black Poisonwood
74	BLACK P. WOOD	Black Poisonwood
74	BLACK P.WOOD	Black Poisonwood
75	POISON WOOD	White Poisonwood
75	POISONWOOD	White Poisonwood
75	W. POISONW00D	White Poisonwood
75	W. POISONWOOD	White Poisonwood
75	WHITE W. WOOD	White Poisonwood
75	W. POISON WOOD	White Poisonwood
75	WHITE P.WOOD	White Poisonwood
75	W. POISONW00D	White Poisonwood
75	WHITE P. WOOD	White Poisonwood
75	PIOSONWOOD	White Poisonwood
75	WHITE P. WOOD	White Poisonwood
75	W. POSIONWOOD	White Poisonwood
75	W. POISIONWOOD	White Poisonwood
76	B.CABBAGE BARK	Black Cabbage Bark
76	BK.CABBAGE BARK	Black Cabbage Bark
76	B. CABBAGE BARK	Black Cabbage Bark
77	W. CABBAGE BARK	White Cabbage Bark
77	W.CABBAGE BARK	White Cabbage Bark
78	WHT.MYLADY	Mylady
78	WHT. MYLADY	Mylady
78	FEMALE MYLADY	Mylady
79	1RONWOOD	Ironwood
79	IROMWOOD	Ironwood
81	FIASAN	Faisan
82	MAMMEY CIRUELA	Mamey ciruela
82	MAMYE CIRUELA	Mamey ciruela
82	MAMET CIRUELA	Mamey ciruela
82	W.MAMEY CIRUELA	Mamey ciruela
82	MAMEY CIRUELLA	Mamey ciruela
83	GANARO WOOD	Granadilo
83	GRANADILLO	Granadilo
83	GRANDILLO	Granadilo
84	BAST.ROSEWOOD	Bastard Rosewood
84	BAST. ROEWOOD	Bastard Rosewood
84	BAST. ROSE WOOD	Bastard Rosewood
84	BAST. ROSEWOOD	Bastard Rosewood
85	ROSE WOOD	Rosewood
86	PASSAS	Black maya
86	PASAS	Black maya
86	WHITE MAYA	Black maya
86	BKACK MAYA	Black maya
86	RED MAYA	Black maya
88	AXE MASTER	Axemaster
88	AXEMASSTER	Axemaster
88	AXEMASTERR	Axemaster
89	PORROT	Parrot
89	PARROT STICK	Parrot
90	PIGOEN PLUM	Pigeon plum
90	PIGEON WOOD	Pigeon plum
91	MONKEY STONE	Monkey Apple
92	LOCUST	Wild Locust
101	BAY LEAF	Botan palm
101	WILD PALM	Botan palm
101	RED BOTAN	Botan palm
101	MAY LEAF	Botan palm
101	BAYLEAF	Botan palm
103	UNNKNOWN	Unknown
103	UNKNNOWN	Unknown
103	UNKNON	Unknown
103	'' '' ''	Unknown
103	UNKNOWN FL.	Unknown
103	'' '' ''	Unknown
103	UNKNKOWN	Unknown
103	UBKNOWN	Unknown
103	UNKNOWN F.L	Unknown
103	`	Unknown
103	UMKNOWN	Unknown
103	]UNKNOWN	Unknown
103	UNKNOWN H.L	Unknown
103	UNKOWN	Unknown
103	53	Unknown
106	MATA PALO	Matapalo
106	MATAPOLA	Matapalo

108	RED COPAL	Copal
108	WHITE COPAL	Copal
108	RED COPLAL	Copal
108	WILD COPAL	Copal
109	TA MAI	Tamay
112	CLAUSIA	Clusia
112	CLUASIA	Clusia
114	CERBATANA	Cerbetana
115	RED MYLADDY	Red mylady
115	REDMYLADY	Red mylady
116	CONTE MO	Cantemo
117	WILD LIME	Limoncillo
117	LEMONCILLO	Limoncillo
118	JAC SABAC CHE	Saba che
118	SABACHE	Saba che
118	SABAC CHE	Saba che
118	SABULCHE	Saba che
118	JAC-SABACHE	Saba che
120	COCOA	Madre cacao
120	WILD COCOA	Madre cacao
120	MADRE CACAO	Madre cacao
121	WILD . APPLE	Wild c. apple
121	WILD APPLE	Wild c. apple
121	CUSTARD APPLE	Wild c. apple
121	WILD C.APPLE	Wild c. apple
121	WILD .C APPLE	Wild c. apple
121	WILD C, APPLE	Wild c. apple
123	PIXOY	Bay cedar
123	BOXH TZOL	Bay cedar
123	RED BAY CEDAR	Bay cedar
123	BAYCEDAR	Bay cedar
124	SAPOTILLO	Sapotillo
124	SAPOTILO	Sapotillo
124	CHICLE MACHO	Sapotillo
124	SAPATILLO	Sapotillo
127	PRICLY YELLOW	Prickly yellow
127	PRIKLY YELLOW	Prickly yellow
127	PRICKY YELLOW	Prickly yellow
128	ZACUL CHE	Zaculche
131	BASDARD CEDAR	Bastard cedar
131	BASSTARD CEDAR	Bastard cedar
131	BASTARD CEDAR	Bastard cedar
131	BATSARD CEDAR	Bastard cedar
131	BASTRAD CEDAR	Bastard cedar
131	BASTAD CEDAR	Bastard cedar
131	BAST. CEDAR	Bastard cedar
132	HORMIGILLO	Hormiga
132	HOMIGILLO	Hormiga
134	TASAB	Tastab
135	SIC CHICA	Sikiya
135	SIC CICHE	Sikiya
136	KATALOSH	Katalox
136	KATALON	Katalox
138	XHOLOL	Tzol
138	TSOL	Tzol
139	PUMKIN STICK	Pumpkin stick
140	FRINGI PANI	Frangi pani
141	COUHNE PALM	Cohune palm
141	COHUNNE PALM	Cohune palm
142	DRAGON TREE	Dragon stick
143	BULLHOOF (MALE)	Bullhoof
143	BULL HOOF	Bullhoof
145	MT.TRUMPET	Trumpet
145	MOUNT.TRUMPET	Trumpet
145	TRUMPETY	Trumpet
145	MT. TRUMPET	Trumpet
146	MAMEY APPLE	Mammee apple
147	LARUEL	Laurel
150	WILD CRABOO	Craboo
152	JUANPECH	Juan pech
152	QUAN PECH	Juan pech
153	BRAY BERRY	Brayberry
155	BLUE BLOSSOM	Blossom berry
156	SOAP SEED	Soapseed
157	HUHU	Huyu
157	HU-YUB	Huyu
157	HUYUB	Huyu
157	PUS OR HUBUH	Huyu
158	ABALO STICK	Abalo
158	AVALO	Abalo
161	WILD KINEP	Kinep
162	CANELLA NEGRO	Cinamon stick
162	CINNAMON STICK	Cinamon stick
162	WILD CINAMON	Cinamon stick
162	WILD CINNAMON	Cinamon stick
164	WILD COFFEE	Bastard coffee
165	WARRYSTICK	Warrywood
166	WORM WOOD	Wormstick
166	GUSANO	Wormstick
166	WORMWOOD	Wormstick
168	W. TAMARIND	Tamarind
168	WILD TAMARIND	Tamarind
169	OCHIOTE TREE	Achiotillo
169	ACHOTILLO	Achiotillo
171	WAIKA PINE WOOD	Waika pinewood
171	WWAIKA PINEWOOD	Waika pinewood
175	ISINCHE	Ishinche
175	IASHIM CHE	Ishinche
175	ISHIM CHE	Ishinche
175	ISHIM TE	Ishinche
175	ISHINTECH	Ishinche
175	ISHIN CHE	Ishinche
176	TURTLE BONELE	Turtlebone
176	TURLEBONE	Turtlebone
176	TURTLE BONE	Turtlebone
177	SUCURUCH	Sacuruch
178	MANO DE LEON	Mano de lion
178	MAHO DE LEON	Mano de lion
180	SUBUL	Sibul
181	COPAL CHI	Copalche
182	OREJA DE MICO	Oruja de mico
184	SACUCHE	Sakulche
184	SACHUCHE	Sakulche
184	SACULCHE	Sakulche
185	BOB	Boy job
185	RED BOY JOB	Boy job
185	BOYJOB	Boy job
186	HAAS CHE	Haasche
186	HA AS CHE	Haasche
188	WACAMAYA	Guacamallo
188	GUACAMAYA	Guacamallo
188	GACAMALLO	Guacamallo

188	GUACAMAYO	Guacamallo
191	BANANASTICK	Banana stick
191	BANNA STICK	Banana stick
192	POWER STICK	Powder stick
192	BAKING POWDER	Powder stick
197	WHITE BRI BRI	Bri bri
197	RED BRI BRI	Bri bri
197	BRIBRI	Bri bri
197	BRI-BRI	Bri bri
198	OURRATEA	Ouratea
198	OROTIO	Ouratea
198	OROTEA	Ouratea
200	P. CARIBEIA	Pine
202	COCKS SPUR	Cockspur
202	COCK SPUR	Cockspur
205	WILD PAWPAW	Wild papaw
205	WILD PAPAYA	Wild papaw
206	KASTCAT	Kascat
206	KNASTE	Kascat
208	RUBBER TREE	Rubber
209	KA NAN	Kanshan
214	LUN LUN	Luwin
214	LUNLUN	Luwin
215	HAS CHE	Asche
215	AM CHE	Asche
217	SAC WAYUM	Sackayom
217	SAC WA YUM	Sackayom
218	BEEF WOOD	Beefwood
219	CORNSTICK	Corn stick
220	TZU UNU UNTE	Tzu tzni
221	CADO BENGO	Cacho venado
221	CACHO VEVADO	Cacho venado
221	CADA BENGO	Cacho venado
221	CACHITO	Cacho venado
223	BULLRT TREE	Bullet tree
228	WILD MANGROVE	Mangrove
228	WHITE MANGROVE	Mangrove
230	SUNUN TE	Sunte
230	SU NUN TE	Sunte
230	SUN TE	Sunte
231	PRICKLE TREE	Cross prickle
231	CROSS PICKLE	Cross prickle
231	CROSS PICKLE	Cross prickle
232	WILD TOBACO	Wild tobacco
233	MURACHO	Morucho
233	MOROCHO	Morucho
236	COHLOCK	Coallock
237	YELLOW STICK	Yellow wood
239	PUPU TE	Pupute
240	WILD NATA	Wild anatto
240	WILD ANATO	Wild anatto
241	HA HA TEE	Cabbage palm
242	CACATEE	Caca tee
242	CA CA TE	Caca tee
244	CHI CHI CASTE	Chichicaste
244	CHICHI CASTE	Chichicaste
245	TUL MASH	Tulmash
245	TULUMASH	Tulmash
250	SU SU	Susu
251	MONKEY CALABASH	Calabash
252	U KAN	Ucan
252	OKAN	Ucan
253	MULUCTEE	Mulacte
253	MULACTEE	Mulacte
253	MOLACTE	Mulacte
253	MULACTU	Mulacte
255	BA LA MASH	Balam mash
255	BALAMASH	Balam mash
255	BALA MASH	Balam mash
256	CHAN-TE	Chan te
258	TU CHIM	Tuchim
258	TUCHUM	Tuchim
259	DE RESH MASH	De resh mesh
259	ERD MASH	De resh mesh
260	MUL BA	Mut ba
269	HUNUNTE	Huum che

Appendix H : Permanent Sample Plot Data Entry

1. Introduction

(i) This document describes how permanent sample plot (PSP) data may be entered in the computer using the dBASE IV package, listed and checked for data entry errors, and plotted as a tree position map via the SYSTAT package. The procedures used have been kept as simple as possible, using elementary commands and functions rather than programs, in order to provide a learning path into Dbase and Systat. More elaborate programs could be written that would provide online checking of data, rather than batch checking as is demonstrated here. However, the programming procedures involved are quite complex, and would tend to create a dependence on external consultants for improvement or modifications. This ultimately would hinder the acquisition of skills within the Forestry Department.

2. Preliminary requirements

(i) The user will normally have his machine configured with three directories that are of relevance:

(ii) The Dbase directory, in which the main Dbase 4 files reside.

(iii) The Systat directory, containing the various Systat modules.

(iv) A data directory, in which the PSP data and output files will reside. For compatibility with the commands shown here, the user should define a pseudo-drive D: for this data directory. For example, if the user has C:\PSP set up to contain the PSP data and other files, the DOS command:

SUBST D: C:\PSP

will create the required pseudo-drive.

(v) It will be found helpful to run the DBSETUP program to define D: as the default path for dbase files, or alternatively, C:\PSP (or its equivalent) as the default directory. If this is not done, then the user should issue the command:

SET DEFAULT TO D:
or SET DIRECTORY TO C:\PSP

at the dot prompt, on entry to Dbase.

(vi) Dbase is normally configured to start in the ASSIST menu system. Although the simple commands described here can be effected from ASSIST via menu choices, it is a cumbersome process. Dependence on ASSIST blocks the process of learning about Dbase, which is essentially a command driven system. The user should therefore exit from ASSIST using the Esc key, and move to the Dot prompt.

(i) The PSP data is stored in file PSP1T.DBF, which has the structure shown in the box opposite. This corresponds directly to the field forms, with the addition of two fields. POM stores notes on the point of measurement height as a decimal number. CHKSUM is the sum of each line of numerical data.

```
Structure for database: D:\PSP1T.DBF
Number of data records:     27
Date of last update  : 22/11/92
Field  Field Name  Type       Width    Dec    Index
    1  PNO         Numeric        3           N
    2  QNO         Numeric        2           Y
    3  TREE        Numeric        4           N
    4  SPP         Numeric        3           N
    5  DIAM        Numeric        5      1    N
    6  DISTE       Numeric        4      1    N
    7  DISTS       Numeric        4      1    N
    8  HEIGHT      Numeric        4      1    N
    9  CS          Numeric        1           N
   10  CF          Numeric        1           N
   11  CL          Numeric        1           N
   12  POM         Numeric        4      1    N
   13  NOTES       Character     14           N
   14  CHKSUM      Numeric        6      1    N
** Total **                      57
```

Box 1 : Structure of PSP dbase file

(ii) The field names used may appear cryptically short. This is to allow the default browse command to fit all the column headings onto one screen. Longer names (eg CROWN_STAT instead of CS) would require wider columns.

(iii) Data entry is initiated using the commands shown in box 2. The SET CARRY command ensures that the plot and quadrat number are automatically repeated as new lines are entered. The SET CONFIRM command requires the user to press **Enter** to move between fields. This is more ergonomically efficient than the default, which moves the cursor as each field is filled, as it allows the operator to settle into a rhythm.

(iv) The BROWSE command brings up the full screen editor. The user can use arrow keys, **PgUp** and **PgDn**, and so on to move through the data. The **Tab** or **shift-Tab** keys are generally convenient for moving quickly to a column. Lines can be added as required. **Ctrl-U** deletes lines. However, Dbase behaviour in respect of record deletion is quite peculiar. A deleted record is simply marked as such, and not physically removed. A menu is available and can be accessed by pressing F10. When editing or data entry is completed, the user should exit back to the dot prompt with **Ctrl-End**. The Esc key also returns to command mode, but changes on the line on which the **Esc** is issued will not be saved to file.

```
USE PSP1T
SET CARRY TO PNO,QNO
SET CONFIRM ON
BROWSE
```

Box 2 Commands to edit PSP data

(v) It is suggested that species codes and check sums are entered for each quadrat manually before starting entry on the computer.

(vi) A weakness of Dbase, in common with many database packages, is that data is lost if the system crashes while a file is open. This data loss may occasionally so corrupt the file that it is unusable without special recovery programs. To limit the damage from such events, it is recommended that a

backup copy of the file is made to diskette after each work session.

4. Listing and verifying data

(i) The Dbase report generator has been used to produce a program for listing and checking data. This is called CHECKSUM. This report can be modified as required, by using the command:

```
MODIFY REPORT CHECKSUM
```

To produce a listing of PSP data on the printer, type:

```
REPORT FORM CHECKSUM TO PRINTER
```

Similary, a report to a file for inclusion in word processed documents can be produced by a command such as:

```
REPORT FORM CHECKSUM TO FILE PSPLIST.PRN
```

(ii) The form is called CHECKSUM because, apart from listing the data, it also prints a flag for each line where a checksum error occurs. The output uses the printer default type size. To print on standard US letter paper (8.5" x 11"), the printer should be set to print at 17 cpi before issuing the REPORT FORM command.

(iii) In order to keep the initial usage as simple a possible, species names have not been added to this output listing. However, they can be added if the database file SPECIES is present in the PSP directory through the following steps:

(iv) Assign the SPECIES file to a work area and open it with the commands:

```
SELECT 2
USE SPECIES ORDER TAG SPP ALIAS SP
```

(v) Revert to the original work area and open the PSP file with:

```
SELECT 1
USE PSP1T
```

(vi) Make a working copy of the report file from DOS to a file such as PSPLIST with the command:

```
!COPY CHECKSUM.* PSPLIST.*
```

(vii) Start the report generator using the working copy:

```
MODIFY REPORT PSPLIST
```

The report generator screen will appear. To learn how to manipulate the fields on the screen, refer to the Dbase report generator documentation. The existing fields to the right of the Species Code column

should be moved about 22 spaces right to make room for a 20 character species name.

(viii) Add a calculated field in the space created based on the function:

```
LOOKUP(SP->LNAME, SPP, SP->SPP)
```

Refer to the Dbase documentation for an explanation of the LOOKUP function. The SNAME field can be used in place of LNAME to return the botanical rather than local name. The Picture option of the Field menu should be selected to edit the field width to 20 characters.

(ix) Exit from the report generator with **Ctrl-End** to save changes. Run the new report with:

```
REPORT FORM PSPLIST TO PRINTER
```

(x) Note that the additional width of the report will mean that wide or landscape oriented paper must be used for printing. If US letterhead is used sideways (landscape mode), the page length should be changed by making the assignment:

```
_plength=48
```

This should be done immediately before the REPORT command.

5. Plotting tree positions with SYSTAT

(i) Tree positions can easily be plotted using SYSTAT. The output can be sent to a printer or plotter. To achieve this, a copy of selected columns is made in Dbase. The following commands are issued:

```
USE PSP1T    (if the file is not already in use)
COPY TO P1Q1 FIELDS TREE,DIAM,DISTE,DISTS FOR QNO=1
```

(ii) The output file P1Q1 will contain the selected columns for quadrat one.

(iii) The TREE field is of numeric type (see Box 1) and must be converted to character type before importing the P1Q1 file into SYSTAT. This is necessary so that the tree numbers can be plotted in SYSTAT using the LABEL option. This done with the following commands:

```
USE P1Q1
MODIFY STRUCTURE
```

(iv) The MODIFY STRUCTURE command displays an interactive screen. The data type of the TREE field should be changed from Numeric to Character, and the screen exited with **Ctrl-End**. The user should then QUIT from Dbase.

(v) It is assumed that the SYSTAT modules will be in a directory called C:\SYSTAT. The data files are assumed to be in directory D:\, which has been logically substituted for a real directory, as explained in paragraph 2..(iv) above.

(vi) The sequence of commands required to produce the plot output are shown in

Box 3 below. From the DOS prompt, the user types DATA, and enters the DATA module. Here the Dbase file is imported and converted to a SYSTAT data file P1Q1.SYS. The user then types EDIT. The interactive data editor will appear, showing the data editing screen. The ESC key is used to move from this to a prompt, whence the user should type in the LET commands. These create two new variable columns.

```
data
fpath 'd:'
save p1q1
import 'd:p1q1.dbf' / type=dbase4
use p1q1

edit
let distn=20-dists
let dclass=int(diam/10)
save p1q1

sygraph

        mode plotter=hpp1 /file plotter.hgl
        mode printer=prx2

output plotter
plot distn*diste / label=tree$,xmin=0,xmax=20,
ymin=0,ymax=20,symbol=2,size=dclass,xpip=5,
ypip=5,grid=3,xlabel="Distance East (m)",
ylabel="Distance North (m)"
```

Box 3 : SYSTAT commands to plot tree map

(vii) DCLASS codes diameters into 10 cm classes, such that trees from 10 to 20 cm are in class 1, 20 to 30 in class 2, etc. This gives values such that the SIZE parameter on the PLOT statement will give different sized symbols for trees according to their diameter class.

(viii) DISTN is the inverse of DISTS. If the latter is used to plot the trees, then a mirror image of the plot will be obtained.

(ix) After completing these transformations, the user calls SYGRAPH. The MODE statements following can be issued interactively, but normally they are edited into the SYGRAPH$.CMD file in the SYSTAT directory. This latter file functions like AUTOEXEC.BAT in DOS, and is executed each time SYGRAPH is started. The MODE statements define output devices. In the example shown, plotter output is sent to a file called PLOTTER.HGL, which will probably be in the SYSTAT directory*. The plotter output will be in HPGL. The printer output is configured for the IBM Proprinter XL driver at medium resolution.

(x) The OUTPUT PLOTTER statement will direct output to the file PLOTTER.HGL. As alternatives, OUTPUT * will display the graph on the screen, and OUTPUT @ will send it to the printer.

(xi) The PLOT statement actually draws the tree positions. The DISTN and DISTE columns are used as x,y coordinates. The LABEL option labels each point with the tree number, and the SIZE option causes the plotting symbol size to vary with the corresponding value in DCLASS.

---

* SYSTAT is a notoriously fickle program that produces error messages of Delphic inscrutability (or none at all). If the sequence of commands shown in the box are executed precisely without any error messages, the file PLOTTER.HGL should be in D:. If it is not found there, search for it in C:\SYSTAT, to which it will default. A similar caveat applies to the P1Q1.SYS file.

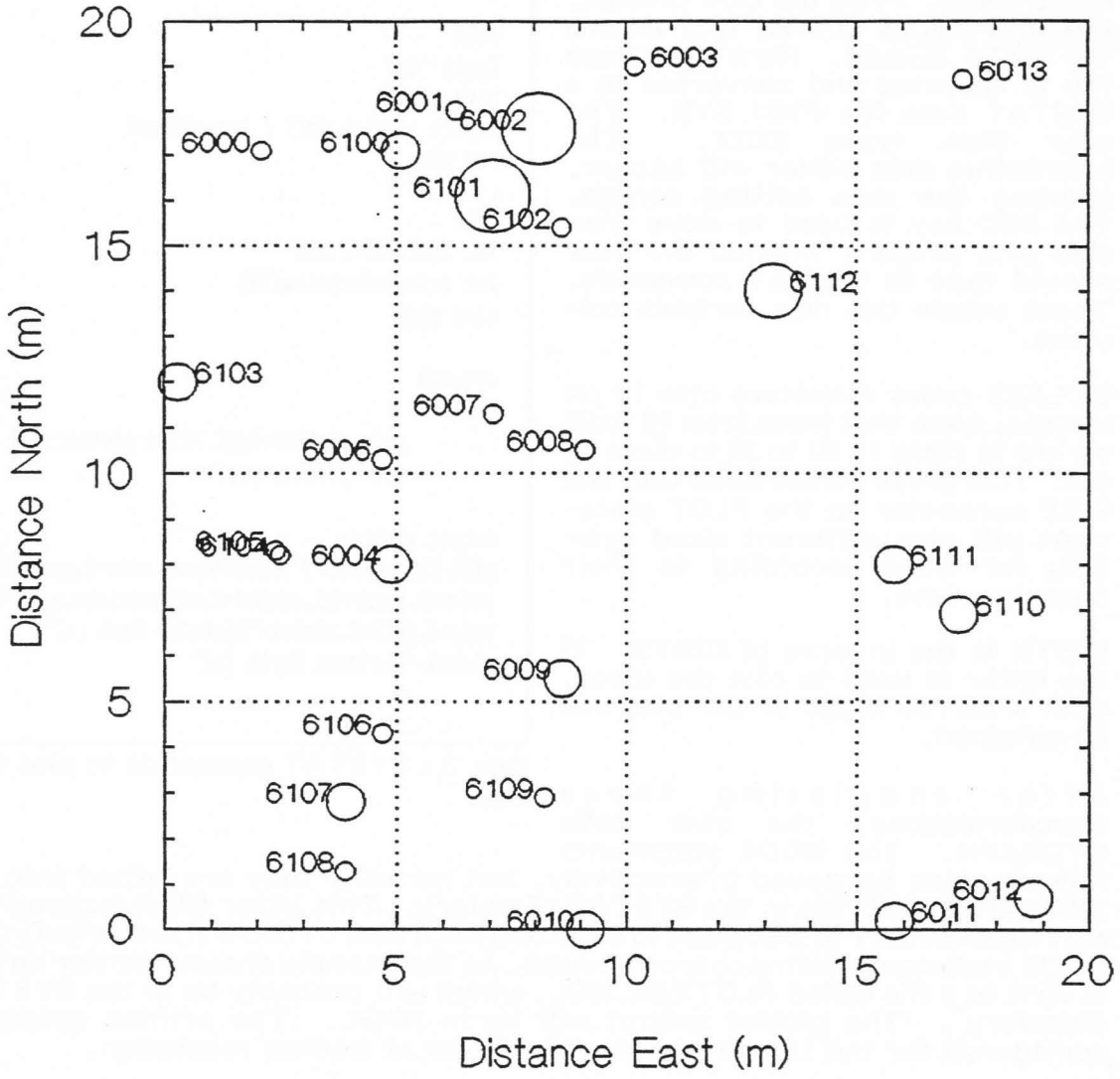

Figure 1 : Map of quadrat 1, PSP 1, showing tree identity numbers. Circle sizes represent 10-cm diameter classes.

(xii) More elaborate plots, involving the whole PSP, require more complex manipulations of the data and optimization of the plotting parameters. It is not practically possible to do this until a graph plotter is available for interactive development of the required programs.

(xiii) It is also possible, given the availability of a plotter, to produce direct HPGL output from within Dbase. This cuts out the rather complicated stages involved in importing the file to SYSTAT.

(xiv) The HPGL output file PLOTTER.HGL can be imported directly into Word Perfect 5.1 as has been done in the present document with Figure 1 above.