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Miscellaneous notes

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THE PLANT NUMBER SCALE — AN IMPROVED METHOD OF COVER ESTIMATION USING VARIABLE-SIZED BELT TRANSECTS

INTRODUCTION

The vegetation ecology of the Transvaal Waterberg is currently being investigated at a scale of 1:250 000 (Westfall in prep.). Vegetation structure is being analysed according to Edwards (1983) using the cover meter (Westfall & Panagos 1984) for cover determinations in each height class. In the floristic analysis, individual species cover is estimated by using the Domin-Krajina cover-abundance scale (Mueller-Dombois & Ellenberg 1974).

A comparison of recorded species cover, being the sum of the class midpoints according to the Domin-Krajina scale (Mueller-Dombois & Ellenberg 1974), with the structural cover should result in the summed species cover for a stand being: 1, greater than the cover of the height class with the greatest cover, and 2, less than the summed cover of all the height classes, provided that 3, quadrat size is such as to include those species contributing significantly to the total cover of the stand.

In the vegetation being investigated, quadrat size is generally commensurate with species richness (Westfall *et al*. 1987). However, the summed estimated species cover was often considerably less than the mean cover for the height classes with the greatest cover for the same stands. Overcompensation for the underestimation of species cover often led to the summed estimated species cover being considerably greater than the summed cover of all the height classes for the same stands (Westfall in prep.). Clearly, improved species cover estimations are required for species cover to have any relevance other than an approximate indication of relative abundance.

In estimating species cover, according to Edwards (1983), the observer is often inclined to ignore grasses without inflorescences and to estimate from a static position without taking plant size and distribution into account. For example, a larger plant should require a larger area to be observed than a smaller plant. Furthermore, although mean canopy diameter can be readily estimated it is often far more difficult to estimate mean distance apart in terms of mean canopy diameter because of often highly irregular plant distribution.

To overcome these problems, the approach suggested here is based on a simple estimate of area and a count of the individuals of a species within the area.

METHODS

The cover of a species is given by Edwards (1983) for hexagonal packing by

$$c = \frac{90,7}{(n+1)^2}$$

where c = percentage crown cover and n = the mean number of crown diameters by which the plant crowns are separated.

Assuming hexagonal packing, the transect area, of which the percentage crown cover is a proportion, is given by:

$$\sin 60° \, (n+1)\, 30D$$

where D = mean crown diameter and 30 = the value for obtaining a minimum of 0,1% cover. Cover of less than 0,1% is not considered significant. Transect length is, therefore, 30D and transect width is sin 60° (n+1). In practice, transect width was taken as slightly less than the average gap between plants within or nearest to the sample quadrat plus the mean crown diameter. The number of individuals of a species was then counted within the transect. Only species occurring within the sample quadrat were recorded and for each a count of individuals within a transect commensurate with each species spacing and size was made. Counts of individuals did not include the first individual as the transect was started adjacent to the first individual. This permitted a cover of less than 0,1% where no individuals were counted. Transect width was never greater than the length as this could have resulted in actual cover values of less than 0,1% being given higher cover values.

The mean number of crown diameters (n) by which the plant crowns are separated within each transect is given by $n = \frac{30-I}{I}$ where I = number of individuals counted. Percentage crown cover can then be calculated according to Edwards (1983). Table 1 shows number of individuals counted, representation by a single character symbol and percentage cover for recording purposes in the field.

Vegetation structure was analysed using the cover meter and the summed species cover was estimated with both the Domin-Krajina scale and the plant number scale as outlined above for five vegetation stands represented by 21 quadrats. The mean of the shortest and longest cross distances of each crown was taken as the crown diameter for each species and these distances were noted in four categories (Edwards 1983) namely, forbs (herbs), grasses, shrubs and trees. Class intervals were selected on a basis of trial and error to give an approximately normal distribution of occurrences within crown diameter class intervals. All estimations were done by an independent observer.

RESULTS

The results of the crown cover determinations are given in Table 2.

TABLE 1.—Number of plant individuals counted with single character symbol and percentage crown cover

No.	Symbol	% Crown cover
0	+	0,00
1	1	0,10
2	2	0,40
3	3	0,91
4	4	1,61
5	5	2,52
6	6	3,63
7	7	4,94
8	8	6,45
9	9	8,18
10	A	10,08
11	B	12,20
12	C	14,51
13	D	17,03
14	E	19,75
15	F	22,68
16	G	25,80
17	H	29,12
18	I	32,65
19	J	36,38
20	K	40,31
21	L	44,44
22	M	48,78
23	N	53,31
24	O	58,05
25	P	62,99
26	Q	68,13
27	R	73,47
28	S	79,10
29	T	84,76
30	U	90,70
31	V	96,85
>31	W	100,00

The Fibonacci sequence, where each number is the sum of the preceding two numbers, provided the closest resemblance to a normal distribution of occurrences within crown diameter class intervals. This is illustrated in Figure 1 with a frequency polygon with the class intervals on a natural logarithmic scale to reduce the effect of increasingly larger class intervals.

The class intervals used for mean crown diameters according to the Fibonacci sequence, are shown in Table 3. Transect lengths were determined by the midpoints of each class interval.

INTERPRETATION

In Table 2 estimations according to the Domin-Krajina cover-abundance scale are considerably lower than those for the single height classes with the most cover. The plant number scale, in contrast, yielded higher values than that of the single height class with the most cover and lower values than the cover of the combined height classes for each relevé, except relevé 37. This indicates a greater precision in estimating cover when using the plant number scale as opposed to the Domin-Krajina scale.

According to Westfall *et al.* (1987), quadrat size should have been larger for the vegetation type represented by relevé 37, but this was not apparent using the Domin-Krajina scale at the time of sampling. However, simple summation of the values obtained by the plant number scale in the field indicated inadequate quadrat size. It is far too time-consuming to verify quadrat size for each quadrat according to Westfall *et al.* (1987). The plant number scale together with a structural analysis of the vegetation provides a simple means of verifying adequacy of quadrat size.

In the frequency polygons (Figure 1) the peaks to the left of the central troughs for forbs, grasses and shrubs are caused by a relatively higher proportion of 0,2 m diameter crowns. This can be attributed to the observer rounding off crown diameters to 0,2 m some of which should have fallen into the 0,211 to 0,34 class. If class intervals had been known at the time of recording, it can be expected that greater care would have been exercised in measurements where crown diameters were close to class borders. The troughs mentioned are, therefore, considered to be a result of measurement inaccuracies which could be overcome by using class intervals.

The use of standard transect lengths as illustrated in Table 3 should simplify transect length determination and provide for variability in crown size. A further advantage could be the simultaneous counting of individuals of different species with similar crown diameters and spacing to save time. It is also suggested that a simple counter be used for recording number of individuals for each species as marking paper for this purpose requires stopping at each individual recorded.

It must be emphasized that the parameter determined here is projected crown cover and not projected foliage cover which is more species and age-dependent.

The class 'r' on the Braun-Blanquet scale and '+' on the Domin-Krajina scale (Mueller-Dombois & Ellenberg 1974) both with 'solitary, insignificant cover' are difficult to determine. Species with a single occurrence in a sample quadrat often have significant cover outside the quadrat. If a stand is defined, as in this study, as 20 ha (Westfall *et al.* 1987), it is impracticable to determine whether a species is 'solitary' within that area. The concept of 'solitary' is relative to the area defined. In the plant number scale used here the lowest cover class is less than 0,1 %, which seems better defined than 'solitary'.

In contrast to the Domin-Krajina scale, the plant number scale has proportionately finer subdivisions at the lower cover values of the scale. This is of significance in the South African context with often high species richness characterized by many dominant species with generally lower cover in contrast to the few dominant species with higher cover often found in the relatively impoverished European vegetation.

TABLE 2.—Percentage crown cover in five vegetation stands represented by relevés 33 to 37

Relevé no.	Percentage crown cover			
	Single height class	Combined height classes	Domin-Krajina scale	Plant number scale
33	55	100	27	60
34	31	104	25	74
35	44	103	19	79
36	41	86	21	53
37	63	146	17	35

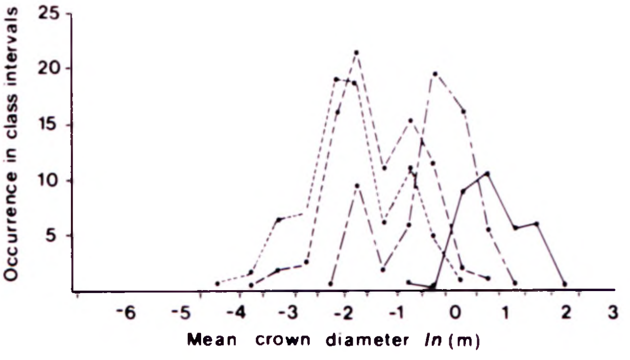

FIGURE 1.—Frequency polygons of occurrence of plants in mean crown diameter class intervals for forbs (....), grasses (– – –), shrubs (–·–·–) and trees (——). Class intervals are according to the Fibonacci sequence on a ln scale.

CONCLUSIONS

The projected crown cover determinations based on area estimations and counting of individuals shows improved precision compared to the Domin-Krajina cover-abundance scale. Although this method is more time-consuming than a purely visual estimation of cover, the use of standard class intervals and a counter should decrease the time required for cover determinations. The method appears more suitable for the species-rich South African vegetation than the traditional European cover-abundance estimation scales. The method also provides a means of verifying quadrat size adequacy.

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TABLE 3.—Class intervals of crown diameters according to the Fibonacci sequence for determining standard transect lengths

Crown diameter class interval (m)	Transect length (m)
0,001–0,01	0,15
0,011–0,02	0,45
0,021–0,03	0,75
0,031–0,05	1,20
0,051–0,08	1,95
0,081–0,13	3,15
0,131–0,21	5,10
0,211–0,34	8,25
0,341–0,55	13,35
0,551–0,89	21,60
0,891–1,44	34,95
1,441–2,33	56,55
2,331–3,77	91,50
3,771–6,10	148,05
6,101–9,87	239,55

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