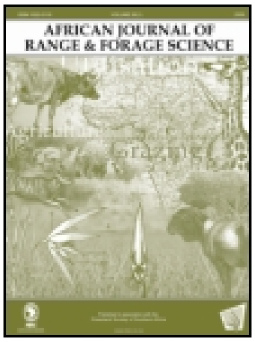

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Use of Braun-Blanquet data for the assessment of veld condition and grazing capacity in grassland

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Abstract

Braun-Blanquet vegetation surveys are easier and quicker to undertake than point surveys. This paper reports on assessment of veld condition and calculation of grazing capacity of five plant communities of the *Ea* land type of the northeastern Orange Free State using Braun-Blanquet data. Veld condition scores were obtained by substituting Braun-Blanquet cover-abundance values for point cover values as required by the ecological index method. Grazing capacity was calculated using published procedures. Results indicated that grazing capacities (0.2–0.3 LSU ha^{-1}, mean = 0.2) fall into the range of current recommendations, and that the condition of the five communities can be classified as fair. This method shows promise for application in the grassland biome for the assessment of veld condition and the estimation of grazing capacity.

Introduction

Stocking rate is probably the single most important element in determining sustainability of animal production from natural veld. The need for veld condition assessment and simultaneous determination of grazing capacity cannot be overemphasized for the sustained use and management of the vegetation of South Africa. Much research has been devoted to the subject of veld condition assessment and grazing capacity (Foran *et al.* 1978; Vorster 1982; Mentis 1983; Willis & Trollope 1987; Danckwerts & Teague 1989).

Research has mainly been concentrated on the grasslands of the eastern Cape and Natal. Tainton (1988) considered a variety of veld condition assessment techniques. Many techniques have inadequacies while some are more applicable to certain areas than to others. As a result, it was decided to recommend only one specific method for each biome. The method recommended for the grassland biome is similar in principle to that of Vorster (1982) (used in karroid vegetation), but has additional species groups to accommodate Increaser Ia and Ib species (Heard *et al.* 1986).

Heard *et al.* (1986) compared five methods of assessing veld condition and found that by using only a limited number of key species to calculate an index of veld condition, a considerable degree of precision could be achieved. These responsive key species provide an indication of the past grazing pressure (Hardy & Hurt 1989) but do not necessarily indicate the grazing potential of an area unless a direct linear relationship exists between veld condition and grazing capacity. Barnes *et al.* (1984) calculated grazing capacity by relating it to veld composition. They divided species encountered in botanical surveys into four palatability classes, each of which was allocated a weighting in order to give the highest correlation between weighted proportional species composition and estimated mean grazing capacity. A deficiency of the data base used by Barnes *et al.* (1984) is that the relative quantities of herbage, which determine amongst other things the grazing capacity, were not measured. According to Hardy & Hurt(1989), this method provides an index of veld condition which is insensitive to changes in species composition brought about by grazing intensity. It therefore does not have potential as a technique for monitoring changes in veld condition. The key species approach, whereby species responsive to the grazing impact are used in the calculation of a veld condition index (VCI), appears to have the greatest potential for indexing veld condition (Hurt & Bosch 1991).

No information, or very little, exists on the vegetation and veld condition of the northeastern Orange Free State. Existing Braun-Blanquet data, initially gathered to identify and classify plant communities (Eckhardt *et al.* in press), were used to assess the condition and grazing capacity of these grassland communities. Due to extreme community heterogeneity, communities of the hills and floodplains were excluded from this study and only data from the plains are presented. The vegetation of the first two terrain units includes woody species, and no ecological grouping system could be found for this growth form. Furthermore, no benchmarks for these terrain units could be identified since the vegetation as a whole was found to be in a relatively badly disturbed state.

Westfall *et al.* (1983) made use of Braun-Blanquet data to assess the condition of sour bushveld. These workers determined canopy cover-abundance and basal cover to facilitate veld condition assessment. The aim of this study was to assess the condition of, and to calculate the grazing capacity of some plant communities in the *Ea* land type of the northeastern Orange Free State using existing Braun-Blanquet data. Vegetation surveys using the

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Braun-Blanquet method are more cost-effective than point surveys. If veld condition and grazing capacity can adequately be estimated from existing community composition data, then a valuable management tool will become available to grassland scientists.

Procedure

One of the prerequisites of the ecological index method (EIM) is the identification of veld benchmarks (VBM) (Vorster 1982) which represent areas of veld that are in optimum condition for sustained livestock production (Tainton 1981). Vorster (1982) defined a benchmark as representing a community in the best known condition in the area. In this study no benchmarks were available as they were not selected during the field survey.

The plant communities of the plains (communities 2.1.1, 2.1.2, 2.2.1, 2.2.2, and 2.2.3, Table 3 of Eckhardt *et al.* in press) cover more than 60% (120 000 ha) of the *Ea* land type, and were used in this study (renumbered 1 to 5, respectively). The communities are represented by 63 relevés (refer to Table 3) which were randomly stratified on different terrain types (Anon. 1984; Eckhardt *et al.* in press). In each relevé of 100 m^2, total floristic composition was recorded and the cover of each species was estimated by using the Braun-Blanquet cover-abundance scale (as used by Werger 1973, Table 1).

Table 1 Mean percentage cover and percentage cover ranges for the cover-abundance scale of Braun-Blanquet (1932), as modified by Werger (1973) and adapted by Vorster (1980)

Cover-abundance scale	% cover ranges	Mean % cover
r, +	<1	1
1, 2m	1.0 – 5.0	3
2a	5.1 – 12.0	9
2b	12.1 – 25.0	19
3	25.1 – 50.0	38
4	50.1 – 75.0	63
5	75.1 – 100.0	88

Grass species from the relevant communities were divided into ecological groups (Trollope *et al.* 1990; Van Oudtshoorn 1991), *viz.* decreaser species (decrease in abundance under mismanagement), increaser I species (increase in abundance when veld is underdefoliated), increaser IIa and IIb species (increase in abundance when veld is lightly to moderately overstocked), and increaser IIc species (increase in abundance when veld is heavily overstocked). Data derived from the *C* land type (Bosch & Janse van Rensburg 1987; Janse van Rensburg & Bosch 1990) and a general species list indicating the ecological status of each species (Van Oudtshoorn 1991) were used to classify the species into the different categories (Table 2). Since the *C* land type is very similar to the *Ea* land type in both topography and species composition the application of the above data is effective.

Table 2 Classification of grass species from the *Ea* land type of the northeastern Orange Free State into ecological groups (after Vorster 1982 and Heard *et al.* 1986)

Species category	Species	Weighting
Increaser I	*Brachiaria serrata*	7
	Harpochloa falx	
	Hyparrhenia hirta	
	Hyperthelia dissoluta	
	Melica racemosa	
	Trachypogon spicatus	
	Tristachya leucothrix	
Decreaser	*Cymbopogon plurinodis*	10
	Digitaria eriantha	
	Eragrostis capensis	
	E. racemosa	
	Helictotrichon turgidulum	
	Setaria sphacelata	
	Themeda triandra	
Increaser IIa + b	*Aristida junciformis*	4
	Elionurus muticus	
Increaser IIc	*Aristida bipartita*	1
	A. congesta	
	A. diffusa	
	Eragrostis curvula	
	E. plana	
	Heteropogon contortus	
	Microchloa caffra	
	Trichoneura grandiglumis	

Weightings were allocated to each ecological group [decreaser = 10, increaser I = 7, increaser IIa and b = 4, and Increaser IIc = 1 (Vorster 1982)]. The average percentage cover of each ecological group for each relevé was obtained by conversion of the Braun-Blanquet cover-abundance values to their class mid-point values following Vorster (1982). The cover-values were then multiplied by the corresponding species category weightings, and the sum of these products provided a VCI for each relevé. A benchmark was selected from all relevés within a certain community by considering those relevés with the highest VCI (i.e. concomitant with the highest values represented by the decreaser group). A condition score (VCS) was calculated for each community using the mean VCI of the relevés in that community expressed as a percentage of the VCI of the relevant benchmark. If the benchmark VCI is assumed to represent the current potential maximum index for that community, the condition of a community can be described (relative to its benchmark) as very poor, poor, fair, good, or excellent (Vorster 1982).

The condition scores calculated for each community were then used to determine the grazing capacity for that community after (Danckwerts & Teague 1989):

$$GC = -0.03 + 0.00289X_1 + 0.000633(X_2 - 419.7)$$

where GC = grazing capacity (expressed as LSU ha^{-1}); X_1 = % veld condition score; and X_2 = mean annual rainfall (750 mm).

As the benchmark of Community 1 had the highest VCI (1 067.0, Table 3) the VCIs of the benchmarks of the remaining communities were expressed as a percentage of this value. The derived values were then used in the above formula to calculate the grazing capacity of each benchmark. If the VCS of each benchmark (100%, Table 3) were applied in the above formula, all benchmarks would have the same grazing capacity, which seems unrealistic. Thus, the above formula was only used to calculate the grazing capacityof each benchmark, while the grazing capacity of each relev in a specific community was calculated as a proportion of that of the benchmark (Danckwerts & Teague 1989). The grazing capacity of a community was calculated as the mean grazing capacity of all the relevs sampled within that community.

Table 3 Mean contributions and standard deviations (*SD*) of species categories to the veld condition indices (VCI) of five communities and their respective benchmarks (VBM) from the *Ea* land type of the northeastern Orange Free State. Community veld condition scores (VCS) and grazing capacities (GC) are calculated from these data

Community	1	VBM	2	VBM	3	VBM	4	VBM	5	VBM
Relevés community^{-1}	8		6		9		31		9	
Decreaser %	23.8	72.0	27.8	48.0	26.7	46.0	29.8	91.0	22.2	44.0
SD	25.7		17.0		12.9		21.7		20.3	
Increaser I %	31.9	41.0	12.5	13.0	7.0	9.0	1.5	1.0	0.2	0.0
SD	22.4		15.4		12.3		3.8		0.4	
Incr. IIa + b %	29.6	12.0	2.8	0.0	23.1	41.0	1.1	3.0	16.8	38.0
SD	22.0		3.3		26.0		15.8		23.8	
Incr. IIc %	21.9	12.0	20.3	0.0	32.9	9.0	44.8	7.0	64.9	22.0
SD	17.4		15.3		23.7		26.4		42.5	
VCI	601.0	1067.0	397.5	571.0	441.0	696.0	408.5	936.0	355.8	614.0
SD	277.1		105.3		150.0		207.0		218.4	
VCS (%)	56.3	100.0	69.6	100.0	63.3	100.0	43.7	100.0	57.9	100.0
SD	26.0		18.4		21.5		22.1		35.6	
GC (LSU ha^{-1})	0.264	0.468	0.233	0.334	0.233	0.368	0.190	0.433	0.200	0.346
SD	0.122		0.062		0.079		0.099		0.123	
Condition	Fair		Good		Good		Fair		Fair	

Results and Discussion

Vernonia oligocephala-Trachypogon spicatus grassland

This community (Community 2.1.1 of Eckhardt *et al.* in press) occurs on low to moderate slopes. Soils are dry, rocky and shallow with a low clay content (Eckhardt *et al.* in press).

Veld condition

The benchmark has a relatively high VCI value (1067,0), which can be ascribed to a high average percentage cover (72%) by the decreaser group (Table 3). The contribution of increaser IIc species to the VCI is typically low, which is characteristic for a benchmark representing veld under well-managed conditions. A high figure for increaser I species stresses the fact that the community as a whole is slightly under-utilized, which favours grass species such as *Hyparrhenia hirta*, *Trachypogon spicatus* and *Brachiaria serrata*. A standard deviation of 25.7% relative to the mean (23.8%) for the decreaser group indicates high variation in decreaser species composition between different relevs. This deviation is reflected in the standard deviation of the VCS and grazing capacity. Theoretically a community should have the same potential VCS and grazing capacity, as environmental factors conditions are fairly uniform and species composition should consequently be similar. The high variation in VCS and grazing capacity within this community is due to different management strategies being applied within this community on different farms or within paddocks. The community as a whole, however, is in fair condition.

Grazing capacity

The grazing capacity of this community was the highest of all communities studied (Table 3). The relatively high standard deviation indicates differences in grazing capacity within the community. Localized overgrazing has lowered the grazing capacity of the community, whilst judicious management in other areas has maintained a relatively high grazing capacity. The average grazing capacity for the eastern highveld, including the areas Vrede, Memel, and Warden, is estimated at 0.25 LSU ha^{-1} (4 ha LSU^{-1}) (Resource Section, pers. comm., Highveld Region, Department of Agricultural Development, Private Bag X804, Potchefstroom, 2520 Republic of South Africa), which is slightly lower than the 0.264 LSU ha^{-1} calculated for this community. Areas in good condition should serve as benchmarks as a comparison with less well-managed areas. Management practices can then be adapted according those applied to veld in good condition. When the grazing capacity of this community is compared with that of the benchmark it is clear that this grassland typeas a whole will have to be improved drastically.

Harpochloa falx-Trachypogon spicatus grassland

This community (Community 2.1.2 of Eckhardt *et al.* in press) occurs on low to moderate slopes, but the soils are relatively moist, rocky, and shallow with low clay content (Eckhardt *et al.* in press).

Veld condition

The VCI of 397.5 suggests that this community is in a good condition (Table 3). The figures, especially for increaser II species, are relatively high compared to those of the veld benchmark, resulting in a relatively high VCS for the community. This is, however, misleading since relatively high values of the increaser group are normally indicative of veld in poor condition. The benchmark contains only decreaser and increaser I species, while other relevés in the community are comprised predominantly of decreaser and increaser I species, and to a lesser degree increaser II species. The relatively small standard deviation (105.3) of the VCI (397.5) (Table 3) indicates uniform species composition within this community. The reason for this is that the veld of this community is possibly relatively stable and does not change dramatically under different management strategies.

Grazing capacity

The grazing capacity is relatively high and constant throughout the community, but can still be improved (Table 3). Despite a higher soil moisture content relative to the *Vernonia oligocephala - Trachypogon spicatus* grassland (Community 1) (Eckhardt *et al.* in press), the grazing capacity of the latter is higher than that of this community. This can be ascribed to a lower vegetation cover, with a subsequent reduction in the amount of plant material available for utilization.

Tristachya leucothrix-Elionurus muticus grassland

This grassland community (Community 2.2.1 of Eckhardt *et al.* in press) is distinguished from Community 4 by a higher percentage of surface rock and lower soil moisture regime (Eckhardt *et al.* in press).

Veld condition

The condition of this grassland community is classified as good. The standard deviation in the cover of decreaser species is low, indicating a small degree of variation between the relevés due to the contribution made by the decreaser species (Table 3). The benchmark displays a high value (41.0%) for the increaser IIa and IIb category, indicating light to moderate overgrazing of the vegetation of this community. From Table 3 it can be seen that the relevés of this community differ strongly with respect to their composition of increaser IIa and b species. Thus moderate overgrazing can be ascribed to overstocking and should therefore be prevented by applying the correct stocking rates.

Grazing capacity

Throughout the community a relatively high grazing capacity (0.233 LSU ha^{-1}) was indicated (Table 3). This is close to the figure of 0.250 LSU ha^{-1} recommended by the Resource Section of the Highveld Region (pers. comm.). The *Tristachya leucothrix -Elionurus muticus* community together with Community 2 has the second highest grazing capacity of all communities in the *Ea* land type.

Heteropogon contortus-Eragrostis plana grassland

This community (Community 2.2.2 of Eckhardt *et al.* in press) occurs on gentle slopes and plains with wetter soils than the former community (Eckhardt *et al.* in press).

Veld condition

Although this community has the highest figure for the decreaser group, increaser IIc species are also strongly represented. The average condition for the community is described as fair (Table 3). Species of the increaser III group are strongly represented. High standard deviations for ecological groups indicate large differences in the composition and thus the condition of this community as a result of different management strategies being applied. The high subtotal (91.0%) for the benchmark decreaser group indicates to what extent the condition of this community can be improved (Table 3).

Grazing capacity

Of all the communities in the *Ea* land type, the *Heteropogon contortus - Eragrostis plana* community has the lowest grazing capacity (Table 3). Since grazing capacity is dependent on vegetation biomass, shortly-grazed areas in many parts of this community have a negative influence on the grazing capacity. This community has the potential of carrying twice as many cattle or sheep per unit area as it does at present provided that it is well-managed. This is based on a comparison of the mean grazing capacity for the community with that of the benchmark (Table 3). Lower lying areas have more clayey and moist soils and are subsequently capable of maintaining relatively high grazing capacities. The largest area of the *Ea* land type is covered by this grassland community (Eckhardt *et al.* in press); thus by increasing its grazing capacity, the grazing capacity of the *Ea* land type as a whole will also be increased.

Themeda triandra-Eragrostis plana grassland

This grassland type (Community 3 of Eckhardt *et al.* in press) occurs on low-lying areas with deep moist soils (Eckhardt *et al.* in press).

Veld condition

This grassland is in fair condition and has the lowest VCI with respect to the other communities (Table 3). Increaser I species are poorly represented, while Increaser IIc species predominate. A high standard deviation for all ecological categories, as well as for the VCI and VCS, illustrate the effect of different management practices applied in different areas on the vegetation. Some parts are overutilized, whilst others are lightly to moderately utilized, the latter areas being characterized by a greater proportion of decreaser species. The benchmark contains a high proportion of species of the increaser IIa and b category, indicating the influence of moderate overgrazing. Normally, this relevé would not have been selected as a benchmark, but was chosen because of its high cover of decreaser species and VCI, as well as low increaser I and IIc cover.

Grazing capacity

There is a considerable variation in the grazing capacity within the community (Table 3). This corroborates the fact that management strategies differ within the community. Grazing capacities of the different relevs vary from 0.044 to 0.346 LSU ha^{-1}. These figures suggest injudicious management applied to the study area. With the application of proper management strategies, the grazing capacity of this community can be increased to a considerable degree.

Conclusion

The greatest problem associated with the assessment of veld condition was the allocation of species to the correct ecological groups. Most of the research concerning this aspect has taken place in the eastern Cape and Natal resulting in available lists of species indicating their ecological status for these areas. However, these lists cannot always be extrapolated to other grassveld types, since the ecological status of a particular species may vary from one vegetation type to another. In this study information applicable to the northeastern Orange Free State (Janse van Rensburg 1987) and the latest list of grass species of South Africa (Van Oudtshoorn 1991) was used for this purpose.

The second problem encountered was the allocation of weightings to each ecological group. The values used in this study are the same as those used by Vorster (1982). Since these weightings determine the accuracy of the EIM, it will be necessary to quantify these values for each ecological group in different areas by characterizing them in terms of grazing values, animal production and soil conservation characteristics (Vorster 1982).

The selection of benchmarks also proved difficult. Well-managed sites were not specifically selected as benchmarks. However, veld in good condition was generally surveyed for vegetation mapping/classification purposes. Benchmarks had therefore to be selected by choosing relevés which represented the best veld available. This procedure is supported by the fact that these relevés have the highest grazing capacities of all relevés used in the analyses. The selected benchmarks are optimal only under present conditions, but may not necessarily be used in the long term. As the general condition of the veld may improve under good management over time, new benchmarks will have to be selected from time to time. This ensures that prevailing veld condition will always be compared with sites in a better condition.

The present overall condition of the communities can be classified as fair. The respective grazing capacities of the different communities compare well with the overall grazing capacity of 0.250 LSU ha^{-1} for the northeastern Orange Free State. The average grazing capacity of all the communities together is 0.224 LSU ha^{-1}, which is slightly lower than the recommended norm.

It must be stressed here that this method was only used to test the suitability of Braun-Blanquet data to determine veld condition and grazing capacity. No real grazing capacity values, determined on a scientific basis, are available for the region, and the values obtained in this study therefore can be applied in the short term. It may be argued that the seven-class cover-abundance scale is not adequate for veld condition assessment purposes, because the class ranges are too wide. We consider, however,that the results obtained confirm the adequacy of the scale.

The EIM conforms to most of the requirements for successful veld condition assessments as set out by Humphrey in 1962 (Vorster 1982). These requirements include accuracy, speed of evaluation of extensive areas, minimum decisions required, objectivity, and ecological basis. It is, however, necessary to know all grass species occurring in the study area. This method has the advantage that botanical composition and cover are used as one indicator instead of considering each separately, which means that fewer calculations are required which makes the method more attractive to land users. Existing Braun-Blanquet data could in the future be applied to the assessment of veld condition and determination of grazing capacities. This will result in more efficient utilization of time required for plant surveys as maximum information is generated from the data.

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