TRiCYCLE Manual

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by Peter Brewer and Daniel Murphy

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Chapter 1. What is TRiCYCLE

TRiCYCLE is a universal dendrochronology file format converter. It currently has support for reading and writing 18 different file formats:

Table 1.1. Dendro data formats supported by TRiCYCLE

Format	Read support	Write support
Belfast Apple	X	X
Belfast Archive	X	
Besancon	X	X
CATRAS	X	
Comma Separated Values (CSV)		X
Corina Legacy	X	X
Excel		X
Heidelberg	X	X
Nottingham	X	X
Past4	X	X
Sheffield	X	X
Topham	X	X
TRiDaS	X	X
TRIMS	X	X
Tucson	X	X
Tucson Compact	X	X
VFormat	X	X
WinDENDRO	X	

TRiCYCLE extracts both data and any metadata present in files and converts them to the Tree-Ring Data Standard (TRiDaS) data model. As TRiDaS is capable of representing the full range of dendro data and metadata, it is then possible to write out the file to any one of the supported formats.

Key features of TRiCYCLE are:

- Seamless support for units where possible
- Interpretation of all metadata
- Handling of different charactersets and line feeds from different operating systems
- Comprehensive warning and exception system which provides detailed feedback when errors are detected in files

For a complete discussion of TRiCYCLE and its underlying libraries please see [Brewer (in review)]

Chapter 2. Installation

TRiCYCLE is a Java application and so can be installed on any modern operating system. To make installation more familiar though we have packaged it up into native installers for Windows, Mac OSX and Linux. Download the relevant package for your operating system from the SourceForge [http://tridas.sf.net] website.

Windows
: Run the setup program and follow the steps. The program will be installed to your hard disk and shortcuts added to your start menu. If you do not have Java installed on your system or you do not have the required version the installer will provide you with assistance to do so.

MaxOSX
: Open the .dmg file in Finder. Drag the TRiCYCLE.app file into your Applications folder, or wherever you'd like it installed. MacOSX comes pre-installed with Java so there is no need to install it separately.

Linux
: An Ubuntu deb package is provided for TRiCYCLE. Install this package with your standard package manager (e.g. sudo dpkg --install TRiCYCLE_X.X.deb). It includes information on the required dependencies therefore it should install everything you need if you are running Ubuntu. On other distributions you may find that the dependencies do not install automatically and the TRiCYCLE installation fails. If this is the case you will have to install sun-java6-jre first manually.

Chapter 3. How to use TRiCYCLE

The first step is to specify the format of your input file(s). Choose your input file format from the pull down list on the File List page. Then you need to specifiy the file(s) that you would like to convert. This can be done in a variety of ways:

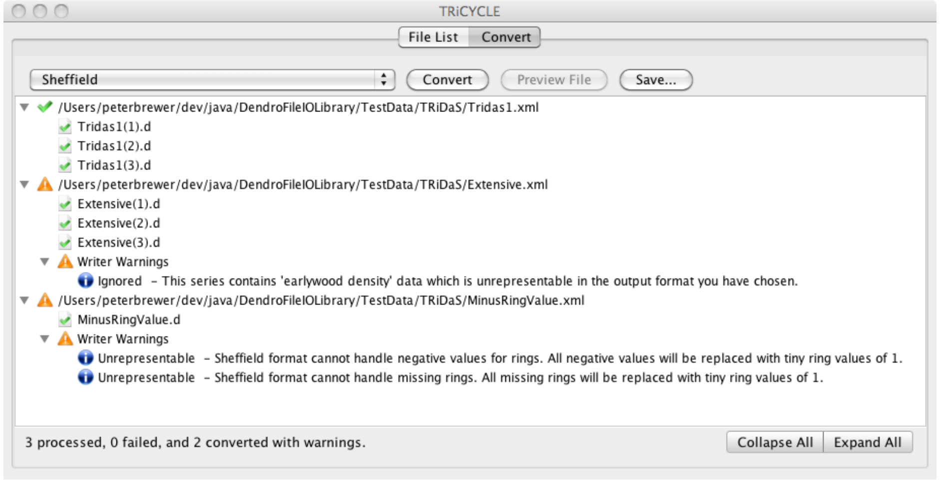
- Click the browse button
- Use the File > Open menu
- Drag files onto the dialog box from your file manager (e.g. Finder on MacOSX, My Computer on Windows or Nautilus, Dolphin, Konqueror etc on Linux).

Once you have your list of files prepared you can then go to the Convert tab.

On the Convert page, the next thing you need to do is select the desired output format from the drop down list. Next, press the convert button and after a short delay your files should appear in the list below. At the bottom of the window, you'll see a summary showing how many files were processed, how many of the convertions failed and how many were converted successfully but with warnings.

The results of the conversion are shown in a tree view on the convert tab. Files that failed to convert are highlighted by a red cross along with a message explaining what went wrong. Each file that converted successfully and with no warnings is shown with a green tick icon below which are shown the output file or files. Depending on the input and output formats chosen, a input file may be converted into one or more output files as some formats can store just one series while others can store multiple series.

Figure 3.1. Screenshot showing the conversion of three TRiDaS files into Sheffield format. The second and third files both include warnings that the Sheffield format is unable to fully represent all the data in the input files.



If there were warnings produced during the conversion process, then the file will be marked with a orange exclamation icon. Warnings can be associated with either the process of reading the input file, or writing the output file. They can also be related to a single series within the file or the input file as a whole. The warning messages are displayed to illustrate the context of the warning. Longer warnings will scroll of the edge of the window, but if you hover your mouse over the warning a tooltip will show the entire message.

If you would like to preview the result of the conversion process you can double click on the output files and they will be displayed in a text viewer. This option is not, however, available for binary formats such as CATRAS and Excel.

Once you are happy with the results of the conversion you can save the files permanently to disk by pressing the save button. It will offer you the option of specifying which folder to save the files to.

Chapter 4. Options

The options panel is available from the file menu. It is split into two sections: Reader config and Writer config.

Character sets

The character set can be set for both the file being read and the file being written. The character set is the system for pairing computer character codes with the character glyphes that we read. The widely used standard was originally ASCII, but this does not include diacritic characters, and characters specific to certain languages. There have since been many character encodings proposed (e.g ISO 8859-1 for Western Europe and ISO 8859-7 for Greece) as well as some that are specific to Windows and Mac operating systems (e.g. Windows-1252 and MacRoman). The character set that is becoming most widely used is Unicode UTF-8. This is capable of representing all 107,000+ distinct characters while remaining backwards compatible with ASCII for the 128 characters that it is able to represent.

If an incorrect character encoding is used to interpret a file, normally the majority of characters will display correctly (where the character sets share the same encodings) but more unusual characters will be displayed incorrectly - typically square boxes or question marks.

TRiCYCLE can using the NIO package to attempt to automatically detect which encoding a file is in. Unfortunately, there is no full-proof way to do this, so by default, this feature is turned off. If you are having problems with character encodings you may like to choose 'Automatic' in the charset box if you have no idea what character encoding your file is in.

The character encoding is set to the default for the operating system you are running. For instance on MacOSX this will be MacRoman and for Windows it will be Windows-1250. If you know your input file is in a different encoding you should set it in the input charset box. If your output file needs to be read on an operating system other than the one you are currently running, then you may like to override the writer charset. Please note that for certain writers, the character set used is part of the file specification (e.g. TRiDaS must be UTF-8). In this case your choice will be ignored.

The final complication with regards character sets is the line feed character(s). For historical reasons different operating systems use different characters to represent a new line. Depending on the software that is used to read a file, this can cause problems. TRiCYCLE itself will automatically adapt to files with any type of line feed characters so reading files in TRiCYCLE will never be a problem. When writing out files, TRiCYCLE will use the default line feed for the operating system you are running, unless you choose a platform specific character set. For instance if you run TRiCYCLE on Windows and choose a MacRoman writing charset, TRiCYCLE will use Mac style line feeds.

Metadata editor

TRiCYCLE works by reading in a data file and translating it into the TRiDaS data model. TRiDaS has a rich array of fields to represent all manner of dendro data and metadata. Although most of these are optional, the TRiDaS specification requires that a handful of these are always filled in. Unfortunately many of the legacy data formats do not contain information for these mandatory fields, therefore TRiCYCLE must fill these with default values. You will most commonly see these defaults as 'Unnamed object' etc in your output file. The metadata editor enables you to override these default values.

Clicking on the reader metadata editor button in the options window will give a table of all the metadata fields that will be set automatically by TRiCYCLE along with their current values. You can change most of these with the exception of those that are required to be a controlled vocabulary. These will require a more complicated interface which we haven't had time to implement yet. The third column in the editor is a tick box to specify whether the value is overriding or not. If ticked, the value specified in this editor will be used regardless of whether a value can be extracted by TRiCYCLE from the input datafiles.

An identical editor is available for the writer. These are the default values used by the writer code for your chosen output format. For instance, TRiDaS does not require that a start year field be set (as in the case of relatively dated series), whereas some output formats do require such a field. If an input file does not contain start year information then some writers need to know which default value for start year to use. Like for the input metadata editor, you can set fields to 'overriding' which means they will be used regardless of whether this information is available in the input dataset.

Naming convention

Some file formats can contain just one data series while others can contain many. When converting from a multi-series format to a single series format this means that one input file is converted to multiple output files. The naming convention is used to determine how to name the output files. The naming convention relates to the filename itself and not the file extension. The file extension is specific to the output format chosen (e.g. Heidelberg files are .fh and TRiDaS files are .xml).

Numerical
: This is the default naming convention. It uses the name of the input data file and appends an incrementing number if more than one output file is produced.

UUID
: This gives all output files a random named based on Universally Unique Identifiers (UUIDs). This is a 36 character hexidecimal code which due to the astronomically large number of possible combinations is guaranteed to be universally unique. A typical filename will look like: 550e8400-e29b-41d4-a716-446655440000.

Hierarchical
: This uses the hierarchical structure of the TRiDaS data model to provide a meaningful name for the output file. It joins together the title of each entity in the file beginning with the project name through to the series name. For files that contain multiple series, the name will contain details of all the entities shared by all the series in the file. For example, if a file contains several series from the same sample, then the file name will be projectTitle-objectTitle-elementTitle-sampleTitle. If the file contains several series from different samples of the same object, then the file would be projectTitle-objectTitle. If multiple output files end up with the same name then like the numerical convention described above, the files will have an incremental number appended to the end. Unfortunately, most input data files do not contain rich name information so files end up being called unnamedProject-unnamedObject-unnamedElement etc. This convention is therefore more appropriate when converting from TRiDaS to other formats.

Chapter 5. Help and more information

The best place to start is through the TRiDaS website (www.tridas.org [http://www.tridas.org]) and the Dendro Data Standards forum. The forum is a email list for the discussion of TRiDaS and other dendro data standards issues. It is open for all to join by emailing Peter Brewer [mailto:p.brewer@cornell.edu].

TRiCYCLE is an open source product therefore we are very pleased to welcome anyone that would like to assist in its development. This obviously includes programmers, but also people willing to help with documentation and translations too. To find out more information please contact Peter Brewer [mailto:p.brewer@cornell.edu].

Chapter 6. Descriptions of file formats

Belfast Apple

Table 6.1.

Format Name	Belfast Apple
Other names	None known
Type	Text file
Extension(s)	Various (includes txt and dat)
Read/write support	Read and write
Reference implementation	No original software is known to exist so TRiCYCLE is proposed as the reference implementation
Data/Metadata	Data only with comment
Single/Multi series	Single
Original designer	John Pilcher

Description

Belfast Apple is a simple text file format (see also Belfast Archive [/corina-manual/Belfast Archive]) originating from the Queens University Belfast lab and originally designed for use on an Apple II computer. This format is not known to be actively used but a large amount of data (especially at Belfast) is archived in this format.

- Line one contains the name of the site or object the data refers to.
- Line two contains the identifier for the sample the data refers to.
- Line three contains the number of data values in the file
- Lines four onwards contain line feed delimited data values as integers in 1/100th mm
- Final line contains a comment typically starting with 'COMMENT -'

Example file

```
FLAG FEN
A1805
106
188
165
184
112
103
111
```

```
239
226
132
143
146
140
100
176
139
124
115
78
80
156
75
110
80
130
83
157
99
115
102
110
108
87
135
107
96
70
128
119
86
101
106
129
88
101
151
106
97
110
97
91
93
100
124
99
134
125
105
96
107
142
```

```
100
208
233
149
81
221
178
140
179
84
121
169
137
190
128
150
113
150
99
238
128
170
101
110
124
143
184
142
221
99
125
121
162
132
100
152
184
178
195
106
90
91
84
95
115
122
COMMENT -   JN 10-NOV-90
```

Belfast Archive

Table 6.2. Summary for the Belfast Archive file format

Format Name	Belfast Archive

Other names	None known
Type	Text file
Extension(s)	Various (includes arx, txt and dat)
Read/write support	Read only
Reference implementation	No original software is known to exist so TRiCYCLE is proposed as the reference implementation
Data/Metadata	Data with limited metadata
Single/Multi series	Multi
Original designer	Martin Munro

Description

Belfast Archive is a simple text file format based on the original Belfast Apple [/corina-manual/Belfast Apple] format at the Queens University Belfast lab. It shares the same features as Belfast Apple [/corina-manual/Belfast Apple] but with the addition of a number of metadata fields at the end of the file.

- Line 1 contains the name of the site or object the data refers to.
- Line 2 contains the identifier for the sample the data refers to.
- Line 3 contains the number of data values in the file
- Line 4 onwards contain line-feed delimited data values as integers
- The lines "[[ARCHIVE]]" and "[[END OF TEXT]]" denote the start and finish of the metadata section

The metadata section contains the following lines:

- Line 1 - start year as an integer.
- Line 2 - unknown
- Line 3 - Double representing the resolution of data values e.g. .1= 1/10ths mm, .01 = 1/100th mm, .001 = microns etc
- Line 4 - unknown
- Line 5 - unknown
- Line 6 - unknown
- Line 7 - Title of the data series
- Line 8 - unknown
- Line 9 - unknown

Example file

```
BELLFRAME
```

```
1
176
342
338
334
409
362
308
360
264
325
318
51
48
47
60
49
48
"[[ARCHIVE]]"
1277
9177
.01
1.035795
0.212144
IAN 21/01/96
TWYNING CHURCH #01
Pith F Sap 32
""
"[[ END OF TEXT ]]"
```

Besancon

Table 6.3. Summary of the Besancon file format

Format Name	Besancon
Other names	SYLPHE
Type	Text file
Extension(s)	Normally .txt
Read/write support	Read and write
Reference implementation	
Data/Metadata	Data and some structured metadata
Single/Multi series	Multi
Original designer	Georges Lambert

Description

The Besancon format is most commonly used in a number of French laboratories. The designer of the format has produced a detailed description of the format than can be downloaded from here besancon-schema.pdf [/corina-manual/Besancon?action=AttachFile&do=get&target=besancon-schema.pdf]

The format allows for multiple series in the same file. Each series (or element block in Lambert's notation) is made up of a header line, optional metadata and a data block each of which are delimited by a line feed.

- The header line begins with a dot character, then one or more spaces, then an element name (without spaces) followed by a space and any number of ignored characters.
- The metadata fields are space or line feed delimited. Each field is recorded using a key of three letters. The format allows for the full spelling out of the field if preferred, but it is the first three letters that are read by software so LON is the same as LONGEUR. Some fields are 'unimodal' in that their presence is all that is required e.g. CAM means that cambium was observed. Other fields are 'bimodal' which means they require a value to be associated with them. In this case the field key is followed by a space and then an integer or string value e.g. POS 1950. The accepted metadata fields are as follows:
  - LON : Number of data values.
  - POS : The temporary first ring date given relatively to a group
  - ORI : The year for the first ring.
  - TER : The year for the last ring. Should be the same as ORI + LON
  - MOE : Pith present
  - CAM : Cambium present
  - AUB : Number of the first sapwood ring

All other information in the metadata block should be ignored. This feature is often used to allow the inclusion of multi-line comments.

- The data block begins with the marker line VAL (like metadata keys, subsequent characters are ignored so sometimes the rest of this line is used for comments). Subsequent lines contain integer values delimited by a space or line feed. Missing rings are marked with a comma character and the end of the data is marked with a semicolon.

Quirks and problems

- From the example file below you will wee that the MOE key is included which according to the specification means that pith is present. However, the additional characters that should be ignored according to the specification clearly show the user is marking the series as having pith not present.
- There is nothing in the specification to say what precision the data values should be in. Following conversations with users it appears that Besancon files are mostly 1/100th mm but this is not always the case. The inclusion of the Précision field in the example below suggests that some
- There are a number of additional fields that are commonly used but which do not appear in the format specification. These are also supported by the DendroFileIOLib
  - ESP : Species
  - ECO : Bark present

Example file

```
. ham22/13
 Lon 129
 Esp quercus sp  Nat lambris
 Précision 1/100
 Moelle non présente
 Aub 0
valeurs
  149  119  156  146  170  187  197  146  191  177
  137  108  160  108  120  177  136  174  190  109
  189  176  170  162  114  126  133  152  146  127
  119  131  146  133  147   82   57   77   77   82
   96   49   97   76   88   82   72   83   81   90
   85   87   78  104  111  132  141  105  104  120
  111  121  115   89   94   88   90  115  111  106
  107  120   80   92   98   84   97   82  100   86
   99   65   85  113   90   82   57   57   99   94
   95  105  120  110   93   96  131  133  123  122
  113  119   95  127   88  104    ,    ,    ,    ,
    ,    ,    ,    ,    ,    ,    ,    ,    ;

. ham22/08b
 Lon 116
 Esp quercus sp  Nat lambris
 Précision 1/100
 Moelle non présente
 Aub 0
valeurs
  143  116  150  154  159  140  153  110  128  138
  156  146  131  124  106  149  119   78   68   77
   85   88   94   85   78   87   84   79   84   76
   78   93   93   85   81  103  102  132  121   97
  101  122  117  103   96  112   95   88   91  111
  101  115  124   92  109   85   93   83  110   83
   80   78   98   94  112  121  126  119  121   95
   87  103   84   87   72   76   86   61  106  108
  103  102   92  100   90   98  108  115  126   95
   99  110   99   97  133   88  114   77   77   91
   91   83    ,    ,    ,    ,    ,    ,    ,    ,
    ,    ,    ,    ,    ,    ,    ;
```

CATRAS

Table 6.4. Summary of the CATRAS file format

Format Name	CATRAS
Other names	
Type	Binary
Extension(s)	.cat
Read/write support	Read only
Reference implementation	CATRAS

Data/Metadata	Data and limited structured metadata
Single/Multi series	Single
Original designer	Roland Aniol

Background

The CATRAS format is the only known binary dendro data format. As such it can't be read by a simple text editor, and can't be imported into spreadsheet or database programs. The format was designed by Roland Aniol for use in his program of the same name. The binary nature of the format means the files are typically much smaller than text files containing similar data. The closed nature of the format originally meant that users were tied to the application, much the fact that users can't manually edit the file means that the validity of files is not a problem like it is with most other dendro formats.

CATRAS is a closed format with no documentation. The format was originally decoded in the early 1990's and permission was granted by Aniol for a converter to be included in Henri Grissino-Mayer's CONVERT5 application on the condition that the format remained closed source. Subsequently others have independently released application and code that can read CATRAS files to a greater or lesser extent.

Following its original release in 1983, CATRAS was updated several times, the most recent version we've seen (v4.35) was released in 2003. Since then CATRAS appears to have been abandoned. As there has been no development of CATRAS, there is no access to the closed source code and all attempts to contact Aniol have failed, we are justified in publicly releasing details of the CATRAS format to ensure users data are not lost. The code in DendroFileIOLib is based on Matlab, Fortran and C code of Ronald Visser, Henri Grissino-Mayer and Ian Tyers.

Reading byte code

Reading byte code is more complicated than reading text files. Each byte is 8-bits and therefore can represent up to 256 values. Depending on the type of information each byte contains, the bytes are interpreted in one of three ways:

Strings

Some of the bytes in CATRAS files contain character information. In the case each byte represents a letter. In java an array of bytes can be directly decoded into a string.

Integers

As a byte can only represent 256 values, whenever an integer is required, CATRAS stores them as byte pairs. Each byte pair consists of a least significant byte (LSB) and a most significant byte (MSB). The order that they appear in files typically varies between platforms and is known as 'endianness'. As CATRAS solely runs of Microsoft (x86) processors we can safely assume that all CATRAS files will be using little-endian (i.e. LSB MSB). The counting in a byte pair therefore works as follows:

Table 6.5.

Value	LSB	MSB
0	0	0
1	1	0

2	2	0
...	...	...
255	255	0
256	0	1
257	1	1
258	2	1
...	...	...
65536	255	255

A byte pair can therefore store 256x256=65536 values (more than enough for most number fields). Matters are complicated though by the need to store negative numbers. In CATRAS pairs with an MSB<=128 are positive, while pairs with an MSB ranging from 255 to 128 (counting backwards) represent negative values

Categories

Categories are typically recorded as single bytes as most categories have just a few possible values. They can therefore be conceptualised as being integers where 0=first option, 1=second option etc. The exception to this is for species as there are more than 256 species. In this case, a byte pair is used in exactly the same way as described for integers above. The only problem for species is that the codes are unique to each laboratory and refer to values enumerated in a separate '.wnm' file. Without this dictionary the species code is of little use.

Dates

Dates are stored as three single bytes, one for day, one for month, one for year. With only 256 values available for 'year', all dates are stored with 2 digit years e.g. 25/12/84. When converting to TRiDaS all years >70 are treated as 20th century, whereas years <70 are treated as 21st century. This is an arbitrary decision for use in this library as CATRAS does not care either way.

Metadata

The first 128 bytes contain the file header information and the remainder of the file contains the ring width data and sample depth data. Our current understanding of the header bytes is as follows but I'm not convinced that these are all correct. Deciphering these requires painstaking work because we must try to ascertain how each byte is being used (e.g. as a byte pair, single byte or as a string):

- 1-32 - Series name
- 33-40 - Series code
- 41-44 - File extension
- 45-46 - Series length
- 47-48 - Sapwood length
- 49-50 - Start year
- 51-52 - End year
- 53 - 1=pith 2=waldkante 3=pith to waldkante

- 54 - 1 = ew only last ring
- 55-56 - Start year
- 59-60 species also needs a catras.wnm file
- 61-63 - Creation date
- 64-66 - Amended date
- 67 - Sapwood
- 68 - 1=valid stats
- 69-75 - dated?
- 84 - 0=raw 1=treecurve 2=chronology
- 85-86 - User id
- 89-92 - Average width
- 93-95 - Standard deviation
- 96-100 - Autocorrelation
- 101-104 - Sensitivity

Data

The remaining bytes in the file contain the actual data values stored as integer byte pairs. It appears that older version of CATRAS included one or more padding values of -1. These values should be ignored. The end of the data values are indicated by a stop value of 999.

Following the ring width data values there are 42 bytes of unknown meaning. These are then followed by byte pairs representing the counts/sample depth for each ring if the series is a chronology.

Unknown bytes

There are a number of bytes in both the header and data sections that are are unaccounted for and are therefore likely to contain data that we are ignoring. For this reason although we could attempt to create CATRAS files from what we know we can't be sure they would be valid:

- Header
  - 57-58
  - 69-82
  - 105-128
- Data
  - 0-42 following end of data marker

Comma Separated Values (CSV)

Table 6.6. Summary of the CSV file format

Format Name	Comma Separated Values
Other names	CSV
Type	Text file
Extension(s)	Various (includes txt and csv)
Read/write support	Write only
Reference implementation	N/A
Data/Metadata	Data only
Single/Multi series	Single (extension to multi possible)
Original designer	N/A

Description

Comma separated values format is a simple text format for representing tabular data. It is not specific to dendrochronology data and is supported by most spreadsheet and database applications. Data is delimited into columns using a comma character to indicate cell boundaries.

Dendro data is written one series per file, with column one containing the year value and column two containing an integer data value in 1/100th mm.

Example file

```
1960, 134
1961, 153
1962, 126
1963, 179
...
```

Corina Legacy

Table 6.7. Summary of the Corina Legacy file format

Format Name	Corina Legacy
Other names	Corina
Type	Text file
Extension(s)	Various (including raw, rec, ind, cln, sum)
Read/write support	Read and write
Reference implementation	Corina
Data/Metadata	Data and some structured metadata
Single/Multi series	Single

Original designer	Mecki Pohl

Description

The Corina Legacy format is the file format used by the Corina software prior to version 2, when it transferred to using TRiDaS [/corina-manual/TRiDaS]. The format was originally designed for use with the MS-DOS version of Corina but was also used as the native file format in the later Java versions (up to and including v1.1).

A Corina file contains yearly data (ring width and number of samples for that year), some fixed metadata, and optionally weiserjahre data and a listing of element samples (for summed samples).

The title comes first, on a line by itself, followed by a blank line. The title is repeated later, so this is only to make it easier for people or external programs to read the title.

The **metadata section** comes next. The syntax is `;TAG value`. Tags are all uppercase. Their order is fixed. Some values are terminated by a newline, others by the next semicolon. Valid tags, and their internal names are:

- ID - 8 character ID used when exporting to Tucson [/corina-manual/Tucson] format
- NAME - Name of the series
- DATING - Either R (relative) or A (absolute)
- UNMEAS_PRE - Number of unmeasured rings towards the pith
- UNMEAS_POST - Number of unmeasured rings towards the bark
- FILENAME
- COMMENTS, COMMENTS2 etc - Free text comments
- TYPE - either C (core), H (charcoal) or S (section)
- SPECIES
- SAPWOOD - Count of sapwood rings
- PITH - either P (present), * (present but undateable), or N (absent)
- TERMINAL - either B (bark), W (waney edge), v (near edge), vv (unknown)
- CONTINUOUS - referring to the outer ring, either C (continuous), R (partially continuous) or N (not continuous)
- QUALITY - either + (one unmeasured ring), ++ (more than one unmeasured ring)
- FORMAT - either R (raw) or I (indexed)
- INDEX_TYPE - type of index used
- RECONCILED - Y or N indicating whether the series has been reconciled against another series

The **data section** comes next and this always starts with the line `;DATA` and for reasons lost in time there are nine spaces afterwards.

Data lines come in pairs, the first line containing the year and data values, the second containing the sample depth/count for each value. For reasons unknown, the first and last data line pair have a slightly different syntax to the others.

- First data line begins with a space and an integer for the first year in the line. There then follows 9 spaces followed by the integer data value for the first ring. The remaining data values (often less than a full decades worth) on that line follow as integers left padded by spaces to take up 6 characters.
- The sample depth line that pairs with this follows next starting with 16 spaces, followed by the sample depth value enclosed in square brackets. The remaining sample depth values follow in square brackets left padding with spaces to take up 6 characters.
- Next comes the first normal data line. This begins with a space, followed by an integer year value. The data values follow as integers left padded by spaces to take up 6 characters. A data line has a decades worth of data values.
- Next comes the normal sample depth line. It begins with 7 spaces followed by each of the sample depth values enclosed in square brackets and left padded with spaces up to 6 characters.
- Data lines continue in pairs until the last line is reached. This is the same as a normal data line except it includes an extra data value 9990 as a stop marker. This data line may have less than a full decade of values.
- The final sample depth line is the same as normal except it is shifted left by 4 characters. A sample depth value is also included for the dummy 9990 stop marker year.

Following the data block there is a blank line and two option blocks of data that are only included if the file is a chronology file.

The next block of information in a chronology file is denoted by a line `;ELEMENTS`. The following lines contain the file names of the data files that have contributed to the creation of the chronology.

Following this is an optional block denoted by the line `;weiserjahre` followed by the weiserjahre data. Each weiserjahre data line begins with a space followed by a integer year value for the first year in the line. The weiserjahre value is left padded with spaces to fill 6 characters and the value itself is written as X/Y where X is the number of samples that show an upward trend in width; and Y is the number of samples that show a downward trend in width. The weiserjahre value is forward facing so the value for ring 1001 shows the trend between ring 1001 and 1002. There is therefore one less weiserjahre value in the final row than there are ring widths.

The final line of Corina data files contains the author's name preceded by a tilde.

Example files

Measurement series file

```
Trebenna Byz fortress 1A

;ID 907011;NAME Trebenna Byz fortress 1A;DATING R;UNMEAS_PRE 1;UNMEAS_POST 1
;FILENAME G:\DATA\TRB\TRB1A.RAW


;TYPE S;SPECIES Juniperus sp.;FORMAT R;PITH +
;TERMINAL vv;CONTINUOUS N;QUALITY +
;RECONCILED Y
```

```
;DATA
 1001         125   219   207   139    62   107    29    91    65
                [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1010    71   132    74   150    75   156   122    81    46    57
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1020   147    78    89   126    73   121    67    71    64   129
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1030   149   155   122   126    53   136    90    65   100    70
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1040    67   111   134    88    40    64    38    34    58    29
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1050    30    43    42    39    33    57    55    26    46    67
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1060    58    37    23    28    26    28    38    19    21    30
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1070    16    21    49    22    32    11    15    16  9990
      [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]

~ Unknown User
```

Chronology file

```
Trebenna, Byzantine Fortress, NW tower 1AB

;ID 907010;NAME Trebenna, Byzantine Fortress, NW tower 1AB;DATING R;UNMEAS_PRE 1;U
;FILENAME G:\DATA\TRB\TRB1AB.SUM


;TYPE S;SPECIES Juniperus sp.;FORMAT R;PITH +
;TERMINAL vv;CONTINUOUS N;QUALITY +
;RECONCILED Y
;DATA
 1001         125   219   207   139    62   107    29    91    65
                [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1010    71   132    74   150    75   156   122    81    46    57
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1020   147    78    89   126    73   121    67    71    64   129
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]
 1030   149   155   122   126    53   136    90    65   100    67
          [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [1]   [2]
 1040    67   101   132   102    40    67    42    36    62    29
          [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]
 1050    30    44    46    40    34    61    55    29    44    63
          [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]
 1060    62    38    22    26    26    28    37    21    21    27
          [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]
 1070    17    18    50    21    33    12    17    16    27    20
          [2]   [2]   [2]   [2]   [2]   [2]   [2]   [2]   [1]   [1]
 1080    18    11     9     8  9990
      [1]   [1]   [1]   [1]   [1]

;ELEMENTS
G:\DATA\TRB\TRB1A.REC
G:\DATA\TRB\TRB1B.REC
```

```
;weiserjahre
 1001   1/0      0/1      0/1      0/1      1/0      0/1      1/0      0/1      1/
 1010   1/0      0/1      1/0      0/1      1/0      0/1      0/1      0/1      1/
 1020   0/1      1/0      1/0      0/1      1/0      0/1      1/0      0/1      1/
 1030   1/0      0/1      1/0      0/1      1/0      0/1      0/1      1/0      0/
 1040   2/0      2/0      0/2      0/2      2/0      0/2      0/2      2/0      0/
 1050   2/0      1/1      0/2      0/2      2/0      0/2      0/2      2/0      2/
 1060   0/2      0/2      2/0      1/1      2/0      2/0      0/2      1/1      2/
 1070   1/1      2/0      0/2      2/0      0/2      2/0      1/1      1/0      0/
 1080   0/1      0/1      0/1
~ Unknown User
```

Excel

Table 6.8. Summary of the Excel file format

Format Name	Excel 97-2004
Other names	None known
Type	Binary file
Extension(s)	xls
Read/write support	Write only
Reference implementation	Microsoft Excel
Data/Metadata	Data only
Single/Multi series	Multi
Original designer	N/A

Description

The Excel file format is a widely used format for storing spreadsheet data. It is a proprietary binary format created by Microsoft.

Although not specifically a dendro data format, support is provided for exporting to this format to make it easier for users to load data into Excel and other spreadsheet and statistical applications. While it would be technically possible to write a reader for Excel files, the inherent variability of Excel files means this would require a large amount of user interaction.

Excel write support for Corina/TRiCYCLE/DendroFileIOLib is provided by the JXL open source library. JXL has a strict open-source license so if DendroFileIOLib is incorporated into another application the author must ensure the license is supported otherwise Excel support must be disabled.

Files are output as follows:

- Row 1 - Header names for each column
- Column 1 - Year values
- Column 2+ - One column for each series containing integer values of 1/100th mm. Cells are left empty if no data is available for a series does not extend to a particular year.

Example

Table 6.9. Example of the layout of an Excel spreasheet produced by the DendroFileIOLib

<>	**A**	**B**	**C**	**D**
1	Years (AD)	Series 1	Series 2	Series 3
2	1670	304		434
3	1671	203		234
4	1672	324		263
5	1673	263		355
6	1674	296	235	
7	1675	269	321	

Heidelberg

Table 6.10. Summary of the Heidelberg file format

Format Name	Heidelberg
Other names	TSAP, FH
Type	Text file
Extension(s)	.fh
Read/write support	Read and write
Reference implementation	TSAP-Win
Data/Metadata	Data and extensible metadata
Single/Multi series	Multi
Original designer	Frank Rinn

Description

The Heidelberg format is the native file format for Rinntech's TSAP-Win software. It supports metadata in the form of keyword-value pairs. There are more than 140 standard keywords specified in the documentation, but users can extend these with their own. This makes the format extremely flexible, but the absence of any checking of data types (strings, numbers categories etc) and no method of validation means that there can be problems interpreting metadata entries.

Heidelberg files can store one or more series in a single file. Each series is represented by a header and a data block.

The header block begins with a line `HEADER:`. This is followed by lines of metadata, with one field on each line, in the format `keywords=value` much like a standard Windows INI file. As mentioned previously there are a number of predefined keywords, all of which are outlined

- AcceptDate
- Age

- AutoCorrelation
- Bark
- BHD
- Bibliography
- Bibliography[n]
- BibliographyCount
- Bundle
- CardinalPoint
- ChronologyType
- ChronoMemberCount
- ChronoMemberKeycodes
- Circumference
- Client
- ClientNo
- Collector
- Comment
- Comment[n]
- CommentCount
- Continent
- CoreNo
- Country
- CreationDate
- DataFormat
- DataType
- DateBegin
- Dated
- DateEnd
- DateEndRel
- DateOfSampling
- DateRelBegin[n]

- DateRelEnd[n]
- DateRelReferenceKey[n]
- DateRelCount
- DeltaMissingRingsAfter
- DeltaMissingRingsBefore
- DeltaRingsFromSeedToPith
- Disk
- District
- EdgeInformation
- EffectiveAutoCorrelation
- EffectiveMean
- EffectiveMeanSensitivity
- EffectiveNORFAC
- Key
- EffectiveNORFM
- EffectiveStandardDeviation
- Eigenvalue
- Elevation
- EstimatedTimePeriod
- Exposition
- FieldNo
- FilmNo
- FirstMeasurementDate
- FirstMeasurementPersID
- FromSeedToDateBegin
- GlobalMathComment[n]
- GlobalMathCommentCount
- GraphParam
- Group
- HouseName

- HouseNo
- ImageCellRow
- ImageComment[n]
- ImageFile[n]
- ImageCount
- ImageFile
- Interpretation
- InvalidRingsAfter
- InvalidRingsBefore
- JuvenileWood
- KeyCode
- KeyNo
- LabotaryCode
- LastRevisionDate
- LastRevisionPersID
- Latitude
- LeaveLoss
- Length
- Location
- LocationCharacteristics
- Longitude
- MajorDimension
- MathComment
- MathComment[n]
- MathCommentCount
- MeanSensitivity
- MinorDimension
- MissingRingsAfter
- MissingRingsBefore
- NumberOfSamplesInChrono

- NumberOfTreesInChrono
- PersId
- Pith
- Project
- ProtectionCode
- Province
- QualityCode
- Radius
- RadiusNo
- RelGroundWaterLevel
- RingsFromSeedToPith
- SampleType
- SamplingHeight
- SamplingPoint
- SapWoodRings
- Sequence
- SeriesEnd
- SeriesStart
- SeriesType
- ShapeOfSample
- Site
- SiteCode
- SocialStand
- SoilType
- Species
- SpeciesName
- StandardDeviation
- State
- StemDiskNo
- Street

- Timber
- TimberHeight
- TimberType
- TimberWidth
- TotalAutoCorrelation
- TotalMean
- TotalMeanSensitivity
- TotalNORFAC
- TotalNORFM
- TotalStandardDeviation
- Town
- TownZipCode
- Tree
- TreeHeight
- TreeNo
- Unit
- UnmeasuredInnerRings
- UnmeasuredOuterRings
- WaldKante
- WoodMaterialType
- WorkTraces

The meaning of many of these keywords is fairly self-explanatory but others are a little more obscure. As there is no data typing or validation the format of the contents of these fields cannot be predicted. This is particularly a problem when trying to compare fields such as Latitude, Longitude and FirstMeasurementDate, but is especially a problem when comparing files produced in different labs.

The header section is followed by a data section denoted by a line containing the keyword DATA: followed by the type of data present which can be one of Tree; HalfChrono; Chrono; Single; Double; Quad. Tree, HalfChrono and Chrono are the original keywords supported by early versions of TSAP but these are now deprecated in preferences of the more generic Single, Double and Quad terms. The terms Single, Double and Quad are largely interchangeable with Tree, HalfChrono and Chrono respectively, but not completely. Double can refer to both Tree and HalfChrono format data. When the newer terms are used, the header keyword DataFormat is used to record whether the data is equivalent to Tree, HalfChrono or Chrono.

Single format - data is typically used for storing raw measurement series. Each data line contains 10 data values each being a left space padded integer taking up 6 characters. Any spare data values in the final data line are filled with zeros. Alternatively it appears that TSAP-Win also accepts this data section as single integer values one per line with not padding.

Double format - data is for storing data with sample depth information - typically chronologies. Like the single format section, data is stored as 10 integer values, each taking up 6 characters and left padded with spaces. The values are in pairs of ring widths and sample depths, therefore five rings are stored per line.

Quad format - data is for storing chronologies with sample depth as well as data on how many of the constituent series increase and decrease. This format therefore requires four numbers for each data point: ring width; sample depth; increasing series; decreasing series. Numbers are stored as integers, left space padded as before, but this time only using 5 characters not 6. Four data points are included on each line, therefore this means there are 16 numbers per row and each row is 80 characters long.

Example file

Raw series

```
HEADER:
DateEnd=-66
KeyNo=27
Project=Growth studies
Length=103
Location=Oak Ridge
Species=PISY
SapWoodRings=14
WaldKante=WKF
State=Tennessy
PersId=FR
KeyCode=271017
Country=USA
DateOfSampling=19931106
TreeNo=5
CoreNo=1
Exposition=North-West
CreationDate=19940526
SoilType=Sand
DATA:Tree
   125   130    99   120   115   145   151   130   135   151
   200   190   151   170   170   174   170   200   210   130
   180   197   210   160   180   155   180   199   140   150
   146   140   145   150   155   110   115   113   120   130
   110   120   150   120   120   110   115   160   160   145
   135   145   125   115   145   149   120   150   160    99
   110    75    70    82    96    90   120   151   155   130
   132   133   149   110   130   120   128   118   125   115
    95    90   110    98    80    85    97    88    70   100
    90    70    80    90    85    78    95    84    70    90
    80    75    70     0     0     0     0     0     0     0
```

Chronology

```
HEADER:
KeyCode=UAKK0530
DataFormat=HalfChrono
SeriesType=Mean curve
Length=105
```

```
DateBegin=987
DateEnd=1091
Dated=Dated
Location=Akkerman  53 ABCD
Species=QUSP
GlobalMathCommentCount=0
ImageCount=0
CommentCount=0
BibliographyCount=0
DATA:Double
   125     1   125     2   264     2   206     2   115     2
   111     2   188     2   308     2   197     2   419     2
   238     2   227     2   279     2   293     2   271     2
   309     2   170     2   204     2   163     2   175     2
   164     2   211     2   134     2   141     2   107     2
    72     2    74     2    91     2   110     2    47     2
    87     2    87     2    35     2    47     2    80     2
    66     2    38     2    82     2    78     2    65     2
    63     2    76     2    67     2    91     2    73     3
    39     3    41     3    78     3    57     3    54     3
    41     3    39     3    52     3    53     3    43     3
    48     3    32     3    32     3    48     3    59     3
    60     3    45     3    37     3    22     3    23     3
    22     3    21     3    25     3    25     4    34     4
    50     4    56     4    41     4    20     4    29     4
    26     4    32     4    42     4    35     3    33     3
    50     3    39     3    49     2    51     2    46     2
    38     2    46     2    35     2    52     2    43     2
    59     2    37     2    46     2    45     2    52     2
    39     2    50     2    34     2    45     2    36     2
    50     2    64     2    58     2    38     2    46     2
```

Chronology

```
HEADER:
DateEnd=485
Length=663
Species=ABSP
KeyCode=set01chr
DATA:Chrono
   46    1    0    0  149    2    1    0   93    2    1    1  102    2    1    1
   81    2    1    1   47    2    0    2   65    3    1    1   84    4    1    2
   78    4    2    2   89    5    2    2  100    5    4    1  106    5    4    1
  116    5    3    2  100    5    1    4  115    5    2    1  108    5    2    3
   93    5    0    5  107    5    5    0  116    5    3    2  159    5    5    0
  136    5    1    4  139    7    0    5  161    8    4    2  150    8    3    4
  151    8    5    3  125    8    0    8  138    8    5    3  153    8    5    2
   94    8    0    8  101    8    3    5  101    9    2    6  112   10    7    1
   93   10    2    7  112   10    9    1  108   11    4    6  131   11    7    3
  135   13    8    3  107   14    2   11   97   14    5    8  135   14   12    2
  124   14    4   10  131   15    5    9  144   15   10    4  146   15    6    9
  129   15    7    8  109   16    3   12  114   16    8    7  132   16   11    2
   96   16    4   12  109   16    8    8  107   16    8    7  132   16   15    1
  118   17    5   10  126   17   12    4  104   17    4   13  117   18   12    5
```

124	18	8	8	117	18	7	9	96	18	6	12	104	19	11	7
114	19	14	5	107	19	6	13	94	21	5	13	126	21	18	2
138	21	13	6	123	21	6	14	123	21	11	8	118	21	6	13
103	21	5	13	100	21	9	10	66	21	1	20	56	21	3	17
75	21	17	3	87	21	16	3	77	21	4	16	119	21	20	1
112	21	8	11	95	21	4	16	111	21	15	5	124	21	16	5
135	22	11	8	141	23	11	10	137	23	13	10	140	23	12	9
122	24	2	20	111	24	10	14	110	24	13	11	137	24	20	3
131	25	9	14	118	25	7	17	126	25	13	10	137	25	14	8
122	25	5	19	118	25	10	15	86	25	3	22	113	25	21	4
89	25	3	21	75	25	4	20	120	25	24	1	88	25	4	21
87	25	11	13	98	25	20	4	112	25	17	4	118	25	16	9
113	25	11	12	132	26	19	3	137	27	8	15	130	27	13	13
128	27	12	15	116	27	8	17	137	28	21	5	97	28	2	26
121	27	22	4	156	27	22	5	110	28	2	25	115	28	14	13
109	28	10	15	116	28	16	11	117	28	15	11	103	28	5	21
95	28	7	19	104	28	18	9	111	28	16	8	96	28	7	18
98	28	8	19	86	27	4	22	107	27	25	2	87	27	6	21
115	27	24	3	100	27	4	21	100	27	12	15	117	28	18	8
110	28	11	16	141	29	24	2	136	29	13	16	115	29	8	21
98	29	7	22	117	28	23	3	91	28	3	25	84	28	11	14
87	28	16	9	81	28	12	15	99	28	24	3	95	28	12	11
109	28	19	6	104	27	12	13	94	27	7	18	88	27	14	9
89	27	13	14	91	27	15	10	103	26	17	5	102	24	11	12
116	23	16	6	81	20	1	18	86	19	11	7	84	19	8	11
97	19	14	5	121	19	15	4	131	19	12	5	117	20	3	15
122	20	10	9	143	20	15	5	137	20	9	11	105	21	2	15
132	21	17	4	107	21	3	14	122	21	14	5	114	21	9	10
97	21	4	16	84	21	5	15	89	21	10	10	86	21	10	10
90	21	15	4	101	21	15	6	104	19	10	9	116	18	10	8
125	18	10	7	112	18	4	14	116	18	12	6	118	18	8	9
83	18	3	15	72	18	2	15	76	18	12	6	88	18	11	6
105	18	15	2	106	18	12	6	139	16	16	0	107	16	1	15
109	16	8	8	103	15	5	10	102	15	4	9	117	15	11	4
138	15	13	2	117	15	4	11	89	15	3	12	85	15	6	9
91	15	9	6	103	17	6	9	123	18	13	4	96	17	2	14
94	17	6	9	140	16	14	2	101	16	1	15	138	16	12	4
121	16	5	11	139	16	12	4	146	16	10	6	105	16	1	15
134	16	15	1	97	16	2	14	137	16	13	2	99	16	1	15
114	16	11	5	119	16	7	6	146	15	13	1	130	17	3	12
177	17	15	2	136	16	2	14	145	15	7	8	136	16	4	11
114	16	1	15	136	17	10	6	153	17	10	7	151	16	4	12
124	17	5	11	141	18	10	7	155	18	15	3	146	20	4	14
144	21	5	15	118	21	4	17	173	22	20	1	135	22	2	20
152	22	16	6	96	22	2	20	117	24	21	1	153	24	20	4
138	24	6	18	205	24	24	0	136	24	0	24	183	24	22	2
134	25	4	20	107	25	3	22	123	25	20	4	111	25	4	21
98	25	8	17	137	25	24	1	119	25	8	17	146	26	21	4
102	26	1	25	98	26	8	17	128	26	24	2	98	26	5	21
125	26	24	2	100	26	4	22	106	26	14	12	125	25	18	7
169	25	22	3	174	25	15	10	204	25	21	4	137	26	0	25
123	26	5	20	114	26	10	15	145	24	17	5	136	24	10	12
150	24	17	7	141	23	10	13	146	23	11	10	126	20	2	17
115	20	5	15	115	20	9	11	124	20	15	5	114	20	6	14

95	20	0	20	104	20	14	5	113	20	11	9	132	20	15	5
123	20	5	15	138	22	14	6	125	22	6	15	93	22	3	18
105	22	15	7	126	22	18	3	138	22	15	5	141	20	10	9
179	20	18	1	146	20	2	17	134	20	7	13	133	20	8	11
148	20	14	6	117	20	6	14	123	20	13	7	115	20	5	15
104	20	4	15	105	20	9	10	118	20	16	4	114	20	11	9
100	20	4	16	104	20	13	7	104	20	11	9	120	18	18	0
111	18	7	11	90	18	2	16	125	18	17	1	95	18	2	16
131	18	18	0	125	18	5	13	124	18	6	12	95	18	2	15
87	18	7	11	91	18	8	10	90	18	6	11	78	18	2	16
91	18	14	3	68	18	3	15	81	18	14	4	80	18	8	10
75	18	8	10	90	18	15	2	83	18	4	12	79	18	9	9
81	18	10	8	76	16	2	13	69	16	5	11	80	16	7	8
74	16	9	7	76	16	10	6	69	16	5	9	62	16	3	13
82	16	16	0	104	16	14	2	77	16	1	14	89	16	10	4
102	16	12	4	94	16	4	10	89	16	5	10	80	16	4	12
68	16	5	11	79	15	9	5	92	13	9	4	97	10	3	6
158	11	6	4	166	11	8	3	156	11	6	5	131	10	2	7
148	10	3	7	138	10	5	5	139	9	5	3	155	10	5	4
181	10	6	4	147	10	2	8	171	10	8	2	159	10	3	7
157	10	4	5	119	10	0	9	164	10	8	1	145	10	4	6
169	10	6	4	199	10	6	4	165	10	3	7	179	10	7	3
136	8	2	6	147	8	4	3	183	7	5	2	180	5	1	4
143	5	3	2	156	5	3	2	144	5	1	4	160	6	2	3
151	6	4	2	181	6	6	0	165	6	1	5	140	6	2	4
121	6	1	5	108	6	2	4	92	6	2	4	128	5	4	1
135	6	3	2	170	6	4	2	166	6	2	4	192	6	4	2
161	7	1	5	165	7	4	3	149	7	1	6	166	7	5	2
147	7	1	5	189	7	6	1	144	7	1	6	166	7	5	2
184	7	3	3	218	6	4	2	237	5	5	0	188	5	0	5
171	5	2	3	149	5	2	3	119	5	0	5	111	5	2	3
122	4	2	1	165	4	4	0	188	4	3	1	164	4	1	3
162	4	1	3	125	4	2	2	166	4	4	0	178	4	3	1
239	4	4	0	140	4	0	4	129	4	1	3	193	4	3	1
165	4	1	2	203	5	4	0	239	5	4	0	220	5	3	2
231	5	3	2	195	5	2	3	204	5	4	1	204	5	2	3
209	5	3	2	209	5	3	2	158	5	0	5	121	5	0	5
102	5	2	3	97	5	1	4	141	5	5	0	152	5	4	1
183	5	4	1	170	5	0	3	170	5	2	3	162	5	2	3
164	5	3	1	203	5	4	1	122	5	1	4	222	6	5	0
167	6	0	6	155	6	3	3	133	6	1	5	123	6	2	4
152	6	4	2	155	6	5	1	225	6	5	1	201	6	1	5
253	6	5	1	180	6	0	6	166	6	3	3	200	6	3	3
176	5	2	2	134	5	2	3	109	5	1	4	123	5	3	1
144	5	4	1	133	5	1	4	162	4	3	1	161	4	2	2
183	4	3	1	225	4	4	0	189	4	0	4	194	4	3	0
187	4	1	3	140	4	3	1	195	4	4	0	158	4	2	2
160	4	2	2	134	4	2	2	150	4	3	1	140	4	1	3
177	4	4	0	191	4	2	1	199	4	2	1	161	4	1	3
125	4	0	4	158	4	4	0	120	4	0	4	122	4	2	0
172	4	4	0	185	4	3	1	183	4	2	2	142	4	1	3
123	5	0	4	92	5	1	4	113	5	4	1	96	5	2	3
118	5	5	0	127	5	3	2	122	6	3	2	129	6	4	2
93	6	0	6	109	6	3	3	105	7	3	3	120	7	5	1

```
   138    7    5    1  129    7    3    4  179    7    5    2  160    7    3    4
   126    7    2    5  158    7    4    3  161    7    2    4  156    6    2    4
   272    6    5    1  215    6    2    4  193    5    1    4  120    5    0    5
   246    5    5    0  252    5    4    1  118    5    0    5  171    5    5    0
   205    5    3    2  224    5    3    2  234    5    4    1  186    5    0    5
   213    5    4    1  164    5    1    4  165    5    2    3  171    5    2    3
   167    5    2    3  131    5    2    3  179    5    5    0  148    5    1    4
   138    5    2    3  142    5    3    2  156    5    5    0  135    5    1    4
   162    5    3    2  156    5    3    2  165    5    4    1  145    5    1    3
   198    5    4    0  175    5    0    5  183    5    4    1  240    4    4    0
   201    4    0    4  193    4    2    2  229    4    3    1  190    4    1    2
   191    4    2    2  176    4    1    3  149    4    0    4  122    4    0    4
   145    4    4    0  145    4    2    2  172    4    3    1  163    4    1    3
   167    4    2    2  149    4    0    3  113    4    0    4  151    4    4    0
   169    4    3    1  148    4    0    3  134    4    1    3  122    4    2    2
   139    4    3    1  122    4    0    4  151    4    3    1  133    4    0    4
   166    4    4    0  124    4    0    4  144    4    4    0  170    4    3    1
   168    4    1    3  124    4    0    4  148    4    3    1  117    4    1    3
   140    4    2    1  114    4    0    4  121    4    3    1  108    4    0    3
   100    4    1    2   94    4    1    3  115    4    4    0  118    4    2    2
   131    4    3    1  123    4    1    3   85    4    0    3  135    4    4    0
   128    4    2    2  155    4    2    2  119    4    1    3  121    4    3    1
   120    4    2    2  157    4    3    1  171    4    3    1  125    4    0    4
   147    4    2    2  140    4    2    2  131    4    1    3  104    4    1    3
   101    4    2    2  118    4    2    2  112    4    2    2  129    4    3    1
   117    4    1    3  167    4    4    0  199    4    4    0  206    4    1    3
   184    4    1    3  189    4    2    2  167    4    0    4  164    4    1    2
   113    4    0    4   99    4    2    2  100    4    2    2  145    4    4    0
   117    4    0    3  138    4    2    2  135    4    1    3  120    4    1    3
   158    4    4    0  141    4    0    4  128    4    3    1  142    4    2    1
   180    4    3    1  143    4    0    4  137    4    1    2  135    4    2    2
   123    4    0    4  144    4    3    1  132    4    1    3  162    4    3    0
   151    4    1    3  124    4    0    4  104    4    1    3   77    4    0    4
   147    4    4    0  131    4    0    4  109    4    0    4  162    4    4    0
   106    4    0    4   99    4    1    3   88    4    3    1  119    4    4    0
   164    4    4    0  112    4    0    4  129    4    3    1  141    4    4    0
   150    4    3    0   93    4    0    4  113    3    3    0  133    3    2    1
   117    3    1    2  122    3    3    0  128    3    2    1  112    3    0    3
   147    3    3    0  113    3    0    3  151    3    3    0  127    3    0    3
   131    3    2    1  141    3    1    2  175    3    3    0  144    3    0    3
   125    3    1    2  152    3    3    0   87    3    0    3  119    3    2    1
   137    3    3    0  103    3    1    2  146    3    3    0  129    3    1    2
   142    3    2    1  118    3    1    1  121    3    1    2  146    3    3    0
   110    3    0    3  119    3    1    1  125    3    1    2    0    0    0    0
```

Nottingham

Table 6.11. Summary of the Nottingham file format

Format Name	Nottingham
Other names	Nottingham Laboratory format
Type	Text file

Extension(s)	Normally txt
Read/write support	Read and write
Reference implementation	Unknown
Data/Metadata	Data only
Single/Multi series	Multi
Original designer	Cliff Litton

Description

The Nottingham format was designed by Cliff Litton. It is a simple text format with no support for metadata.

Line 1 contains a series name and an integer indicating how many data values there are in the file. Subsequent lines contain the data represented as 1/100th mm integers in twenty columns seemingly in either 4 characters or 3 characters + 1 space.

There is no known reference implementation for this format and few known examples of data so little is known about how it should handle unusual situations such as negative values, values >999 etc.

Example file

```
TWYN01    176
 342 338 334 409 362 308 360 264 325 318 134 151 219 268 290 222 278 258 173 198
 294 202 170 176 172 121  87 130 114 108 170 135 131 126  87 100  86 104 103 127
 112  94  96 120 168 149 119 124  79  67  88  90  93  77  49  42  53  38  57  43
  50  41  56  66  62  55  55  45  47  63  58  60  44  45  49  50  62  61  43  54
  91  60  56  43  52  51  65  68  55  44  41  75  94  78  63  69  58  75  55  47
  58  46  62  45  52  50  77  50  63  75  77  64  66  57  80  57  78  65  68  75
  65  98  85  82 119  89  85  87  83 108 129 123 160 117 129 121  88  69  97  77
  96 106  71  89  50  65 133  89  88  50  60  95  95  91 102 158  83  55  98  70
  45  46  40  36  64  58  52  58  56  94  51  48  47  60  49  48
```

PAST4

Table 6.12. Summary of the PAST4 file format

Format Name	PAST4
Other names	P4P, PAST 4 Project File
Type	Text file
Extension(s)	.p4p
Read/write support	Read and write
Reference implementation	PAST4
Data/Metadata	Data and some structured metadata
Single/Multi series	Multi
Original designer	Bernhard Knibbe

Description

The PAST4 format is the native file format for SCIEM's PAST4 software. It is a hybrid XML file, containing most metadata in structured XML but some metadata and all data as plain text. It is unique amongst dendro data formats in that it contains not only data and metadata but also settings information for the PAST4 software such as details on what colours to use in graphs, which series should be displayed on screen etc. The general structure of a P4P file is as follows:

- Project header (required)
- Settings (optional)
- Groups (required, repeatable)
- Records (required, repeatable)

The root XML tag for the file is `<PAST_4_PROJECT_FILE>`. Inside this is the `<PROJECT>` tag which contains the following attributes:

- ActiveGroup - Zero based index specifying which group is active
- EditDate - Date the file was last edited
- Groups - Number of groups within this project
- Locked - Either TRUE or FALSE indicating whether a password is required to open the file
- Name - Name of the project
- Password - Password used to lock the project
- PersID - Abbreviation of the authors name
- Records - Number of records in the project
- Reference - Zero based index indicated which is the reference series (-1 if none selected)
- Sample - Zero based index indicating which is the selected sample (-1 if none selected)
- Version - Version number for this PAST4 format. At the time of writing only one version exists (400).

Of these fields only Name, Groups and Records are mandatory. The project tag can also contain a `<![CDATA[` tag which allows the storing of a project description in plain text.

Next comes the `<SETTINGS>` tag. This is one very large XML tag with many attributes controlling the what PAST4 should display the data. The contents of this tag are optional and are therefore irrelevant for the transfer of dendro data.

Next comes one or more `<GROUPS>` tags. A group is an arbitrary collection of series, perhaps representing a number of measurements of a single object, or perhaps an administrative collection of series. Groups can be nested in a hierarchy, but rather than use the hierarchical nature of XML files, the format instead lists all groups side-by-side and maintains the relationships through the use of an 'owner' attribute containing the index of the parent group. This arrangement means than any changes to the hierarchy, or the deletion of a group requires all indices to be carefully updated to avoid corrupting the file. The group tag has the following attributes:

- Name - Name of the group

- Visible - Either TRUE or FALSE indicating whether the group should be shown in graphs
- Fixed - Either TRUE or FALSE indicating whether the group can be moved
- Locked - Either TRUE or FALSE. If locked the group can be used in the calculation of further mean values.
- Changed - Internal TRUE or FALSE value for keeping track of changes
- Expanded - TRUE or FALSE value indicating whether the group should be expanding in the project navigator window
- UseColor - TRUE or FALSE value for is content should be displayed in color
- HasMeanValue - TRUE or FALSE indicating if the group has a dynamic mean value
- IsChrono - TRUE or FALSE indicating if the group mean is calculated with sample depth information
- Checked - TRUE or FALSE indicating if the group is locked and checked
- Selected - TRUE or FALSE indicated in the group is selected in the project navigation window
- Color - 24bit integer indicating the RGB volor value for the group using Borland format
- Quality - Integer value describing the quality of the group mean
- MVKeycode - String code for the group. If empty the Name field is used
- Owner - Integer pointing containing the index of the parent group if this group is in a hierarchy. If its a top level group it should be -1.

As with the project tag, the group tag can also contain a `<![CDATA[` section for storing a plain text description of the group.

The final tag type in the file is the `<RECORDS>` tag. These contain the actual data series and most of the metadata. Like group tags, records tags are placed side-by-side in the file and are placed into the group hierarchy by the use of the 'owner' attribute. In addition, the tag also has the following attributes:

- Keycode - Name of the series
- Length - Integer for the number of rings
- Owner - Integer index to the group to which this record belongs
- Chrono - TRUE or FALSE indicating whether this record has density information
- Locked - TRUE or FALSE indicating in the record can be moved
- Filter - TRUE or FALSE indicating if an indexing function is appled to the data
- FilterIndex - Integer index for the filter used
- FilterS1 - Parameter 1 for the filter
- FilterS2 - Parameter 2 for the filter
- FilterB1 - Additional filter parameter
- FilterWeight - Additional filter parameter
- Offset - Position of the first ring

- Color - 24bit RGB color for record in Borland format
- Checked - TRUE or FALSE indicating is the record is selected for use in the dynamic group mean
- !VShift - Temporary integer value added to data value to shift vertically in graphs
- IsMeanValue - TRUE or FALSE indicating if this is a dynamic mean value
- Pith - TRUE or FALSE
- SapWood - Integer storing the number of sapwood rings
- Location - String location information
- Waldkante - String description of presence of waney edge
- FirstValidRing - Integer indicating which ring is the first valid ring. If >0 then some rings are discarded
- LastValidRing - Integer indicating which ring is the last valid ring. If >0 then some rings are discarded
- UseValidRingsOnly - TRUE or FALSE - internal use only
- Quality - Integer indicating the quality of the record

The record tag then contains a `<HEADER>` tag with a `<![CDATA[` section which includes additional free-text header information. There are no requirements as to how information should be laid out in this field however many users seem to adopt the Heidelberg [/corina-manual/Heidelberg] style of keyword=value.

Next comes the `<DATA>` tag which is empty except another `<![CDATA[` section. This is where the actual ring width data is stored. Each data value is recorded on a separate line (using CR LR line breaks). Each line contains the following six tab delimited fields:

- Ring width as a floating point number
- Sample depth
- Number of sample increasing
- Latewood percentage as a floating point value 0-1 (0 if not known)
- Duplicate/backup ring width value using to store the original ring width value. If an index is applied the ring with value in column 1 is altered.
- Comment string about this particular ring

Example file

Sheffield

Table 6.13. Summary of the Sheffield file format

Format Name	Sheffield
Other names	D Format
Type	Text file

Extension(s)	.d
Read/write support	Read and write
Reference implementation	Dendro for Windows
Data/Metadata	Data and some structured metadata
Single/Multi series	Single
Original designer	Ian Tyers

Description

Sheffield format is a dendro specific text file designed by Ian Tyers for his Dendro for Windows application. It is probably most widely used in the UK but is also used in continental Europe as well as New Zealand.

The format contains both data and some structured metadata with each field/value stored one per line. The order of fields is fixed so missing data must be indicated by the use of a question mark.

Table 6.14.

Line	Description	Details	Example
1	Site name/sample number	free form text not including , " ( ) up to 64 characters	Fennings Wharf 1080a
2	Number of rings	whole positive number	124
3	Date type	single character; A = absolute date, R = relative date	A
4	Start date	whole number (can be negative) (if absolute 10001 = 1AD)	10943
5	Raw Data type	single character; R = annual raw ring width data (NB earlier versions used some other codes here for species e.g. ABEFPSU these are all interpreted as equivalent to R)	R
	Mean Data type	single character; W=timber mean with signatures, X=chron mean with signatures, T = timber mean, C = chron mean, M = un-weighted master sequence	
6	Raw Sap number	whole positive number or 0	9
	Mean Number of timbers/chronologies	whole positive number	

7	Raw Edges inf.	single character; Y = has bark, ! = has ?bark, W = terminal ring probably complete (i.e. possibly Winter Felled), S = terminal ring probably incomplete (i.e. possibly Summer Felled), B = has h/s boundary, ? = has ? h/s boundary, N = has no specific edge, (NB but may have sap), U = sap/bark unknown, C = charred outer edge, P = possibly charred outer edge	Y
	Mean Chronology Type	single character; R = raw unfiltered data, 5 = 5 year running mean, I = indexed data, U = unknown mean type	
8	Author and comment	free form text not including , " ( ) up to 64 characters	IGT 4/2/1995
9	UK National grid reference	2 characters +even no of digits up to 14 characters in all, ? = not known	TQ67848675
10	Latitude and longitude	NEW e.g. 53.382457;-1.513623 previously e.g. N54^{50} ^{W003}50, ? = not known	`N51^30 W1^20`
11	Pith	single character; C = centre of tree, V = within 5 years of centre, F = 5-10 years of centre, G = greater than 10, ? = unknown	G
12	Cross-section code	Two character code; first character, A = whole roundwood, B = half round, C quartered, D radial/split plank, E tangential/ sawn plank. second character, 1 untrimmed, 2 trimmed, X irregularly trimmed. or, X = core /unclassifiable, ? unknown/unrecorded	D1
13	major dimension	whole number in mm, 0 if unrecorded or mean	140

14	minor dimension	whole number in mm, 0 if unrecorded or mean	50
15	unmeasured inner rings	single character+whole number; use pith codes + number of rings or, H = heartwood, N = none	C15
16	unmeasured outer rings	single character+whole number; use edges code + number of rings except that S = sapwood with no edge and V is the spring felling equivalent other codes are, H = heartwood with no edge, N = none	Y13
17	group/phase	free form text not including , " ( ) up to 14 characters	Well 34
18	short title	free form text not including , " ( ) up to 8 characters	1080a
19	period	single character; C = modern, P = post medieval, M = medieval, S = Saxon, R = Roman, A = pre Roman, 2 = duplicate e.g. repeat measure, B = multiperiod e.g. long master, ? = unknown	M
20	ITRDB species code	4 character code - refer to ITRDB species codes	QUSP
21	Interpretation and anatomical notes	? =no interpretation/ notes. The interpretation and the anatomical notes can be in any order but each must consist of three parts, a single character A or I for anatomy or interpretation, a separator ~, for interpretations the date of the start, for anatomy the ringno, a separator ~, for anatomy the anatomical code for interpretations P for plus, 0 for felled and a number for the length of the range, where more than one record is present these	I~11066~0~A~100~S

		are separated by ~, there must not be a terminal separator and each record must consist of the tree parts. The anatomical codings can be anything of a single character but supported usage is based on Hans-Hubert Leuschners anatomical codes; D = Density Band, R = Reaction Wood, L = Light Latewood, H = Dense Latewood, F = Frost Ring, K = Small Earlywood Vessels - oak, G = Great Latewood Vessels - oak, T = Wound Tissue, N = Narrow Latewood, A = Light Latewood End, P = Narrow and Light Latewood, Q = Narrow and Dense Latewood	
22	data type	single character; D = ring widths, E = early-wood widths only, L = late-wood widths only, R = late+early wood widths (i.e. reverse of normal rings), I = minimum density, A = maximum density, S = early, late; (i.e. sequentially & separately), M = mixed (? means of others)	D
23+	for each width (equivalent to the value of length) the individual increments etc. if a C X T or W type mean	no negatives or 0's	etc
+	check field	single character H	
+	for each width the individual weightings of the mean sequences. If an X or W type mean	no negatives or 0's	
+	check field	single character R	
+	for each width the number of individual series with rising values	no negatives	
+	check field	single character F	

+	for each width the number of individual series with falling values	no negatives	

Quirks and workarounds

The format copes with the problem of the non-existent year 0AD/BC by adding 10000 to all year values. Therefore:

Table 6.15.

Year	Sheffield format
1AD	10001
1BC	10000
9999BC	2
10000BC	1

Example file

```
York Hungate Boat 4 timber mean
170
A
10784
W
4
R
made IT 24/2/2009
?
?
?
?
0
0
N
N
A
HunBoat
M
QUSP
?
D
391
454
309
314
270
273
229
319
267
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128
163
221
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214
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4
0
1
2
4
0
2
4
0
4
4
2
1
1
4
1
1
```

```
2
0
2
0
2
1
4
1
1
2
1
2
2
1
0
3
2
4
1
2
4
2
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3
2
0
1
2
2
0
1
3
0
2
1
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1
```

```
0
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1
0
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1
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1
0
0
0
0
1
0
0
1
1
1
3
0
1
2
2
```

```
1
0
0
2
1
3
0
2
3
2
1
0
3
1
0
3
0
0
4
0
3
0
4
3
0
1
3
1
4
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4
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0
4
2
2
3
3
2
0
2
0
4
2
3
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3
2
0
4
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0
```

```
4
0
0
2
3
3
0
3
2
2
4
2
4
2
3
0
3
3
2
3
2
2
3
4
1
2
0
3
2
0
1
4
3
2
2
1
3
1
1
1
3
3
0
0
1
3
2
1
1
3
2
0
2
0
```

```
1
2
2
2
1
1
1
1
0
1
0
1
1
0
0
0
0
0
0
1
1
1
1
1
0
0
```

Topham

Table 6.16.

Format Name	Topham
Other names	Instrument format
Type	Text file
Extension(s)	.txt
Read/write support	Read and write
Reference implementation	
Data/Metadata	Data only
Single/Multi series	Single
Original designer	John Topham

Description

The Topham format is probably the most simplistic of formats consisting of just a column of decimal data values and no metadata whatsoever. Each data value is a decimal ring width in millimetres.

Example file

```
3.42
3.38
3.34
4.09
3.62
3.08
3.60
2.64
3.25
3.18
3.42
3.38
3.34
4.09
3.62
3.08
3.60
2.64
3.25
3.18
3.42
3.38
3.34
4.09
3.62
3.08
3.60
2.64
3.25
3.18
113.42
3.38
3.34
4.09
3.62
3.08
3.60
2.64
3.25
3.18
3.42
3.38
3.34
4.09
3.62
3.08
3.60
2.64
3.25
3.18
3.42
3.38
3.34
4.09
```

```
3.62
3.08
3.60
2.64
3.25
3.18
```

TRiDaS

Table 6.17. Summary of the TRiDaS file format

Format Name	TRiDaS
Other names	Tree-Ring Data Standard, TRiDaS XML
Type	Text file
Extension(s)	xml
Read/write support	Read and write
Reference implementation	TRiCYCLE/DendroFileIOLib
Data/Metadata	Data and structured metadata
Single/Multi series	Multi
Original designers	Esther Jansma, Peter Brewer, Ivo Zandhuis

Description

TRiDaS (Tree-Ring Data Standard see http://www.tridas.org) is a data format designed by over 80 dendrochronologists and computer scientists as part of the DCCD [http://www.dendrochronology.eu] project and the Dendro Data Standard forum. It is designed to accurately represent any dendro data and metadata and it is hoped over time the dendro community will accept TRiDaS as the de facto standard for all dendro data.

The format uses extensible markup language (XML) which means the standard can be extended and evolve as future needs change. The format is structured around the eight data entities described below:

A project is defined by a laboratory and encompasses dendrochronological research of a particular object or group of objects. Examples include: the dating of a building; the research of forest dynamics in a stand of living trees; the dating of all Rembrandt paintings in a museum. What is considered a “project” is up to the laboratory performing the research. It could be the dating of a group of objects, but the laboratory can also decide to define a separate project for each object. Therefore, a project can have one or more objects associated with it.

An object is the item to be investigated. Examples include: violin; excavation site; painting on a wooden panel; water well; church; carving; ship; forest. An object could also be more specific, for example: mast of a ship; roof of a church. Depending on the object type various descriptions are made possible. An object can have one or more elements and can also refer to another (sub) object. For instance a single file may contain three objects: an archaeological site object, within which there is a building object, within which there is a beam object. The list of possible object types is extensible and is thus flexible enough to incorporate the diversity of data required by the dendro community. Only information that is essential for dendrochronological research is recorded here. Other related data may be provided in the form of a link to an external database such as a museum catalogue.

An element is a piece of wood originating from a single tree. Examples include: one plank of a water well; a single wooden panel in a painting; the left-hand back plate of a violin; one beam in a roof; a tree trunk preserved in the soil; a living tree. The element is a specific part of exactly one object or sub object. An object will often consist of more than one element, e.g., when dealing with the staves (elements) of a barrel (object). One or more samples can be taken from an element and an element may be dated using one or more derivedSeries.

A sample is a physical specimen or non-physical representation of an element. Examples include: core from a living tree; core from a rafter in a church roof; piece of charcoal from an archaeological trench; slice from a pile used in a pile foundation; wax imprint of the outer end of a plank; photo of a back plate of a string instrument. Note that a sample always exists and that it can either be physical (e.g. a core) or representative (e.g. a picture). A sample is taken from exactly one element and can be represented by one or more radii.

A radius is a line from pith to bark along which the measurements are taken. A radius is derived from exactly one sample. It can be measured more than once resulting in multiple measurementSeries.

A measurementSeries is a series of direct, raw measurements along a radius. A single measurementSeries can be standardised or a collection of measurementSeries can be combined into a derived- Series. The measurements themselves are stored separately as values.

A derivedSeries is a calculated series of values and is a minor modification of the “v-series” concept proposed by Brewer et al. (2009). Examples include: index; average of a collection of measurementSeries such as a chronology. A derivedSeries is derived from one or more measurementSeries and has multiple values associated with it.

A value is the result of a single ring measurement. Examples include: total ring width; earlywood width; latewood width. The values are related to a measurementSeries or a derivedSeries. In case of a measurementSeries the variable and its measurement unit (e.g. microns, 1/100th mm etc) are recorded as well.

For a full description of the standard see Jansma et al. (2010) available online at Science Direct [http://dx.doi.org/10.1016/j.dendro.2009.06.009] and the TRiDaS website [http://tridas.org/documents/tridas.pdf].

Example file

```
<?xml version="1.0" encoding="UTF-8"?>
<tridas xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.tridas.org/1.2.1 ../dev/sourceforge/tridas/XMLS
    xmlns="http://www.tridas.org/1.2.1" xmlns:xlink="http://www.w3.org/1999/xlink"
    <project>
        <title>Aegean Dendrochronology Project</title>
        <identifier domain="dendro.cornell.edu">C</identifier>
        <createdTimestamp certainty="exact">1997-02-01T14:13:51.0Z</createdTimesta
        <lastModifiedTimestamp certainty="exact">1997-02-01T14:13:51.0Z</lastModif
        <type>Dating</type>

        <description>Our key long-range goal is to build long multi-millennial sca
            chronologies in the Aegean and Near East that will extend from the pre
            Holocene to cover, broadly speaking, the last 10,000 years of human an
            history. Our raison d'être is to provide a dating method for the study
            prehistory in the Aegean that is accurate to the year. This kind of pr
```

```
        now, been lacking in ancient studies of this area. Indeed, few archaeo
        stimulate as much rancor as chronology, especially that of the Eastern
        The work of the Aegean and Near Eastern Dendrochronology Project aims
        some kind of rational and neutral order to Aegean and Near Eastern chr
        Neolithic to the present. </description>
    <laboratory>
        <name>Malcolm and Carolyn Weiner Laboratory for Aegean and Near Easter
        <address>
            <addressLine1>B48 Goldwin Smith Hall</addressLine1>
            <addressLine2>Cornell University</addressLine2>
            <cityOrTown>Ithaca</cityOrTown>

            <stateProvinceRegion>NY</stateProvinceRegion>
            <postalCode>14853</postalCode>
            <country>USA</country>
        </address>
    </laboratory>
    <category>Archaeology</category>
    <investigator>Peter I Kuniholm</investigator>

    <period>1976-present</period>
    <reference>reference1</reference>
    <object>
        <title>White Tower, Thessaloniki</title>
        <identifier domain="dendro.cornell.edu"
            >28acb483-f337-412f-a063-59d911c37594</identifier>
        <createdTimestamp certainty="exact">1997-02-01T14:13:51.0Z</createdTim

        <lastModifiedTimestamp certainty="exact">1997-02-01T14:13:51.0Z</lastM
        <type normalStd="Corina Dictionary" normalId="4" normal="Building">Bui
        <description>The White Tower of Thessaloniki was originally constructe
            to fortify the city's harbour.</description>
        <coverage>
            <coverageTemporal>Ottoman</coverageTemporal>
            <coverageTemporalFoundation>Stylistic</coverageTemporalFoundation>

        </coverage>
        <location>
            <locationGeometry xmlns:gml="http://www.opengis.net/gml">
                <gml:Point srsName="urn:ogc:def:crs:EPSG:6.6:4326">
                    <gml:pos>40.6263 22.9485</gml:pos>
                </gml:Point>
            </locationGeometry>
            <locationPrecision>20</locationPrecision>

            <locationComment>Thessaloniki, Greece</locationComment>
        </location>
        <object>
            <title>Fourth floor</title>
            <type>Floor</type>
            <element>
                <title>C-TWT-65</title>

                <identifier domain="dendro.cornell.edu"
```

```
    >89dbd409-03a3-42a0-9391-62c6be7009ad</identifier>
<createdTimestamp certainty="exact">1997-02-01T14:13:51.0Z</cr
<lastModifiedTimestamp certainty="exact"
    >1997-02-01T14:13:51.0Z</lastModifiedTimestamp>
<type normalStd="Corina Dictionary" normalId="3" normal="Rafte
<description>15th Rafter from the south</description>
<taxon normalStd="Catalogue of Life Annual Checklist 2008" nor
    normalId="49139">Quercus sp.</taxon>

<dimensions>
    <unit normalTridas="metres"/>
    <height>1</height>
    <width>1</width>
    <depth>1</depth>
</dimensions>
<authenticity>Original</authenticity>

<sample>
    <title>C-TWT-65-A</title>
    <identifier domain="dendro.cornell.edu"
        >ff688357-b2d4-4394-a21a-90696cd4558c</identifier>
    <createdTimestamp certainty="exact"
        >1997-02-01T14:13:51.0Z</createdTimestamp>
    <lastModifiedTimestamp certainty="exact"
        >1997-02-01T14:13:51.0Z</lastModifiedTimestamp>
    <type normal="Corina Dictionary" normalId="1" normalStd="S
        >Section</type>

    <samplingDate certainty="exact">1981-07-25</samplingDate>
    <state>Dry</state>
    <radius>
        <title>C-TWT-65-A-B</title>
        <identifier domain="dendro.cornell.edu"
            >5b7baa8b-cd4e-4b3b-88fa-82939420e544</identifier>
        <createdTimestamp certainty="exact"
            >2006-05-04T18:13:51.0Z</createdTimestamp>

        <lastModifiedTimestamp certainty="exact"
            >2006-05-04T18:13:51.0Z</lastModifiedTimestamp>
        <woodCompleteness>
            <pith presence="absent"/>
            <heartwood presence="incomplete"/>
            <sapwood presence="complete"/>
            <bark presence="present"/>
        </woodCompleteness>
        <measurementSeries>

            <title>C-TWT-65-A-B-A</title>
            <identifier domain="dendro.cornell.edu"
                >8c50234e-8eda-41bb-b578-01cc881d1ea1</identif
            <createdTimestamp certainty="exact"
                >1997-02-01T14:13:51.0Z</createdTimestamp>
            <lastModifiedTimestamp certainty="exact"
                >1997-02-01T14:13:51.0Z</lastModifiedTimestamp
```

```
                                <analyst>Laura Steele</analyst>
                                <dendrochronologist>Peter I Kuniholm</dendrochrono

                                <measuringMethod normalStd="Corina Dictionary" nor
                                    >Measuring platform</measuringMethod>
                                <interpretation>
                                    <firstYear suffix="AD">1254</firstYear>
                                    <statFoundation>
                                        <statValue>8.3</statValue>
                                        <type>t-score</type>
                                        <usedSoftware>Corina 2.10</usedSoftware>

                                    </statFoundation>
                                    <deathYear suffix="AD">1535</deathYear>
                                    <provenance>Possibly from the region of Serres
                                </interpretation>
                                <values>
                                    <variable normalTridas="Ring width"/>
                                    <unit normalTridas="1/100th millimetres"/>
                                    <value value="54"/>

                                    <value value="111"/>
                                    <value value="71"/>
                                    <value value="40"/>
                                    <value value="56"/>
                                </values>
                            </measurementSeries>
                        </radius>
                    </sample>
                </element>

            </object>
        </object>
    </project>
</tridas>
```

TRIMS

Table 6.18.

Format Name	TRIMS
Other names	None known
Type	Text file
Extension(s)	Normally .rw
Read/write support	Read and write
Reference implementation	Unknown
Data/Metadata	Data only
Single/Multi series	Single

Original designer	Unknown

Description

This is a simple data only text file format. These files were originally produced using the Henson rotary micrometer measuring stages but have largely been phased out.

- Line 1 - Initials of user that created the series
- Line 2 - Date the file was created in dd/MM/YY format
- Line 3 - Year of first data value
- Line 4+ - Space character followed by an integer data value in 1/100th mm
- Final line - Space character + 999 denoting end of series.

Example file

```
ds
09/10/91
 1816
 169
 96
 165
 85
 139
 87
 112
 102
 60
 43
 164
 172
 142
 193
 143
 172
 229
 198
 158
 112
 128
 181
 171
 206
 137
 73
 103
 131
 177
```

```
179
244
173
161
202
341
149
263
197
375
266
369
120
212
217
191
238
254
147
225
103
207
207
140
182
148
110
181
120
263
256
999
```

Tucson

Table 6.19. Summary of the Tucson file format

Format Name	Tucson
Other names	Decadal, RWL, CRN, ITRDB
Type	Text file
Extension(s)	Various (including tuc, rwl, dec, crn)
Read/write support	Read and write
Reference implementation	COFECHA
Data/Metadata	Data with some structured metadata. However standardisation of metadata is very poor resulting in metadata often being little more than free text comments
Single/Multi series	Multi
Original designer	Richard Holmes

Description

The Tucson format is perhaps the most widely used dendro data format. Unfortunately it seems there was never definitive documentation. Support for the format has been incorporated into a number of dendro applications but without format documentation there are variations in these implementations resulting in quite a lot of subtle differences in files. The often tight association between the Dendro Program Library (DPL) and the ITRDB means that perhaps the most definitive documentation for the format is the ITRDB website [http://www.ncdc.noaa.gov/paleo/treeinfo.html#formats].

The Tucson format is best considered as covering two different sub-formats which are often referred to by their file extensions (RWL and CRN). RWL files are used for storing ring width data, whereas CRN files are used for storing chronologies.

The ITRDB website [http://www.ncdc.noaa.gov/paleo/treeinfo.html#formats] includes detailed information on how to include structured metadata in Tucson format files. Unfortunately there are no tools for creating and/or validating Tucson files so the vast majority of files circulating in the community today (including those in the ITRDB) do not adhere to these standards.

RWL files

Tucson RWL files begin with three lines of metadata. Strictly these lines should contain structured metadata, but with no software to assist in this, users either only partially stick to these rules, or reject them entirely instead using the three lines as free-text comment lines. The metadata should be set out as follows:

- Line 1 - Chars 1-6 Site ID
- Line 1 - Chars 10-61 Site Name
- Line 1 - Chars 62-65 Species Code followed by optional ID number
- Line 2 - Chars 1-6 Site ID
- Line 2 - Chars 10-22 State/Country
- Line 2 - Chars 23-30 Species
- Line 2 - Chars 41-45 Elevation
- Line 2 - Chars 48-57 Lat-Long in degrees and minutes, ddmm or dddmm
- Line 2 - Chars 68-76 1st & last Year
- Line 3 - Chars 1-6 Site ID
- Line 3 - Chars 10-72 Lead Investigator
- Line 3 - Chars 73-80 comp. date

Then follows the data lines which are set out as follows:

- Chars 1-8 - Series ID - the series ID should be unique in the file so that it is clear where one series ends and another begins when multiple series are present in the same file.
- Next 4 chars - Year of first value in this row.

- Ten data values consisting of a space character and 5 integers. The file and last data line for a series may have less than 10 data values so that the majority of lines begin at the start of a decade.

The final data value should be followed by a a stop marker which is either 999 or -9999. When a stop marker of 999 is used this indicates that the integer values in the file are measured in 0.01mm (1/100th mm) units, whereas if a -9999 stop marker is used the units are 0.001mm (microns). The stop marker is therefore used to indicate the end of the data series and the units the data are stored in.

There appears to be no official specification as to how missing rings should be encoded, but the standard notation seems to be to use -999 or 0.

CRN files

Tucson CRN files are used to store chronology data. In addition to each data values they also have space for a sample depth or count value to record how many values were combined to give each data value. CRN files should strictly begin with the same 3 header lines that are described above for RWL. Like RWL files the specification is often partially adhered to and at times ignored completely.

The data lines for CRN files are quite different to RWL:

- Chars 1-6 - Series ID
- Next 4 chars - Year of first value in this row.
- Ten data value blocks consisting of four integer characters for the data value, then a space, then two integer characters for sample depth.

The stop marker in a CRN file should be 9990.

Workarounds and quirks

- No information was given as to how to handle the non-existent year 0AD/BC. For data files with years all in the AD period, this is not a problem. Most dendro software seem to treat year numbers in Tucson files as using the 'Astronomical Calendar' whereby 1 = 1AD, 0=1BC, -1=2BC etc. This goes against what most dendrochronologists assume (and do) when using Tucson files. For instance most people that work entirely in the BC period use negative integers to represent BC years e.g. -5 as 5BC. With no clear specification and different people interpreting the format in different ways, there is no way of being certain what data negative year numbers in Tucson files mean.
- Tucson format places a restriction of just four characters to the year values. This means that strictly the earliest value a Tucson file can represent is -999. Some users work around this by steeling the last character of the series ID to give them five characters for the year. For example: `ABCDEFG-9999`. This conversely limits the series ID to 7 characters. To add to the confusion, other users have been known to add an arbitrary number (e.g. 5000) to all year numbers to overcome this problem.
- The fact that 999 is used as the stop marker for series in 1/100th mm means that Tucson files cannot store a ring value of 9.99mm. In the unlikely event that a sample should have this large a ring, it should be rounded up or down to 998 or 1000.
- Some programs appears to add padding values after the stop marker to fill the rest of the 10 data values in the row.
- Some data files seem to use 9990 as a stop marker
- Some files appears to use a full-stop character to indicate empty data values after the stop marker.

- Data values in RWL files are space delimited, however some programs use tabs instead.
- When reading Tucson files, COFECHA and ARSTAN ignore all lines that do not match the standard data line format. As such, some users have used this to enable them to include multiple comment lines in their files.

Example file

RWL style

```
107     1 OBERGURGL
107     2 AUSTRIA      NORWAY SPRUCE      6726  4652N01101E     1466 1970
107     3 GIERTZ                                                  08   76
107011  1911    78    93    43   100    93   110   135   115   102
107011  1920    92   125   110   135    98    80    75   125   102   110
107011  1930   105   105    95   120   135   140   110   120   130   135
107011  1940   120   130   130   165   135   145   155   160    88   135
107011  1950   140   150   140   130   115   130   130   110   110   135
107011  1960   125   120   135   160   15    102   105   135   105   140
107011  1970   120   115   100   110   110   999
107012  1862   450   580   550   480   620   420   390   420
107012  1870   360   370   300   360   470   460   410   430   510   500
107012  1880   500   510   500   410   380   430   340   380   350   400
107012  1890   290   260   270   320   340   370   330   310   240   170
107012  1900   280   300   300   310   350   400   300   280   280   180
107012  1910   190   290   270   210   230   300   220   360   240   260
107012  1920   200   270   250   230   270   210   160   210   220   200
107012  1930   170   250   200   130   140   210   210   180   190   180
107012  1940   170   180   190   190   190   200   190   180   110   180
107012  1950   220   230   180   220   200   240   220   210   240   260
107012  1960   210   220   200   200   170   230   250   270   230   260
107012  1970   220   200   190   200   999
107021  1913    43    64    55    75    87    73    60
107021  1920    45    65    70    63    60    50    46    60    54    39
107021  1930    45    35    50    52    60    85    78    72    80    97
107021  1940    90    80    73    98    83    85    80    84    67    95
107021  1950    80    88    90    75    73    80    85    66    85    82
107021  1960    77    67    63    76    87    64    73    70    63    73
107021  1970    65    54    46    57    45   999
107022  1879   400
107022  1880   400   550   450   410   360   440   430   320   120   100
107022  1890    80    80   130   170   250   360   360   500   430   360
107022  1900   500   640   650   750   990   990   650   600   520   300
107022  1910   330   390   330   300   420   380   300   460   280   360
107022  1920   260   390   400   350   420   380   250   310   300   310
107022  1930   260   300   330   240   200   240   260   280   310   340
107022  1940   330   320   410   410   430   530   500   500   290   400
107022  1950   390   360   310   330   330   400   340   310   450   400
107022  1960   420   350   360   290   290   350   400   400   380   430
107022  1970   480   460   320   430   999
```

CRN style

```
107089 1 Antalya, Elmali Isletmesi                           CDLI
107089 2 Turkey       Cedar            1800M  3640 02955          1370 1988
107089 3 Peter I. Kuniholm
1070001370 567  11115  1 798  11105  11407  1 398  1 436  1 543  1 490  1 225  1
1070001380 127  1  39  1  29  1  69  1 178  1 445  1 227  1 510  11020  11120  1
10700013901390  11310  1 979  11585  11111  1 444  1 214  1 520  1 275  1 224  1
1070001400 153  1 371  1 567  1 711  1 835  1 687  1 322  1 291  1 291  1 218  1
1070001410 168  1 378  1 557  1 410  1 315  1 202  1 531  1 765  1 797  1 840  1
1070001420 440  1 774  1 946  1 838  1 397  1 380  1 206  1 510  1 695  1 521  1
1070001430 461  1 978  1 967  1 857  1 978  1 733  1 522  1 333  1 577  1 477  1
1070001440 730  1 752  1 932  1 955  1 898  1 629  11170  1 738  1 920  1 363  1
1070001450 863  1 896  1 965  1 390  1 172  1 126  1  69  1 209  1 313  1 883  1
10700014601255  11220  11364  11035  11364  11282  11364  11611  11369  11273  1
10700014701797  12035  11821  11927  11819  11807  11464  21421  21009  21089  2
10700014801042  21040  21404  2 955  21291  2 982  21186  21042  2 728  2 781  2
1070001490 800  21040  2 503  2 869  21387  21365  21574  21591  22178  21594  3
10700015001629  31282  31126  31409  31433  31406  31239  31479  3 990  31063  3
10700015101026  31035  31175  31217  31500  31358  31171  31140  31005  31340  3
10700015201225  31164  31283  31496  31439  31603  31335  3 982  3 973  31147  3
10700015301086  31146  41403  41454  41209  41451  41292  4 964  41003  41289  4
1070001540 895  4 951  4 745  4 835  4 800  41182  4 952  41097  4 973  4 973  4
10700015501158  41370  41245  41392  41215  41047  51133  5 847  5 961  51295  5
10700015601287  51082  5 899  51012  51195  51409  51107  5 962  5 970  51031  5
1070001570 990  51028  51206  51092  51414  51209  51090  51265  51261  51019  5
1070001580 791  5 995  5 956  5 933  61144  61022  61001  61007  61097  61290  6
10700015901263  6 902  71002  71151  71032  8 968  8 592  8 940  8 936  81131  8
10700016001098  81128  81334  81255  91136  91097 101273 101075 10 952 10 897 10
1070001610 915 10 991 10 735 10 708 10 627 10 848 101010 10 872 10 959 101138 10
10700016201173 101122 101191 101146 10 928 10 820 10 935 10 741 10 812 101126 10
10700016301123 10 781 101111 101054 101275 101052 101068 101049 101016 10 970 10
10700016401093 101159 101023 101159 101060 101117 101314 10 843 101057 101040 10
10700016501030 101268 10 971 101059 101078 101170 101159 101388 101194 101260 10
1070001660 917 101222 101052 101165 101325 101608 101161 121181 12 931 12 992 12
1070001670 750 12 675 12 614 12 638 12 624 12 600 12 506 12 681 12 887 12 708 12
1070001680 797 12 940 12 955 12 886 12 878 12 970 12 916 12 861 12 861 121021 13
1070001690 928 13 961 131043 13 936 13 939 131003 13 619 13 846 13 838 13 822 13
1070001700 717 13 699 14 746 14 900 141022 14 781 14 968 141028 141051 141341 14
1070001710 980 14 817 14 718 14 642 14 554 14 589 14 637 14 677 16 710 16 877 16
1070001720 930 16 931 16 718 16 721 16 616 16 576 16 519 16 790 161046 161067 16
10700017301047 171141 181080 181128 181144 181112 191066 191252 19 971 191076 19
10700017401284 191242 191001 191145 191219 191162 19 576 20 979 231148 231062 23
10700017501119 231255 231267 231352 231397 231487 231116 231092 231150 23 938 23
10700017601118 241240 241258 241023 24 971 241071 241124 241225 241135 241114 24
10700017701072 241171 24 853 24 964 241075 24 820 241154 241059 241270 241022 24
10700017801098 24 903 241038 241147 241141 241162 24 782 241221 241424 241208 24
1070001790 974 241265 241256 241281 241166 241580 24 889 24 955 241158 241101 24
1070001800 949 24 990 24 813 24 758 24 821 24 914 24 889 24 999 24 991 241163 24
10700018101068 241184 24 852 24 870 241037 241070 241132 241047 24 978 24 852 24
1070001820 839 241063 241045 24 957 24 958 24 997 24 841 241209 241053 241013 24
1070001830 920 241103 241151 241166 24 850 24 962 24 944 24 871 24 989 24 906 24
1070001840 697 24 973 24 779 24 647 24 689 24 731 24 981 24 709 24 949 24 580 24
```

```
1070001850 619 24 345 24 545 24 688 24 723 241046 24 738 24 785 24 742 24 815 24
1070001860 842 241015 24 888 24 884 24 792 24 594 24 902 24 885 24 841 24 770 24
1070001870 822 24 710 24 838 24 783 24 697 24 768 24 515 24 670 24 855 24 793 24
10700018801021 25 932 25 799 25 902 251038 251017 25 739 25 750 25 963 251149 25
1070001890 798 24 871 24 870 24 625 24 772 24 827 241046 241182 24 701 24 704 24
1070001900 977 241237 241249 241162 241118 241007 241271 241123 241116 241045 24
10700019101167 24 827 24 482 24 952 241370 241260 24 783 241169 241096 241108 24
10700019201387 241484 241293 241182 241282 241527 241261 241146 24 920 24 859 24
10700019301235 241335 24 799 24 819 241000 24 763 241111 241019 24 916 241252 24
10700019401537 241387 231217 23 929 23 685 23 894 231106 231123 231089 23 896 23
10700019501384 231172 231151 231130 231244 231187 231118 231144 231268 231245 23
10700019601547 231015 231208 231203 231109 23 602 23 690 23 684 23 901 23 968 23
1070001970 963 231095 231368 231069 231084 21 936 191146 191362 191288 191572 19
10700019801034 19 870 191186 191047 19 968 191089 191272 191231 191083 189990  0
```

Tucson Compact

Table 6.20. Summary of the Tucson Compact file format

Format Name	Tucson Compact
Other names	Compact
Type	Text file
Extension(s)	Normally rwm
Read/write support	Read and write
Reference implementation	Various DPL programs including FMT
Data/Metadata	Data only
Single/Multi series	Multi
Original designer	Richard Holmes

Description

The Tucson Compact format was design by Richard Holmes for use with a number of the applications in the Dendro Program Library (DPL). Holmes designed it as a space saving alternative to the standard Tucson [/corina-manual/Tucson] format at a time when disk space was expensive. The format never really caught on, perhaps due to the complexity and variability of the format.

The key feature of Tucson Compact format is the inclusion of a code that describes the layout of the data within the series. This code means that only the required amount of space is allocated to each data value in the text file with little wastage. No space is provided for metadata.

Tucson Compact files can contain one or more series of data so the description of a data series below can be repeated multiple times in a single file. All lines should be 80 characters long and the first line of a series is denoted by a tilde (~) in the final column. This meta line contains four fields:

- Chars 0-9 = number of data values terminated with =N
- Chars 11-19 = start year terminated with =I
- Chars 21-68 = series title

- Chars 69-79 = fortran format descriptor
- Char 80 = Tilde marker

The Fortran format descriptor in the example below is -2(26F3.0). The constituent parts are as follows:

- -2 = this is the scaling factor for the data values. In this case -2 = 10^{-2} = 0.01.
  - Please note that in the Convert5 program this scaling factor is only read once in the first header line so files with multiple series each with different scaling factors will read incorrectly.
- 26F = means there are 26 values in each line
- 3.0 = means that each data value should be read as 3 integer values

The example below therefore means there are 26 data values per line each consisting of 3 digits which should be interpreted by multiplying by 0.01 (i.e. values are in 1/10ths mm).

Example file

```
     176=N    1277=I TWYN01                                                   -2(26F3.0)~
142338334409362308360264325318134151219268290222278258173198294202170176172121
 87130114108170135131126 87100 86104103127112 94 96120168149119124 79 67 88 90
 93 77 49 42 53 38 57 43 50 41 56 66 62 55 55 45 47 63 58 60 44 45 49 50 62 61
 43 54 91 60 56 43 52 51 65 68 55 44 41 75 94 78 63 69 58 75 55 47 58 46 62 45
 52 50 77 50 63 75 77 64 66 57 80 57 78 65 68 75 65 98 85 82119 89 85 87 83108
129123160117129121 88 69 97 77 96106 71 89 50 65133 89 88 50 60 95 95 91102158
 83 55 98 70 45 46 40 36 64 58 52 58 56 94 51 48 47 60 49 48
```

VFormat

Table 6.21. Summary of the VFormat file format

Format Name	VFormat
Other names	Orange Juice
Type	Text file
Extension(s)	Various but commonly .!oj
Read/write support	Read and write
Reference implementation	VFormat
Data/Metadata	Data with some structured metadata
Single/Multi series	Multi
Original designer	Tommy Reimers and Hans-Hubert Leuchner

Description

A relatively extensive format which includes highly encoded header lines for metadata. VFormat files have an array of file extensions depending on the type of data the files contain.

VFormat files can contain mutliple data series. Each series contains 2-4 header lines followed by a number of data lines. The metadata fields are encoded into the header lines in specific character positions. In line 1 the character positions are as follows:

- 1-12 = Series identifier. The series identifier also determines the filename. If there is just one series in the file then the series identifier will be the same as the filename. For files with multiple series, the filename will use characters 1-7 of the series identifiers that are the same throughout the file with the remaining (different) characters replaced by an underscore. The 8th character of the filename would contain a running number for files that would otherwise be named the same. The series identifier is made up of the following characters:
  - 1 = Code representing the project or country
  - 2 = Code representing the region of ecological area
  - 3-4 = Code number for sample site (optionally encoded using hexadecimal or hexatresimal to enable values greater than 99).
  - 5-6 = Series/tree number (optionally encoded using hexadecimal or hexatresimal to enable values greater than 99).
  - 7 = Height code encoded as follows: 1 = 1m, 2=2m, 9=9m, A=10m, B=11m, S = Lumber height 30cm, T = breast height =130cm.
  - 8 = Running number if several series have the same values in columns 1-7.
  - 9 = Fixed as a dot character
  - 10 = Either ! (single), % (partial), # (mean curves or chronologies)
  - 11 = Code for statistical treatment. One of F (frequency filtered series); I (index); M (mean); O (original); P (pointer-year stat); Q (cluster-pointer-year stat); R (residual); S (moving deviation or variance); T (trend, fitted curve, model); W (wuchswert); X (series with standardized running mean and variance); Z (central moment, deviation or variance between several series).
  - 12 = Code for the measured parameter. One of D (mean density); F (earlywood width); G (maximum density); J (ring width); K (minimum density); P (percentage latewood); S (width of latewood).
- 13-15 Measurement units
- 16-20 Length of series
- 21-24 Species either encoded using ITRDB taxon codes or by using the first two letters of the genus and species.
- 25-30 Year of the last ring
- 31-50 Description
- 51-58 Measurement date (ddMMyy or ddMMyyyy)
- 59-60 Initials of author
- 61-68 Last modified date (ddMMyy or ddMMyyyy)
- 69-70 VFormat version identifier (00,01 etc)
- 71-73 Estimated number of missing rings as the start of the series

- 74-75 Standard error of this estimate (. if unknown)
- 76-78 Estimated number of missing rings at the end of the series
- 79-80 Standard error of this estimate (. if unknown)

The second data line is a free text comment up to 80 characters.

VFormat files from version 10 onwards then contain a third header line. This contains 8 floating point numbers of 10 digits each. These represent:

- Longitude
- Latitude
- Altitude
- Height of the tree's measurement
- Four other user definable numbers

VFormat files from version 20 onwards contain a forth header line. This is of the same format as line 3 but each of the values is user definable.

Following the 2-4 header lines come the data lines. These lines are made up of 10 data fields each containing 8 characters. Each data field is made up as follows:

- Two character code for validity and importance:
  - space = full validity
  - ! = not yet used
  - " = not yet used
  - # = not yet used
  - $ = no validity for long-term evaluations
  - % = no validity for single-value evaluations
  - & = no validity except for cumulative stats
  - ' = no validity at all, unknown value

The second character is a pseudo-binary character used to define a weighting factor. For full details of the complex method for calculating this weighting factor see vformat.pdf [/corina-manual/VFormat?action=AttachFile&do=get&target=vformat.pdf]

- One character user definable code for recording information about the data value
- Five digit floating point data value which is divided by 100 for interpretation

Example file

```
G1101020.!OJmm    81Qusp  1510FLA-02  32 /572            HL01.04.9002  810 10 .
G1101020.!OJ/S20102_0.!OJ/_
     281     221     225     169     178     197     126     103     112     130
     132     207     176     175     126     150      99     131     187     204
     218     172     202     115     135     130     196     135     142     129
     144     116      92      71     109     120     137      98      86     117
      64      79      72      61      62      82      75      81      83      69
      83      66      84      95      85      94      87      99      92     109
     150     108      70     113     119     120     122     107     111     114
     123     145     112     145     164     158     122     177     155     182
     153
G1101050.!OJmm   121Qusp  1516FLA-05  13 /586            HL01.04.9002 1510 13 .
G1101050.!OJ/S20105_0.!OJ/_
     448     286     341     213     346     371     745     719     580     466
     487     353     279     323     422     436     351     238     135     172
     179     210     277     145     165     261     263     190     194     183
     127     110     144     189     135     154     217     110     115      99
     106     101     106     198     191     185     185     160     112     152
      93      95      83     176     165     193     139     101      93     113
      85     145     174     157     132     130      74      52     114     138
     174     132     144     125      83     124     118     127     150     189
     152     133     117      91     104      96      56      90     130     126
     103     163      92     103     174      99     117      85     123     116
     147     127     145     133     155     144     114     115     121     111
     174     113     112      89      99     130     111     104     164     110
     139
```

WinDENDRO

Table 6.22. Summary of WinDENDRO file format

Format Name	WinDENDRO
Other names	
Type	Text file
Extension(s)	Normally .txt
Read/write support	Read only
Reference implementation	WinDENDRO
Data/Metadata	Data with some structured metadata
Single/Multi series	Multi
Original designer	Regent Instruments

Description

WinDENDRO format is a dendro text file format designed by Regent Instruments for their WinDENDRO software. Regent Instruments claims the format is proprietary. Although it is unclear whether such a claim is legally binding for a plain text file, the authors of DendroFileIOLib have decided to comply by not implementing a WinDENDRO format writer. However, in the interests of the dendro community and to ensure users can gain access to their data, DendroFileIOLib does include support for reading WinDENDRO format files.

WinDENDRO files differ from most other formats in that they contain a great deal of information specific to the image used to measure the sample. The WinDENDRO software allows users to measure ring widths from scans or photographs of samples rather than by using a traditional measuring platform.

WinDENDRO files are really just tab-delimited text files with data in columns in a specific order with a few additional header lines.

Line 1 should contain 8 tab-delimited fields

- Field 1 = WINDENDRO
- Field 2 = WinDENDRO file format version number, either 3 or 4
- Field 3 = Orientation of the data: R = in rows; C = in columns. All WinDENDRO files are in rows
- Field 4 = The column number where the data values begin. For version 3 files this is 13 and version 4 files this is 36
- Field 5 = The direction the data is recording in: P = pith to bark; B = bark to pith
- Field 6 = Whether the data is recorded incrementally (I) or cumulatively (C). WinDENDRO files are always incremental.
- Field 7 = Whether the bark width has been measured (Y or N). If yes, then there will be one more data value than there are rings
- Field 8 = RING

Line 2 contains the field names. For version 3 files these are:

- **TreeName** - The name of the tree being measured
- **Path identification** - ID of the path along which the series is measured
- **Site identification** - Name of the site from which the tree was taken
- **YearLastRing** - Year of the last ring in the series
- **Sapwood** - Distance (in mm) from the start of the sample to the start of the sapwood.
- **Tree height** - Height of tree in metres
- **Tree age** - Age of the tree. If unknown this should be 0, then it is assumed to be equal to the number of rings
- **SectionHeight** - Height up the tree in metres at which the sample was taken
- **User variable** - User defined variable - must be numerical
- **RingCount** - Number of rings the series contains
- **DataType** - Keyword indicating the type of data measured. This can be: RINGWIDTH; EARLYWIDTH; LATEWIDTH; EARLYWIDTH%; LATEWIDTH%; DENSITY; EARLYDENSITY; LATEDENSITY; MAXDENSITY; MINDENSITY; RINGANGLE.
- **OffsetToNext** - The number of lines to skip to go to the next data line of the same type. For instance a file can contain earlywood and latewood data for multiple samples. If this is the case then each sample will have two rows, one for each variable, and the OffsetToNext field will be 1.

In additional to these fields, version 4 files also include the following:

- **ImageName** - The filename for the image used to do this analysis. If the image was taken directly from the scanner or camera then this field will be SCANNER
- **Analysis Date Time** - Date and time the measurements were initially saved to disk in format dd/mm/YYYY HH:mm
- **Acquisition Date Time** - Date and time the image file was acquired in format dd/mm/YYYY HH:mm
- **Modified Date Time** - Date and time the file was last modified in format dd/mm/YYYY HH:mm
- **ImageSize H V NBits Channel** - The image size in pixels followed by bits per pixel per channel (8 or 16), channel used for analysis (Grey, RGB, R G or B)
- **CalibMethod XCal YCal EditedDendro** - Method of calibration: Intr (Intrinsic); Obj (ObjKnownDiam). This is followed by the size of a pixel and Y or N indicating if the image has been edited in WinDENDRO
- **ScannerCamera Make Model Software** - Details about the imaging hardware
- **LensFocLength [35mm]** - The 35mm equivalent focal length of the imaging lens
- **PathBegX BegY EndX EndY Width** - The coordinates for the start of the path/radius followed by the path width
- **RingBoundary AutoMan Meth Precise** - Details about the path taken. Ring boundary - Tg (tangent to ring) or Perp (perpendicular to path); Detection method - A (automatic) or M (manual); Ring detection method - Int (intensity differences) or T&S (teach and show); whether the 'more precise detection' method is active (Y) or not (N)
- **EarlywoodDef** - Earlywood-latewood transition criteria
- **DensActive Media Calib** - Density Analysis active (Y or N); Density Media setting (F - negative file or photo, W wood direct xray, positive film or photo); Light calibration setting (Acq - after image acquisition, Man - manual; No - none)
- **DensNSteps MatDens Interpol** - Number of steps and the density of the step wedge used for calibration followed by the interpolation method used between steps: Lin (Linear) Spl (Spline)
- **DensStepsThick** - The thickness of each step of the wedge used for density calibration
- **DensStepsLightInt** - The light intensity of each step of the wedge determined during the light intensity calibration
- **DensStepsWoodDens** - Equivalent wood density of each step of the wedge determined during light intensity calibration
- **DiskArea** - Area of the sample
- **DiskPerim** - Perimeter of the sample
- **DiskAvgDiam** - Average diameter of the sample
- **DiskFormCoef** - Sample area form coefficient
- **CompWoodArea** - Total area occupied by the compression areas

- **VoidArea** - Total area occupied by the void areas
- **PathLength** - Length of radius measured

Lines 3+ contain the actual data and metadata, one line for each series. Following the 13 or 36 columns of metadata (depending on file version) there are x number of columns containing ring values. The values are recorded as floating point data. The units for these data values are: mm for widths; % for percentages; g/cm3 for densities; radians for angles.

Example file

```
WINDENDRO       4       R       36      P       I       N       RING
TreeName        Path identification     Site identification     YearLastRing    Sa
3               IRA     1997    0       0       0       0       0       67      RI
5               IRA     1997    0       0       0       0       0       58      RI
1               IRA     1997    0       0       0       0       0       56      RI
2b              IRA     1997    0       0       0       0       0       52      RI
32              IRA     1997    0       0       0       0       0       52      RI
4               IRA     1997    0       0       0       0       0       44      RI
```

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