Bothalia 15, 1 & 2: 241–244 (1984)

A cover meter for canopy and basal cover estimations

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Keywords: basal cover, canopy cover, grassland, method, woodland

ABSTRACT

A simple, inexpensive, pocket-sized cover meter for estimating both canopy and basal cover is described. The cover meter is based on the visual superimposition of canopy-to-gap ratio scales, on to vegetation. Tests indicate that, in certain vegetation types, accuracy is comparable to the wheel-point apparatus in estimating basal cover. Canopy cover is estimated in classes according to the Domin-Krajina cover-abundance scale.

INTRODUCTION

The accuracy of visually estimating canopy cover in Braun-Blanquet vegetation analyses is dependent on the observer's experience in estimating cover. The Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg, 1974) has large class intervals to facilitate cover estimation. The large class intervals, however, do not permit detection of significant differences in vegetation cover. Consequently, interpretation of Braun-Blanquet tables places greater emphasis on presence or absence of species than on species cover.

In a recent vegetation study (Westfall, 1981) the Domin-Krajina cover-abundance scale (Mueller-Dombois & Ellenberg, 1974) was used to determine veld condition and trend, because of the smaller class intervals than in the Braun-Blanquet cover-abundance scale. However, the smaller class intervals increase the difficulty of cover estimation. This difficulty led to the development of a simple, inexpensive, pocket-sized cover meter for canopy-cover determinations. The success of the cover meter was such that its application was extended to basal-cover determinations.

DESCRIPTION AND USE OF THE COVER METER

The cover meter is based on cover estimation by the canopy-to-gap ratio method (Edwards, 1983) where cover is given in terms of the ratio of the mean canopy diameter to the mean distance, as number of canopy diameters, between the canopies of the plants. Two black-and-white 35 mm positive slides (transparencies) with various canopy-to-gap ratios (Figs 1 & 2) depicted by horizontal bars and corresponding spaces, to the right of each bar, are used. Basal cover is estimated with the slide of Fig. 1 and canopy cover is estimated with the slide of Fig. 2. Slides may be constructed by photographing Figs 1 & 2 directly. The appropriate slide is placed in a Cenei F3, or similar, pocket slide viewer.

A canopy or basal diameter together with the gap to a random neighbour, to the right, is observed with the free eye while the ratios observed in the slide viewer are visually superimposed on the image observed by the free eye. A filter, made of paper or exposed film, and placed in front of the slide, reduces the light input which can facilitate superimposing the two images. The observer selects a bar and corresponding space to the right of the bar which, when superimposed on the canopy or basal diameter and gap, produce the best fit, and reads the appropriate cover percentage, canopy: gap ratio (∅) or Domin-Krajina cover-abundance value (Figs 1 & 2). The proportions between bars and spaces for a given percentage cover remain the same, so that backward or forward movements by the observer to match the images, are limited. The observer should, however, remain at right angles to the canopies or basal diameters observed.

The cover meter was tested to determine limits of accuracy and minimum samples required.

STUDY AREAS

The estimates of basal cover were determined in grassland plots at the Botanical Research Institute in Pretoria, during March 1983. The canopy cover estimates were determined in Acocks's (1975) Mixed Bushveld at the Nylsvley Nature Reserve, near Naboomspruit, Transvaal, also during March 1983. The stands were all selected to provide variation in total cover.

METHODS

Basal cover

Basal cover was determined for each of the three 20 m × 20 m grassland plots by:

(i) A wheel-point apparatus (Tidmarsh & Havenga, 1955), with points 0,38 mm in diameter and 1 m apart. A sample of 1 000 points was taken in each plot.

(ii) The cover meter, with 30 random readings in each plot based on a grid with lines 1 m apart. Grid co-ordinates were selected by random numbers (Fisher & Yates, 1949). The nearest grass beneath the grid intersection points was selected together with the nearest neighbour intercepted by the grid lines. The observer faced in a constant direction for all recordings and used the right-hand grid line to determine the nearest neighbour, for convenience.

Although grass, forbs and shrubs were recorded

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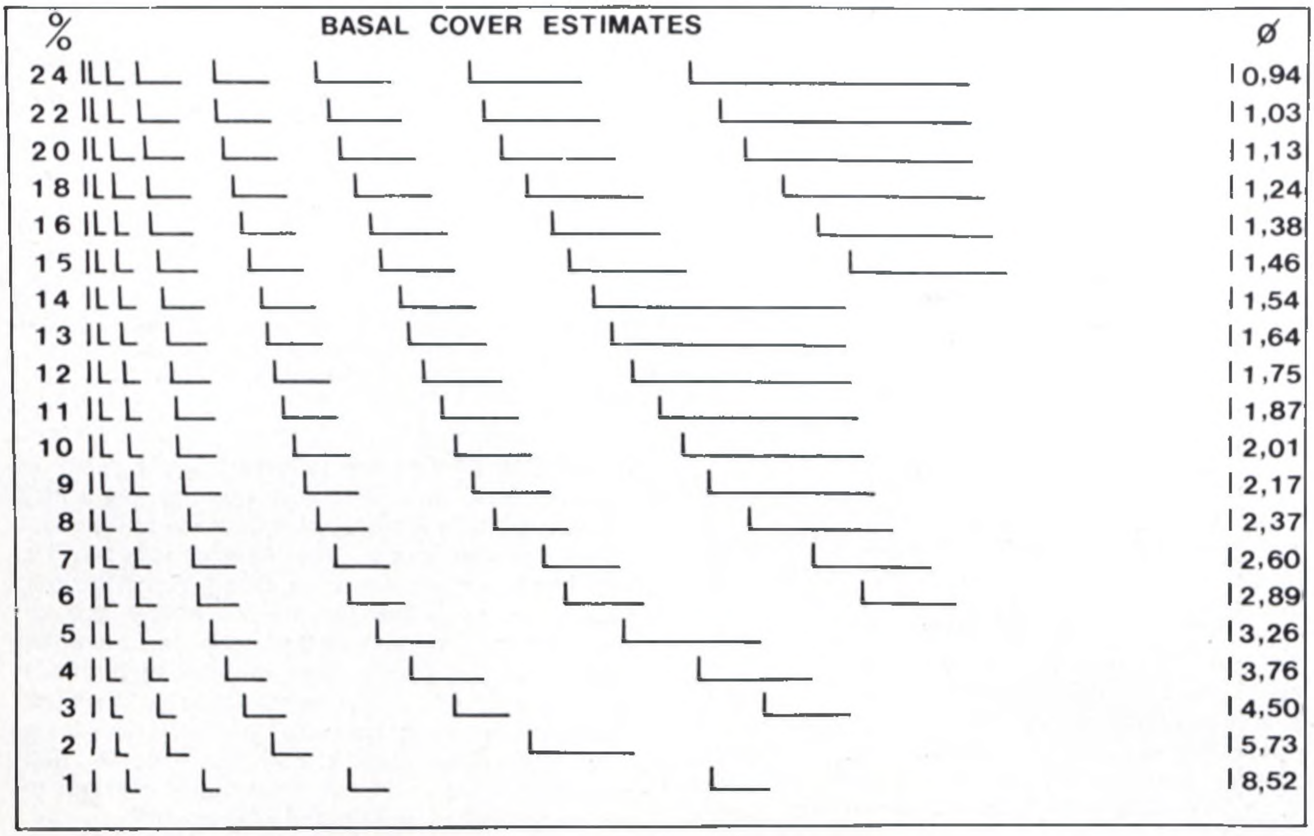

FIG. 1.—The basal cover-scale showing percentage basal cover and ratios (Ø) of basal diameter to gap. The horizontal bars represent basal diameters and the corresponding spaces to the right represent gaps. The width of the vertical lines at the extreme left represents bars.

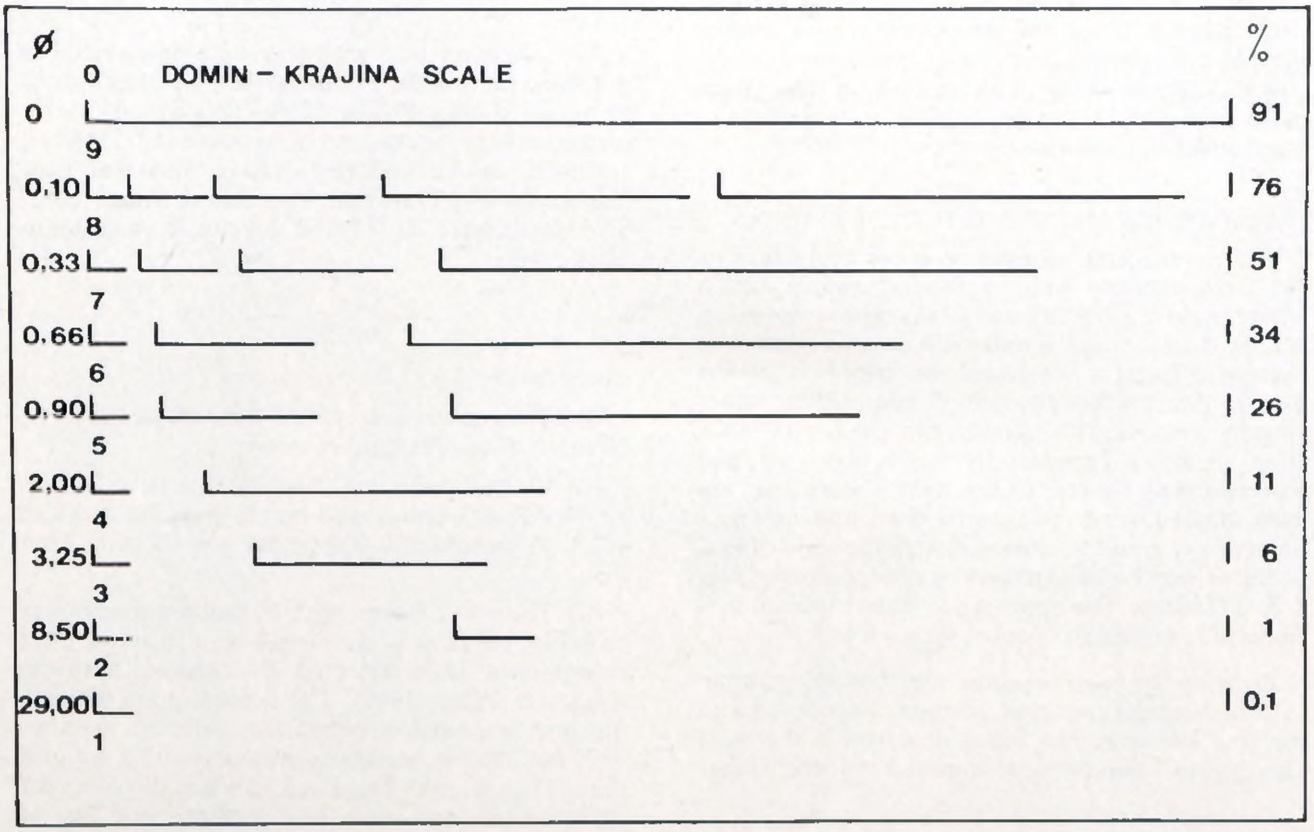

FIG. 2.—The canopy-cover scale showing canopy-to-gap ratios (Ø) and percentage canopy cover. The Domin-Krajina cover-abundance values are for the classes between the canopy-to-gap ratios or percentage cover. The horizontal bars represent canopies and the corresponding spaces to the right represent gaps.

separately for each method, only the grass component is considered here.

The basal cover estimates with the cover meter were tested for normal distribution according to Southwood's (1966) method as used by Van Ark (1981). The number of samples required for different limits of accuracy were then determined for the three basal cover plots individually and jointly, according to the formula (Van Ark, 1981):

$$N = \frac{(t.\ S)^2}{(d.\ \bar{x})}$$

where
- N = number of samples
- t = table value for the t- distribution with (n-1) degrees of freedom
- S = standard deviation with (n-1) degrees of freedom
- d = level of accuracy expressed as a decimal
- $\bar{x}$ = mean.

Canopy cover

Eight stands, each with a different degree of canopy cover, were selected from 1: 4 000 scale aerial photographs. A plot of 2 cm × 2 cm was demarcated on the aerial photographs in each stand, representing approximately 80 m × 80 m in the field. A single cover meter reading with the Domin-Krajina cover-abundance scale was recorded of a visually representative sample of the whole plot within each plot. Only trees above 2 m in height were taken into account. The 2 cm × 2 cm demarcated areas on the aerial photographs were traced on to film together with the tree (above 2 m tall) canopies. The traced canopies were cut out and weighed, the remaining film was weighed as also the total 2 cm × 2 cm film with canopies as a control. The results were expressed as percentage canopy cover.

TABLE 1.—Comparison of estimates of total grass basal cover with the wheel-point method and the cover meter in three grassland plots

	Plot 1 % cover	Plot 2 % cover	Plot 3 % cover
Wheel-point method	6,3	10,3	5,4
Cover meter	6,8	10,5	5,5
Difference	0,5	0,2	0,1

TABLE 2.—The minimum number of cover-meter samples required in three grassland plots for different limits of accuracy with 95% confidence limits

Limits of accuracy (%)	Minimum number of samples required			
	Plot 1	Plot 2	Plot 3	Combined Plots
5	1260	412	2226	1041
10	315	101	577	260
15	140	45	253	116
20	79	26	142	65
25	50	16	92	42
40	20	6	36	16

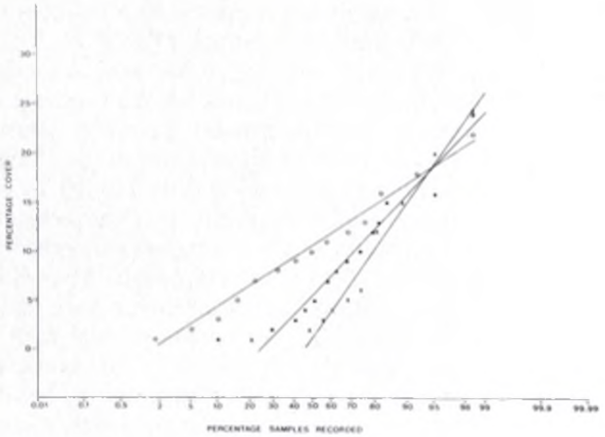

FIG. 3.—A simple test for normal distribution on probability graph paper (Southwood, 1966). A straight line through the plotted points indicates a normal distribution. Plots 1 (......) and 2 (ooooo) are approximately normally distributed but plot 3 (xxxx) is not a normal distribution.

RESULTS

Basal cover

The comparison of total grass basal cover with the wheel-point method and cover meter is given in Table 1. The values for the cover meter are the means of 30 samples. The cover meter samples are approximately normally distributed for Plots 1 and 2 according to Southwood's (1966) method of determining normal distribution (Fig. 3). Spatial heterogeneity of grass tufts accounts for the lack of a normal distribution of samples in Plot 3 (Fig. 3). The minimum samples required with 95% confidence limits for different limits of accuracy with the cover meter are given in Table 2 for each of the three plots.

Canopy cover

The comparison of tree canopy cover, for trees above 2 m in height, with the canopy cover determined from aerial photographs and the cover meter is given in Table 3.

TABLE 3.—Comparison of tree canopy cover, for trees above 2 m in height, with canopy cover determined from aerial photographs and the cover meter

Canopy cover from aerial photographs (%)	Canopy cover class with cover meter (%)
3	1–6
8	6–11
15	11–26
29	26–34
38	26–34
56	34–51
78	76–91

DISCUSSION AND CONCLUSIONS

The accuracy of the cover meter, as in the wheel-point apparatus, (Tidmarsh & Havenga, 1955) decreases for a given number of samples, with decreasing basal cover (Tables 1 & 2). For 10%

basal cover, 26 samples are required with the cover meter for a 20% limit of accuracy (Table 2). The wheel-point apparatus requires 1 000 points for a similar limit of accuracy (Tidmarsh & Havenga, 1955). However, 26 cover-meter samples takes approximately a third of the time required for 1 000 points. A 20% limit of accuracy means that for 10% basal cover there is 95% certainty that the results will be in the range of 8–12%. The grass canopies in the three grassland plots were knee-high. This did not detract from estimating basal cover with the cover meter, because the gap between basal tufts, being greater than the bases, was of greater importance in estimating basal cover than tuft basal diameter. Where the basal tuft size is greater than the spaces between tufts, tall grass could prevent use of the cover meter. In practice, it was seldom possible to obtain perfect fits of basal diameter to gap and bar to space. The best fit was recorded with emphasis placed on the gap and space fit, where the ratio of basal diameter to gap ratio was greater than one.

The discrepancies of the cover meter in estimating canopy cover in classes for the 38% and 56% cover values obtained from aerial photographs (Table 3) may be attributed to incorrect selection of a representative sample. In phytosociological surveys, the problem of a single cover value representing an entire community does not arise, because cover is expressed as a rañge of cover values represented by each relevé in the community. The range may be summarized as mean cover degree (Mueller-Dombois & Ellenberg, 1974). As in the case of basal cover, the best fit between canopy to gap and bar to space is obtained when emphasis is placed on the gap and space fit, where the canopy to gap ratio is greater than one.

Although visually superimposing two different images requires a little practice, the cover meter is an extremely simple and portable device for rapidly estimating both basal and canopy cover. The accuracy of the cover meter depends on the user's requirements which may be a quick estimate of cover or a more time-consuming assessment. Unlike the single wheel-point apparatus, the cover meter can be used by a single observer and is also very inexpensive.

ACKNOWLEDGEMENTS

The authors thank Dr D. Edwards for his support, Dr J. C. Scheepers for comments and suggestions and Dr H. van Ark for assistance with the statistical analyses.

UITTREKSEL

'n Eenvoudige, goedkoop sakbedekkingsmeter vir die bepaling van beide kruin- en basalebedekking word beskryf. Die bedekkingsmeter is gebaseer op die visuele ooreenlê van kruin- tot gapingskale op die plantegroei. Toetse dui aan dat by sekere plantegroei tipes, akkuraatheid is met die wielpunt-apparaat vir basalebedekking vergelykbaar. Kruinbedekking word in klasse volgens die Domin-Krajina bedekkingsgetalsterkte skaal bepaal.

REFERENCES

ACOCKS, J. P. H., 1975. Veld types of South Africa. 2nd edn. *Mem. bot. Surv. S. Afr.* 40: 1–128.

EDWARDS, D., 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14: 705–712.

FISHER, R. A. & YATES, F., 1949. *Statistical tables for biological, agricultural and medical research.* London: Oliver & Boyd.

MUELLER-DOMBOIS, D. & ELLENBERG, H., 1974. *Aims and methods of vegetation ecology.* New York: John Wiley.

SOUTHWOOD, T. R. E., 1966. *Ecological methods with particular reference to the study of insect populations.* London: Chapman & Hill.

TIDMARSH, C. E. M. & HAVENGA, C. M., 1955. The wheel-point method of survey and measurement of semi-open grasslands and Karoo vegetation in South Africa. *Mem. bot. Surv. S. Afr.* 29: 1–49.

VAN ARK, H., 1981. Eenvoudige biometriese tegnieke en proefontwerpe met spesiale verwysing na entomologiese navorsing. *Wet. Pamf. Dep. Landb. Vis. Rep. S. Afr.* No 396.

WESTFALL, R. H., 1981. *The plant ecology of the farm Groothoek, Thabazimbi District.* M.Sc. thesis, University of Pretoria.

Bothalia 15, 1 & 2: 245–258 (1984)

A vegetation survey of the Cape of Good Hope Nature Reserve. I. The use of association-analysis and Braun-Blanquet methods*

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Keywords: association-analysis, Braun-Blanquet, fynbos, phytosociology, plant community

ABSTRACT

The survey aimed to establish broad vegetation units that could be mapped on an extensive scale in the Cape of Good Hope Nature Reserve at the southern tip of the Cape Peninsula. This paper compares the performance of two methods, association-analysis and the Braun-Blanquet method as developed by the Zürich-Montpellier School of Phytosociology. One hundred 50 m^2 sample plots, covering the whole Reserve, were placed systematically at grid intersections on the 1:18 000 topographical map, at 1 000-yard (914 m) intervals. Species lists, recording merely presence of all species with permanently recognizable aerial parts, were made for each plot.

The association-analysis resulted in a classification of 23 final groups of sample plots, of which only five groups showed high floristic and ecological homogeneity. Of the remainder, eight groups contained some anomalous, misplaced plots, and ten represented small, isolated fragments of natural units. The original data were then analysed using Braun-Blanquet methods to provide an independent classification for comparison with the former. The Braun-Blanquet communities were found to be more homogeneous in terms of previously defined habitat groupings and showed floristic relationships consistent with these groupings.

It is concluded that, with the type of sampling used, the synthetic phytosociological Braun-Blanquet method provides a more natural classification of plant communities of the Reserve than does the monothetic divisive association-analysis method.

INTRODUCTION

When Acocks (1975) first wrote his Veld types of South Africa in 1953, little was known of the ecology of the complex fynbos vegetation of the Capensis region (Taylor, 1978). Acocks was therefore unable to subdivide fynbos to the same extent as he did the vegetation of other parts of South Africa. Though there had been general descriptions of fynbos by Marloth (1908) and Adamson (1938) and a few quantitative studies like those of Wicht (1948) and Rycroft (1951), there was still scant information on the response of different types of fynbos to treatments like veldburning and grazing. To determine the effects of such treatments, experimental research was initiated locally but these isolated projects could not be satisfactorily compared with one another, or extrapolated to other areas, in the absence of a synoptic account of fynbos. To fulfil this need, it was decided in the early 1960's to conduct a primary survey of Cape Mountain Fynbos (Acocks's Veld Types 69 and 70) and, for this purpose, a suitable method had to be found. The survey of such a large area — some 37 000 km^2 in rugged mountain terrain — would have to be divided into components, and the method would have to be sufficiently formalized and uniform to allow valid comparison of data from each component. In seeking a method suitable for a major survey of this kind, a trial on a smaller area of fynbos was required.

The Cape of Good Hope Nature Reserve (Fig. 1) was chosen as the site for the trial, because its flora was comparatively well known (Adamson & Salter, 1950), and its area large enough (77 km^2) and its vegetation sufficiently diverse to provide a representative sample of fynbos. The work was begun by the author in 1966 and presented as a thesis to the University of Cape Town (Taylor, 1969).

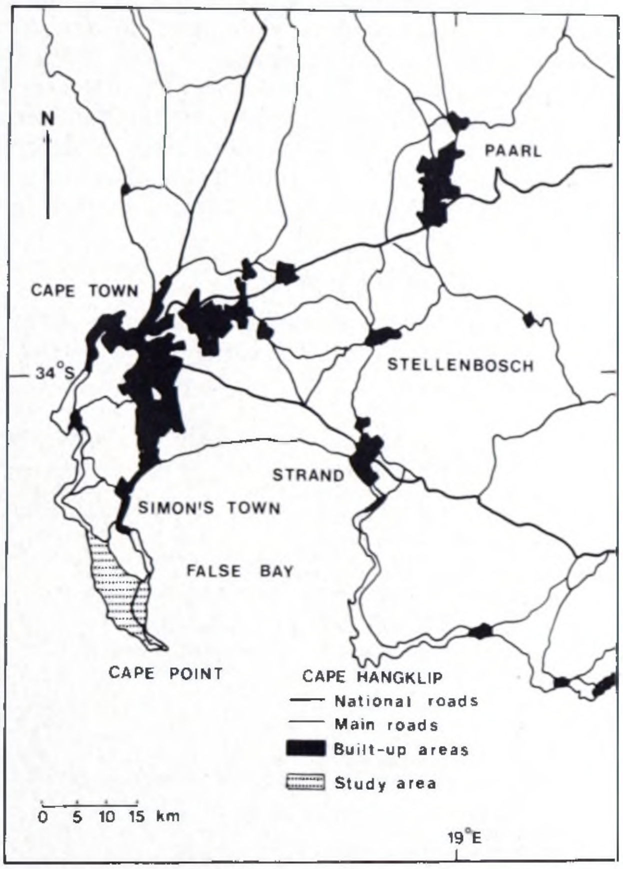

FIG 1.—Geographical location of the study area.

* Based on an M.Sc. thesis, University of Cape Town.

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