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EDITORIAL

Commencing with this issue, new editorial arrangements have been made. We are keen users of the DELTA system and belong to an organisation which has a strong commitment to the methodology. With a panel of three editors, the Newsletter should appear regularly.

We are pleased to have the opportunity to give public thanks to Dr Robert Webster, USDA, for his editorship of DN 2-7 during which it became established, appeared regularly, developed a recognisable format and, above all, filled a need. We looked forward with anticipation to each issue and learnt a lot about program features, new developments and alternative programs. In relinquishing the editorship, Robert can feel that he has firmly established the Newsletter, and we can take it up with the pioneering done.

A change of editorship is a time to consider other changes and innovations. As well as a new appearance, there will be regular columns and more personal content. We hope there will be a wide contribution of material and perhaps some debate involving criticism and reply. It is necessary for the subscription list to be updated, so we are requesting subscribers to tell us if they want to continue receiving the Newsletter, and we will be levying a modest fee to cover some of our costs. Currently the Newsletter has 560 subscribers from 50 countries.

There is inevitably a strong Australian flavour to this issue, partly because the delay since the last issue meant that we received few external contributions, partly because DELTA is widely and actively used in Australia, and partly because we wish to inform you about our own database activities.

We plan to publish issues of the DELTA Newsletter each April and October. Articles, suggestions on content, correspondence and technical queries and solutions will be welcome. They may be sent as paper copy, or preferably on disk as text files or by email.

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PERSONAL PROFILE: DR MICHAEL J. DALLWITZ

Mike Dallwitz is a natural choice for our first Personal Profile because he originated the DELTA data format and is the author or co-author of several computer programs for use with taxonomic data.

Born in Adelaide, South Australia on 20 May 1943, Mike later attended the Australian National University in Canberra. His degrees from that University are Bachelor of Arts with Honours in Pure Mathematics, Bachelor of Science with Honours in Physics, and Doctor of Philosophy in Solid State Physics. A temporary Lectureship in the Department of Physics at A.N.U. followed in 1969-1970. Since 1970 when he was appointed Research Scientist, Mike has worked for the Division of Entomology, Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO), located in Canberra, where he is currently a Principal Research Scientist.

Originally employed to provide mathematical expertise in ecological projects, Mike contributed to such projects as modelling of cattle tick populations and tick borne diseases, and modelling of insect development rates. The increased use of computers led to Mike being given responsibilities for managing the Division's computing staff, writing general purpose software, and consulting on computing matters for other staff. This work has continued almost to the present. However, insect taxonomy is also a concern of the Division of Entomology, and in 1971 Mike started writing a program for generating identification keys (KEY: Dallwitz, 1974).

A few years later Mike met Leslie Watson of the Australian National University, who was using Richard Pankhurst's KEYGEN program and

had, with Peter Milne of CSIRO Division of Computing Research, devised a more flexible format for preparing data for this program (Watson & Milne 1972). Dallwitz and Watson discussed data formats and decided the initial approach could be improved. This was the origin of the DELTA format (DEscriptive Language for TAXonomy, Dallwitz 1980a). Mike has worked closely with Watson ever since and says that "the development of the programs would not have been possible without his collaboration." In the last few years Mike has collaborated in the writing of the programs with his Division of Entomology colleague Toni Paine.

The DELTA format is a multi-purpose format for taxonomic data, and has been improved and extended over the years. Whilst intended for general use to record and exchange data, and as a data source for any taxonomic programs, Mike and collaborators have themselves written a conversion program which converts DELTA format data into the formats required by a number of other programs as well as into natural language (CONFOR: Dallwitz, 1980b; Dallwitz & Paine, 1986) and programs which perform some of the tasks required by taxonomists, e.g. KEY (Dallwitz, 1974), INTKEY (Watson et al., 1989), TYPSET (Dallwitz & Zurcher, 1988) and DIST (Dallwitz & Paine, unpublished).

Dallwitz & Paine's program INTKEY (Watson et al., 1989) was developed from a modification from 1982 of Richard Pankhurst's program ONLINE (Pankhurst & Aitchison, 1975) version 3. After a time it was completely rewritten with new features as INTKEY, and subsequently rewritten again with further new features, optional pop-up menuing and the ability to display images.

In recent years especially, Mike Dallwitz has travelled extensively to attend conferences, make working

visits to collaborators, provide demonstrations and training workshops, and participate in projects such as the International Organisation for Plant Information (IOPI) and the International Working Group on Taxonomic Databases (TDWG). There has also been a growing correspondence, both paper and electronic, about the programs and the DELTA data format, and planning for future developments. Mike's philosophy behind the development of the programs is to produce practical tools, not just to develop methods. The programs evolve through feedback from users. The aim is to provide pathways for the data from one program to another to avoid manual manipulation of data wherever possible. He says (Dallwitz, in press) "We want the programs and the data to have depth and flexibility, without ad hoc restrictions built in, so that people can use them in ways we did not anticipate. We want the programs to be able to benefit both the compiler of the data and end-user. Perhaps these aims are rather ambitious, but I think we are succeeding to some extent."



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PROGRESS REPORT ON THE CSIRO DELTA PROGRAMS (1 OCTOBER 1992)

M.J. Dallwitz

The first shareware versions of the DELTA programs for MS-DOS were released in June 1991, and there have been 5 releases since. The main enhancements in these releases have been as follows.

All of the programs except INTKEY version 3 were ported to Unix.

CONFOR (data translation). Typesetting marks in output files were placed under user control, and an option for unlimited line length was added (these changes will allow users to define output formats suitable for importing into word processors). Improvements were made in methods of removing redundant words from natural-language descriptions. Punctuation marks (full stop, semicolon, decimal point, and two kinds of comma) were made user-definable, to cater for languages other than English. A directive was added to allow the formatting of descriptions in Chinese. Directives were added to generate ranges for numeric characters, when only a single value has been recorded (the ranges are used in KEY and INTKEY to improve the reliability of identifications). 'Nested' comments were implemented, to allow the recording of subsidiary information such as probabilities. An option for translation into HENNIG86 format was added. Directives were added for passing information about images to INTKEY.

DELFOR (data maintenance). The character-reordering function was transferred from CONFOR and its operation greatly simplified.

INTKEY (interactive identification and information retrieval). The program was completely rewritten, to include the following features. Commands and parameters can be selected from menus. Context-sensitive help is available. All of the commands, messages, and help are obtained from simple text files, so that the program can be converted to other languages by non-programmers. Taxa can be accessed by name in all contexts. The list of 'best' characters is continuously sorted and displayed during generation. Illustrations can be linked to characters and taxa. Larger data sets can be handled. There is a 'demonstration' mode to make operation simpler and more robust for use in unsupervised displays.

Enhancements of DELTA Format and of the CSIRO DELTA Programs

Major enhancements of the DELTA format, and of the CSIRO programs which use the format, will take place over the next three years. The project will be supported by the CSIRO Division of Entomology and the Australian National Parks and Wildlife Service. The design of the

new system will be carried out in close consultation with taxonomists. Suggestions and discussion are invited in public forums such as the DELTA Newsletter, the Taxacom Internet mailing list and workshops such as that to be held in October 1993 in Perth (see Future Meetings, this issue).

A new program will be written to carry out the data maintenance and translation currently done by CONFOR and DELFOR. The program will run under Microsoft Windows, and will include a built-in editor. The enhancements already planned include: extension of 'extreme values' to multistate characters; more flexible placement of comments; unambiguous association of comments with values; 'coded' comments, e.g. probabilities, references, flagging of values to be omitted for certain applications; a new character type for cyclic characters, e.g. month of year; reordering of taxa; merging of character and taxon files; splitting and merging of characters; provision for specifying a taxonomic hierarchy; passing of information up and down the taxonomic hierarchy; improvement of wording of natural-language descriptions; passing of relevant qualifying information (e.g. probabilities) to identification and classification (cladistic and phenetic) programs; foreign-language versions of the program; direct passing of data to other programs via subroutine calls.

In order to speed up the consultation process, suggestions should be as specific as possible, and should try to anticipate and overcome difficulties. For example, instead of just suggesting 'eliminate redundant words in natural-language descriptions', suggest rules by which this could be achieved and syntax or menu systems with which the rules could be specified, and provide examples to show that the rules produce acceptable output for a variety of character wordings, attribute codings, and natural languages.

To subscribe to the Taxacom mailing list send the following mail message.

To: listserv@harvarda.harvard.edu

Subject:

signup taxacom your name

Listserv will automatically determine your network mail address.

PANKEY NOTES

R.J. Pankhurst

(28 Oct. 1992, addendum 2 Dec.1992)

New affiliation

Richard J. Pankhurst has been working at the Royal Botanic Garden, Edinburgh, since October 1991, where he is head of the section of Taxonomic Computing. The RBGE has a Novell network of IBM PCs and supports the Revelation database, especially for its garden records (in BG-BASE). The PANDORA floristic database (in Advanced Revelation) is supported by the Garden and is being used for three Flora projects. The database activities of the scientific staff, the library and the garden are being coordinated with databases of scientific names and bibliography in AREV, using TDWG standards throughout. The PANKEY programs for DELTA are being supported by RJP under the heading of a consultancy called Taxonomic Systems with the official agreement of the RBG.

New book

Practical Taxonomic Computing by RJP was published by Cambridge University Press in 1991, price £24.95, ISBN 0-521-41760-0 as an update of the previous *Biological Identification* (1978). It is intended to be a definitive text on computing methods for taxonomy. The four major sections of the book are for databases, identification methods and classification methods, and expert systems. The jacket blurb says that the book is a must for all students of biodiversity.

Flora Europaea database

The Cambridge University Press plans to publish a checklist based on the Flora Europaea database, which is now being maintained at the RBGE in AREV. Work is now underway to input the new data from the revision of Volume 1 of the Flora Europaea, which is now in the press. RJP will produce the new checklist from the revised database.

New versions of PANKEY programs

The latest version 7 of the online identification program offers either commands from the keyboard or working with menus and mouse. Both characters and taxa can be illustrated by one to many images in VGA colour, and the names of files for images are defined in special files outside DELTA. There are new options for switching between identification and retrieval modes, and for controlling the effect of conditional characters. There are new commands for selecting groups of both taxa and characters.

The DEDIT program (DELTA Editor) has been improved to the extent that it is now possible to define a completely new DELTA file from scratch. Think of DEDIT as a kind of word processor but which only knows about DELTA data files. It is available free of charge.

Versions of PANKEY programs in SPANISH are available. These are version 6 of ONLINE, the interactive key constructing program KCONI, the batch key constructing program KEY3M3 and the description printing program DESCRIP3. These versions were developed in Xalapa, Mexico in 1991 with the help of the staff of INECOL.

TDWG meeting

RJP has attended the 8th meeting of the Taxonomic Databases Working Group (TDWG) where he has been organising a list of standard descriptors, i.e. DELTA characters for the higher plants. Will anybody who has DELTA files for plant groups in the *tropics*, especially general characters at *family* level, please contact him. Further input is needed for the elaboration of the list of standard descriptors.



AN INTRODUCTION TO COMPUTER IMAGES*

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Pixels and Resolution

A 'pixel' (picture element) is the smallest component of a computer image. When an image is being manipulated by the computer, a pixel is regarded as a dot of a single colour (although when the image is displayed, each pixel may be made up of even smaller dots). An image is made up of pixels located on a rectangular grid. The resolution of the image may be defined as the number of points in the grid, e.g. 640 x 480 (640 pixels wide by 480 pixels high); or as the spacing of the grid points, e.g. 75 dpi (75 dots per inch). When discussing the internal storage and processing of images, it is better to specify the number of grid points. The grid spacing is meaningful only when the image is outside the computer, that is, when it is being scanned or displayed.

Vector images

'Vector' images store mathematical descriptions of shapes. For example, a straight line could be represented as the coordinates of its start and finish; a circle as the coordinates of its centre, and its radius; and a text symbol as the coordinates of a set of points around its outline. The colour and thickness of lines can be specified, and closed curves can be filled with simple patterns. However, vectors cannot easily represent complex 'continuous-tone' images, such as a typical photograph. Vector images are easy to modify. Each object in the image retains a separate identity, and can be altered, moved, or deleted, and placed over or under other objects. The mathematical objects are converted to pixels only when the image is to be displayed. Thus, output quality can be improved almost indefinitely by using high-resolution output devices such as laser printers or typesetters. Even on computer displays of comparatively low resolution, fine detail can be seen by zooming in on a part of the image.

These properties make vector images very suitable for drawings containing lines and simple shading. Programs for creating and editing vector drawings have been successfully used for biological illustration by several organizations.

Bitmap images

'Bitmap' ('raster') images store the colour value of each pixel. They are therefore suitable for storing photographic images, which can be converted to bitmap form by means of a scanner (see below). The resolution at which an image is scanned sets a permanent limit on the amount of detail that can be seen.

Bitmap images tend to be difficult to modify. All of the pixels are independent - they are not explicitly grouped into larger structures or objects. Editing programs may attempt to identify objects by looking for boundaries between regions of different colour or brightness, but this is not always possible. If an object is moved or deleted, it is difficult or impossible to correctly fill in the area thus exposed, unless it is uniform or almost uniform.

'Unmapped' ('true-colour' or 'grey-scale') images store the colour value for each pixel directly. Unmapped colour images usually use 3 bytes for each pixel - 1 for each of the primary colours (1 byte = 8 bits). This allows 256 intensity levels for each primary colour, and therefore 16777216 different colours. (Some formats use only 5 bits per primary colour, giving 32 intensity levels and 32768 different colours. This is rather unsatisfactory, as the eye can readily discern the difference between adjacent levels.) Grey-scale images (i.e. continuous-tone 'black-and-white' photographs) require 1 byte per pixel, and true black-and-white images require only 1 bit per pixel.

* From TDWG Newsletter, with permission.

'Mapped' ('paletted') images store colour values indirectly. The colours in a mapped image are restricted to a numbered set of colours, called the 'palette'. Each colour in the palette is defined by three numbers giving the intensities of the primary colours. The colour of a pixel is defined by specifying the number of its colour in the palette. The advantage of this scheme is a reduction in the amount of memory required to store the image. (For example, an image using a palette of 256 3-byte colours requires 1 byte per pixel, plus 768 bytes for the palette.) The disadvantage is that it may not be possible to represent the colours with sufficient accuracy. A typical colour image may contain several thousand different colours. A process called 'colour reduction' is used to choose a palette for an image, and to replace each colour by the closest colour from the palette. A palette of 256 colours can give reasonably good results for most images, but a careful examination of a mapped image will usually reveal colour 'contours', where the jump from one palette element to another takes place. This effect is particularly noticeable in large areas of gradually changing colour, such as a sky.

Image formats and compression

There is a large number of formats for storing digital images. Most were developed for use with a particular program, but some of these formats have become de facto standards, and are used by many programs. A few formats were developed specifically for interchanging files between different programs and computers.

Most bitmap formats have provision for reducing the file size by 'compressing' the image data. The amount of compression depends on both the compression method and the nature of the image. Most compression methods work well on images that have large areas of uniform colour. For example, a simple line drawing could usually be compressed to less than 1/10th of its original size.

The following are some of the formats most commonly used.

CGM (Computer Graphics Metafile). A vector format developed for file interchange.

GIF (CompuServe Graphics Interchange Format). A mapped bitmap format developed for file interchange. Gives good compression.

JPEG (Joint Photographic Experts Group). A bitmap format for unmapped images, developed as a standard by ISO and CCITT (Wallace 1991). The main feature of this format is extremely good compression of continuous-tone images. Some information is lost in the compression, and there is a trade-off between amount of compression (which may be specified by the user) and image quality. For most images, 20:1 compression may be achieved without noticeable degradation. (By comparison, the GIF format gives about 2:1 compression with continuous-tone images. Because GIF images are mapped, they effectively have an additional compression of 3:1 (for colour images), but information is lost in the colour reduction, as explained above.) Compressing and decompressing JPEG images with general-purpose computers is slow. However, special hardware is available which can decompress an image in a fraction of a second.

PCX. A mapped bitmap format developed by Zsoft for their paint programs.

Targa. A bitmap format developed by Truevision for use with their Targa graphics cards. Usually used for unmapped images, but mapped images are also supported.

TIFF (Tagged Image File Format). A very flexible bitmap format, supporting mapped and unmapped images. Widely used on Macintosh computers and for desktop publishing, and becoming more popular on IBM-compatible PC's.

Creating and editing images

Bitmap images can be produced from existing drawings or photographs by 'scanners', which measure the brightness and/or colour of the original at each point of a grid. 'Flatbed' scanners scan large, usually opaque, material, such as the page of a book. The maximum resolution is usually 300-600 dpi. 'Slide' scanners scan small transparencies, such as 35 mm slides or negatives. The maximum resolution is usually between 1000 and 6000 pixels along the longer dimension of a 35 mm slide. Grey-scale ('black-and-white') scanners should be capable of distinguishing 256 grey levels if continuous-tone photographs are to be scanned (16 levels are enough for line drawings). Colour scanners should distinguish 256 levels for each primary colour.

Bitmap images are edited with 'paint' programs, such as Adobe Photoshop (Mac) or Aldus Photostyler (IBM PC). Paint programs usually have provision for scaling, and conversion between different formats, but these facilities may be rather limited. Image Alchemy (Handmade Software, 15951 Los Gatos Blvd, Suite 17, Los Gatos, CA 95032, USA) is a comprehensive program for format conversion (including JPEG), colour reduction, and scaling of bitmap images on IBM PC's and Sun computers. A shareware version of Image Alchemy, and some other shareware or free programs for viewing and processing bitmap images on IBM PC's, are available on Internet, in the directory/delta/graphics of the anonymous FTP area at spider.ento.csiro.au.

Vector images are created and edited with 'draw' programs, such as Aldus Freehand (Mac), Micrografx Designer (IBM PC), or CorelDraw (IBM PC). These programs often allow the use of a bitmap image as a guide for producing a vector image. A bitmap image containing well-defined edges, such as a scan of a line drawing, can be traced automatically to produce a first draft of the vector image. Bitmap images produced from continuous-tone photographs can be traced manually. The programs can also convert vector images to bitmap images.

Hardware for displaying images

Most IBM and Macintosh PC's store images in mapped form on the graphics card, and can therefore display at most 256 colours simultaneously. Graphics cards capable of displaying unmapped colour images are available, but have been expensive until recently.

The standard IBM VGA card has a highest resolution of 640 x 480 pixels and has 256 kB of memory. It is limited to 16 simultaneous colours at the highest resolution (256 colours would require 307200 (= 640 x 480) bytes of memory). It can display line drawings quite well, but is inadequate for continuous-tone images. The latter require a 'super' VGA card with at least 512 kB of memory. Super VGA cards with 1 MB of memory, and capable of displaying 256 colours at a resolution of 1024 x 768 or 32768 colours at 800 x 600 are now available quite cheaply. Super VGA cards require a multisync monitor. Many monitors display 1024 x 768 images in an 'interlaced' mode, which tends to cause flickering. Non-interlaced monitors are preferable, but are more expensive. Another potential problem is a change in the size, position, or proportions of the display area when the resolution is changed. A few monitors (including most NEC monitors) overcome this problem by storing separate adjustment values for each resolution.

Recommendations for storing scanned images

Images should be scanned and stored in such a way that they will be able to take advantage of improvements in display hardware. The resolution of the master copies should be as high as possible (preferably at least 1024 x 768). Lower-resolution versions can easily be made for display on currently available hardware. Line drawings can be stored compactly as GIF files with 16 grey levels. Using 16 grey levels gives smoother lines than 2 levels (black and white). (Using 256 grey levels does not give a noticeably better result, and produces larger files.) Continuous-tone colour and grey-scale images should be stored in JPEG format. They can be converted to other formats (including mapped formats) as necessary.

Reference

Wallace, G. K. (1991). The JPEG still picture compression standard. *Communications of the Association for Computing Machinery* 34: 30-44.

DELTA MENU SYSTEM FOR WINDOWS

N. S. Lander

The DELTA package includes a number of programs which use descriptive data coded in DELTA format for a variety of applications, including those which create printed keys and natural language descriptions, those which perform interactive identification and information retrieval, and those which allow conversion for use by cladistic and phenetic software. Further, in order to construct and maintain a DELTA system efficiently it is necessary to utilise certain other software for tasks such as text editing and viewing, and image viewing, scaling, compression and conversion.

Thus, as one works with a particular data set, moving from task to task and testing the results of one's efforts will inevitably involve repetitious entry of a necessarily large array of commands, switches and file names. This is especially bothersome to DELTA tyros; even for adepts it can be tedious.

Some time ago I wrote the prototype of DELTA MENU SYSTEM (WINDOWS), a software management system which brings together the DELTA and other software employed under an easily operated shell. It presents the user with the choice of many of the tasks involved in creating and maintaining a DELTA implementation and some of the available applications which utilise descriptive data in DELTA format. For workaday chores at least, DMS (WINDOWS) obviates the need for exiting to DOS to issue commands from the DOS Prompt direct, or from resorting to the WINDOWS Task Manager, Program Manager or File Manager. As provided, DMS (WINDOWS) is set up to call the following third-party software:

Software	Purpose
DMS (WINDOWS)	software management
FILEVIEW	text file viewing and browsing
PAINTSHOP	image file viewing, format conversion; colour manipulation, and scaling
WINEDIT	text file editing
WINJPEG	compressed image file viewing and conversion
WINNAV	file management

DMS (WINDOWS) is a stand-alone program written using the freeware version of AURORA BASIC. FILEVIEW, PAINTSHOP, WINEDIT and WINJPEG are shareware programs. WINNAV appears to be genuine freeware. On-screen help for DMS (WINDOWS) itself is not available, but its use is reasonably intuitive. Hypertext style help for FILEVIEW, PAINTSHOP, WINEDIT and WINJPEG are available by clicking on "Help" once the relevant software is loaded. However, there is no substitute for careful and regular reading of the manuals for the software employed, including the Changes and Primer files provided with the DELTA distribution discs. These manuals may be viewed on-screen through the use of the DMS (WINDOWS) Documentation Menu.

For all the non-WINDOWS software called by DMS (WINDOWS) corresponding PIF files are provided, thus enabling the user to easily customize certain aspects of their operation. With the exception of INTKEY (Version 3), DMS (WINDOWS) attempts to launch all non-WINDOWS programs in a Window which remains open once the task has been completed - an option which is, of course, available only on machines with a 386 processor or above. On 286-based machines, such applications run full screen: however, on exit they will pause and ask for a user response. Either way, this allows the DMS (WINDOWS) user to read exit messages from the various software involved.

DMS (WINDOWS) is by no means an expert editor in the sense that Richard Pankhurst's DEDIT is. Nonetheless, it brings together all the software necessary to use and maintain a DELTA implementation in a uniform, menu-driven environment. I would stress that DMS (WINDOWS) is but the prototype of a more fully featured version written in MS Visual Basic currently in preparation and available shortly, perhaps before you read this.

DMS(WINDOWS) is currently available from the author on request. An earlier, DOS-based version - an implementation of the shareware menuing system AUTOMENU - is also available. It's always good to get feedback. If you find DMS (WINDOWS) at all useful send me a postcard or give me a ring on 09-334-0487. More importantly, if you find it wanting or even downright useless please take the time to put your criticisms and suggestions in writing and send them to me at the address that heads this document.



UTILITIES FOR DELTA DATA ENTRY AND TAXON SUMMARY GENERATION

T.D. Macfarlane

The following two utilities were written or modified by M.J. Dallwitz whilst attending a recent DELTA training workshop, in response to requests. They are TED box programs, i.e. they are programmed in the language of the programmable editor TED (Text Editor) which, like these two utilities, is distributed by Dallwitz with the CSIRO DELTA programs. Documentation for TED is also distributed although not needed for using the utilities.

1. ENTITEM (ENTer ITEM) is for entering DELTA items, our experience being that other such programs are not suitable to our needs. This utility is not a DELTA editor, and has obvious limitations, but it works, saves a lot of time compared with fully manual data entry, reduces errors because the text of each character is displayed at the time of data entry, and being simple it has not distracted Dallwitz from progressing toward a future fully featured data entry and editing facility (see Dallwitz, Progress report, page 5 in this issue).

ENTITEM requires the following files in the DELTA directory or elsewhere on the path of the computer: TED.EXE, ENTITEM.BOX, ENTITEM.BAT, ENTITEM.HLP. The character list file CHARS is needed in the working directory, as is the specifications file SPECS for subsequent checking.

To run the program, enter ENTITEM at the DOS prompt (this invokes a command in the batch file ENTITEM.BAT, which runs the box program ENTITEM.BOX).

Then choose one of the options:

- | | |
|----------|---|
| Start | - Start a new item. |
| Continue | - Continue entering an incomplete item. |
| Help | - Display the documentation. |

Start is followed by a prompt for an item name, then the text of the first character is displayed and the character number(s), value(s) or text (any of which may be null) is entered, including any required comments enclosed in <>. The rest of the characters follow in sequence, but it is possible to skip to character n by entering #n, or to quit by entering * (in which case the program will save the data in a file called ITM which will automatically be read for completion of the item next time the program is run). A value may be continued by ending the line with "+".

When the item is complete, a new file is created. The name of this file is derived from the item name by removing comments, blanks, etc., truncating to 8 letters, and adding the extension .CHK. This file contains all the necessary commands to be used as the directives file in a CONFOR run, e.g. CONFOR SPECIESX.CHK. This checks the item (for consistency with SPECS), and produces a tidied file with extension .ITM, which can then be inserted in the main ITEMS file.

ENTITEM only permits entry to proceed in a forward sequence through the character list, although unfinished items can be continued. Editing, including the addition of omitted characters, must be done subsequently in the resultant file.

2. SPSUMM (SPecimen SUMMary) takes items (i.e. DELTA descriptions) at one taxonomic level such as specimens and produces summaries of them at a higher level such as species. This was in response to a desire of several workers to score and enter data at the specimen level more fully than is allowed by the CONFOR variant items facility. SPSUMM requires the following files in the DELTA directory or elsewhere on the path of the computer: TED.EXE, SPSUMM.BOX, SPSUMM.BAT.

The items representing specimens are entered as usual except that all those belonging to the same species must be contiguous in the file and must have the same item name (they can be differentiated by a data element, e.g. a specimen number). The default items file name is SPITEMS (SPecimen ITEMS). At the DOS prompt, enter SPSUMM to run the program, respond to the prompts for the items file name and an output file to be used later by INTKEY, and the job proceeds as follows.

Starting files: SPITEMS, CHARS, SPECS, SPOINT (sample distributed with programs).

Enter SPSUMM: this runs the batch file SPSUMM.BAT, which calls the box program SPSUMM.BOX. Files created by the program: SPITEMS.TMP (a new version of SPITEMS in which the specimen items belonging to a single species now have differentiating numbers following the item name), SPSUMM.TMP (a command file for the program INTKEY to amalgamate the data from all the specimen items of single species into a single summary items file for each species).

Next the batch file runs the program CONFOR, resulting in the following files: SPIITEMS (a conversion of SPITEMS.TMP into the format required by INTKEY), ICHARS (a conversion of CHARS into the format required by INTKEY).

Finally the batch file runs the program INTKEY to carry out the commands in the file SPSUMM.TMP (see above) resulting in the output file ITEMS which contains summaries of the specimen data for each species. Currently the text characters and comments are all lost, although consideration is being given to joining text characters together. Numerics are expressed as a range with mean. States of characters have a number in <> indicating the number of subordinate items possessing that state. INTKEY displays the summary DELTA format descriptions of the items: hitting the end key causes an end to this display and quitting from the program.

Conventions could be adopted such as reserving the first "specimen" item for data from miscellaneous sources such as publications, and the second for a description of the type specimen of the species.

This program provides adequate concatenation of data (passing of data up the taxonomic hierarchy) for some purposes and is certainly preferable to a manual procedure. However the loss of comments and text characters is a weakness. Mike Dallwitz and colleagues plan to build a procedure for passing data up and down the hierarchy in a far more sophisticated manner in an enhanced database version of the DELTA system (see Dallwitz, Report on the CSIRO DELTA programs, this issue, p.5).

Acknowledgements

The documentation accompanying or included in the utilities has been used in preparing this note. Mike Dallwitz and Helen White are thanked for comments.

SPOTLIGHT ON DELTA FEATURES

This box will be a regular feature of the Newsletter. It will focus on individual features of the DELTA data format, of the CSIRO DELTA programs or of the PANKEY programs.

The CONFOR directives **ABSOLUTE ERROR** and **PERCENT ERROR**

These recently introduced CONFOR directives are for those situations where you have only a single measurement value for a real numeric character for one or more of your taxa. This may be because the data were taken from a publication where only a single value was given or because you have only one specimen. If a particular species of plant was always exactly 31 cm tall, then height could be used as one of its identifying features. However it is much more likely that the species will be like every other one and exhibit a range of heights, even if you don't yet know that range. Having only the one value in the data would make this species difficult to identify using height because exactly 31 cm, or a range containing it, would need to be entered to obtain a match. Any other single value entered, or ranges stopping very close to, but not including, 31 cm would fail to produce a match for this taxon. Therefore it is desirable for keys and interactive identification programs to allow a match for this species within a range around the single known value, so that the species is not erroneously eliminated from contention during the identification process because of too-precise data for that character. However it would not be a good idea to put invented data (e.g. a guessed range of heights) in the original DELTA format data. That should contain only facts.

With one or other of these two commands, an appropriate range can be substituted for any single measurement value during a CONFOR conversion of the data to KEY or INTKEY formats, by giving a number representing measurement units (with **ABSOLUTE ERROR**) or representing a percentage (with **PERCENT ERROR**) for adding to and subtracting from the single value to result in a range for each relevant taxon. The consequence is an increased likelihood of correctly identifying taxa without altering the original factual data. Choosing an appropriate range is the province of the user, and will be affected by their experience with the organisms concerned.

The CONFOR directive **CHARACTER NOTES**

This CONFOR directive allows any amount of descriptive text about characters to be stored. This might include explanations about how to interpret the character and its states, and references to literature or example taxa. The information is printed after each relevant character description in output produced with the **PRINT CHARACTER LIST** directive. The information is also available during an INTKEY session, the existence of notes for a particular character being indicated on the menu line at the top of the screen. Thus it acts as a text alternative or supplement to a character image (but note that an image can contain text, including labels and pointers).

Previously character explanations could only be included by using <comments> associated with character features and states. However the **CHARACTER NOTES** approach permits the text of notes to be formatted with or without typesetting in order to provide a more pleasing appearance, to stand out better from the character list in printouts (e.g. by means of indentation), and to be included or excluded for different purposes. The character list can thus be less cluttered.

Use of **CHARACTER NOTES** can result in the building up of a glossary, or the section in a revision that provides explanations of the characters and their states.

△ T.D. Macfarlane

FUTURE MEETINGS

Taxonomic Databases Meetings in Australia

A workshop/meeting on **Taxonomic Databases for Biological Data** is planned for early October 1993. A **preliminary discussion and planning meeting** was held during the Southern Temperate Ecosystems conference at the University of Tasmania, 20 January 1993, to plan the agenda of the main workshop and form an organising committee. Participation from institutions such as the Western Australian Herbarium and the Australian Biological Resources Study as well as individuals was indicated.

Possible topics for the main workshop include: databases currently available or under development; data formats and software; prospects for standards and cooperation; whole flora or fauna approaches; linking different kinds of databases; public access and public release (published) systems; current and future technology; demonstrations of systems.

The workshop will be held on the 3 & 4 October 1993 immediately following the planned Australian Systematic Botany Society symposium 'Systematics, Evolution and Conservation of the Western Australian Biota' in Perth (30 September - 2 October 1993).

Originating group:

Alex Chapman, Nicholas Lander, Terry Macfarlane W.A. Herbarium, Perth and Paul Hattersley, ABRS.

REPORTS OF MEETINGS AND WORKSHOPS

Two workshops on DELTA were held by the Western Australian Herbarium during 1992, with financial assistance from the Australian Biological Resources Study.

The first, 17-20 February, took into account the needs of beginners. Dr Mike Dallwitz conducted the workshop. 20 people attended, mainly botanists from the Herbarium but also from other parts of the organisation, universities and another Australian herbarium. Several zoologists were among the number. There was a wide range of DELTA experience among the participants, all of whom learnt a great deal and were able to improve existing databases or establish new ones. Following the workshop, Dr Dallwitz held discussions with the workshop organisers and other staff of the W.A. Herbarium about databases and future DELTA developments.

The second, 21-24 September, was an advanced level workshop. It was presented by Dr Mike Dallwitz and Dr Leslie Watson. Twenty people attended at least parts of the course and again the W.A. Herbarium contributed most participants but again with botanists and zoologists from other institutions, and from two other Australian herbaria. As a consequence, these and earlier workshops held elsewhere have provided a wide spread of trained users around Australia who can provide local training and advice. Material covered in the course included detailed guidance on the use of the programs INTKEY (identification and information retrieval, diagnostic descriptions), KEY, image display and typesetting of output.

△ T.D. Macfarlane



Participants at the DELTA workshop, Perth, September 1992. L to R:
Nicholas Lander, Andrew Doust, Les Watson, Mike Dallwitz, Alex Chapman, Terry Macfarlane, Tracey Spokes, Richard Cowan, Roberta Cowan, Roger Spencer, Helen White, Terry Houston, Gillian Perry, Barbara Main, Anne Morrison, Bruce Maslin, Grazyna Paczkowska.

Photo: Suzanne Curry

WESTERN AUSTRALIAN HERBARIUM DATABASES AND THE INFORM PROJECT**A.R. Chapman**

In institutions such as herbaria and museums there are at least four major information sources that can be usefully transformed into electronic databases. There are the collection details gleaned usually from the specimen labels, nomenclatural information on names currently or historically used to identify the specimens, literature references to taxonomic publications and other library material, and descriptive information for circumscription and identification of the taxa. The Western Australian Herbarium is using computers to manage all four raw data sources.

Herbarium Databases

Our collection comprises an estimated 450,000 specimens. In 1985 databasing of the specimen label data was commenced using TITAN software (from Knowledge Engineering, Melbourne) on the UNIX platform. The WAHERB database now holds records for 50% of the collection. This database has been modified and enhanced over the years and is now fully compliant with the national HISPID (Herbarium Information Standards and Protocols for the Interchange of Data) standard. There are currently five full-time database operators inserting or editing records and WAHERB is closely tied to the curation and incorporation processes within the herbarium. Distributional data from the database is beginning to be used in-house with Geographic Information System (GIS) packages such as MapInfo on the PC and ARC/INFO on UNIX workstations.

It has been estimated that there are 12,000 vascular plant taxa in Western Australia. The W.A. Herbarium is custodian of the plant names in the state and maintains census information for these names in the WACENSUS database. This database has been constructed with data from the Census of Vascular Plants of Western Australia (Green, 1985) and the Census of Australian Vascular Plants - CAVP (Hnatiuk, 1990). It will also contain data on the non-vascular flora and includes current names, synonyms, misapplications and exclusions and the corresponding literature references. The data is stored in an ORACLE database on the Department's VAX network. Part of our custodial role is to inform the national census database (CAVP) of the current status of names from our state and protocols for this are under development.

The state's botanical library is housed at the W.A. Herbarium and the holdings have recently been entered

into the WALIB database, also in TITAN software. It contains library data on over 7,000 books and journals including much of the taxonomic literature describing species of the W.A. flora. It is accessible to all staff from their PCs via our recently installed Banyan Vines network, greatly increasing the functionality of this prime research tool.

The INFORM project

In herbaria, museums and universities taxonomic descriptions and keys are continually being generated and published. Once published, however, this work is static and must be regenerated, often from scratch, for new works. The editors of this newsletter are working together on the INFORM research project to develop the framework, methods and computing tools necessary for the long-term capture, maintenance and presentation of descriptive taxonomic information on the W.A. flora. In the future we envisage every taxon will have a master description coded in DELTA format which is maintained and updated as standard procedure for any revisionary or flora treatment. Our first exploration of such an approach is with a subset of the rare and endangered flora occurring in the state.

The INFORM project is necessarily ambitious and has already crystallised numerous problems, such as the need for an agreed set of core characters; the need to pass data up and down the taxonomic hierarchy; the possibilities for coding items at the specimen level rather than the conceptual taxon level; and the requirement for access from within DELTA to data already stored in other database formats.

We feel that there is also a great need at the national level for discussion of these and other problems, communication about the projects in which DELTA is already being used and coordination of the development of both DELTA software and a national framework for the efficient capture and integration of individual DELTA projects. To this end we are initiating a two-day workshop in October 1993 as a forum for these and related issues to be addressed (see Future Meetings in this issue, p.14, for further information).

Internationally there is much work being done on databasing and interchange standards. Here the INFORM group has assisted by contributing from our work here a

draft list of core taxonomic characters to the recent Taxonomic Databases Working Group (TDWG) meeting in Xalapa, Mexico where it was adopted as the current working document.

In summary, we feel that it is timely for taxonomic institutions to begin to adopt a coordinated approach to modern technology in all aspects of their mission in order to remain relevant in the coming century. There is a rejuvenated forum at the international level with TDWG and IOPI (International Organisation for Plant Information) and keen and committed individuals within many of the institutions worldwide. In Australia at least, national

recognition of the issues and a forum for cooperation and coordination is the next requirement.

References

Croft, J. (1992). 'Herbarium Information Standards and Protocols for the Interchange of Data'. Australian National Botanic Gardens.

Green, J. (1985). 'Census of the Vascular Plants of Western Australia'. Western Australian Herbarium.

Hnatiuk, R. (1990). 'Census of Australian Vascular Plants'. Bureau of Flora and Fauna.



A COMMON DIRECTORY FOR PLANT TAXONOMIC DATABASES

Nicholas S. Lander

At the second meeting of the International Organisation for Plant Information (IOPI) held in November 1992 at Xalapa, Mexico, a proposal by the Information Systems Working Group to establish a 'Common Directory for Taxonomic Databases' (CD) containing information about taxonomic databases was accepted. In essence, the CD is to be a database of databases allowing users to make queries by taxon name, and possibly also by geographical region, etc. to find which databases contain required information. The names could be at any taxonomic level and have any status (e.g. accepted names and synonyms would not be distinguished). Queries to the CD would be made available via Internet. Organisations connected to Internet could provide a query service for those without a connection.

'Local Directories' (LDs) would be set up to provide information to the CD. The CD would obtain this information by Internet. LDs could be implemented as part of existing database systems, or as ad hoc systems. The protocol for communication between the CD and the LDs would be defined, but there would be no restriction on how the LDs obtained their information (e.g. manual entry, or direct access to databases). Access to information in an LD would be under the control of the LD administrator. User queries would be handled by the CD, not the LDs; the LDs would handle only requests by the CD for information with which to update the CD.

The CD would index plant names against database names. Database attributes would comprise the following searchable fields: database name, update date, region covered, data medium, access method, Internet access, and keywords; and there would be a field for a text description of each database. Thus a query to the CD on a given plant name would simply inform the user in which databases information linked to that name is located, what kind of information (chemical, ecological, ethnological, genetical, geographical, horticultural, nomenclatural, etc) is available, and how it might be accessed.

It was agreed that the CD could be implemented relatively easily and would be complementary to the IOPI Checklist. Prototypes of the CD and LDs are to be developed by April 1993. The CD prototype will be located physically at the Australian National University (ANU), Canberra, with development assistance from Canberra (CSIRO National Insect Collection; Environmental Resources Information Network, and Australian National Botanic Gardens), Sydney (New South Wales University of Technology), St Louis (Missouri Botanical Garden), and Beltsville (Soil Conservation Service, Agricultural Research Service).

Adapted from International Organisation for Plant Information (1993). Information Systems Group: Executive Report of Proposals (Activities 1991-1993). IOPI-2: Xalapa.

AVAILABLE WORKING DATABASES

(A space to announce or publicise available working databases, with any associated publications. Contributions welcome.)

Database name: *The Families of Angiosperms.*

Authors: L. Watson & M.J. Dallwitz.

Taxa (no. & scope): Angiosperm families of the world (558, narrowly defined). Descriptions 'complete' to the extent of being operable for interactive identification.

Characters (no. & type): 509 characters and quasi-characters. Morphology (vegetative, inflorescence, floral, fruit); seedling germination type; embryology, anther ontogeny; nodal, leaf, stem and wood anatomy; pollen morphology and cytology, stigma type; photosynthetic pathway, phytochemistry; phyteogeography and ecology; alternative classifications of Dicotyledons (superorder/subclass to Order) of Dahlgren, Cronquist and Takhtajan and into Crassinucelli/ Tenuinucelli, and of Monocotyledons after Dahlgren, Clifford and Yeo.

Images: Taxon images (b & w) from Le Maout & Decaisne (1873) being incorporated, with about 220 in the current distribution package.

Data format: Original in DELTA format, potentially available on request for research purposes. Distributed with the INTKEY program as a package for identification/information retrieval, with illustrations, complete natural language descriptions and references, all for screen display.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publication: Watson, L. and Dallwitz, M.J. (1991). The families of angiosperms: automated descriptions, with interactive identification and information retrieval. *Australian Systematic Botany* 4: 681-695.

Price: Free.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au. L e s s conveniently, on floppy disks from L. Watson, Taxonomy Lab, Research School of Biological Sciences, Australian National University, Canberra A.C.T. 2601, Australia (FAX +61 6 249 4437).

Database name: *Grass Genera of the World.*

Authors: L. Watson & M.J. Dallwitz.

Taxa (no. & scope): The genera of Poaceae (785, narrowly defined). Comprehensive generic descriptions for interactive identification (including leaf fragments), etc.

Characters (no. & type): 495 characters and quasi-characters. Morphology (vegetative, inflorescence, spikelet, floret, fruit, embryo, seedling); leaf blade anatomy, photosynthetic pathway and C4 types, culm polysaccharides, cytology and nuclear DNA content; intergeneric hybrids; phyteogeography and ecology; species number, nomenclature (comprehensive for synonyms), classification (Subfamilies, Supertribes, Tribes); Rusts and Smuts; economic aspects.

Images: About 250 in the current distribution package, mainly consisting of line drawings from 'Grasses of Southern Africa' (Gibbs Russell *et al.* 1990), plus a small selection of b & w and coloured photos.

Data format: Original in DELTA format, potentially available on request for research purposes. Distributed with the INTKEY program as a package for identification/information retrieval; with facilities for screen display of illustrations, complete natural language descriptions, summarised classification, references and lists of species examined; and facilities to extract subsets for 40 world regions, weeds etc.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publications: Watson, L. and Dallwitz, M.J. (1992), *The Grass Genera of the World* (1038 pp. C.A.B. International, Cambridge). Gibbs Russell *et al.* (1990), *Grasses of Southern Africa: an identification manual with keys, descriptions, classification, automated identification and information retrieval from computerized data* (National Botanic Gardens/Botanical Research Institute, Pretoria).

Price: Free.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au. L e s s conveniently, on floppy disks from L. Watson, Taxonomy Lab, Research School of Biological Sciences, Australian National University, Canberra A.C.T. 2601, Australia (FAX +61 6 249 4437).

Database name: *The Grasses of Australia: Subfamily Pooideae.*

Authors: C.M. Mihaich, M.J. Henwood & L. Watson.

Taxa (no. & scope): Currently comprising the 32 genera and 170 species of Triticeae and Poeae. Comprehensive floristic descriptions, plus leaf anatomy for about 50 species (precursor of a complete identification/information retrieval package for the 250 Pooideae of Australia, and for preparation of descriptions and keys for the Flora of Australia treatment).

Characters (no. & type): 660 characters and quasi-characters. Morphology (vegetative, inflorescence, floral, fruit); cytology; tribal classification; phytogeography and ecology; specimen citations.

Images: Taxon and character images pending.

Data format: Original in DELTA format, distributed with the INTKEY program as a package for identification/information retrieval, with sample illustrations, complete natural language descriptions and references, all for screen display.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publication: In preparation.

Price: Free.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au; or on floppy disks from C.M. Mihaich, Taxonomy Lab, Research School of Biological Sciences, Australian National University, Canberra A.C.T. 2601, Australia (FAX +61 6 249 4437).

Database name: *The Grasses of Australia: Panicoideae*

Authors: R.D. Webster (floristic descriptions), L. Watson & J. Lenz (physiology, anatomy).

Taxa (no. & scope): 45 genera, 260 species. Complete comprehensive floristic package for the Paniceae and Isachneae, plus assignment to photosynthetic pathway and C4 types, and leaf anatomy for 52 species. Basis of descriptions and keys for the Flora of Australia treatment.

Characters (no. & type): 424 characters and quasi-characters. Morphology (vegetative, inflorescence, floral, fruit); leaf blade anatomy (incomplete); photosynthetic pathway and cytology; phytogeography and ecology; specimen citations.

Data format: Original in DELTA format, distributed with the INTKEY program as a package for identification/information retrieval, with complete natural language descriptions for screen display.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publication: Webster, R.D. (1987), *The Australian Paniceae (Poaceae)*, 322 pp. (J. Cramer, Berlin).

Price: Free.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au; or on floppy disks from L. Watson, Taxonomy Lab, Research School of Biological Sciences, Australian National University, Canberra A.C.T. 2601, Australia (FAX +61 6 249 4437).

Database name: *The Genera of Leguminosae-Caesalpinioideae.*

Authors: L. Watson & M.J. Dallwitz.

Taxa (no. & scope): Detailed descriptions of 177 genera, operable for interactive identification, etc.

Characters (no. & type): 136 characters and quasi-characters. Morphology (vegetative, inflorescence, floral, fruit, seed, seedling); germination type; leaf, stem and wood anatomy; pollen ultrastructure; cytology; distribution; synonyms, tribal classification.

Data format: Original in DELTA format, potentially available on request for research purposes. Distributed with the INTKEY program as a package for identification/information retrieval, with complete natural language descriptions and list of species sampled for leaf anatomy, all for screen display.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publications: Watson, L. (1981), An automated system of generic descriptions for Caesalpinioideae, and its application to classification and key-making (with 168 descriptions and keys on microfiche), in Polhill, R.M. and Raven, P.H. (eds.), *Advances in Legume Systematics* (Ministry of Agriculture, Fisheries and Food, Great Britain. Royal Botanic Gardens, Kew). Watson, L. and Dallwitz, M.J. (1983), *The Genera of Leguminosae-Caesalpinioideae: Anatomy, morphology, classification and keys* (Research School of Biological Sciences, Australian National University).

Price: Free.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au. Less conveniently, on floppy disks from L. Watson, Taxonomy Lab, Research School of Biological Sciences, Australian National University, Canberra A.C.T. 2601, Australia (FAX +61 6 249 4437).

Database Name: *Sedge genera of the world.*

Author: Jeremy J. Bruhl.

Taxa (no. & scope): 122 genera. Comprehensive morphological descriptions, plus leaf and culm anatomy, assignment to photosynthetic pathway.

Characters (no. & type): 370 characters and quasi-characters. Synonyms, morphology (vegetative, inflorescence, floral, fruit, embryo), anatomy (leaf and stem), geography, ecology, taxonomy (tribal and subfamilial), specimen citations, literature references.

Images: Taxon and character images pending.

Data format: Original in DELTA format, distributed in INTKEY format (INTCYP) with the INTKEY program as a package for identification/information retrieval, with complete natural language descriptions and references for screen display.

Program: INTKEY (Dallwitz & Paine; shareware, \$100).

Related publication: Bruhl, J.J., Watson, L., and Dallwitz, M.J. (1992). *Genera of Cyperaceae: interactive identification and information retrieval. Taxon* 41: 225-34.

Price: Free on INTERNET, \$30 by mail.

Available from: INTERNET - anonymous ftp from huh.harvard.edu, or spider.ento.csiro.au; or on floppy disk from J.J. Bruhl, Department of Botany, University of New England, Armidale, NSW 2351, Australia (FAX +61 67 73 2429; Email: jbruhl@metz.une.ed.au).



DELTA Registration and Order Form

The full set of DELTA System programs are available on MS-DOS disks, or by anonymous ftp from the Taxacom FTP server at Internet address huh.harvard.edu.

The Taxacom file /pub/software/delta/Index.txt contains an index of the available files (note the upper-case 'I'). To view this file without terminating the ftp session, give the ftp commands 'get Index.1st' and '! more Index.1st'. Most of the subdirectories of /pub/software/delta contain a file Download.1st which contains information about downloading and installing the programs in that subdirectory. Files other than .1st, .txt, and .ps must be transmitted in binary mode (set by the ftp command 'binary'). Program updates are announced on the Taxacom Technical mailing list. To subscribe, send the following mail message.

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