A simplified method to determine the abundance of grass functional groups in natural grasslands

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Abstract

A functional classification of grass species into four groups has been proposed by Ansquer et al. (2004) according to their leaf dry matter content. These plant functional groups (PFTs) show well differentiated properties for vegetation use (e.g. digestibility). The aim of this work was to assess the reliability of an easy methodology for identification of the dominant grass group in a given grassland community to facilitate technical advising.
Three methods of botanical relevés were tested on grasslands of beef and dairy production systems of the Aubrac region (Central Massif) in France. These methods display differences in complexity of the field work: a complete botanical description according to Braun-Blanquet (1928), the method proposed by De Vries & De Boer (1959) and a simplified non destructive adaptation of the latter.
Data analyses were performed using Spearman ranks correlation test on grasslands classification according to different variables, mainly the species richness and the proportion of grass functional groups.
As expected, results show differences in the number of species listed. Nevertheless, no difference of grasslands classification based on PFTs dominance was observed between the various methods. We conclude that the simplest of them could be used to asses the grass dominant group necessary to implement grassland management tools.

Keywords: botanical composition, grass contribution, functional groups of grasses, grassland typology, grassland management

Introduction

Agronomic advice on the management of permanent grassland has long been based on the floristic composition of the plant communities. Shortage of time or knowledge for the identification of species has hindered the widespread adoption of this approach in the daily work of advisors. Research work aimed at simplifying the diagnosis of the grassland flora has led to the use of a functional approach (Lavorel and Garnier, 2002). This has resulted in the establishment of four functional types of perennial grasses (A, B, C and D), characterised by their dry matter content of water saturated leaves (LDMC). These groups are also distinguished by their habitat preference (from fertile to less fertile), their phenology (from earlier to later earliness) and their digestibility at the vegetative stage (from more to less digestible). These functional types, established at the species level, in turn allow permanent grasslands to be categorised as A, B, C and D according to the dominant grasses in the community. The work of identifying species is thus reduced to simply identifying the dominant perennial grasses in the flora of each field. Nevertheless, this identification can be very time-consuming if exhaustive methods are used. The objective of this work is to test a simplified method of determining dominant functional groups in a meadow, in contrast to the methods normally used in botanical or ecological surveys.

Materials and methods

We have studied 60 mown or grazed permanent pastures (Aveyron France) varying in the amount of applied fertiliser and in the modalities of cutting and grazing). Three methods of botanical surveying were compared in order to record in each field the following variables: total number of species, proportion of grasses and proportion of functional types (A, B, C or D). Species of these groups have preference for high or low fertility conditions which corresponds respectively to species having capture resource strategies (A and B) or conservation resource strategies (C and D).

The De Vries & De Bauer's method was used on 60 fields where an exhaustive botanical survey was carried out using a procedure adapted from the frequency rank method (de Vries et de Boer, 1959) : sampling along a transect of 20 handfuls (10 x 10cm) spaced about 5m apart; thorough sorting of the different species and estimation of the fraction of biomass of each species (a score [0-6] for the abundance of each species so as to obtain a score of 6 for each handful, the species present but scarce being scored 0). For a given field, the relative abundance score for each species is calculated as the sum of the scores obtained for each species in the various handfuls/the maximum score obtainable (20 x 6 =120).

The second method (Simplified), used on the same 60 fields, was a quick simplified botanical survey (30 minutes per field), simply identifying the dominant species. The recordings were made along a transect on 10 equidistant 40 cm quadrats. In each quadrat, we recorded the visual abundance of the main species by using the same scoring system as in the De Vries & De Bauer's method. Species with less than 15% abundance within the quadrat were not recorded. For each field, we therefore have a number of species which are the only dominant ones, together with the relative abundance of these dominant species.

The third method (Braun-Blanquet) was applied to a sub-sample of 13 fields (4 mowed meadows, 5 valley pastures and 4 summer pastures) out of the ones used for the other two methods. This enabled us to draw up an exhaustive list of all the species present on a total area of 256 m^2 (a square 16m x 16m). An abundance-dominance score was given to each species by taking account of its fractional soil cover, using the abundance-dominance method of Braun-Blanquet (1928). The proportion of grasses and functional types was calculated from these abundance-dominance scores. Table 1 summarises the characteristics of the three methods used and the variables obtained for each field.

Table 1. Characteristics of the records from the different methods and the variables obtained

Method	Number of fields	Sampling	Species recorded	Area sampled	Average time	Number of species	Abundance of species
De Vries & De Bauer	60	100m transect 20 handfuls 10x10 cm	All	0,2 m²	4 h (2 people)	Yes	Yes
Simplified	60	Field diagonal 10 quadrats 40x40 cm	Dominant species	1,6 m²	30' (1 person)	No	On dominant species
Braun-Blanquet	13	Percentage ground cover	All	256 m²	4 h (2 people)	Yes	Yes

Results and discussion

The data obtained enable one to compare the three methods over 13 fields, and methods De Vries & De Bauer and Simplified over all 60 fields. Table 2 shows the correlation coefficients obtained for the three methods for two of the variables studied on the 13 common fields. The third variable (N), which was not determined directly in Simplified method, does not show a significant correlation with the other two. The percentage of grasses obtained by the

Simplified method is significantly correlated with the values obtained by the other two methods. On the other hand, the percentages of grasses obtained by methods Braun-Blanquet and De Vries & De Bauer are not significantly correlated because of the difference in the methods of estimating the proportions of species, which was based on biomass in one case (De Vries & De Bauer's method) and on ground cover in the other (Braun-Blanquet). The percentages of grass types A + B (Species having resource capture strategies) are strongly correlated between methods Braun-Blanquet and De Vries & De Bauer and also with the Simplified method.

Table 2. Correlation coefficients (Pearson) for the variables Percentage of grasses (%G) and percentage of functional types having a resource capture strategy (%A + %B) between the methods compared in pairs (n=13)

	Method		
Variables	De Vries & De Bauer and Braun-Blanquet	De Vries & De Bauer and Simplified	Braun-Blanquet and Simplified
% grasses	0.53 ^{ns}	0.68 *	0.79 ***
%A + %B	0.87 ***	0.93 ***	0.84 ***

*** P≤0.001, * P≤0.01, ^{ns} Not significant.

Table 3 summarises the Spearman correlation coefficients (data not normally distributed) for the two methods used on 60 fields (De Vries & De Bauer and Simplified) on the grass variables of type A + B and of each functional type considered separately. It is clear that the classifications of the fields are very significantly correlated for all the variables considered.

Table 3. Correlation coefficients (Spearman) for the variables proportion of grasses (%Grasses) and proportions of functional types, A (%A), B (%B), C (%C) and D (%D) between methods De Vries & De Bauer and Simplified (n= 60).

	%Grasses	%A	%B	%C	%D
r^2	0.54 ***	0.83 ***	0.82 ***	0.87 ***	0.46 ***

*** P≤0.001

Conclusions

All these results therefore show a close agreement between the proportions of grasses and of functional types observed using the Simplified method and methods using exhaustive botanical data, used on 13 (De Vries & De Bauer and Braun-Blanquet) or 60 (De Vries & De Bauer) fields.

The quick simplified recording method (Simplified) may therefore be used by agricultural advisors to characterise grasslands, since it enables one to detect the grass functional groups forming the majority of the grassland biomass. Furthermore, it only requires a short working time in the field (30 minutes) and simplifies the botanical expertise to the recognition of the dominant grasses.

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