Journal of Vegetation Science 13: 451-453, 2002

JUICE, software for vegetation classification

Tichý, Lubomír

Department of Botany, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic; E-mail tichy@sci.muni.cz

Abstract. The program JUICE was designed as a Microsoft® WINDOWS® application for editing, classification and analysis of large phytosociological tables and databases. This software, with a current maximum capacity of 30 000 relevés in one table, includes many functions for easy manipulation of table and header data. Various options include classification using COCKTAIL and TWINSPAN methods, calculation of interspecific associations, fidelity measures, average Ellenberg indicator values, preparation of synoptic tables, automatic sorting of relevé tables, and export of table data into other applications (word processors, spreadsheet programs or mapping packages). JUICE is optimized for use in association with TURBOVEG which is the most widespread database program for storing phytosociological data in Europe.

Keywords: COCKTAIL; Computer program; Database; Diagnostic species; Phytosociological table; Relevé; Species group; TURBOVEG; Vegetation survey.

Introduction

The development of modern computer technology is a new challenge for vegetation classification. Large computerized databases of vegetation relevés have emerged during the 1990s (Ewald 2001). Software packages such as TWINSPAN (Hill 1979), SYN-TAX (Podani 1994), MULVA (Wildi & Orlóci 1996) or PC-ORD (McCune & Mefford 1999) based on cluster analysis and reciprocal averaging are widely used as a common standard of conventional classification methods. However, the results of these classification methods strongly depend on the structure of the source data – two different phytosociological tables of the same vegetation classified by e.g. TWINSPAN may produce different results. This disadvantage was demonstrated in a comparison of two independent data sets of the same vegetation type from the Czech Republic and Germany (Bruelheide & Chytrý 2000).

The new classification method COCKTAIL (Bruelheide 1995; 2000) represents one of the options of vegetation classification and parametrization which produce more robust results, making use of information on species affinities in a wider range of different habitats or in a larger area. The COCKTAIL algorithm closely resembles the procedure followed in the traditional Braun-Blanquet approach, which is improved by statistical measuring of fidelity. Sociological species groups are detected and continuously optimized according to tests of interspecific associations in large databases. The combination of different species groups using logical operators allows the user to re-define commonly known vegetation units in a formal way (Bruelheide 1997, 2000; Pflume 1999). The process of defining sociological groups and vegetation units can include subjective decisions, but all these decisions are controlled to be statistically sound. Such classification is also suitable for formal re-defining of the existing empirical classification systems.

JUICE is a program for Microsoft® WINDOWS® which includes many user functions for easy visualization, manipulation and processing of both large and small phytosociological tables, including the COCKTAIL classification method.

General features of the program

The JUICE program is a multifunctional editor of phytosociological tables such as MEGATAB (Schaminée & Hennekens 2001) with advanced classification and parametrization functions. The program is supported by computer operation systems WIN9x or higher and runs on computers with a minimum internal memory of 32 MB. The current maximum size of the table is about 30 000 relevés and 4000 species.

The JUICE program loads species checklist and header data in plain text and species data file in Cornell condensed format. Recommended source of the input data is the database program TURBOVEG (Hennekens 1996; Hennekens & Schaminée 2001) which is used as the standard database package within the European Vegetation Survey. The latest updates of TURBOVEG can easily create the species checklist in a JUICE format and export files with header and table data, which are directly accepted by JUICE.

The JUICE program provides several export options: (1) export of selected table parts into text or spreadsheet format; (2) export of synoptic tables; (3) clipboard for transfer of relevés; (4) mapping of selected species or sociological groups in the program DMAP by A. Morton (http://www.dmap.co.uk); (5) header data export to spreadsheet programs or statistical packages.

Other functions include, for instance, TWINSPAN classification and calculation of average Ellenberg indicator values (Ellenberg et al. 1991) for each relevé, Beals smoothing function (McCune 1994), COCKTAIL classification method, analysis of synoptic tables, and expert system function for automatic classification according to earlier defined criteria.

Data processing

A vegetation table loaded in the program is displayed in the main program window which is divided into three sections: (1) species section (left side of the table area), (2) relevé numbers (upper part), and (3) cover-abundance data (centre of the table area). One can use 8 different colours for selection of species or relevés. Species (relevé) moving, sorting, aggregating, deleting etc. can be done with the mouse or by manipulation with blocks of different colours. Full relevé header data can be easily displayed in the same order as the relevés in the table. JUICE enables selection of relevés according to the header data values.

The TWINSPAN classification method (Hill 1979) is included as an independent program. The results of the classification can be used as sorting criteria for relevés. Species classification by TWINSPAN can be also displayed directly in the table. However, a more efficient way of sorting species in a table is based on the analysis and sorting of the synoptic table according to fidelity, i.e. species concentration in the vegetation unit. The program includes the following fidelity measures: binomial u value, hypergeometric u-value, ϕ-coefficient, χ^2, G-statistic, Fisher's exact test (Chytrý et al. 2002) and Indicator Value (Dufrêne & Legendre 1997). Synoptic tables can be displayed in four different forms (percentage, categorical, fidelity measure and maximum abundance). The program supports table sorting according to the synoptic columns and their detailed analysis. For each vegetation unit, the program extracts statistically defined diagnostic species, constant (frequent) species, and dominant species.

Although it contains many different functions for manipulation of phytosociological tables, JUICE was primarily developed for a comprehensive vegetation analysis using the COCKTAIL classification method, which consists of the iterative algorithm for optimization of species group and vegetation unit. Diagnostic species can be detected for a given vegetation unit by the calculation of the fidelity value, or the vegetation unit can be defined by a given group of diagnostic species. The manual selection of diagnostic species allows subjective modification according to the traditional Braun-Blanquet concept, which is statistically tested by measuring fidelity.

The COCKTAIL algorithm begins with calculation of all species fidelities to a pre-defined vegetation unit or with a pre-selected species group. The JUICE program supports basic tests of species-to-species fidelities. A starting group of species defines a set of relevés in which more than half of all species of the group occur. The fidelity of all species to the selected relevés is calculated. All species are ranked by their fidelity value. Species with the highest fidelity value are displayed in a separate window. If there are some species with a high fidelity value, they can be allocated to the species group. Thus the list of species assigned to the group changes and the process continues by a new selection of relevés and fidelity calculation. The final result of the optimization process is a group of species with a high statistical tendency of co-occurrence (Bruelheide 2000).

Species groups can be used to re-define existing, subjective classifications. A closer correspondence with traditional syntaxa can be achieved by logical formulas, which formally combine species groups with dominant species defined by minimum cover value. Such formalized classification enables generation of an expert system. This function, which determines an automatically phytosociological assignment according to earlier defined classification criteria, is also included in the JUICE program.

Additional information

The program JUICE is frequently updated and I welcome suggestions for further improvement. A freeware version can be downloaded from the web site of the Department of Botany, Masaryk University at http://www.sci.muni.cz/botany/juice.htm, where additional information, technical instructions and a sample table are also available. A detailed user's guide with description of most program functions and options is downloaded together with the program as a help file in the installation package.

Acknowledgements. I thank Milan Chytrý, Marie Derková, Julian Dring, Michal Hájek, Stephan Hennekens, Jason Holt, Martin Kocí, and Ilona Kuželová for comments and testing the program during the process of its development. This research was funded through projects GA ČR 206/99/1523 and MSM 143100010 (Working Group Biodiversity).

References

Bruelheide, H. 1995. Die Grünlandgesellschaften des Harzes und ihre Standortsbedingungen. Mit einem Beitrag zum Gliederungsprinzip auf der Basis von statistisch ermittelten Artengruppen. *Diss. Bot.* 244: 1-338.

Bruelheide, H. 1997. Using formal logic to classify vegetation. *Folia Geobot. Phytotaxon.* 32: 41-46.

Bruelheide, H. 2000. A new measure of fidelity and its application to defining species groups. *J. Veg. Sci.* 11: 167-178.

Bruelheide, H. & Chytrý, M. 2000. Towards unification of national vegetation classifications: A comparison of two methods for analysis of large data sets. *J. Veg. Sci.* 11: 295-306.

Chytrý, M., Tichý, L., Holt, J. & Botta-Dukát, Z. 2002. Determination of diagnostic species with statistical fidelity measures. *J. Veg. Sci.* 13: 79-90.

Dufrêne, M. & Legendre, P. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. *Ecol. Monogr.* 67: 345–366.

Ellenberg, H., Weber, H.E., Düll, R., Wirth, V., Werner, W. & Paulissen, D. 1991. Zeigerwerte von Pflanzen in Mitteleuropa. *Scripta Geobot.* 18: 1-248.

Ewald, J. 2001. Der Beitrag pflanzensoziologischer Datenbanken zur vegetationsökologischen Forschung. *Ber. Reinhold -Tüxen-Ges.* 13: 53-69.

Hennekens, S.M. 1996. *TURBO(VEG). Software package for input, processing, and presentation of phytosociological data*. IBN-DLO Wageningen, NL and University of Lancaster, UK.

Hennekens, S.M. & Schaminée, J.H.J. 2001. TURBOVEG, a comprehensive database management system for vegetation data. *J. Veg. Sci.* 12: 589-591.

Hill, M.O. 1979. *TWINSPAN. A Fortran program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes*. Cornell University, Ithaca, NY.

McCune, B. 1994. Improving community analysis with the Beals smoothing function. *Ecoscience* 1: 82-86.

McCune, B. & Mefford, M.J. 1999. *PC-ORD. Multivariate analysis of ecological data. Version 4*. MjM Software Design, Gleneden Beach, OR.

Pflume, S. 1999. *Laubwaldgesellschaften im Harz – Gliederung, Ökologie und Verbreitung*. Universität Göttingen, DE.

Podani, J. 1994. *Multivariate data analysis in ecology and systematics. A methodological guide to the SYN-TAX 5.0 package*. SPB, Amsterdam, NL.

Schaminée, J.H.J. & Hennekens, S.M. 2001. TURBOVEG, MEGATAB und SYNBIOSYS: neue Entwicklungen in der Pflanzensoziologie. *Ber. Reinhold-Tüxen-Ges.* 13: 21-34.

Wildi, O. & Orlóci, L. 1996. *Numerical exploration of community patterns. A guide to the use of MULVA-5*. Ed. 2. SPB, Amsterdam, NL.

Received 11 May 2001;
Revision received 9 January 2002;
Final version received 4 March 2002;
Accepted 5 March 2002.
Coordinating Editor: H. Bruelheide.