Koedoe 20: 67–75 (1977)

TECHNIQUE FOR DESCRIBING WOODY VEGETATION COMPOSITION AND STRUCTURE IN INVENTORY TYPE CLASSIFICATION, ORDINATION AND ANIMAL HABITAT SURVEYS

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Abstract – Woody structure and composition is recorded to provide for calculating per species, stem growth form and height class: (a) canopy regime at different height levels; (b) total projected canopy cover; and (c) density. Quadrat size is determined independently at each site for each height class to suit the density and distribution of plants.

The technique presented here provides a site description of woody vegetation composition and structure. The technique was designed to obtain one sampling unit per site in semi-detailed inventory type surveys of large areas in the Kruger National Park (KNP) Republic of South Africa. Combined with a Braun-Blanquet type sample in 10 m x 20 m quadrats for grasses and forbs, the results are to be used for Braun-Blanquet type floristic classification and for floristic and structural ordination (Werger 1974; Whittaker 1973). By following the same descriptive procedures in selected animal habitats and on experimental burning plots, habitats and fire treatments are to be related to the inventory of floristic community types and structural gradients within community types.

Woody structure and composition is recorded to provide for calculating per species, stem growth form and height class:

(a) canopy regime at different height levels;
(b) total projected canopy cover (cf. Coetzee, van der Meulen, Zwanziger, Gonsalves and Weisser 1976); and
(c) density.

Canopy regime at different height levels and total projected canopy cover are calculated as horizontal spread, i.e. area, from canopy diameters and is expressed as percentage of sampling unit area. Canopy regime at a height level is calculated from canopy diameters at that height level, whereas total projected canopy cover is based on maximum canopy diameters. Density is expressed as number of individuals per hectare.

Three common stem growth forms are distinguished:–

(1) "Tree form" – individual with single stem;
(2) "Light shrub form" – individual with 2–4 stems; and
(3) "Bushy shrub form" – individual with 5 or more stems

More growth forms may be introduced as occasion demands, e.g. "Standing dead" and "Fallen dead" for dead individuals with stem diameter ≥ 10 centimetre.

For classing plants according to height and sectioning canopies, the following height levels are taken: $< 0{,}75$ m; 0,75 m– $< 1{,}5$ m; 1,5 m– $< 2{,}5$ m; 2,5 m– $< 3{,}5$ m; 3,5 m– $< 5{,}5$ m; and $\geq 5{,}5$ m. With heights below 0,75 m rounded off to 0,5 m and heights above that to the nearest full metre, heights and canopy sections are recorded as 0,5 m, 1 m, 2 m, 3 m, 4m–5 m and > 5 metre.

Canopy regime and density for different species, stem growth forms and height classes are recorded in square quadrats. Quadrat size is determined independently at each sampling site for each height class to suit the density and distribution of plants (cf. Walker 1976). Irregular distribution of individuals or low densities result in large quadrats including many individuals, whereas regular distribution or high densities lead to smaller quadrats including fewer individuals. The square quadrat is enlarged stepwise, retaining a fixed quadrat centre, until the height class to be recorded occurs in four equal sectors (quadrants) around the centre. In this sense an observer in the centre of the quadrat is "immersed" in that portion of a stand of a height class occurring within the quadrat.

The centre of the quadrat may fall in a cluster of plants of a particular height. The scale of survey may dictate that such clusters are not to be regarded as entities to be described separately but as phases of a larger entity to be evened out over the larger stand of vegetation in the description. The centre of the quadrat should then be moved out of the cluster. This would ensure that individuals of more than one cluster as well as the areas between clusters will contribute to the analysis. Quadrats are enlarged to the required size in the following steps: 10 m x 10 m, which is the minimum size; 20 m x 20 m; 30 m x 30 m; 40 m x 40 m; and 50 m x 50 m, i.e. 0,25 ha, the chosen maximum size for such quadrats in the Kruger National Park. The procedure is as follows:–

Use cable or rope to construct a rectangular cross with four equal arms of 25 m length, calibrated at 5 m intervals. For each height class four test squares are determined, one in each of the quadrants delimited by the cross. The test square is the smallest, from the following possibilities, that would include a rooted portion of a plant of the relevant height class: 5 m x 5 m; 10 m x 10 m; 15 m x 15 m; 20 m x 20 m and 25 m x 25 m. The largest of the four test squares determines the quadrat size for the height class to be recorded. The quadrat is namely a square with centre at the centre of the cross and divided by the cross into four quarters, each the size of the largest test square.

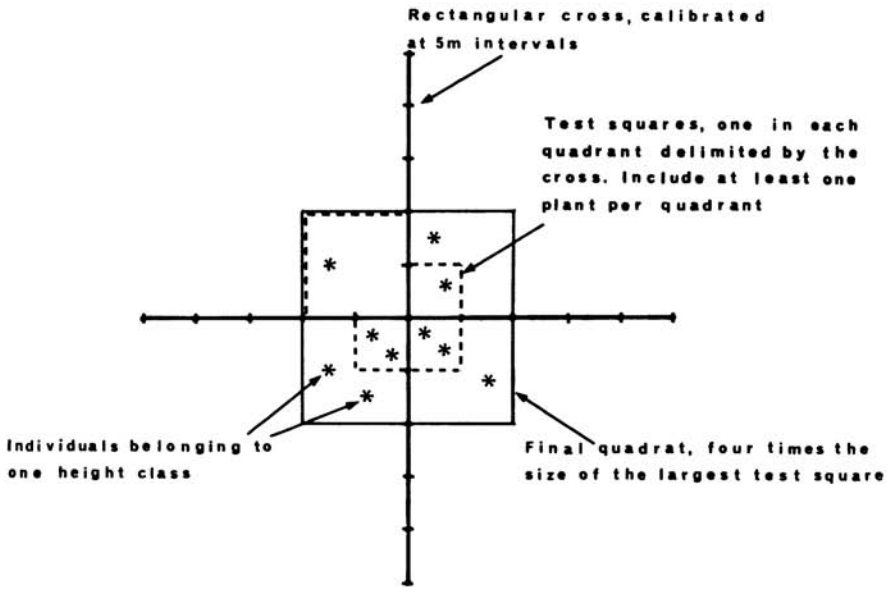

Fig. 1. Procedure for determining quadrat size for a height class, e.g. 1 m tall plants. Test squares are enlarged in steps until at least one plant is included.

The procedure is illustrated in Fig. 1 for one height class e.g. 1 m tall plants (0,75 m– < 1,5 m). The figure shows that 5 m x 5 m squares are large enought to include a 1 m plant in three quadrants, but in the fourth a 10 m x 10 m square is required to include such a plant. The quadrat size for 1 m tall plants is therefore four contiguous, nested, 10 m x 10 m squares, i.e. one square of 20 m x 20 m with an area of 400 square metres. The procedure is repeated to determine a suitable quadrat size for each height class and if required also for standing dead and fallen dead plants. The results are entered in the small table in the top left hand corner of the field sheet as shown in Fig. 2. Only the length of one side of a test quarter is entered in the table under the headings "Test dimensions" and "Quadrat Dim". The latter is a repetition of the dimension for the largest test quarter.

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Quadrat dimensions

Height class (m)	Quadrat Dim.	Quadrat Area	Test dimensions 1	2	3	4	Remarks
6+	25		15	–	25	–	
4-5	–		–	–	–	–	
3	25		25	–	10	15	
2	10		10	10	5	5	
1	10		10	5	5	5	
0,5	10		10	5	5	10	
† standing							
† fallen							

Quadrat No. 84

Date: 76/3/9

Surveyor BJC & PJN

Species	Code	Growth form	Stem dia.cm	Canopy diameter (dm) at height intervals 0,5m	1m	2m	3m	4-5m	6+	Remarks
	SECVIR S			2						
	ACANIGY			3	10	18				
	ACANIGY			2	10	10				
	ACANIGY			4	12	1				
	ACANIGS			6	1					
	ACANIGS			2						
	ACANIGS			5	13	999				
	EHRRIGS			10	4					
	ACANIGY			4	10	15	6			
	COMIMBB	30						10	30	6m tall

Fig. 2. Example of a field sheet used for recording structure by the Variable Quadrant Plot. The figures under "Test dimensions" each show the length of one side of a test square; those under "Quadrat Dim" one side of the largest test square. The actual length of one side of the final quadrat is twice the figure under "Quadrat Dim".

For each individual of a height class, occuring in the quadrat for that height class, one line on the field sheet shown in Fig. 2 is completed as follows:

Column 1: The collector's number or other reference where the species name is unknown.

Columns 2–7: The species name in code form, e.g. the first three letters of the generic name, followed by the first three letters of the specific epitheton (cf. Walker, Ross and Beeston 1973).

Column 8: Code for growth form, e.g. it is practice to use "B" for Tree Form (Boomvorm), "Y" for Light Shrub (Ylstruik), "S" for Bushy shrub (Struik), "D" for Standing Dead and "L" for Fallen Dead.

Columns 9–11: Stem diameter in cm if stem diameter is equal to or greater than 10 centimetre.

Columns 12–29: Each subsequent group of three columns is for recording canopy diameter, in decimetre, at a different

height level. The diameter recorded should give a realistic picture of the canopy regime at that height interval; neglegible extremes are ignored. Canopy diameter columns are not completed for dead individuals. Dead wood on live plants often contribute strongly to vegetation structure for prolonged periods, e.g. one or two seasons between burns. Sometimes such wood is only removed with the next burn to be replaced immediately by dead wood resulting from the burn. Information on such dead wood, coupled with floristic and physiographic data may assist in discerning fire-induced structural phases of potentially similar structural types. Dead wood protruding above a live coppicing canopy is therefore recorded in code form as a "canopy diameter" of "999" at each of the higher altitudes at which it occurs.

A computer programme to process the data thus recorded was written by Miss B. Weisswange* and Tables 1–3 are examples of the main results obtained per stand. In Table 1 it may, e.g. be seen that at a particular site the quadrat size for 4 m–5 m tall individuals was 900 m^2 and in this quadrat 21 such individuals were encountered. The total number of individuals taken into consideration in all subsampling units, irrespective of height, was 65.

Table 1

Example of printout showing Quadrat sizes for individuals of different heights at one particular sampling unit

Height of individuals	Quadrat dimentions (m)	Quadrat surface (m^2)	Number of individuals
6m+	30 x 30	900	7
4–5m	30 x 30	900	21
3m	20 x 20	400	8
2m	30 x 30	900	13
1m	20 x 20	400	7
0,5m	20 x 20	400	9
Total			65

Table 2 shows that total canopy regime at the 3 m level is 25% of the area. To this figure of 25 the single stemmed form contributed 11, the light shrub form five and the bushy shrub form nine. Plants of 4 m–5 m height contributed most to canopy regime at the 3 m level, contributing

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Table 2

Example of printout for one particular sampling unit, showing percentage canopy regime of woody plants at different height levels and contribution towards these percentages by different growth forms and individuals of different heights

Height level	Percentage canopy regime									
	Total	Growth form			Height of individuals					
		B	Y	S	6m+	4–5m	3m	2m	1m	0,5m
6m+	2,42	1,59	0,83	0,00	2,42	0,00	0,00	0,00	0,00	0,00
4–5m	21,54	10,19	7,97	3,38	11,28	10,26	0,00	0,00	0,00	0,00
3m	25.29	10.59	5,59	9,12	5,96	17,81	1,52	0,00	0,00	0,00
2m	16,78	1,59	3,34	11,85	1,45	9,91	3,77	1,64	0,00	0,00
1m	8,13	0,01	0,89	7,24	0,57	2,77	1,67	2,48	0,65	0,00
0,5m	5,74	0,01	0,35	5,39	0,14	1,33	1,04	1,32	0,92	0,99

18 to the total figure of 25, followed by plants taller than 5 m, which contributed six to the total at 3 m level. Three metre plants contributed only 1,5% at the 3 m level.

From Table 3, the density of 4 m–5 m tall plants may be read as 233

Table 3

Example of printout for one particular sampling unit, showing density of woody plants of different height and growth form

Height of individuals	Density (individuals per hectare)			
	Total	Growth form		
		B	Y	S
6m+	78	33	44	0
4–5m	233	100	33	100
3m	200	0	0	200
2m	144	0	0	144
1m	200	0	50	150
0,5m	225	0	75	150

individuals/ha of which equal amounts of 100 each are trees and bushy shrubs and only 33 are light shrubs.

The computer programme also breaks the aforementioned information plus total projected canopy cover down into contributions to the data by different species and different combinations of species, growth form and plant height. Minor tables printed out deal with: (a) number of individuals of different species, growth forms and heights with purely dead wood protruding into higher levels than that occupied by the live

canopy; and (b) density of standing and fallen dead individuals per classes of stem diameter.

Three investigating teams have to date described 600 sites in all major vegetation types in the KNP at 6–8 sites per team per day, including the technique described here, a Braun-Blanquet type analysis of grasses and forbs, a soil profile description and general habitat data. A team comprised a research officer, a skilled technician and 3–4 unskilled labourers. Data is still being collected and processed and it will be some time before the results are available.

A Variable Quadrant Plot (V Q P) such as described here need not necessarily accurately represent an area much larger than itself. Owing to the procedure for determining quadrat size the structure described in the quadrat is, or closely approximates, one in which a large animal may find itself freely immersed. If within one structural type, conceived as such at a courser (smaller) scale, the procedure described here yields essentially different descriptions, these differences matter because they may be experienced as differences by large animals whatever the type and scale of pattern involved (cf. Kershaw 1964). It is of consequence to know, e.g., that within a floristic type such structural differences exist. There are nevertheless areas in the KNP where one would by informal inspection expect quadrats, of a sufficient size to smooth out detailed large scale pattern of little interest in the type of inventory envisaged, to show little variance. Before embarking on the present survey the performance of the technique was tested in two such areas by comparing the density calculations obtained by the V Q P with those from full counts two years previously on 0,5 ha, 1 ha and 2 ha plots. The two areas are in the following vegetation types (van Wyk 1973).

(a) Red bush-willow/mopaniveld on granite; and
(b) Shrub mopaniveld on basalt plains.

In the Red bush-willow/mopaniveld density determinations by the V Q P was compared with full counts at the same locality on two contiguous 0,5 ha plots (Table 4).

The V Q P brought a saving of 89%, 89%, 91% and 95% on the number of individuals counted in the four height classes respectively as compared with counts on a one ha plot. Yet densities obtained for the various height classes in the V Q P were for all intent and purpose the same as those obtained by full counts on either of the two 0,5 ha plots or the two 0,5 ha plots combined, namely: 30–50 individuals per ha for taller than 5 m plants; approximately 100 per ha for 4 m–5 m plants; and 200–250 per ha for each of the height classes below 4 metre.

In the Shrub Mopaniveld only the one m height class was considered for the test. The V Q P density estimate was compared with counts on four 0,5 ha plots in nearby vegetation with visually similar structure (Table 5). Density was approximately 600 individuals per ha on two of the 0,5 ha plots and 900–1 000 per ha on the other two 0,5 ha plots. With a saving of 97% on the number of individuals counted on one ha and of 96% on the area investigated, the nearby V Q P density estimate

differed only 7%–9% from the densities for the two 0,5 ha plots with 600 individuals per hectare.

Table 4

Comparison between density calculations by Variable Quadrant Plot on the one hand and by full counts on two 0,5 ha plots on the other, in Red bush-willow/mopaniveld

Height class	Variable Quadrant Plot		Complete counts (Individuals per ha)		
	Individuals counted	Individuals /ha	0,5 ha plot no 1	0,5 ha plot no 2	plots no 1 and 2 comb.
5m	8	32	48	38	43
4–5m	11	122	102	106	104
3m	20	222	176	206	191
2m	20	222	238	234	236
1m	10	250	236	238	237
Total	69	848	800	822	811

These two empirical tests strongly suggest that the V Q P accurately represents considerably larger areas containing them where very course pattern, of consequence in habitat description, is absent.

Table 5

Comparison between density calculations in Shrub Mopaniveld for 1 m height class by Variable Quadrant Plot (V Q P) on the one hand and counts on four 0,5 ha plots on the other

V Q P			Complete counts on 0,5 ha plots (individuals per ha)			
Plot area ha	Individuals counted	Individuals /ha	No 1	No 2	No 3	No 4
0,04	23	575	638	618	890	978

Acknowledgements

Drs J. W. Morris and G. K. Theron and messrs J. Bredenkamp, P. J. Nel, A. L. F. Potgieter and N. van Rooyen made useful comments and suggestions during field trials of the technique.

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