

TWO EXAMPLES OF THE USE OF NUMERICAL CLASSIFICATION AND ORDINATION METHODS IN THE ANALYSIS OF STRUCTURE AND CHOROLOGY OF VEGETATION TYPES

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Keywords: classification, chorology, ordination, texture, vegetation types.

Abstract. Two examples of application of numerical classification and ordination methods to textural and chorological data of vegetation types defined with the Braun-Blanquet approach are presented.

Introduction

Vegetation data can be classified on the basis of different criteria: physionomic, dynamic, floristic etc. (Westhoff & van der Maarel, 1978), therefore many classifications could be proposed which may give information about vegetation diversity (see Feoli, 1983). Comparison between different classifications and ordination of the same phytosociological data is always a useful tool in understanding correlations and making interpretations for compositional changes (see Orłóci, 1978). Feoli, Lagonegro & Biondani (1981) present an example of classification evaluation on the basis of external variables. The same can be done with internal characteristics of vegetation such as structure and chorology. In the present paper I give two examples on the use of classification and ordination methods to investigate the structure and chorology of vegetation types defined with the Braun-Blanquet approach. I would like to stress that the vegetation types should be the basis for the structural and functional studies of vegetation.

Example 1

With this example I show an application of cluster analysis to answer the following question: are floristically defined vegetation types distinguishable also in terms of texture (see Barkman, 1978)?

The example is taken out from a previous paper (Blasi & Scoppola, 1981). Two well defined associations and some types without syntaxonomical interpretation are compared by their weighted life form spectra. These have been computed on the basis of phytosociological tables of relevés from different areas in the Central Apennines:

- a) M. Velino (Avena & Blasi, 1980)
 - 1) Saturejo montanae-Brometum erecti
 - 2) Seslerio nitidae-Brometum erecti
 - 3) A type of Mesobromion s.l. of difficult syntaxonomical interpretation.
- b) Central Apennines (different mountains) (Avena & Blasi, 1979)
 - 4) Saturejo montanae-Brometum erecti
 - 5) Transitional type (facies) between Saturejo montanae-Brometum erecti and Seslerio nitidae-Brometum erecti.
- c) Valsorda (Umbria) (Bruno & Covarelli, 1968)
 - 6) Seslerio nitidae-Brometum erecti em. Biondi & Blasi (1982)
 - 7) Seslerio nitidae-Brometum erecti sesleriëtosum apenninae
 - 8) Seslerio nitidae-Brometum erecti var. with Bromus erectus and Koeleria splendens.

In order to answer the question, the method of average linkage clustering (Anderberg, 1973) has been applied to the similarity matrix between the weighted life form spectra of the 8 phytosociological tables. The similarity between the spectra has been computed by the similarity ratio coefficient (see Westhoff & van

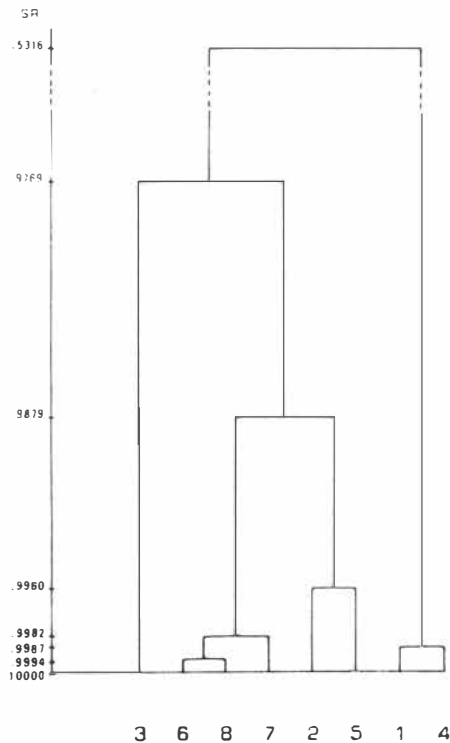


Fig. 1 — Dendrogram of similarity between the phytosociological units on the basis of weighted life form spectra (Blasi, Scoppola 1981).

der Maarel, 1978). The resulting dendrogram is presented in Figure 1. It defines two main clusters (3, 6, 8, 7, 2, 5) and (1, 4) respectively including the spectra of *Seslerio nitidae-Brometum erecti* and those of *Saturejo montanae-Brometum erecti*. The hierarchical structure proves that the transitional facies 5 is, texturally, more similar to the former than to the latter and also that the type 3 has a texture more similar to *Seslerio nitidae-Brometum erecti* than to *Saturejo montanae-Brometum erecti*. By rearranging the weighted life form spectra according to the sequence of the dendrogram:

	3	6	8	7	2	5	1	4
P	3.8	----	----	----	----	----	----	----
Ch	8.8	15.2	16.6	17.9	19.6	23.6	57.8	59.6
H	79.8	83.0	83.2	80.5	77.3	74.4	38.4	36.7
T	2.2	1.7	0.1	1.5	0.6	----	2.6	2.5
G	5.4	0.1	0.1	0.1	2.5	2.0	2.2	1.2

a clear pattern of variation is detectable. The trend concerns chamaephytes and

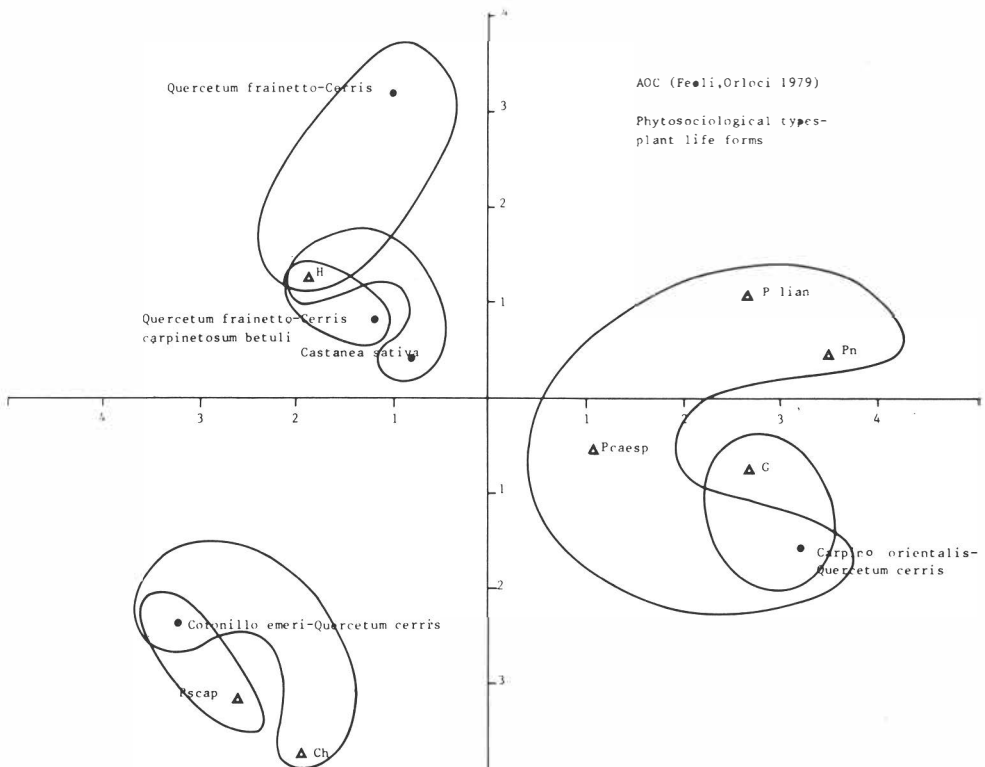


Fig. 2 — Ordination of the types and life-forms based on the first two canonical variates (Blasi 1984).

hemipterophytes only, the other life forms do not show any trend. From the table it is evident that the two associations have different texture, *Seslerio nitidae-Brometum* is dominated by Hemipterophytes while *Saturejo nitidae-Brometum* by Chamaephytes. This comparison could be done also without clustering techniques, however in this case no quantification of similarity would be possible. The fact that in the previous paper Avena & Blasi (1979) have considered the type 5 as a facies of *Saturejo montanae-Brometum erecti* it is not supported by the results of cluster analysis applied to textural data. This suggests to analyse again the floristic data with numerical methods both for classification and predictive analysis (see Orlóci, 1978; Feoli, 1983) in order to see if the differences are mainly due to species composition or to different proportions between species.

Example 2

In this example I present an application of analysis of concentration to weighted life forms and chorological spectra of vegetation types of oak woods of Lazio. The example is taken out from Blasi (1984). The analysis of concentration has been used to order the types on the basis of their spectra and also to quantify the relationships between the different life forms and chorological elements and the types as suggested by Feoli & Lagonegro (1982). The method when applied to cover data has not the same statistical meaning as in case of occupancy counts data (Feoli & Orlóci, 1979), however it can be used to obtain values for deterministic comparisons.

The life form and chorological spectra have been computed on the basis of phytosociological tables of the following types (Blasi, 1984):

- 1) *Quercetum frainetto-cerris* Oberd. 1948 em. Horvat 1959.
- 2) *Quercetum frainetto-cerris carpinetosum betuli* Blasi 1984
- 3) *Coronillo emeri-Quercetum cerris* Blasi 1984
- 4) *Carpino orientalis-Quercetum cerris* Blasi 1984
- 5) Type with *Castanea sativa* (Blasi, 1984).

The ordination of life forms and the types is presented in Figure 2. The maximal influence levels in respect to the first canonical variate are marked with lines including the types and the life forms. The figure indicates that the types 1, 2, 5 are texturally characterized by high frequency and cover of hemipterophytes, the type 3 by high frequency and cover of scapose phanerophytes and chamaephytes while *Carpino orientalis-Quercetum cerris* by high frequency and cover of geophytes, caespitose phanerophytes, lianose phanerophytes and nano-phanerophytes.

The joint ordination of the types and chorological elements is presented in Figure 3. Also in this case the lines include the types and chorological elements with the highest influence level with respect to the first canonical variate (first factor). Since in Europe there is a strong relationship between the climate and the range of the species especially if the mediterranean element is considered, the first canonical variate can be interpreted as a climatic factor. In fact the North-European element and the Stenomediterranean element are on the opposite sides on the canonical variate. *Coronillo emeri-Quercetum cerris* is characterized by high frequency and cover of the North European and Mediterranean montane elements. *Quercetum frainetto-cerris* its subassociation and the type with *Castanea sativa* are

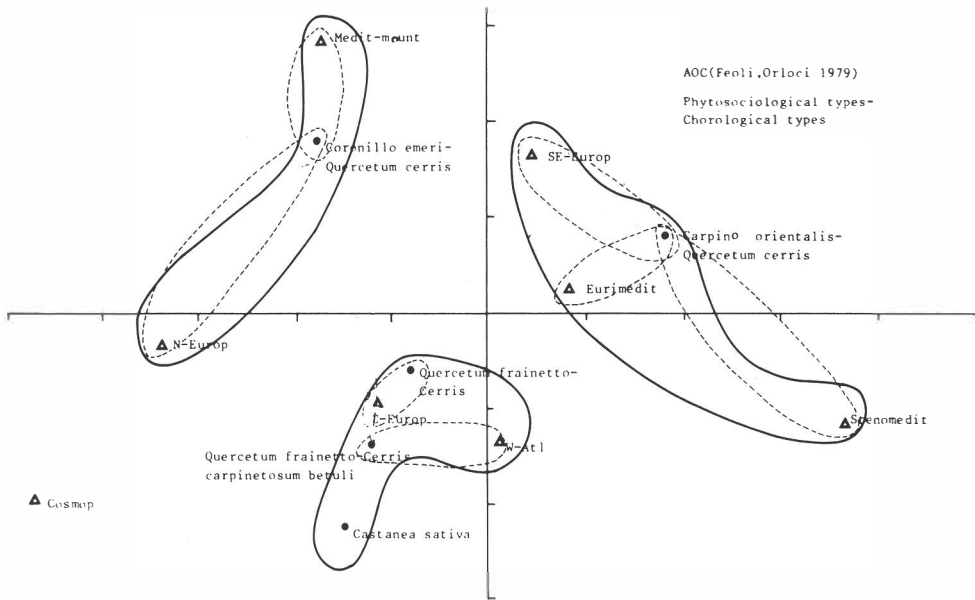


Fig. 3 — Ordination of phytosociological and chorological types based on the first two canonical variates of AOC (Blasi 1984).

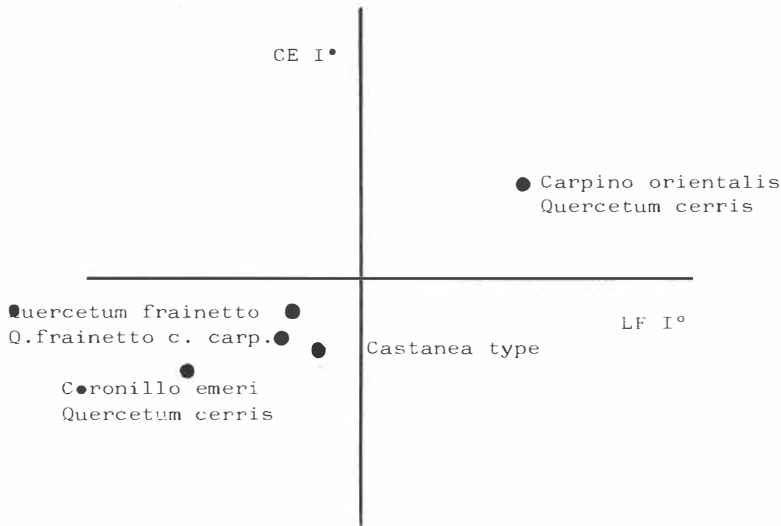


Fig. 4 — Correlation between the first canonical variates of AOC on the basis of life form spectra (LFI) and on the basis of chorological spectra (CE I).

all characterized by high frequency and cover of the Central European element and West-Atlantic element; *Carpino orientalis-Quercetum cerris* is characterized by high frequency or cover of SE-European, Eurimediterranean and Stenomediteranean elements. If the first canonical variates of the two ordinations are used to construct a correlation diagram (Figure 4) a linear relationship between them can be deduced. This suggests that a linear relationship can be presumed between the textural and chorological variation of the vegetation of oak woods of Lazio. The three figures should also suggest that in the woods under study the Stenomediterranean, Eurimediterranean and SE-European elements are mainly caespitose phanerophytes, lianose phanerophytes, nano-phanerophytes and geophytes, the Central European and W-Atlantic species are mainly hemycryptophytes and that the Mediterranean montanae are mainly scapose phanerophytes and chamaephytes. The analysis proves to be informative about the relationships between chorology and structure of vegetation types which according to Westhoff & van der Maarel (1978) should constitute the main criteria for vegetation classification.

Conclusions

The examples show how the correlation between floristic data, structural and chorological data can be verified on the basis of phytosociological types defined according to the Braun-Blanquet approach. The floristically defined types offer the frame to formulate hypotheses about vegetation structure and chorology; they can be considered as tools on which develop further biological researches on vegetation. The types do not need to have precise syntaxonomical definition, they have to be considered just abstract classes useful to present and illustrate the multidimensional variation of vegetation.

Riassunto. Alcuni tipi di vegetazione definiti con il metodo di Braun-Blanquet sono stati confrontati sulla base dei loro spettri biologici e corologici ponderati. Vengono presentati due esempi di applicazione di metodi numerici. Nel primo (pascoli dell'Appennino) la classificazione numerica viene usata per valutare per via indiretta la correlazione tra i dati floristici (i tipi sono definiti su base floristica!) e i dati strutturali. Nel secondo caso l'analisi della concentrazione viene usata per stimare in modo diretto la correlazione fra forme biologiche ed elementi corologici e i tipi di vegetazione. In entrambi i casi risulta evidente l'utilità della tipificazione fitosociologica indipendentemente da un preciso inquadramento sintassonomico. I tipi dovrebbero essere considerati come insiemi che forniscono la struttura logica (classificazione) per misure di correlazione.

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