

Vegetation survey of Sengwa

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ABSTRACT

The approach and initial results of a vegetation survey of the Sengwa Wildlife Area are outlined. The objectives were to produce a vegetation classification and map sufficiently detailed to serve as a base for the management of the natural vegetation. The methods adopted consist of (a) stratification of the area into homogeneous units using 1:10 000 colour aerial photographs; (b) plotless random sampling of each stratum by recording cover abundance on the Braun-Blanquet scale for all woody species; and (c) analysis of the data by indicator species analysis using the computer programme 'Twinspan'.

The classification produced is successful in achieving recognizable vegetation types which tie in well with known environmental features.

RÉSUMÉ

ÉTUDE DE LA VÉGÉTATION DU SENGWA

L'ébauche et les premiers résultats d'une étude de la végétation dans la réserve de faune du Sengwa sont décrits. Les objectifs étaient d'établir une classification et une carte de la végétation suffisamment détaillées pour servir de base à la gestion de la végétation naturelle. Les méthodes adoptées consistent en (a) une stratification de la région en unités homogènes en utilisant des photographies aériennes en couleur au 1:10 000, (b) un échantillonnage au hasard de chaque strate en y relevant le coefficient d'abondance-dominance suivant la méthode de Braun-Blanquet, pour toutes les espèces ligneuses, et (c) l'analyse des données par l'analyse des espèces indicatrices en utilisant le programme d'ordinateur 'Twinspan'.

La classification obtenue permet de reconnaître des types de végétation qui correspondent bien au milieu étudié.

INTRODUCTION

In a developing country in which much land-use is based on exploitation of natural ecosystems there is a need for a national policy of utilization of the resources in those systems, the most basic of which is vegetation.

Planning the management of resources requires knowledge of the distribution of those resources in space; there is a need therefore, in the case of vegetation, for maps on as detailed a scale as possible. A practical approach to the mapping of vegetation necessitates classification into vegetation types. In Zimbabwe the existing vegetation classification is that of Wild & Fernandes (1967), however it is insufficiently detailed and accurate for present needs, as recognized by Robertson (1979). A useful and detailed classification would have the following features:

1. A type should represent a unique environment. This will not always be possible since communities change along environmental gradients and are not always delimited by sharp boundaries. Conversely, vegetation may sometimes be made up of a mosaic of small, well defined patches impossible to map individually. However, pragmatism dictates that divisions should be made even where it can be recognized that such a division represents an arbitrary point on a continuum, or includes more than one environment.
2. There should be a common approach by all those involved in different parts of the country, so that results are comparable.

3. The method of producing the classification should be objective. Generally, subjective methods require an ecologist with a great deal of experience. Our need is for a method that can be applied by a number of less experienced observers with the same results.

As a test-case for a rapid, detailed and objective classification, I have taken the Sengwa Wildlife Research Area (18° 10'S, 28°10'E, area 373 km²). This area is ideal in containing a large spectrum of habitat types in a small area, and an immediate need exists for a vegetation map for research purposes.

METHODS

The methods adopted can be conveniently divided into three phases, namely stratification, description and classification.

Stratification

Ideally, one would like to sample stands at random and allow an objective classification method to construct the groups. This is inefficient because a widespread type will be oversampled, whereas a rare one may not be sampled at all, and misleading because, if a stand happens to straddle an environmental boundary, the species associations it contains will be artificial. The alternative is stratification, whereby the area is divided up into strata of similar environment and random samples are taken within strata. In the case of Sengwa, strata were identified as homogeneous patches on 1:10 000 colour aerial photographs (Figs 1 & 2). It was not expected that the strata would perfectly represent the environmental types present, i.e. some environments that had not been recognized as distinct might

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FIG. 1.—Aerial photograph of part of Sengwa Wildlife Research Area.

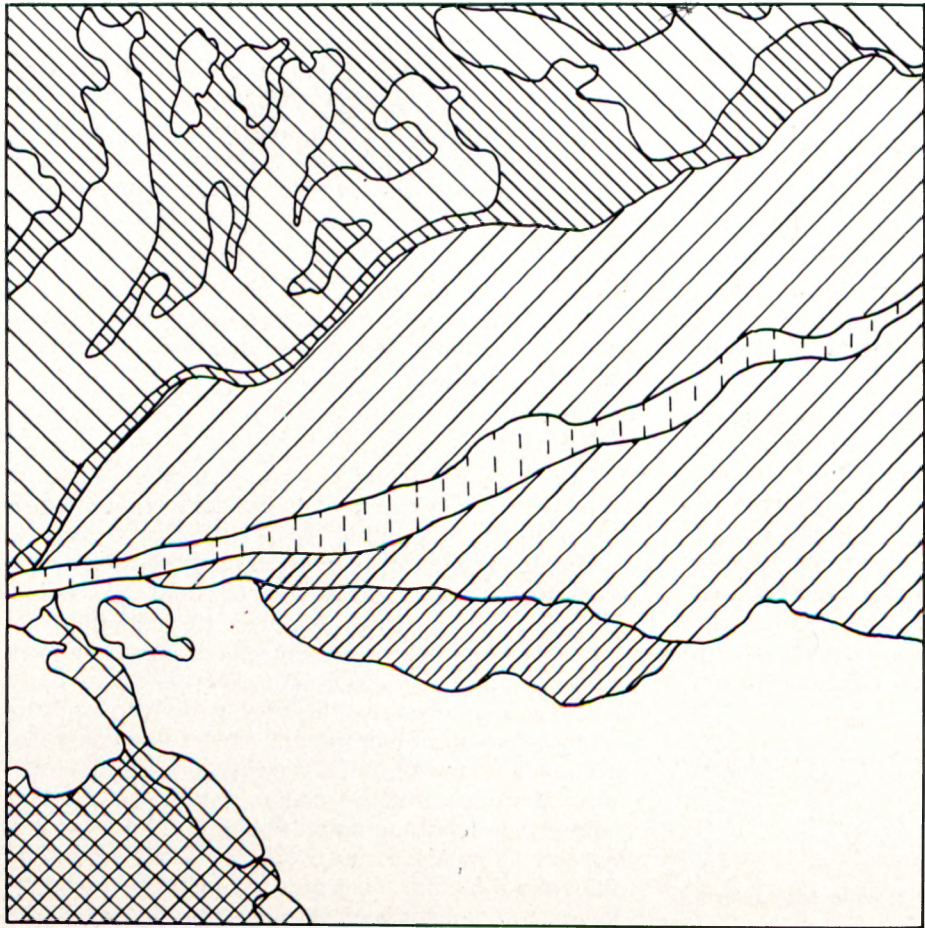


FIG. 2.—Stratified interpretation of Fig. 1.

be lumped as one stratum, leading to some undersampling. However, it is believed that the improvement over random sampling is considerable. An important constraint on strata is that they should account for the whole area. This gives all environments a good chance of being sampled whether or not they have been recognized as strata. In our case, small areas difficult to assign to strata were sampled separately. Strata which appeared more heterogeneous on the photographs were sampled more intensely. It is important to remember that the stratification represents the first hypothesis about possible types present. The subsequent classification may falsify this by making two types within one stratum. Then the hypothesis has to be refined by looking for the environmental boundary not previously seen, and resampling to test the new hypothesis. When a classification is arrived at, producing types that do not conflict with strata, there is the basis for a vegetation map. If it is not possible for the eye to detect an environmental boundary on photographs, it may still be possible to detect it by computer analysis of satellite images, though this has not been attempted at Sengwa.

Stands were chosen randomly from the strata as points from which description would begin. The presence of any stratum boundary in the vicinity was noted to guard against the generation of artificial associations.

Description

Following Robertson (1979), it was felt that woody vegetation alone could be used to characterize types. Initial trials suggested that accurate quantities give no better results than simple cover abundance. The laying out of plots was therefore deemed unnecessary. Since the size of the project requires rapid description of stands, time saved by ignoring herbs, doing no measurements and using plotless sampling was useful. Each stand was described on the basis of woody species only, the criterion for inclusion of a species being that it should be listed in Drummond (1975). From the randomly selected point, the stands were walked in a direction at right angles to the nearest stratum boundary, and away from it. Cover abundance was rated on the Braun-Blanquet scale for each species and separately for three layers, namely trees (over 3 m), shrubs (1–3 m) and small woody plants (0–1 m). (A combined estimate of these was made for later analysis.) Description was finished when no new species were seen. The main danger of having unlimited plot size is walking into a different community. This was guarded against by knowing where the stratum boundaries were, and noting whether the stand appeared homogeneous.

Classification

As an alternative to clustering methods based on generalized distance measures, I have used one based on ordination.

Ordination plots stand in multidimensional space where species are the axes. New axes are then created which express the total variation between

stands more economically. When the stands are plotted on the new axes an impression of the relationship between stands is given.

Indicator species analysis (Hill, Bunce & Shaw, 1975) is a divisive method of clustering based on a reciprocal averaging ordination (Hill, 1973) which was used with some success in the classification of forest in Ghana (Hall & Swaine, 1976). This method takes the first axis of the reciprocal averaging ordination and divides the stands into two halves at the centre of the distribution. A small number of 'indicator species' are chosen according to how well their presence differentiates one side of the distribution from the other.

The groups so produced are then treated independently in the same way, thus giving a hierarchical classification. The allocation of indicators at each division enables a stand in the field to be allocated to a group using a key, and without having to consider too many species, which means once the classification has been made, a relatively inexperienced observer will be capable of placing a stand in a group in the field — a very great advantage.

With reciprocal averaging, an ordination of stands in species space and species in stand space are produced simultaneously (Hill, 1973), so the indicator analysis process can also be carried out to classify species. This enables a phytosociological table to be drawn up which displays the relation between stand groups or types and species in the classification, resembling a Braun-Blanquet association table.

The programme used for the Sengwa data was 'Twinspan' (Hill, 1979). This carries out a two-way indicator analysis for species and stands.

RESULTS AND DISCUSSION

Fig. 3 illustrates a phytosociological table constructed by 'Twinspan' on 122 preliminary stands described at Sengwa. The table is provided with stands as rows and species as columns, i.e. the reverse of the usual format. Stands have also been divided into 11 stand groups by horizontal lines. These are the groups produced by the programme, and numbering from the top, the hierarchy may be expressed as follows:

([(1 2) (3)] (4 5) (6 7)) [(8 9) (10 11)]

i.e. the first split of the analysis divided the stands in groups 1–7 from the rest, the second divided groups 1–3 from 4–7 and so on. Splits made after the third are not so meaningful in this case, though the programme could be made to carry on the process until there was one species per group.

Lines delimiting species groups have been drawn down the table; these show which species groups are important in each stand group. A black square denotes a species occurrence in a stand.

As might be expected from a divisive method such as this, when a natural group occurs in the centre of the ordination, it is likely to be split artificially. In this case, groups 8 and 3 have affinities, but have gone to different sides of the hierarchy at the first division. The groups themselves are sensible.

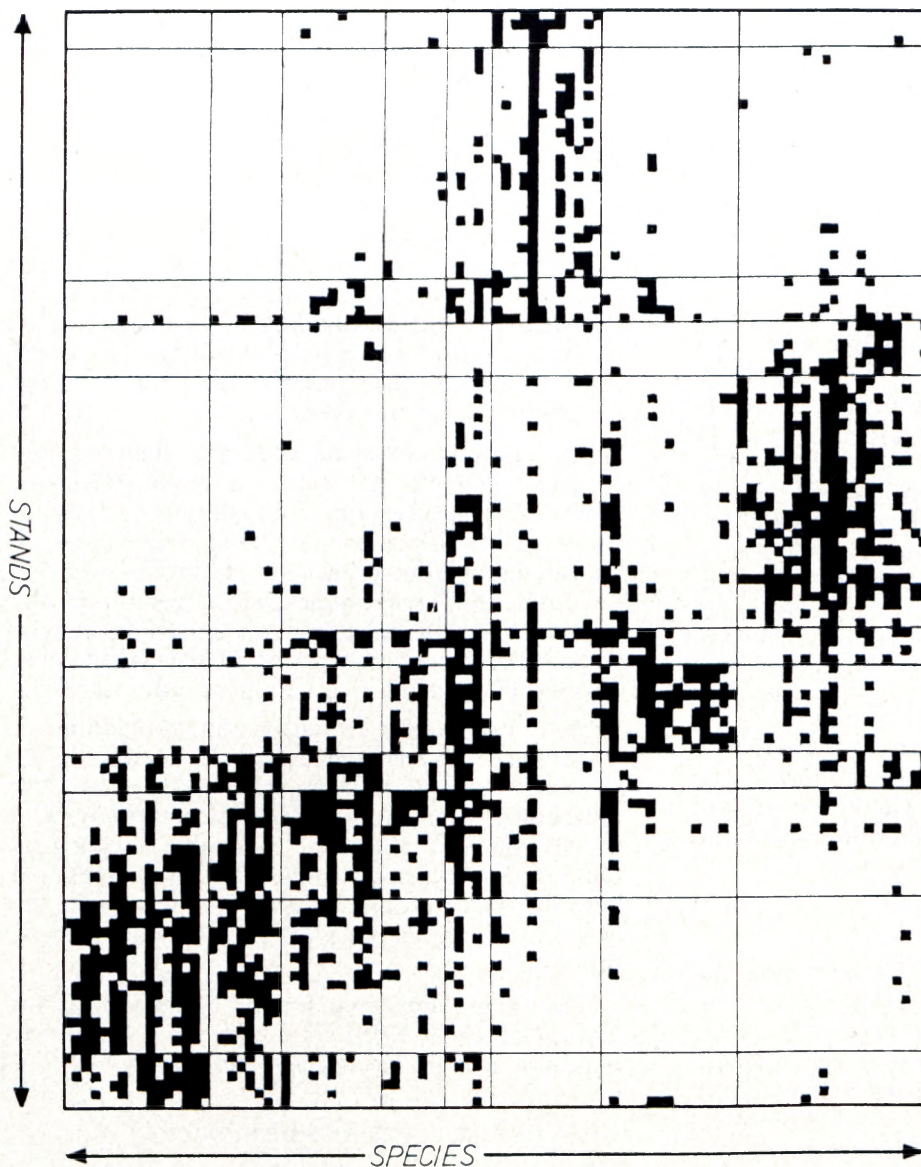


FIG. 3.—Phytosociological table 122 stands from Sengwa Wildlife Research Area constructed by 'Twinspan'.

representing different strata, but the classification is unnatural. I do not believe, however, that this detracts from its usefulness.

The classification is successful in achieving interpretable vegetation types. Working from the top, the interpretation of the 11 groups is as follows:

1. *Colophospermum mopane* woodland on calcareous soil
2. *C. mopane* woodland on clay
3. *C. mopane* woodland on shallow alluvium overlying clay.
4. *Acacia albida* flood-plain woodland.
5. *Combretum imberbe*, *C. mossambicense* river terrace woodland
6. *Combretum eleagnoides*, *Colophospermum mopane* thicket and woodland on sandy eluvium.
7. *Baikaea plurijuga*, *Combretum celastroides* dry forest and tickle on deep sands.
8. *C. mopane*, *Combretum fragrans* wooded grassland on shallow alluvium.
9. *Brachystegia* spp.—*Julbernardia globiflora* escarpment woodland on sandy soil.
10. *Brachystegia* spp.—*J. globiflora* escarpment woodland on shallow sandy soil.
11. *J. globiflora*—*Diplorhynchus condylocarpon* woodland and scrub on shallow gravel.

As can be seen, there is evidence of uneven sampling of environments in the table. Although it is recommended that this be avoided, the method is clearly robust where this is concerned.

Further sampling will refine the classification to the point where strata may be mapped as vegetation types.

CONCLUSIONS

The initial results of the Sengwa vegetation survey suggest that indicator species analysis on plotless stands with semi-quantitative data is a rapid and useful approach. Although initial data left something to be desired in the way of thoroughness of sampling, a good classification was produced which tied in with known environmental features.

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