



User's Guide to the Free Delta Editor

An Interactive Environment for DELTA

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Introduction

The Free Delta Editor (FDE) is a standalone expert editor and interactive software management system for editing [DELTA](#) data and directives files and running DELTA based programs: CONFOR, KEY, DIST (and INTKEY5/INTIMATE5 in the MS-Windows version) and viewing/printing the results. With FDE, you can do a complete analysis of a taxonomic descriptive dataset, from data-checking to key construction, under a uniform, menu-driven, easily operated shell.

This tool provides an interactive, user-friendly interface to DELTA-format files as a real DELTA data entry/maintenance program, able to handle large amounts of data, limited only by available memory.. It is possible to insert or delete items, characters, and states, through forms and dialog boxes, without having to worry about the consistency of the DELTA files. A database-like interface makes it easy to setup and maintain the main DELTA data files (ITEMS, CHARS and SPECS), as well as several of the DELTA directives files (TONAT, TOKEY, TODIS). A spreadsheet-like visualization facility for item and character data is also available.

It also makes possible to start all DELTA programs and create dichotomous keys for identification, natural-language descriptions, statistical reports, distance matrices, cluster and ordination analysis, etc., providing a viewer to look at and print the results (output files).

It also integrates with the R environment for statistical computing and graphics to perform cluster analysis on distance matrices generated from DELTA data, as well as with the TNT parsimony analysis program.

On the other side, although Free Delta is able to process regular DELTA-coded files, it is not identical to the original DELTA system. We implemented all improvements that are convenient, based on our experience with other taxonomic computing systems. In particular, it has a better treatment of quantitative data, more analytical and format-conversion procedures, and many other useful features. See Appendix 3 for a summary of the differences between Free Delta and the original DELTA system.

Requirements

FDE requires:

- Microsoft Windows '95, NT 4.0, or later versions of these systems ('98, Me, 2000, XP, Vista, 7, 8, 8.1, 10).
- Many distributions of GNU/Linux 2.0 or later.
- The DELTA suite of programs (CONFOR, KEY, DIST).

When installed, FDE requires about 8 MB of disk space.

Distribution

The latest versions of FDE are available from the [Free DELTA website at SourceForge](#). The source code is also available from [GitHub](#).

The distribution package consists of an executable installation file for the MS-Windows version and a Debian package for the GNU/Linux version, both containing the program and documentation.

To install the program, download and save the installation package to any folder on your computer, and execute it by double-clicking on its name from your file manager program. After installation, start the software by clicking on the proper item at the start menu. Executable versions for MacOSX are not yet available.

License

FDE is free software, available under the terms of the [GNU General Public License](#) version 3 (GPL3). The DELTA programs (CONFOR, KEY, DIST) are distributed under the terms of the Mozilla Public License version 2 (MPL2).

User Interface

The FDE user interface resembles, but is not a clone of, that of the CSIRO and ALA Delta Editors. See Appendix 3 for a summary of the differences between Free Delta and the original DELTA system.

Main Window

In the FDE main window, two views of the data are always available: the List View (Figure 1) and the Matrix View (Figure 2). These views are accessible by clicking on the labeled tabs above the Items list.

In the List View (the default), the main window consists of three panels (Figure 1). The upper left pane displays the items (taxa) list, the upper right pane displays the character tree, and in the lower panel the attribute values are displayed and edited.

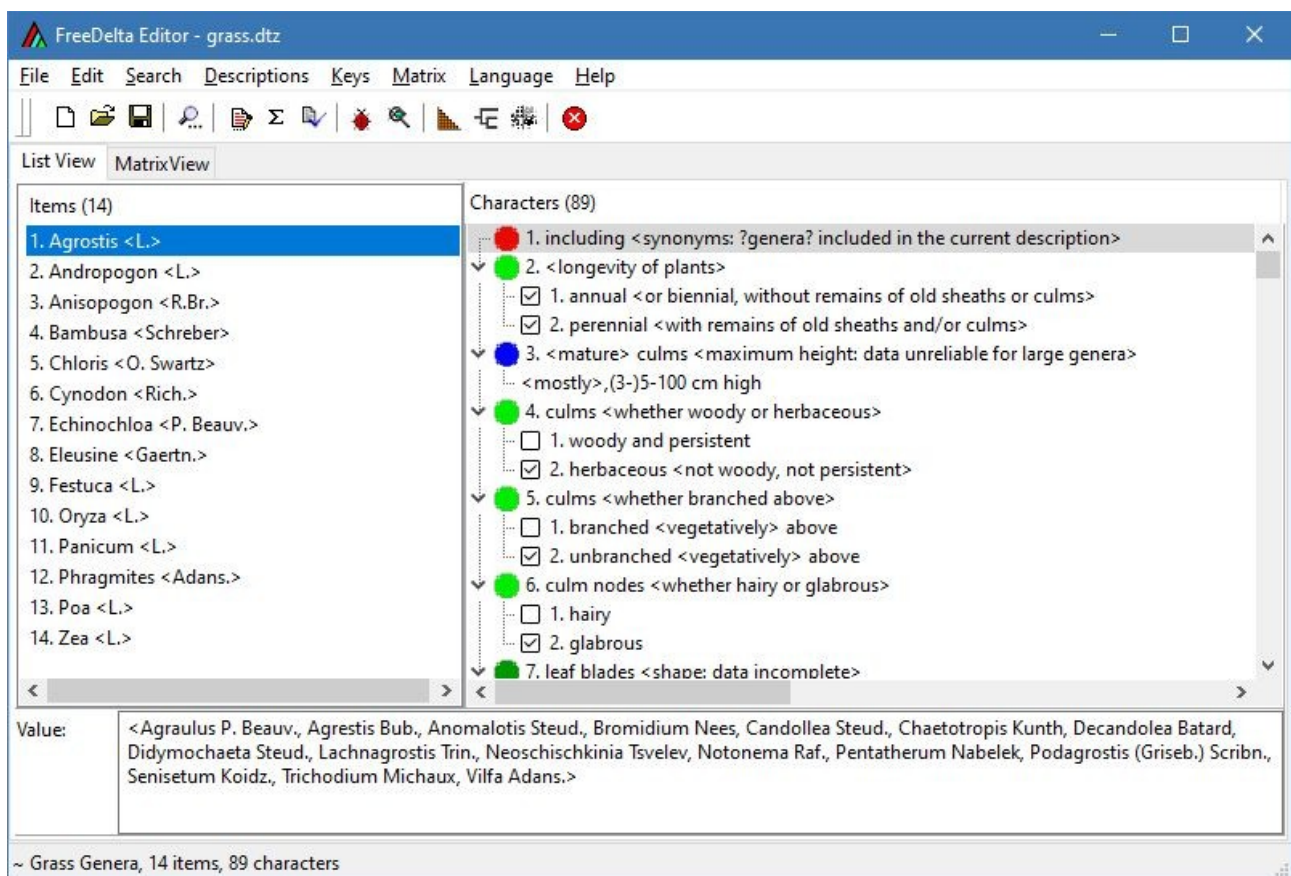


Figure 1 – FDE List View.

The Matrix View (Figure 2) provides an interface similar to that of a spreadsheet program like MS-Excel or OO-Calc.

	including <synonym? genera? included in the current	<longevity of plants>	<mature> culms <maximum height: data unreliable for large	culms <whether woody or herbaceous>	culms <whether branched above>	culm nodes <whether hairy or glabrous>	leaf blades <shape: data	leaf blades <mid-width data very incomplet	leaf blades <whether pseudopet	<adax ligule <prese
Agrostis <L.>	<Agraul...	1/2	,(3-)5-100	2	2	2	1	0.2-10	U	U
Andropogon <L.>	<Anath...	1/2	8-250(-4...	2	1/2	U	1	U	1/2	U
Anisopogon <R.Br.>	U	2	60-110	2	U	2	2	2-3	U	U
Bambusa <Schreber>	<Arund...	2	(200-)50...	1	1	2	U	U	1	U
Chloris <O. Swartz>	<Actino...	1/2	10-300	2	U	2	1	U	U	U
Cynodon <Rich.>	<Caprio...	2	4-60(-100)	2	U	2	1	U	U	1
Echinochloa <P. Beauv.>	<Ormith...	1/2	40-360	2	1/2	2	U	U	U	1/2
Eleusine <Gaertn.>	U	1/2	10-150	2	U	2	1	U	U	U

including <synonyms: ?genera? included in the current description>

<Agraulis P. Beauv., Agrestis Bub., Anomalotis Steud., Bromidium Nees, Candollea Steud., Chaetotropis Kunth, Decandolea Batard, Didymochaeta Steud., Lachnagrostis Trin., Neoschischkinia Tsvetlev, Notonema Raf., Pentatherum Nabelek, Podagrostis (Griseb.) Scribn., Senisetum Koidz., Trichodium Michaux, Vilfa Adans.>

~ Grass Genera, 14 items, 89 characters

Figure 2 – FDE Matrix View.

Clicking the right mouse button on each of the panes opens a popup menu with options for inserting, modifying or deleting items or characters in the list. Double-clicking on an item or character will open the item (Figure 3) or character editor dialog (Figure 4).

Item Editor Dialog

This dialog (Figure 3) allows the inclusion or modification of item (taxon) names. It may be opened either by the Add Item, Edit Item, and Insert Item options from the Edit menu; by right-clicking the mouse in the item list of the List View panel and selecting 'Insert new item' or 'Append new item' options from the popup menu; or by double-clicking on an item name in the List View.

Comments can be provided between angle brackets (<>) and should be used for the taxon authority.

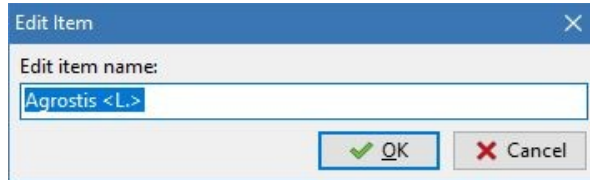


Figure 3 – Item editor dialog.







Character Editor Dialog

This dialog (Figure 4) allows the inclusion or modification of character names and their associated states, notes, and dependencies. It may be opened either by the Add Character, Edit Character, and Insert Character options from the Edit menu; by right-clicking the mouse in the character tree of the List View panel and selecting 'Insert new character' or 'Append new character' options from the popup menu; or by double-clicking on a character name in the List View.

This dialog has a number of panels. These panels contains several different controls, which can be selected by tabs, for editing the character descriptions, types, states, and units, as well as character notes and dependencies.

Character description. This is a simple edit control containing the 'feature', or basic description of the character. As with 'conventional' DELTA coding, the feature description should usually begin with a lower-case letter. Comments can be provided between angle brackets (<>).

Character types. This is a 'radio button' control that indicates the character type. The type should be chosen for any newly define character. It is possible to freely reassign the type of a character once it has been defined.

Character states. This panel contains a list of currently defined character states for qualitative (unordered and ordered multistate) characters, a check box and a group of image buttons. The user selects among states via the list control. The description of each state may then be edited by clicking the 'Edit' button (). New states can be appended to the end of the list by clicking the 'Add' button (). Clicking the 'Delete' button () deletes the currently selected state. States in the list control can be re-ordered by using the 'Up' () and 'Down' () buttons. The 'Clear' button () deletes the entire list of states. This panel is disabled for quantitative and text characters.

The 'Implicit' check box allows the specification of the currently selected state as the 'implicit' state. When the character is not recorded for a taxon, the implicit state value is assumed.

Character unit. This is a simple edit control containing the character unit for quantitative (integer and real) characters. This field is disabled for qualitative and text characters.

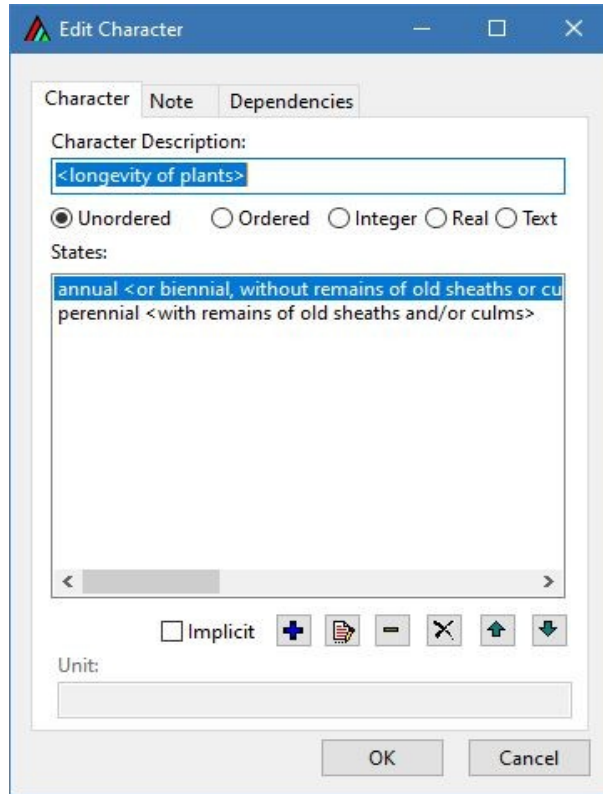


Figure 4 – Character editor dialog.

Character Notes Dialog

This panel (Figure 5) consists of a single large text edit control, where supplementary information (notes) about the character may be entered.

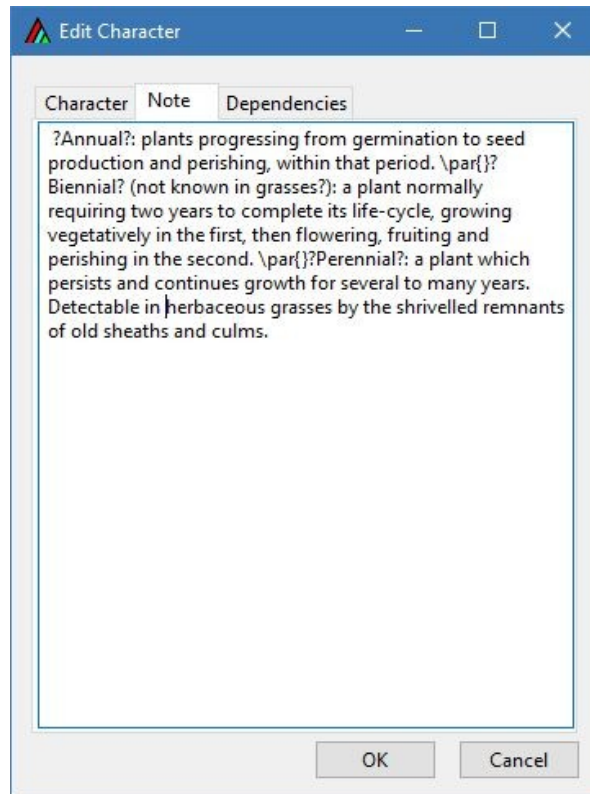


Figure 5 - Character notes dialog.

Character Dependencies Dialog

This panel (Figure 6) is used for defining 'controlling attributes'; that is, combinations of one or more states within a character, which when encoded for in a given item can make other 'dependent' characters inapplicable.

The panel contains a drop-down list of controlling attributes defined for the currently selected character and a checklist box containing the characters within the dataset. To define a new controlling attribute, select it from the list of controlling attributes and use the checklist box to select the characters which are made inapplicable by that attribute.

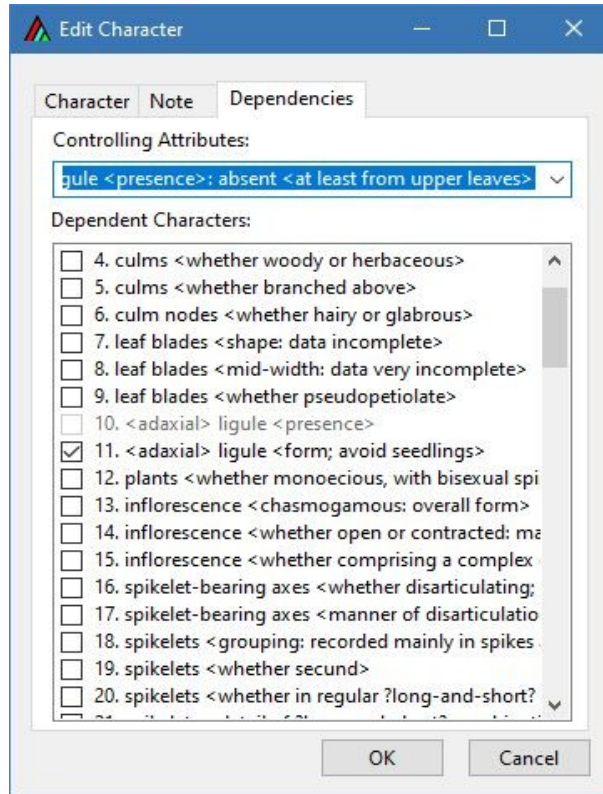


Figure 6 - Character dependencies dialog;

Attribute Editor Panel

This panel (lower-left pane) allows to enter and edit item descriptions.

It displays the DELTA encoding for the currently selected item and character, using the conventional DELTA style. Angle brackets should be placed around comments, but should not be used around text attributes.

Operation

File **Alt-F**


The File menu offers choices for opening, saving or printing files, importing and exporting data, and exiting the program.

New **Ctrl-N**

Automatically opens a blank dataset for editing with the title of "Untitled". You can start entering data right away.

Open **Ctrl-O**

The Open command displays the File Open dialog box. In this dialog box you select the data file you want to edit.

 *Under Microsoft Windows, it is also possible to open a file in FDE by double clicking on a Free Delta data file in Windows Explorer, identified by the extension '.dtz' (unless extensions have been hidden in the Folder Options), or by a Free Delta icon (▲).*

Close

Save data in the current dataset to disk and close the dataset. If your data file is titled "Untitled", you will be asked to supply a file name. Otherwise, the data is saved to disk using the current window title. If you have made changes but not saved them, the program will ask whether you want to save or discard your changes before you close the file.

This command is disabled until you open a dataset for editing.

Save **Ctrl-S**

Save data in the current dataset to disk and continue editing. If your window is titled "Untitled", you will be asked to supply a file name. Otherwise, the data is saved to disk using the current window title.

The original file is saved as a backup copy with the extension .BAK, and any old backup copy is deleted.

This command is disabled until you open a dataset for editing.

Save As

Save data in the current dataset to disk under a new file name. You will be asked to which file you would like to save the data. The file may be an existing disk file, or a new file.

Once your data is saved, you can continue using the editor on the current editi. Note that the window title will change to reflect your new file name.

The original file is saved as a backup copy with the extension .BAK, and any old backup copy is deleted.

This command is disabled until you open a dataset for editing.

Print

Prints the characters, coded items, or item names.

This command is disabled until you open a dataset for editing.

Print the Characters

Runs CONFOR with directives file PRINTC, to output the character list in a more readable form, with optional headings.

Print the Items

Runs CONFOR with directives file PRINTI, to reformat and output the item descriptions in a more readable form, suitable for publication.

Print the Item Names

Runs CONFOR with directives file PRINTN, to print the item names.

Import

Imports data from other programs into a Free DELTA dataset.

DELTA Format

Converts the data contained in text files in the DELTA format (the CHARS, ITEMS, and SPECS files) into a Free DELTA dataset.

The program will prompt for the folder where the DELTA files to be imported can be found.

Text Format

Converts a file of comma-separated values into an items file of a Free DELTA dataset.

Each line of the input file corresponds to an item, with values separated by commas. The first value on the line is the item name, and subsequent values are the DELTA-format character values, which may include comments. A character value may be optionally enclosed in double quotes.

A file in this format can be exported from an electronic spreadsheet, in which the first column contains the item names, and subsequent columns contain the character values.

The program will prompt for the name of the file of comma-separated values.

Export

Exports data into a variety of standard formats (DELTA, NEXUS, TNT, XDELTA) for use by other programs.

This command is disabled until you open a dataset for editing.

DELTA Format

Converts the data into text files in the DELTA format (the CHARS, ITEMS, and SPECS files).

XDELTA Format

Converts the data into the XDELTA XML file format defined Dodds (1999).

Text Format

Converts the data into a tab-delimited text file.

Clear Recent Files List

Lists the most recently opened files. To open a file from the list, click on its name.

Quit Ctrl-Q

The Exit command terminates the program. If you have made changes but not saved them, the program will ask whether you want to save or discard your changes before you exit the program.

Edit **Alt-E**

The Edit menu allows you to add, modify, or delete items and characters. You can also “clone” (copy) an item, enter item descriptions, merge character lists, or view images using the INTIMATE image-annotation program.

Add Item **Alt-Ins**

Displays the Item Editor Dialog (Figure 3) which allows the input of an item (taxon) name. The new item is appended to the end of list.

This command is disabled until you open a dataset for editing.

Insert Item **Shift-Alt-Ins**

Displays the Item Editor Dialog (Figure 3) which allows the input of an item (taxon) name. The new item is inserted at the current position.

This command is disabled until you open a dataset for editing.

Edit Item **Ctrl-I**

Displays the Item Editor Dialog (Figure 3) which allows to modify the currently selected item (taxon) name.

This command is disabled until you open a dataset for editing.

Delete Item **Alt-Del**

Deletes the currently selected item.

This command is disabled until you open a dataset for editing.

Clone Item **Ctrl-C**

Clones (*ie.*, copy) the entire description of the currently selected item, The cloned item is inserted at the current position.

This command is disabled until you open a dataset for editing.

Add Character **Ctrl-Ins**

Displays the Character Editor Dialog (Figure 4) which allows the input of data for each character. The new character is appended to the end of list.

This command is disabled until you open a dataset for editing.

Insert Character **Shift-Ctrl-Ins**

Displays the Character Editor Dialog (Figure 4) which allows the input of data for each character. The new character is inserted at the current position.

This command is disabled until you open a dataset for editing.

Edit Character **Ctrl-E**

Displays the Character Editor Dialog (Figure 4) which allows to modify the data related to currently the selected character.

This command is disabled until you open a dataset for editing.

Delete Character Ctrl-Del

Deletes the currently selected character..

This command is disabled until you open a dataset for editing.

Merge Character Lists Ctrl-M

Merge (join) two character lists, by appending another character list to that of the currently editing dataset.

The program will prompt for the name of the folder where the CHARS file to be merged can be found.

This command is disabled until you open a dataset for editing.

Database Title Ctrl-T

Displays a dialog box (Figure 7) which allows you to enter or modify the descriptive title (heading) of the current dataset, which may subsequently be used to label the output.

This command is disabled until you open a dataset for editing.

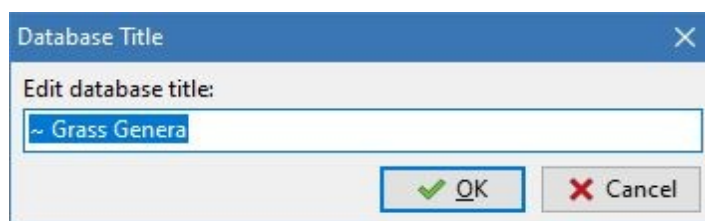


Figure 7 – Database title dialog.

Images Ctrl-G

This command runs INTIMATE (*INTkey Image AnnoTation Editor*), a program for associating images with particular characters or items, and to aid in the placement of various forms of annotation on these images. See the INTIMATE documentation (Dallwitz *et al.* 1993) for details.

This command is disabled until you open a dataset for editing.

Script

Displays a text editor window with syntax-highlighting (Figure 8), which allows editing and running of CONFOR/KEY/DIST directives files containing sets of instructions that will be read and processed by various DELTA programs (similar to the 'action sets' used by the CSIRO/ALA DELTA Editors).

This command is disabled until you open a dataset for editing.

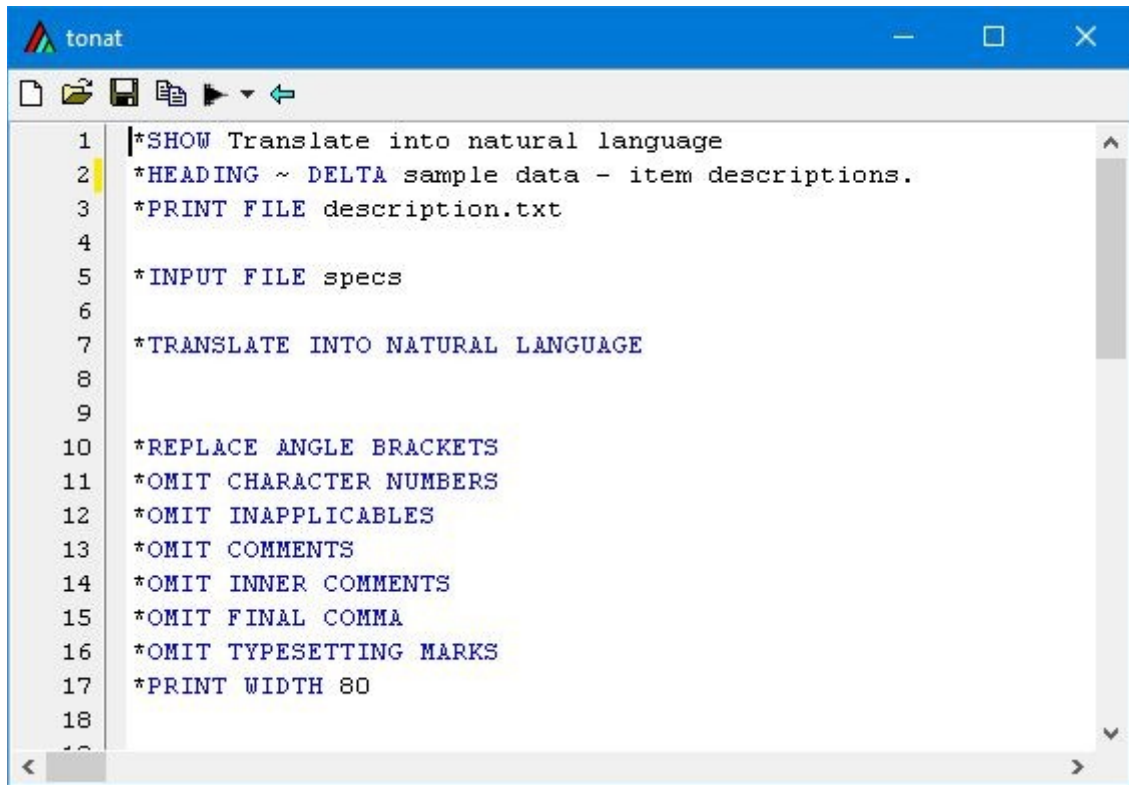


Figure 8 - The script editor

Search **Alt-S**

The Search menu allows you to look for items or characters within your current editing dataset.

Find **Ctrl-F**

Find a particular bit of text in your current editing dataset. A dialog box (Figure 9) will appear asking you what text to find, and gives you the option of finding text that is case sensitive (which means text must match the case of the text you entered before a match is found) or whole words only which means that no match will be found if the text you input is part of a word).

This command is disabled until you open a dataset for editing.



Figure 9 - Find text dialog.

Find Next **F3**

This will allow you to quickly repeat the last Find operation without having to enter your search parameters again.

This command is disabled until you open a dataset for editing.

Go to Line **Ctrl-G**

This will prompt you to enter a specific item/character line number (Figure 10), to which the cursor will be moved.

This command is disabled until you open a dataset for editing.

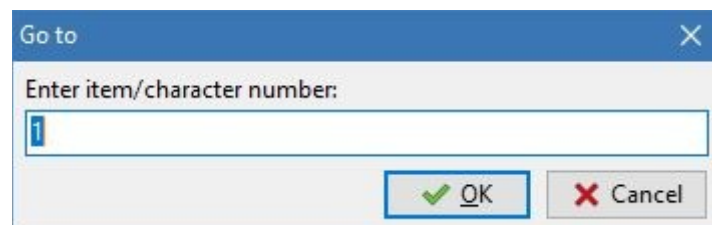


Figure 10 – Go to line dialog.

Descriptions

Alt-D

The Descriptions menu runs the format-conversion program CONFOR to generate natural language descriptions, produce a statistical summary of the data, and print a list of uncoded characters.

Natural Language

Runs CONFOR with directives file TONAT (Figure 11) in order to produce natural-language descriptions (Figure 11).

This command is disabled until you open a dataset for editing.

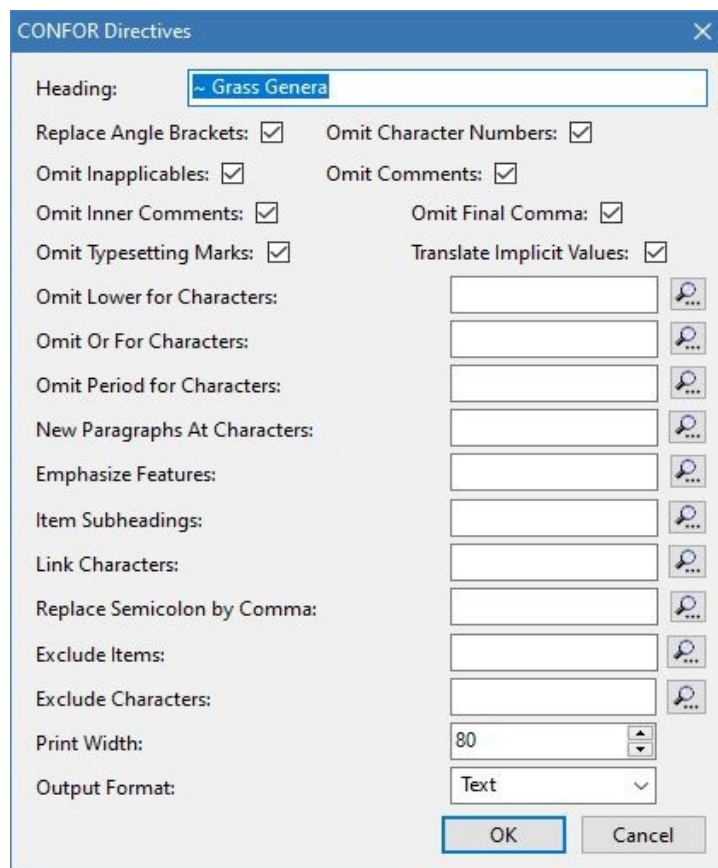



Figure 11 – TONAT directives dialog.

 The *ITEM SUBHEADINGS field must be entered as a semicolon-separated list, for example: 2. Habit, vegetative morphology; 12. Inflorescence; 25. Female-sterile spikelets; 26. Female-fertile spikelets, florets, fruit; 68. Photosynthetic pathway, leaf blade anatomy; 77. Special diagnostic feature; 78. Taxonomy, distribution; 87. Anatomical references; 88. Illustrations.

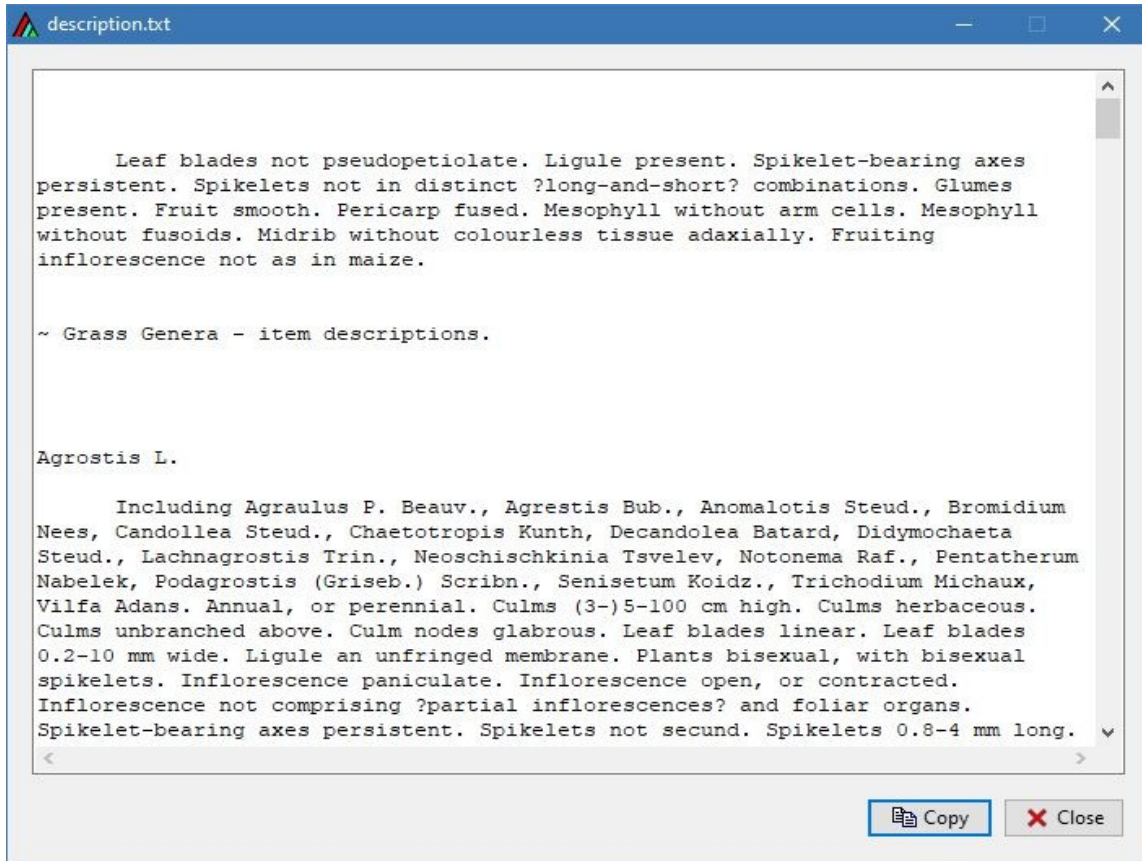


Figure 12 - Natural-language description.

Character Summary

Runs CONFOR with directives file SUMMARY in order to print a statistical summary of the data (Figure 13).

Numeric characters are expressed in terms of mean, standard deviation, maximum, and minimum, while multistate characters show the distribution of the items according to the individual states.

This command is disabled until you open a dataset for editing.

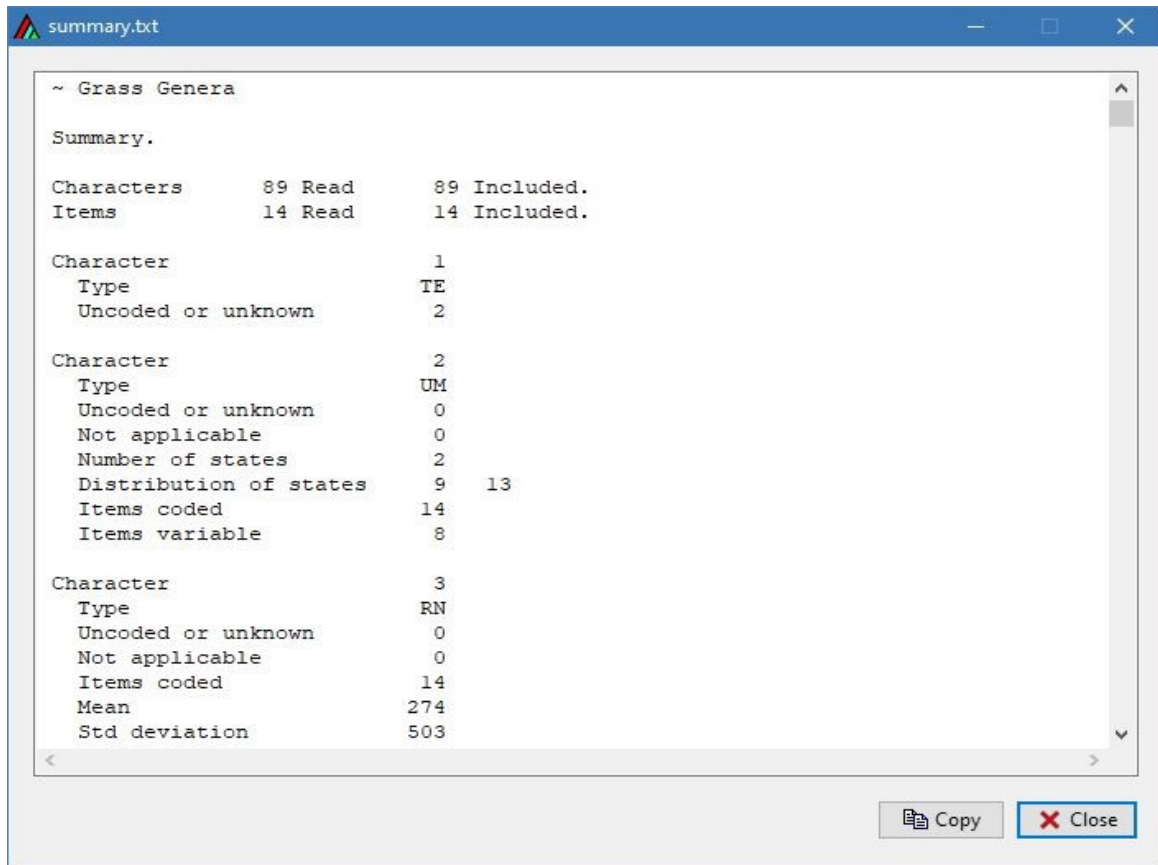


Figure 13 – Character summary report.

Uncoded Characters

Runs CONFOR with directives file UNCODED, to print the uncoded characters (Figure 14).

This command is disabled until you open a dataset for editing.

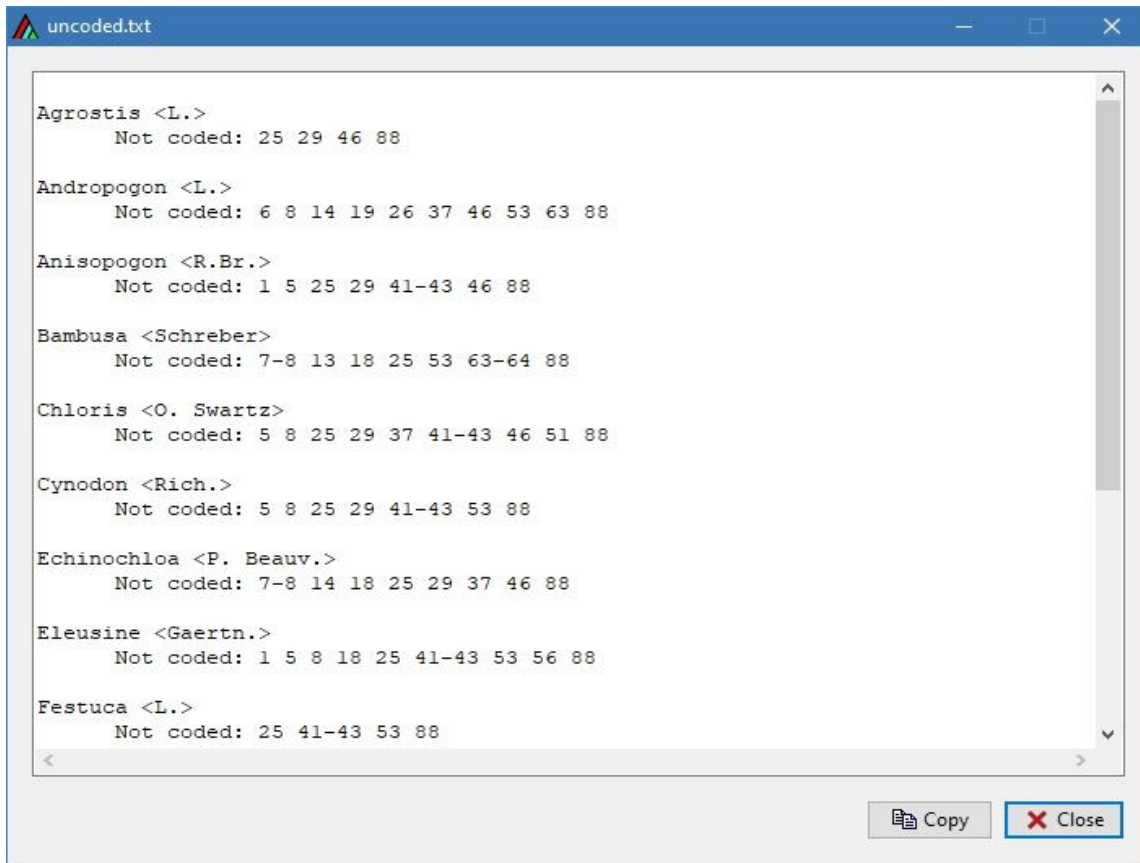


Figure 14 – Uncoded characters report.

Keys

Alt-K

The Keys menu runs the key generation-program KEY and the interactive identification and information retrieval program INTKEY5.

Conventional Key

Runs KEY, a program for generating identification keys (Dallwitz, 1974), in the conventional bracketed, or in a tabular format resembling a tree diagram.

Input to the program consists of two binary files (KCHARS and KITEMS), produced by the TRANSLATE INTO KEY FORMAT option of CONFOR, with directives file TOKEY (Figure 15) in order to convert the data into the format required by the key-generation program KEY, and an optional directives file (KEY), which controls execution of the program. See Chapter 5 of the *DELTA User's Guide* (Dallwitz *et al.*, 1993) for details.

KEY Directives

Heading: ~ DELTA sample data

Add Character Numbers:

No Bracketted Key: No Tabular Key:

Number of Confirmatory Characters: 0

Treat Characters as Variable: [] [...]

Use Normal Values: [] [...]

Character Reliabilities: [] [...]

Key States: [] [Σ]

ABASE: 1.20

RBASE: 1.40

REUSE: 1.01

VARYWT: 0.80

Include Items: [] [...]

Include Characters: [] [...]

Print Width: 80

Output Format: Text

OK Cancel

Figure 15 – TOKEY directives dialog.

The output file contains the dichotomous key in bracketed (Figure 16) or in tabular format (or both). This command is disabled until you open a dataset for editing.

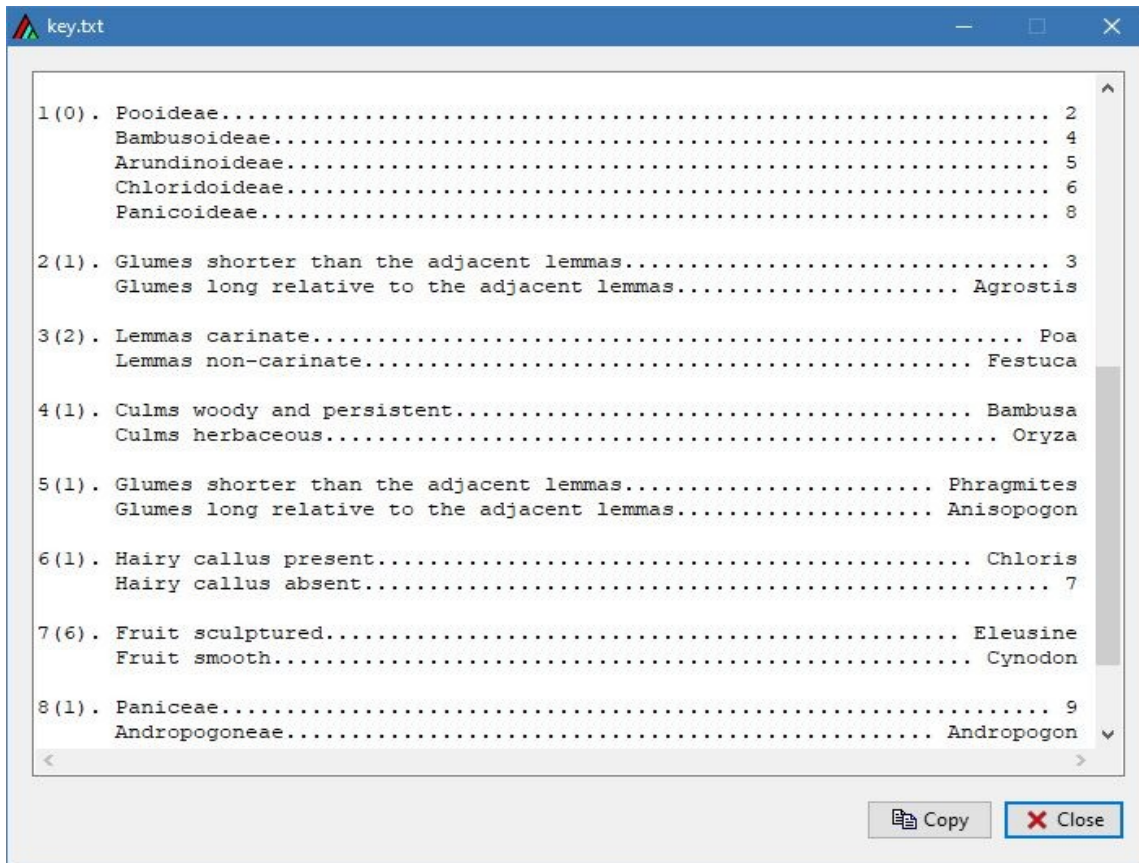


Figure 16 - Dichotomous key in bracketed format.

Interactive Key

Runs INTKEY5, an interactive program for identifying a specimen by comparing its attributes with stored descriptions of taxa. The program can also be used to query the stored data (Watson *et al.*, 1988, 1989; Bruhl *et al.*, 1992; Dallwitz, 1993).

Input to the program consists of two binary files (ICHARS and ITEMS) produced by the TRANSLATE INTO INTKEY FORMAT option of CONFOR, and an optional initialization file (INTKEY.INK) containing commands which are executed when the program starts. See Chapter 7 of the *DELTA User's Guide* (Dallwitz *et al.*, 1993) for details.

The program INTKEY5 offers research features for taxonomic identification and information retrieval which are lacking in less sophisticated programs (Dallwitz, 1993). They include optional display of extended notes on characters and character state definitions; direct handling of numeric values, which therefore do not have to be arbitrarily ranged; the ability to alter the treatments of unknowns, inapplicables and overlapping values, as required for different applications; retrieving text information (as synonyms, references, etc.); restricting operations to subsets of characters or taxa; defining keywords to represent subsets of characters and taxa; locating characters by included words, and taxa directly by name; specifying character reliabilities (i.e., weights) appropriate for particular purposes (rendering practical the calculation of "best" characters for large sets of characters and taxa); obtaining lists of taxa possessing or lacking particular attributes or combinations of attributes; listing similarities or differences between taxa; describing, comparing, contrasting, and diagnosing taxa, in terms of specified sets of characters, and generating files suitable for input to other DELTA programs (for example, to highlight diagnostic features in printed descriptions). INTKEY5 permits screen display of digitized pictures, at high resolutions and in large numbers; and it handles large sets of data, with acceptable response times.

 This option is available only under Microsoft Windows.

Matrix

Alt-M

The Matrix menu runs the distance-matrix program DIST and, if available, the R environment for statistical computing and graphics. It also offers an option for running the parsimony analysis program TNT.

Distance Matrix

Runs DIST, a program for generating a distance matrix. Distances are calculated among taxa using a modified version of Gower's (1971) general similarity coefficient. See Chapter 4 of Sneath & Sokal (1973) for an explanation.

Input to the program consists of a binary file (DITEMS) produced by the TRANSLATE INTO DIST FORMAT option of CONFOR (Figure 17), in order to convert the data into the format required by the distance-matrix program DIST, and an optional directives file (DIST), which controls execution of the program. See Chapter 6 of the *DELTA User's Guide* (Dallwitz *et al.*, 1993) for details.

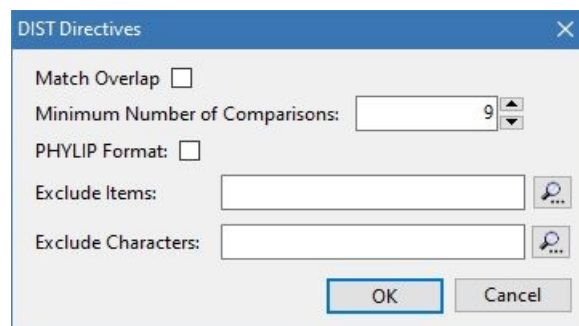


Figure 17 – TODIS directives dialog.

The output file contains the distance matrix in upper-triangular form, without the diagonal (Figure 18). This command is disabled until you open a dataset for editing.

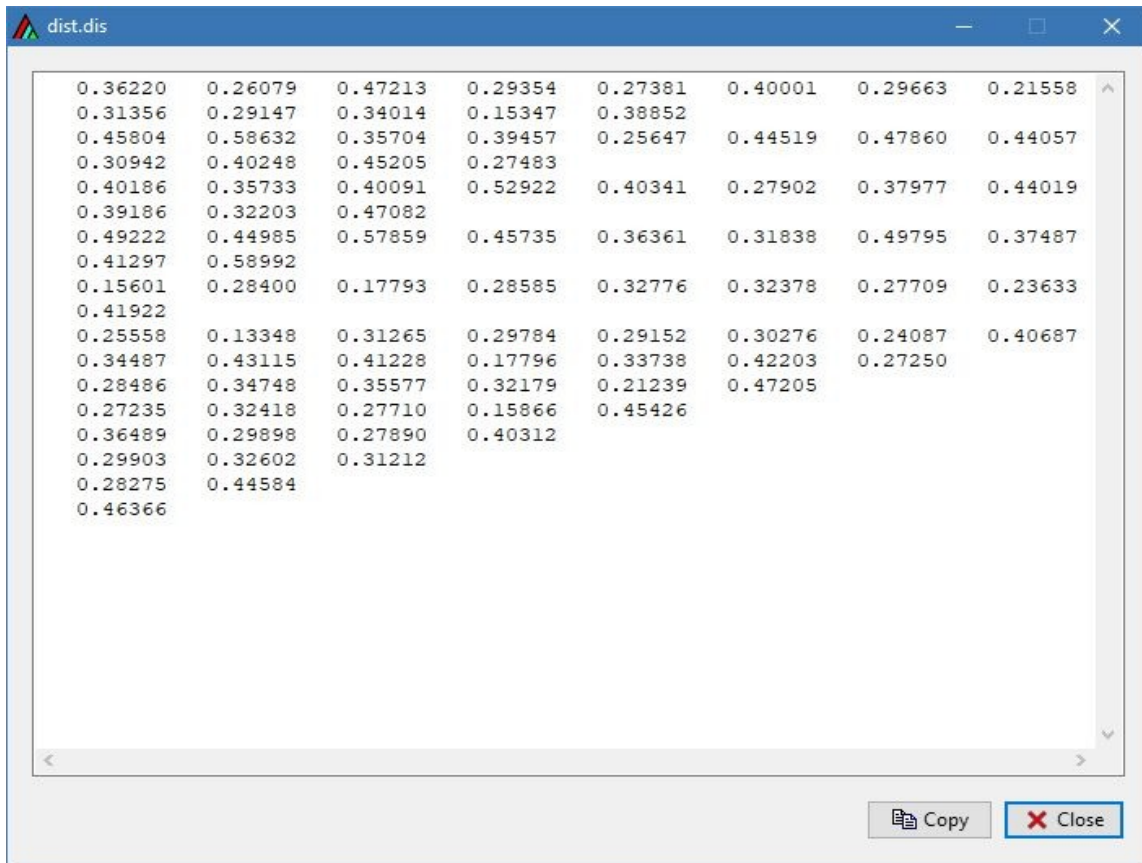


Figure 18 – Output distance matrix.

Cluster Analysis

Runs [R](#), a free software environment for statistical computing and graphics (Ihaka & Gentleman, 1996), to perform agglomerative clustering on the distance matrix generated by the DIST program (Figure 19) by seven combinatorial sorting strategies (single linkage, complete linkage, average linkage, weighted linkage, centroid, median, and Ward’s method), generating a dendrogram (Figure 20). See Chapter 5 of Sneath & Sokal (1973) for an explanation of these methods.

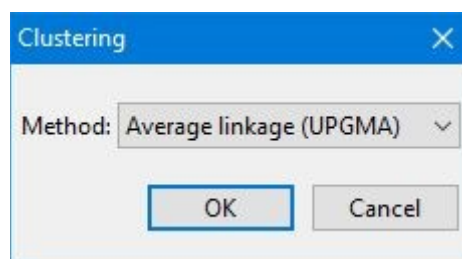


Figure 19 – Clustering options dialog.

This command is disabled until you open a dataset for editing and a distance matrix is generated.

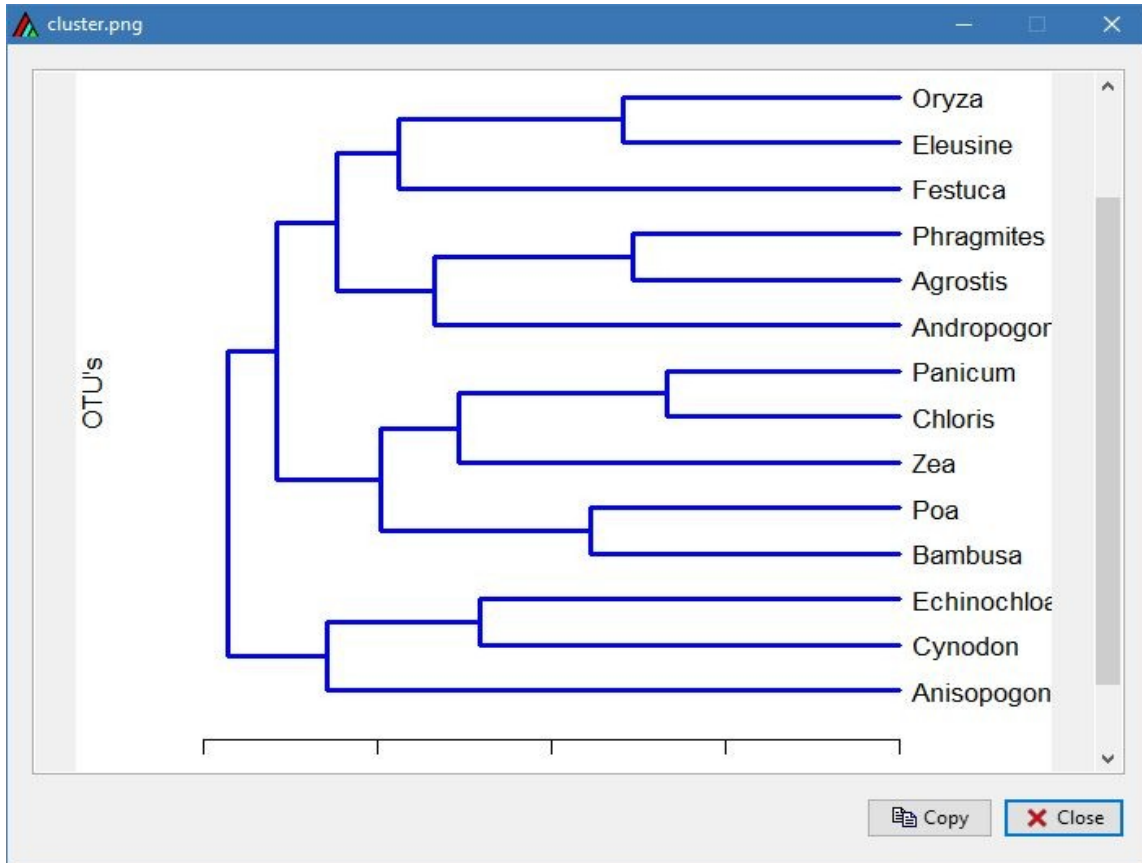


Figure 20 – Dendrogram generated from the distance matrix.

This option works on distance matrices produced by the program DIST.

Principal Coordinates Analysis

Runs R, to perform an ordination of the distance matrix generated by the DIST program (Figure 21) using the method of principal coordinates (Gower 1966).

This command is disabled until you open a dataset for editing and a distance matrix is generated.

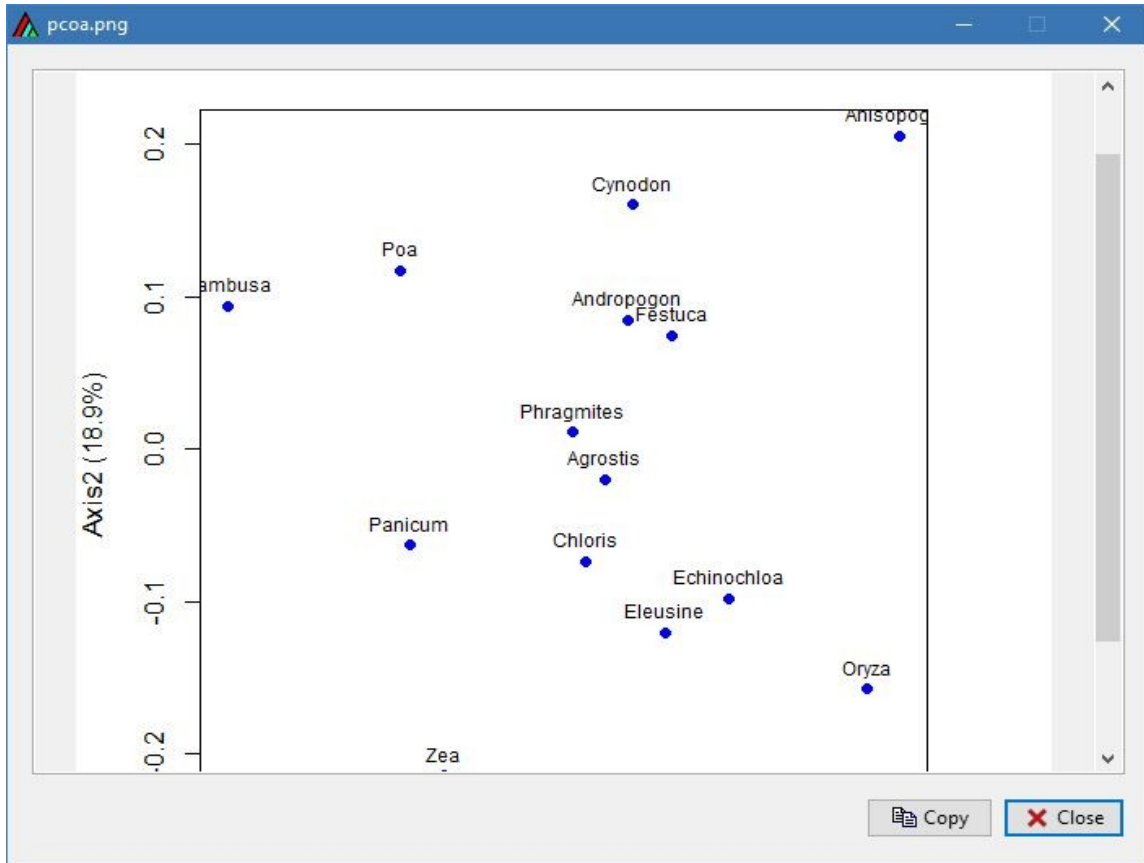


Figure 21 – Principal coordinates analysis generated from the distance matrix.

This option works on distance matrices produced by the program DIST.

Parsimony Analysis

Runs CONFOR with directives file TOHEN or TONEX (Figure 22) in order to convert the data into the format required by the phylogenetic analysis programs [PAUP](#) (Swofford 2003) and [TNT](#) (Goloboff *et al.* 2008).

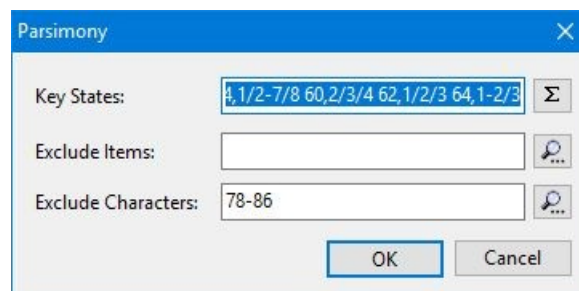


Figure 22 - TOHEN/TONEX directives dialog.

This command is disabled until you open a dataset for editing.

 This option is available only under Microsoft Windows (32- and 64-bit) and GNU/Linux (64-bit).

Language **Alt-L**

The Language menu allows to change the default language. The Free Delta Editor is currently available in English (default), French, and Brazilian Portuguese. The selected language will also be used in IINTKEY5 interface and help file (INTKEY.HIN).

Any interested person can provide a translation for her/his native language. No knowledge of programming is required, just a freely available and easy to use software tool as [POEdit](#) or [Virtaal](#). Please contact me for further details.

Help **Alt-H**

The Help menu provides access to an About box which gives general information about the program and the operating system.

Help Index **F1**

Displays the main index or contents page for the program help file.

About FDE

Displays a dialog box that shows some information about the program, as the name, a copyright notice, and a version number, as well as about the operating system on which the program is running (Figure 23).

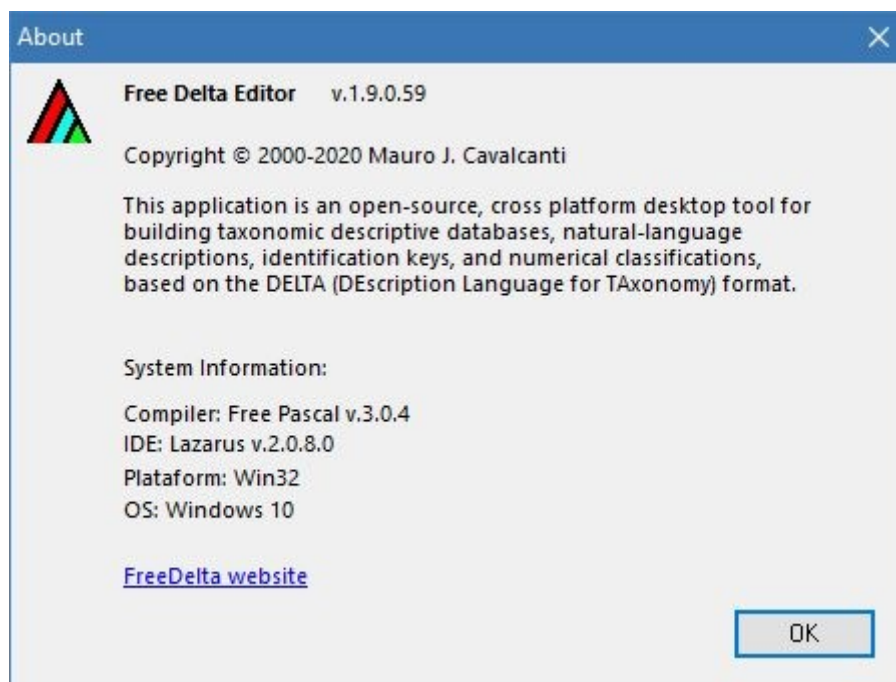


Figure 23 – FDE information dialog.

Remarks

FDE always looks for the DELTA executables (CONFOR, KEY, DIST) in the installation directory.

FDE only runs the DELTA programs KEY, INTKEY5, and DIST if it detects the presence of the mandatory input files to these programs (KCHARS and KITEMS for KEY, ICHARS and IITEMS for INTKEY5, and DITEMS for DIST), which implies that the user must first runs CONFOR via the Descriptions, Keys, or Matrix menus, in order to proceed to generating natural-language descriptions and dichotomous keys, running interactive identification, or calculating a distance matrix.

FDE is quite independent of the CSIRO/ALA Delta programs, so there is no need to install (or uninstall, in case any of them is already installed on a user's machine) these tools beforehand. The exception is if one wants to use an interactive key from the Free Delta Editor, which then requires that the CSIRO Delta INTKEY5 program be installed separately (this program is not provided with the Free Delta Editor installation package).

You can enter data either by typing the data directly into the editor or by importing existing DELTA text files (CHARS, ITEMS, SPECS) using the File/Import option of the main menu.

See Appendix 3 for a summary of the differences between Free Delta and the original DELTA system.

Appendix 1. About DELTA

The [DELTA](#) (*DEscription Language for TAXonomy*) format developed in Australia by Mike Dallwitz and his collaborators (Dallwitz, 1980, 1993) is an internationally recognized standard for coding descriptive taxonomic data. The associated programs which comprise the DELTA System provide facilities for maintaining data, producing natural language descriptions and keys, interactive identification and information retrieval, and converting data to formats required by programs for cladistic and phenetic analysis.

The DELTA format allows all kinds of taxonomic characters, whether they be qualitative (binary or multistate, ordered or unordered) or quantitative (integer or real, with units if needed). Comments are allowed anywhere, and character dependency can be described. Directives are included to control computer processing.

The DELTA system thus combines traditional taxonomic practice with modern computer technology to produce a key tool which can be used by biologists to integrate biodiversity information.

Several sets of data have already been prepared using DELTA, as for flowering plant families (Watson & Dallwitz, 1991), grasses (Watson & Dallwitz, 1981; Watson *et al.*, 1986a, 1986b, 1989), sedges (Bruhl *et al.*, 1992), legumes (Watson, 1981), beetles (Askevold & O'Brien, 1994), plant viruses (Boswell *et al.*, 1986), etc. Some of these datasets incorporate line, gray-scale, and colour images for characters and/or taxa.

A complete description of the DELTA format and directives is given by Dallwitz *et al.* (1993). Other very useful sources of information on DELTA are Webster (1988), Partridge *et al.* (1993), Askevold (1993) and Coleman *et al.* (2010). Dallwitz & Paine (1991) provide a detailed technical definition of the DELTA format. See also Chapter 5 of Pankhurst (1991) for a very clear explanation of DELTA.

Characters and Attributes

A character is a way of describing a taxon. The DELTA format recognizes the following character types:

- multistate (qualitative) ordered or unordered
- numeric (quantitative) integer or real
- free text

A multistate character has two or more states, eg:

```
#5. caudal fin colour/  
    1. light yellow/  
    2. blue <rarely>/
```

A numeric value may have units, eg:

```
#6. standard length/  
    mm/
```

Text characters are enclosed in angle brackets, eg:

```
#10. <geographic distribution>/
```

Each character must be preceded by a cross hatch (#), a unique number, a period (.), and a space. Each character state is preceded by a number, a period, and a space. The characters and character states must be terminated by a slash (/). Units in numeric characters have no state number, and are also terminated by a slash. Comments must be enclosed in angle brackets (<>); the left (opening) bracket must be preceded by a blank, and the right (closing) bracket must be followed by a blank or slash. These comments are used by the interactive identification program, INTKEY, but do not appear in natural-language descriptions or keys.

An attribute is the description applied to a taxon or specimen, coded in DELTA format, eg:

```
5,1 6,20-45 10<Bermuda and Massachusetts to Brazil>
```

which would read:

Caudal fin colour light yellow. Standard length 20 to 45 mm. Bermuda and Massachusetts to Brazil.

A typical attribute coded in DELTA format consists of a character number and a state number, separated by a comma (eg., 5,1). Text attributes consist of a character number with text contained within angle brackets (eg., 10<Bermuda and Massachusetts to Brazil>). We can also have several states of a character separated by "/" (meaning *or*), as well as by "&" (meaning *and*). Ranges are denoted by "-" (meaning *to*). The three separators /, -, and & can be combined within the same attribute, and comments can be associated with any of the character states within an attribute. Ranges of values of numeric characters can include parentheses to indicate values outside the normal range.

Attributes may sometimes be unrecorded or inapplicable.

Appendix 2. DELTA Library

The DELTA Library is a general-purpose collection of Free Pascal routines for handling text files in DELTA format. They are intended for use within the biological research community to provide processing routines for reading and parsing DELTA datasets, and so were designed with the following (optimistic) guidelines:

- Ease of use. Keep parameters to a minimum.
- Data independence. Work with any DELTA datafile, anywhere, anytime.
- Support for both CONFOR and PANKEY directives and format conventions.

DELTA Library may be freely distributed and used, under the terms of the [GNU Lesser General Public License](#) version 2 (LGPL2). Feel free to incorporate these routines into your own individual application programs or database systems. The latest versions can be downloaded from the [Free DELTA website](#).

Appendix 3. Differences between Free Delta and DELTA

- The Free Delta Editor uses conventional zip-compressed files (with the '.dtz' extension) to store all DELTA-formatted data (items, characters, specifications, and directives). At a minimum, these files must include the three basic DELTA files (CHARS, ITEMS, and SPECS) and can be created either by exporting an already existing dataset from the CSIRO Delta or ALA Delta programs and compressing them into a zip file (changing its extension to .dtz), or by using the Import option from the File menu. ***The Free Delta Editor is not able to read or import the files in '.dlt' format used by the CSIRO/ALA Delta Editors.***
- The mandatory DELTA directives *MAXIMUM NUMBER OF STATES, *NUMBER OF CHARACTERS and *MAXIMUM NUMBER OF ITEMS are not used by the Free Delta Editor parsing routines; instead, the routines which read DELTA obtain the required information from the data files themselves.
- The *MANDATORY CHARACTERS directive is ignored by the Free Delta Editor.
- The Free Delta Editor parsing routines do not support ranges of character numbers in the *CHARACTER NOTES directive, so character numbers **must** be written out separately for each character in the CNOTES file, eg #6-8 should be written out as #6, #7, #8.
- Nested inner comments ('<< >>') are not supported in the Free Delta Editor.
- Single (') or double (") quotes in item descriptions are not allowed in the Free Delta Editor..
- RTF (*Rich Text Format*) marks are not interpreted by the Free Delta Editor; if they are present in the data, they are kept but are not supported whatsoever.

Appendix 4. Importing data from CSIRO DELTA Editor

The Free Delta Editor is not able to directly read files in '.dlt' format used by the CSIRO/ALA Delta Editors. Before these data can be used by FDE, they must be 'exported' to text files. These comprise data files in the DELTA text format (SPECS – specifications; CHARS – character list, and ITEMS – item (taxon) descriptions).

To export data stored in a .dlt file to DELTA text files, execute the CSIRO or ALA Editor and select the 'File > Export Directives' menu option. The following dialog will be displayed (Figure 24).

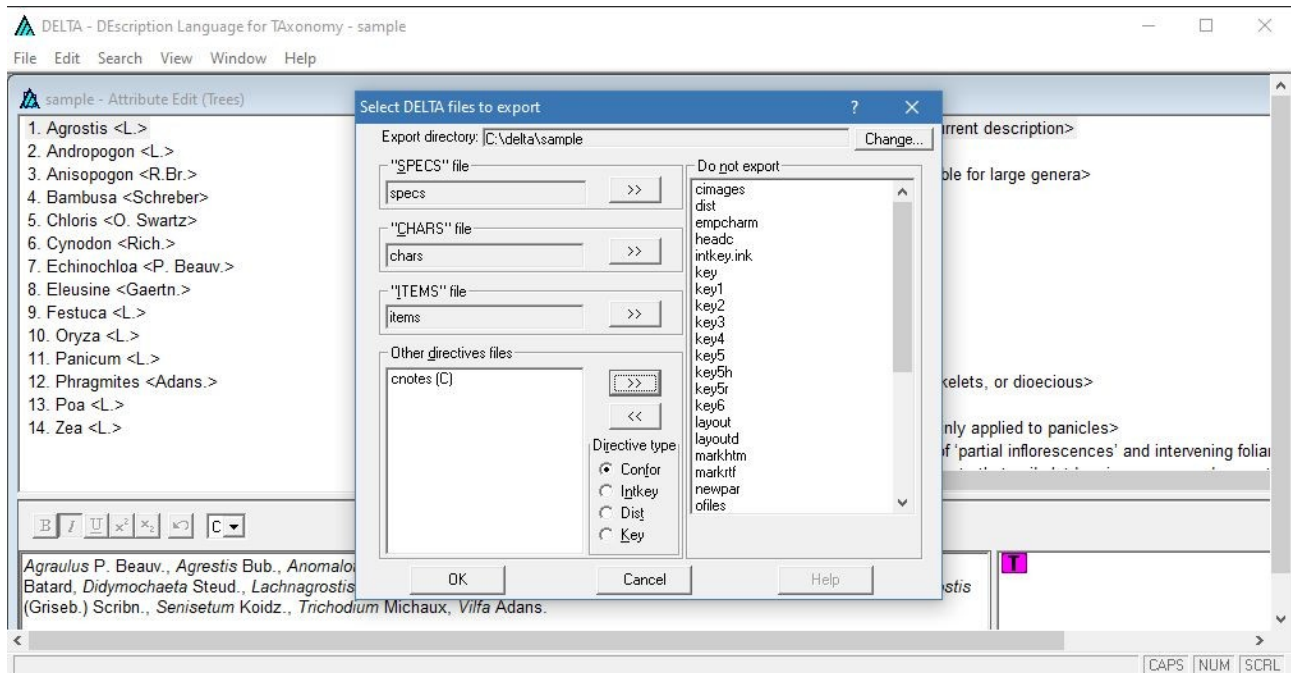


Figure 24 - CSIRO DELTA Editor export dialog.

Select only the mandatory data files (CHARS, ITEMS, SPECS and, if any, CNOTES) and click 'OK'. An 'Export Status' window will show progress. When the process is finished, click 'Done' and the an 'Export Log' window will be displayed.

To import the data just exported from the DELTA Editor into the Free Delta Editor, execute FDE and select the 'File > Import > DELTA' menu option. The following dialog will be displayed (Figure 25).

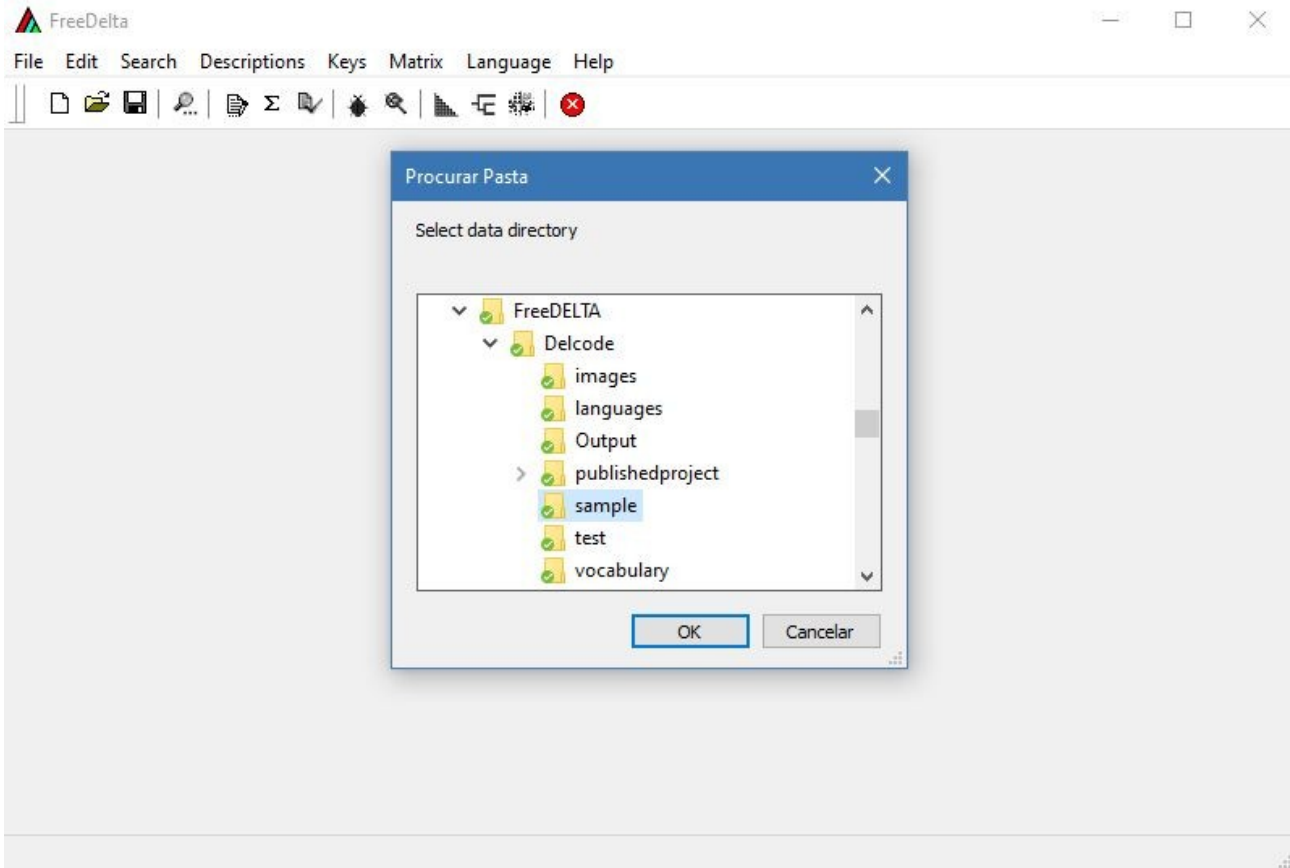


Figure 25 – FDE import dialog.

Select the directory in which the DELTA text files exported from the DELTA Editor were saved. A 'File Save' dialog box will be displayed for entering the name of the file which will store the imported data.

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Credits

FDE is written in [Free Pascal](#) 3.0 and the [Lazarus](#) 2.0 integrated development environment, using the third-party components [HistoryFiles](#) by Andrea Russo, [HtmlViewer](#) by Dave Baldwin and [SynFacilSyn](#) by Tito Hinostroza.

The self-extracting installation file for the Microsoft Windows version was produced by the program [Inno Setup](#), written by Jordan Russell. The Debian package for the GNU/Linux version was created using the [Debreate](#) Package Builder, written by AntumDeluge.

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