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ORDINATION METHODS TO ASSESS PASTURE CONDITION

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ABSTRACT

Pasture condition can be assessed by comparing species occurrence across a range of sites. Ordination techniques simplify these multi-attribute data and display differences between sites. To interpret this pattern, the species distributions are mapped over the site configuration. This technique is applied to a data set from the northern Mitchell grass community around Julia Creek, where the species frequencies of 48 permanent monitoring sites have been measured. For a recording in May 1991, *Astrebla spp* and *Iseilema spp* contributed most to the site pattern. Their direction of increase in frequency across sites is opposing but not exactly opposite, indicating some degree of interaction. This, together with other variation inherent in the data, requires at least two dimensions of the ordination to adequately represent the site configuration. For some site/season combinations, condition is dependent on complex species relationships and cannot be reduced to a simple pattern or a single condition index.

INTRODUCTION

When assessing the pasture condition at a site, measurements are made of species occurrence and soil properties. Such data must be simplified for interpretation; the challenge is to reduce the dimensionality with minimal distortion or loss of information. Multivariate techniques, primarily ordination, have been applied to this type of data. Reviews on the strengths, weaknesses and dangers of these techniques are well documented (for example, Austin 1980, James and McCulloch 1990).

An ordination displays similarities between sites based on the measured attributes. To understand the pattern in these site distributions, one imposes the attribute data over the pattern of sites.

This application of an established technique highlights the importance of higher order dimensions in an ordination, where information contributed by each species can be displayed in a complementary way. It also follows the concept of Stuart-Hill and Hobson (1991) in that 'condition' is dependent on the purpose for which each individual wants to use the rangeland. Thus a pattern is displayed, but any subjective interpretation is left to the viewer. The approach used here reduces a complex pattern to a comprehensible level, but does not take it to the extreme of a single index, such as a condition score.

METHODS

Forty-eight permanent recording sites were set up in the northern Mitchell grass community around Julia Creek, Queensland (lat 20° 39', long 141° 45'), in January, 1990. The sites were deliberately selected to cover a range of pasture condition following the method of Bosch and Gauch (1991). Recordings of the species encountered at each of 300 step points have been made in January 1990, May 1990, and May 1991. Of the 70 to 95 species encountered at each recording, some were combined to form common species groups, and then the set was reduced to those species occurring at a minimum of three sites.

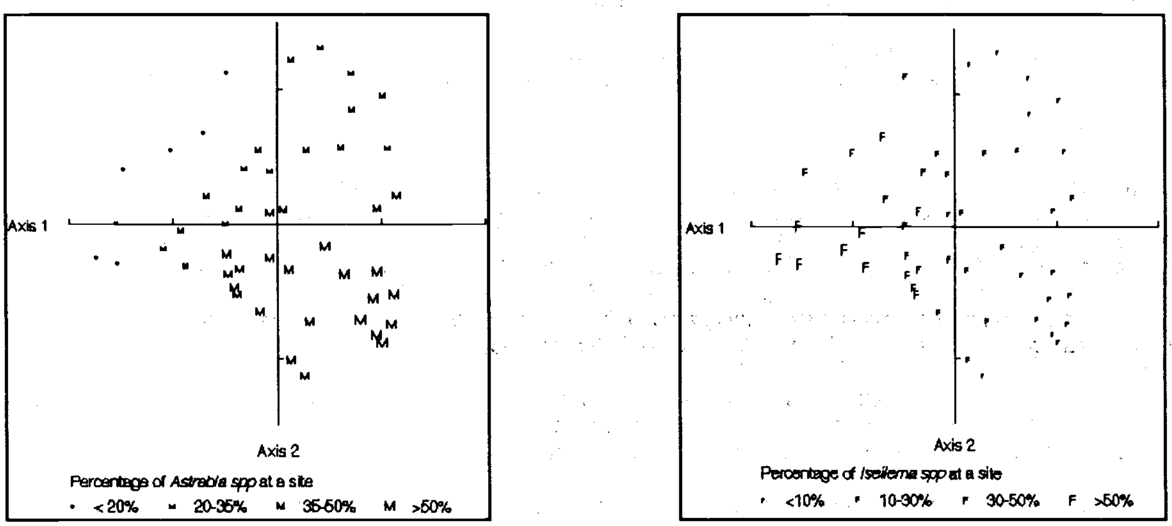
The ordination technique of hybrid multidimensional scaling (Faith *et. al.* 1987) was applied to the data to reveal the pattern between sites. Two dimensions were selected for the ordination, based on a stress value of 0.19 which is barely in the acceptable range recommended by Kruskal (1964). One of the recording times, May 1991, has been chosen to demonstrate the results. For this recording time, 41 species were used in the ordination. Seasonal conditions prior to May 1991 were a very wet summer (531 mm in the

December to February quarter at the Julia Creek Post Office) followed by a dry autumn.

RESULTS

A display of the similarities between the 48 sites is only meaningful when species information is superimposed. Figure 1 shows the pattern between ggthe sites and the occurrence of the two most discriminatory species; *Astrebla spp* (Mitchell grass) and *Iseilema spp* (Flinders grass). The frequency of *Astrebla spp* ranged from 8 to 74 %, while *Iseilema spp* varied from 0 to 90 %.

In **Fig. 1a** a small number of sites have a high proportion of *Astrebla spp* and are closely grouped showing a high level of similarity. The configuration then rapidly expands in a fan-shaped fashion where sites with equivalent levels of *Astrebla spp* are a distance apart. The change in the frequency of *Astrebla spp* does not fully explain the pattern across sites. Extra explanation is offered for the same spatial configuration of sites by the distribution of *Iseilema spp* in **Fig. 1b**.



(a) (b)

Figure 1: A two-dimensional ordination of the 48 monitoring sites, superimposed with
(a) the percentage of *Astrebla spp* at a site,
(b) the percentage of *Iseilema spp* at a site.

The sites with a high frequency of *Iseilema spp* are closely grouped (Figure 1b), and frequency then decreases across the sites in a fan-shaped manner. The direction of decrease however, lies across, but not solely opposite to, the direction of change in *Astrebla spp*. This indicates an interaction between the two species. Other minor species contributing some information to the pattern of sites are *Panicum spp, Streptoglossa spp* and *Eragrostis spp*, which varied in frequency from 0 to 40 %.

DISCUSSION

The insight gained by considering species other than *Astrebla spp* alone complements the information about any site, even though this species is dominant in the community. To quantify the interaction between species it is necessary to consider at least a two-dimensional configuration of sites. Also the stress level of the ordination technique indicated that at least two dimensions were required for an adequate representation of the pattern of sites. This supports the idea that expressing condition in terms of a single dimension may not always provide an adequate description of a complex system, particularly in the presence of interactions. A further technical reason for considering the higher dimensions of the ordination is to allow for a nonlinear response of species to gradients (Austin and Noy-Meir 1971). Other techniques such as Principal Components Analysis restrict the response to be linear.

The interpretation of either ordination axis as a condition gradient would be misleading in the presence of the interaction. The extremes of a gradient tend to be well-defined with high frequencies of *Astrebla spp* occurring with low levels of *Iseilema spp* and vice-versa. However the middle range is more difficult to interpret as a variable frequency of *Iseilema spp* can be found with any given frequency of *Astrebla spp*. The minor species offer some explanation of this variation. For this particular configuration of sites and underlying species distributions, there does not appear to be a simple solution to the assessment of condition.

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