Use of veld condition assessment to set objectives and targets for an ISO 14001 environmental management system for Vaalbos National Park

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ISO 14001 is a procedural approach to environmental management, based on a philosophy of continual improvement. The planning element of ISO 14001, requires that environmental objectives and environmental targets are set to achieve the goals of the environmental policy. The stocking of game in Vaalbos National Park, is an aspect which impacts on the environment. Veld condition assessment, is essential to set objectives and targets for the management of the stocking rates in the park. Regular monitoring and a flexible management style is necessary to accommodate the fluctuation in veld condition caused by varying climatic conditions and other factors. This ties in well with the requirements of ISO 14001, an environmental management system, which requires that short and long term objectives and targets be set for managing an environmental aspects (e.g. veld utilisation) and environmental impacts (e.g. loss of biodiversity) that these targets are regularly monitored and improved upon.

Key words: environmental management system, ISO 14001, veld assessment, Vaalbos National Park, stocking rates, carrying capacity, wheel point method.

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Introduction

Environmental management can be described as the management and control of all aspects (and activities) of an organisation which could impact (positively or negatively) on the environment (Van Rensburg 1996).

The ISO 14001, a procedural environmental management system, is a tool which an organisation can use to manage its environmental aspects and impacts (SABS ISO 1996a). The following elements are included in the environmental management system (SABS ISO 1996a):

- commitment and policy,
- planning,
- implementation and operation,
- checking and corrective action and
- management review.

The philosophy of ISO 14001 is one of continual improvement of the environmental management system. Continual improvement results in the improvement of the standard and reliability of environmental management within the organisation. As part of the planning element of ISO 14001, objectives and targets are set by the organisation to meet the goals and objectives of the organisations environmental policy (SABS ISO 1996b).

An environmental management system (EMS) is therefor a tool, which can be used

to manage the environmental aspects and impacts of Vaalbos National Park (a small national park) and improve its environmental performance (Bancroft 1998). Biota management as one of the aspects of Vaalbos National Park, includes the stocking of game, managing of game populations and the managing of the veld through burning or grazing. All of these activities could impact on the environment. It is therefore necessary that objectives and targets be set, which will enable the management of the environmental impacts of biota management.

Bancroft (1998) found that ISO 14001 was suitable for implementation in small to medium national parks. It is accepted that Veld Condition Assessment is a tool to identify and quantify the impacts of veld utilisation. The aim of this article is to illustrate that this tool can also be used to set the objectives and targets and monitor if these environmental goals of biota management are achieved (as required by ISO 14001).

Veld management, a component of biota management, can be described as the utilisation and conservation of natural veld, without adversely affecting the vegetation (Brown 1997). This management approach has an impact on the environment, in particular the veld. To be able to manage veld effectively it is necessary to monitor the veld condition and set objectives and targets for its management (Mentis 1989; Brown 1997).

The aim of this study was to determine the veld condition and the grazing capacity of plant communities (with a woody canopy cover of < 25 %) of the Vaalbos National Park and determine the annual variation of the grazing capacity (1993–1997). The result of this empirical investigation was used to determine a benchmark for the grazing capacity of Vaalbos National Park. This benchmark could be used to set objectives and targets for stocking rates as part of biota management for the planning element of an environmental management system for Vaalbos National Park (Bancroft 1998).

Veld condition refers to a functional characteristic of the veld, for example food production or palatability. The assessment of veld condition, if repeated at intervals, may provide a descriptive measure of direction and rate of change of the veld in response to current management practises (Brown 1997).

Grazing capacity can be defined in terms of the number of animals that can be maintained on an area without deterioration of vegetation or soil (Brown 1997). The GRAZE veld assessment model (Bredenkamp 1990), was used to determine a grazing capacity benchmark. This model was successfully used by Brown (1997) in a plant ecological study and wildlife management plan of the Borakalalo Nature Reserve, in the North West Province.

Study Area

Location

Vaalbos National Park (proclaimed in 1986) is situated approximately 60 km north-northwest of Kimberley, in the Northern Cape. Vaalbos National Park consists of two sections, the largest one, the Than-Droogeveld section (18 120 ha) and Graspan/Holpan section (4576 ha). Vaalbos National Park extends from 28°25'S—28°40'S and 24°12'E—24°26'E. Bezuidenhout (1994, 1995) gives a detailed description of the vegetation of the entire Vaalbos National Park. The present study is focused on the Than-Droogeveld section (referred to as Vaalbos), because the re-introduction of animals is concentrated on this section.

Physiography and vegetation types

The landscape varies from flat to gently undulating plains, with an altitude that varies from 1011 m to 1175 m. Acocks (1988) classifies the largest part of Vaalbos as Kalahari Thornveld invaded by Karoo (Veld Type 17), while a small section along the banks of the Vaal River, consists of the False Orange

River Broken Veld (Veld Type 40). Van Rooyen & Bredenkamp (1996) describe the vegetation as part of the Savanna Biome, namely the Kimberley Thorn Bushveld.

Soils

Bezuidenhout (1994) states that the soil type varies from deep red and yellow apedal sands (Hutton and Clovelly soil forms) to shallow and stony (Mispah and Kimberley soil forms) while the soil in the north western flood plain is moderately deep and clayey (Valsrivier soil form) (Soil Classification Working Group 1991).

Climate

The rainfall, mainly during summer, is very erratic, can vary from 700 mm per year to less than 300 mm per year (July–June). The average rainfall (1986–1997) is just over 400 mm per year. Distribution of annual rainfall can also vary, from a concentration over one or two months to evenly distributed over four or five months (Fig. 1). Temperatures vary from 44 °C in summer to –4 °C in winter (Bezuidenhout 1994).

Large Herbivores

The following large herbivores occur in Vaalbos: black rhinoceros, blue wildebeest,

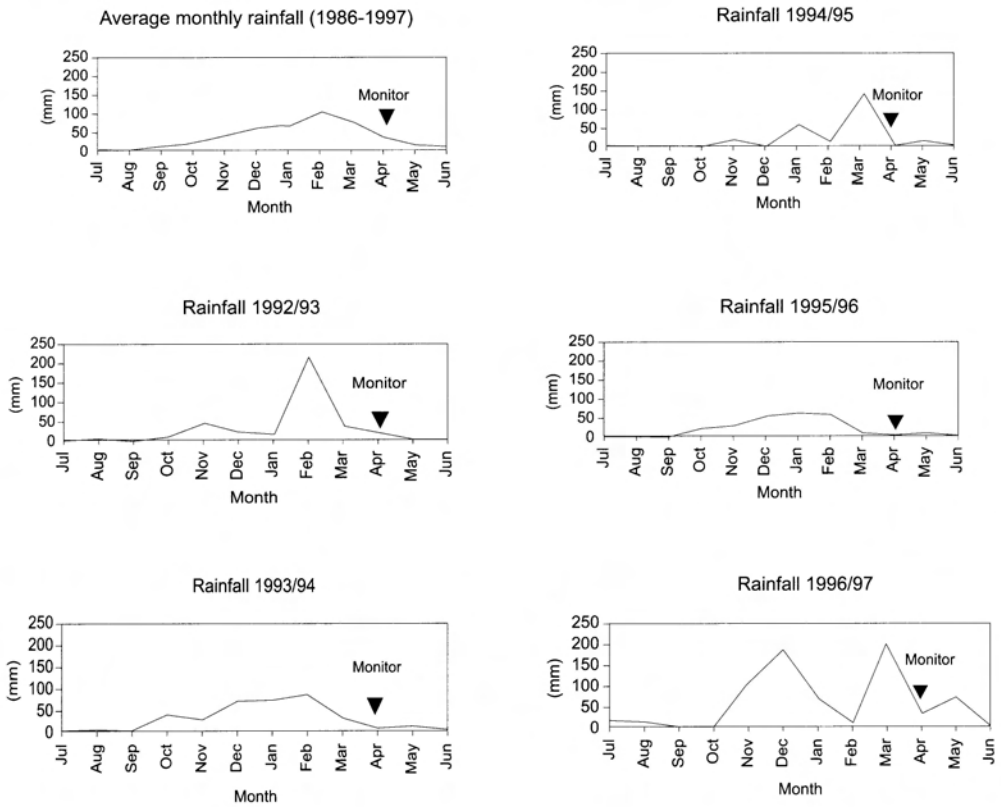

Fig. 1. Average monthly rainfall (1986 - 1997) and annual rainfall (1993 - 1997) for Vaalbos.

buffalo, duiker, eland, gemsbok, giraffe, kudu, red hartebees, roan, springbok, steenbok, tsessebe, warthog, white rhinoceros and zebra.

Black rhinoceros (introduced 1987), buffalo (introduced 1987), white rhinoceros (introduced 1992), tsessebe (introduced 1995) and roan (introduced 1996) are seen as priority species in the large herbivore management of Vaalbos. The requirements of these priority species is one of the management objectives according to which the veld is managed.

Vegetation

Bezuidenhout (1994) summarises the habitat of the eleven plant communities as follows:

1. *Schmidtia pappophoroides-Themeda triandra* Grassland of deep (>1.2 m) to moderately deep (0.3–0.8 m), well-drained sandy soil. The canopy cover of the woody component (trees and shrubs) is 5%.
2. *Grewia flava-Acacia erioloba* Woodland of deep (>1.2 m) well-drained red sandy soil of the western part of the park. The canopy cover of the woody component is 22.5%.
3. *Lycium hirsutum - Acacia erioloba* Woodland of deep (> 1.2 m) well-drained yellow sandy soil of the north-north eastern part of the park. The canopy cover of the woody component is 18%.
4. *Rhus ciliata - Tarchonanthus camphoratus* Shrubland of moderately deep (0.3 –0.8 m) sandy soil. The *Rhus ciliata - Tarchonanthus camphoratus* Shrubland is well distributed especially the shrub *Tarchonanthus camphoratus* commonly know as Vaalbos. The canopy cover of the woody component is 40%. The herbaceous layer is well developed and has a canopy cover of 53%.
5. *Acacia erioloba-Acacia tortilis* Woodland on ancient gravel filled water courses. The canopy cover of the woody component is 45%.
6. *Boscia albitrunca - Acacia mellifera* Shrubland on the isolated rocky hills. The canopy cover of the woody component is 15%. Poorly developed herbaceous layer has a canopy cover of 40%.
7. *Acacia tortilis - Acacia mellifera* Shrubland on shallow (<0.3 m) stony soil with large rocks on the soil surface. The canopy cover of the woody component is 40%.
8. *Enneapogon cenchroides - Acacia tortilis* Woodland on relative recently deposited Vaal River gravel. The canopy cover of the woody component is 35%.
9. *Pentzia incana - Acacia mellifera* Shrubland on shallow (<0.3 m) stony soil with small stones on the soil surface. The canopy cover of the woody component is 47%.
10. *Eragrostis* species - *Chloris virgata* Grassland on the moderately deep (0.3 – 0.8 m) clayey soil. The canopy cover of the woody component is 5%.
11. *Combretum erythrophyllum - Acacia karroo* Woodland on the deep (>1.2 m) alluvial soil of the banks of the Vaal River. The canopy cover of the woody component is 50%.

Method

Background

The study was conducted on the following plant communities (with a woody component canopy <25 %) as described by Bezuidenhout (1994):

Schmidtia pappophoroides-Themeda triandra Grassland (4300 ha);

Grewia flava-Acacia erioloba Woodland (1241 ha) ;

Lycium hirsutum-Acacia erioloba Woodland (3743 ha);

Eragrostis species-*Chloris virgata* Grassland (377 ha);

Rhus ciliata-Tarchonanthus camphoratus Shrubland (5379 ha).

Due to the relatively high woody component (> 25 % canopy cover) in combination with the poorly developed herbaceous layer (< 40 % canopy cover), which made a wheel point transect impractical, plant communities 5, 6, 7, 8, 9, 11 were excluded from the study.

An exception in this group is the *Rhus ciliata - Tarchonanthus camphoratus* Shrubland. Although the woody component canopy cover in this plant community is > 25 %, the herbaceous layer is well developed and a wheel point survey could be done .

Data Collection

A wheel point survey, as described by Tidmarsh and Havenga (1955), was conducted at 14 sample sites. A minimum of two sample monitoring sites per plant community were selected, care was taken to ensure these sites were representative of that community (Fig. 2).

These sample sites were marked and their positions logged with a Global Positioning System (GPS), for future reference. A fixed point photograph was also taken to add a visual reference. A sample site consisted of a 100 m transect between two fixed markers.

The "Wheel" consisted of two spoked-wheels, with each wheel having 2 marked spokes (1 per half rotation). The start of the transect was on the right side of the line between the fixed points. The "wheel" was then moved along and the nearest plant to each marked spoke was recorded until 200 points were recorded. If 200 points were not recorded by the end of the 100 m, the wheel was moved approximately 2.0 m from the line and recording continued in the direction of the starting point until 200 points were recorded. Each time the marked spoke touched the base of a plant, it was recorded as a strike. This data was used to determine the average % basal cover of the plot and when the spoke fell on a bare (minimum of 50 cm radius from spoke) area, this was recorded as a bare area. The estimated percentage tree and shrub canopy cover was also noted. Monitoring was done in the middle of April of each year.

Data Analysis

The frequency of each grass species was expressed as a percentage of the total number of plants (200) per sampling site recorded. The ecological status of each species was allocated to one of the following categories:

Decreaser (d) – A species which is dominant in good veld, but decreases when veld is mis-managed;

Increaser I (i1) – A species which is dominant in poor veld and increases with under utilisation or selective grazing;

Increaser II a(i2a) – A species which increases with light overgrazing;

Increaser II b(i2b) – A species which increases with medium overgrazing;

Increaser II c(i2c) – A species which increases with heavy overgrazing (Trollope *et al.* 1990 in Van Oudtshoorn 1991).

Fourie & Visagie (1985) and Van Oudtshoorn's (1991) classifications of ecological status of the various grass species were used to place each species in categories.

Schmidtia pappophoroides and *Eragrostis bicolor* were classified as decreasers (contrary to increaser IIa suggested by Fourie & Visagie (1985)). The reason for this is that the vegetation type at Vaalbos is not typically the *Tarchonanthus*-lime veld of the Barkly West area, but more typically Kalahari veld, with deep red sands (Bezuidenhout 1994).

These classifications were then entered into the GRAZE model (Bredenkamp 1990), together with the following information, needed by the model:

size of plant community (ha);

estimated % tree canopy cover/plant community;

estimated % shrub canopy cover/plant community;

estimated % grass canopy cover/plant community;

accessibility for game/plant community;

fire regime per plant community; and

annual rainfall(mm).

The rainfall was recorded from July – June of each year. The rainfall data from the previous year was used e.g. July 1992 – June 1993 were used for the vegetation data recorded in April 1993. Monitoring data from 1993–1997 were compared to determine any variations in veld condition and grazing capacity for Vaalbos.

Results

1. Veld Condition of plant communities

1.1. *Schmidtia pappophoroides-Themeda triandra* Grassland

The high percentage of decreaser species and low percentage of increaser IIc species (Table 1) is a clear indication that the

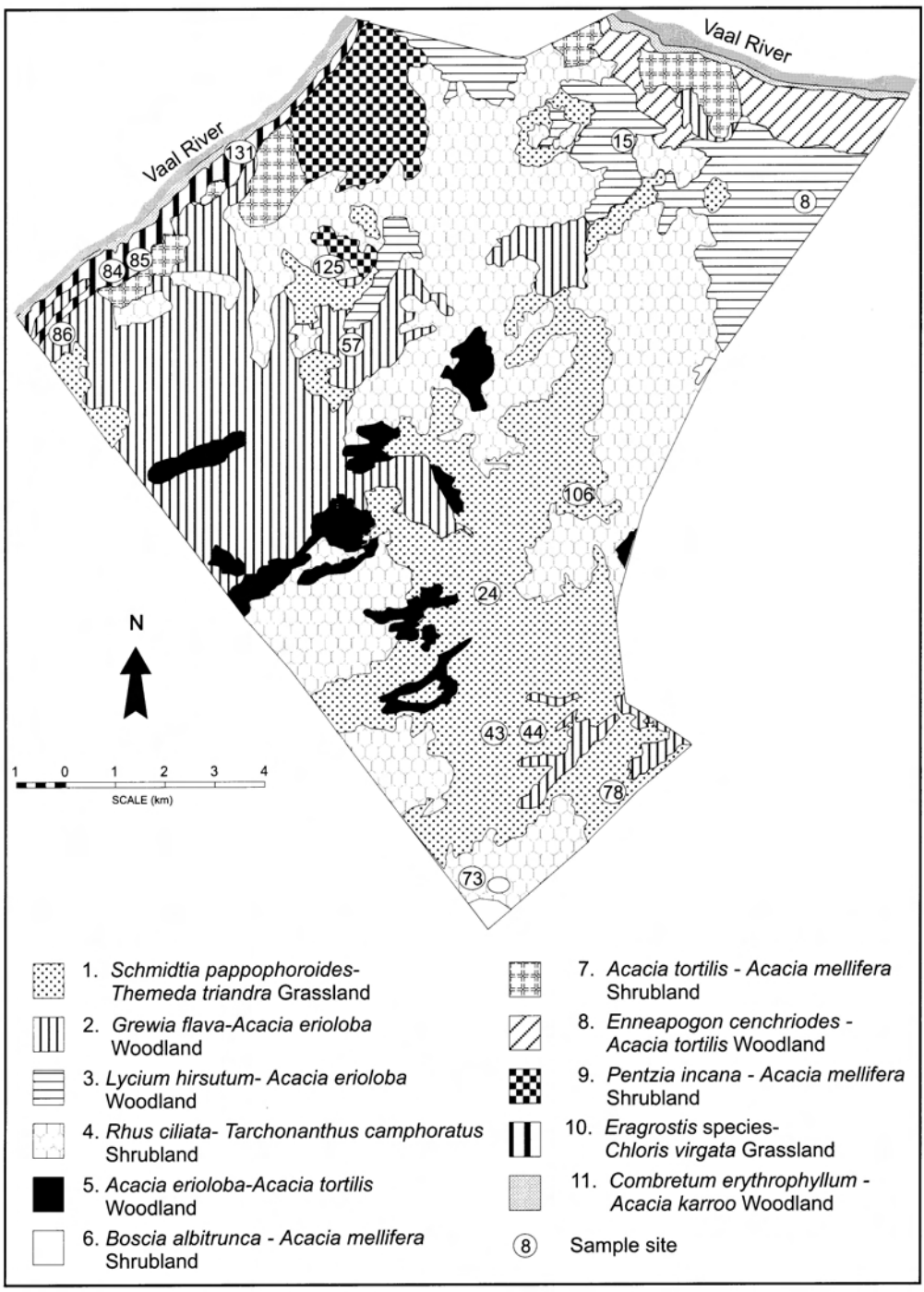

Fig. 2. Vegetation map and monitoring sample site of Vaalbos.

Schmidtia pappophoroides-Themeda triandra Grassland is in good condition. The fact that there is a variation between years can be attributed to the rainfall rather than the stocking rate (Table 1 and Fig. 1). The rainfall in 1992/93, 1994/95, 1996/97 indicated a sharp peak over February-March. This would appear to be more beneficial to the growth of decreaser grass species than the same (or higher) rainfall spread over a few months (1993/94 and 1995/96).

1.2. *Grewia flava-Acacia erioloba* Woodland

The increase in percentage of decreaser species, since 1993, indicates good veld condition (Table 2). The *Grewia flava-Acacia erioloba* Woodland does not appear to be as sensitive to rainfall, as the *Schmidtia pappophoroides-Themeda triandra* Grassland (Table 2, Fig. 1). An increase in animal use of the area (field staff observation) might account for the variation in the veld condition. Before 1995, the *Grewia flava - Acacia erioloba* Woodland was underutilised. After a later introduction of game and an increase in existing populations (especially blue wildebeest and red hartebeest), this area has been utilised more frequently by antelope.

1.3. *Lycium hirsutum-Acacia erioloba* Woodland

The *Lycium hirsutum-Acacia erioloba* Woodland appears to have followed the same tendency as the *Grewia flava-Acacia erioloba* Woodland. The high percentage of decreasers, with an increase in this percentage over the monitoring period indicates good veld condition (Table 3). The *Lycium hirsutum-Acacia erioloba* Woodland does not appear to be as sensitive to rainfall, as the *Schmidtia pappophoroides-Themeda triandra* Grassland (Table 3, Fig. 1). This community has also been prone to underutilisation before animals such as blue wildebeest, buffalo and tsessebe were introduced into the area. This also explains the variation in the veld condition as indicated in Table 3.

An increase in animal use of the area (field staff observation) might account for the variation in the veld condition. Before 1995, the *Lycium hirsutum-Acacia erioloba* Woodland was under utilised. After a later introduction of game (especially blue wildebeest, buffalo and tsessebe), these animals moved into this area.

1.4. *Eragrostis* species-*Chloris virgata* Grassland

The high percentages of increaser IIc species and low percentage of decreaser species is an

Table 1
Veld condition of Schmidtia pappophoroides - Themeda triandra *Grassland (VNP)*

	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
Total LSU (Vaalbos)	509	412	547	601	506
Decreasers %	83.9	62.1	85.3	69.9	73.2
Increasers I %	0	0	0	0	0
Increasers IIa %	12.8	21.6	8.0	15.5	12.2
Increasers IIb %	1.5	14.2	3.8	10.2	10.0
Increasers IIc %	1.8	2.1	2.9	4.4	4.6
Encroachers %	0	0	0	0	0
Bare soil %	0	0	0	0	0
Total	100	100	100	100	100

indication of excessive over utilisation (Table 4). Two of the main reasons for this are over grazing (due to higher nutrient content of clayey soil) relatively low rainfall (annual rainfall decreased, Fig. 1; Table 4).

This small (377 ha) section of flood plain, the only of its kind in Vaalbos. The soils of this area are relatively rich in nutrients. This causes a congregation of game (especially blue wildebeest, red hartebeest, springbok, warthog and zebra), in this area.

1.5. *Rhus ciliata - Tarchonanthus camphoratus* Shrubland

The *Rhus ciliata - Tarchonanthus camphoratus* Shrubland shows a high percentage of decreaser species, which increase over the monitoring period (Table 5). This is an indication that the veld is in good condition.

2. Grazing Capacity of Vaalbos

According to Brown (1997) the following should be considered before making recommendations on actual stocking rate: management objectives, knowledge of grazing capacity, veld condition, selectivity of game for different plant species or plant communities, the number of game, herd composition (age and sex).

Due to the large number of variables and unpredictable rainfall, the fixing of a benchmark should be conservative. Therefor when determining a benchmark for Vaalbos, including the following factors will ensure that the benchmark determined will be conservative:

grazing capacity during the year with the lowest rainfall, was used as a benchmark,

the area of the excluded plant communities, was not taken into account when calculating the grazing capacity.

The stocking rate recommended by the Department of Agriculture, for the Kimberley/Barkly West region, is 12 ha/LSU. Since the manipulation of game movements is more difficult than domestic stock, a more conservative grazing capacity of 16 ha/LSU (estimated by Vaalbos National Park management committee) is currently used for Vaalbos.

According to Table 6 and Fig. 3 this estimate, would appear to be fairly accurate. The grazing capacity in 1996, when the rainfall was almost at its lowest, was and 16.1 ha/LSU as determined using the GRAZE model) was chosen as the benchmark. The previous year (1995) could not used as a benchmark, due to incomplete vegetation monitoring data.

The actual stocking rate of the park has been conservative (Fig. 3) and this could be the reason why the stocking rate has had such an

Table 2
Veld condition of Grewia flava - Acacia erioloba *Woodland (VNP)*

	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
Total LSU (Vaalbos)	509	412	547	601	506
Decreasers %	69.5	67.5	88.2	80.0	81.3
Increasers I %	0	0	0	0	0
Increasers IIa %	23.7	0.0	0.0	0.0	0.0
Increasers IIb %	1.8	22.7	7.0	13.0	11.0
Increasers IIc %	5.0	9.8	4.8	7.0	7.7
Encroachers %	0	0	0	0	0
Bare soil %	0	0	0	0	0
Total	100	100	100	100	100

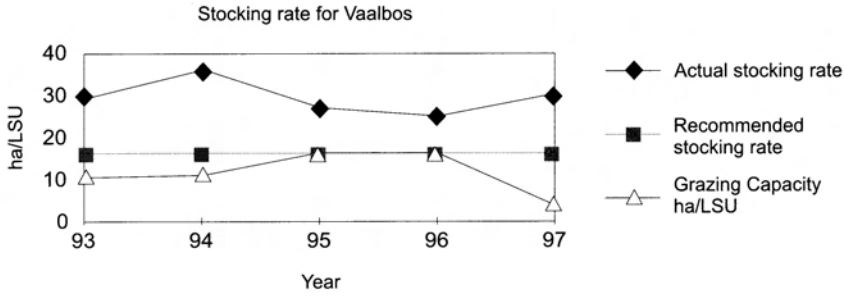

Fig. 3. Stocking rate of Vaalbos.

insignificant impact on the veld condition of the plant communities, other than the *Eragrostis* species - *Chloris virgata* Grassland.

It is important to consider the veld condition and carrying capacity of each plant community separately (Table 6). Although the average stocking rate is well within the set standards, the condition of flood plain (*Eragrostis species - Chloris virgata* Grassland) is deteriorating due to severe grazing pressure and relatively low rainfall during recent years (Table 4).

Concluding remarks

ISO 14001 requires that an organisation identifies and quantifies significant environmental aspects and impacts, sets objectives and targets to manage these environmental aspects and impacts. Monitoring and assessment of the veld condition of the different plant communities in Vaalbos, is critical to estimate the grazing capacity for the park, and in so doing set objectives and targets in order to achieve veld management goals. An effective monitoring method is therefor needed for both veld condition assessment and grazing capacity assessment.

Table 3
Veld condition of the Lycium hirsutum - Acacia erioloba *Woodland (VNP)*

	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
Total LSU (Vaalbos)	509	412	547	601	506
Decreasers %	64.3	60.5	88.5	81.2	81.2
Increasers I %	0	0	0	0	0
Increasers IIa %	31.0	27.8	5.7	9.8	7.0
Increasers IIb %	2.2	5.2	5.0	6.5	8.5
Increasers IIc %	2.5	6.5	0.8	2.5	3.3
Encroachers %	0	0	0	0	0
Bare soil %	0	0	0	0	0
Total	100	100.0	100.0	100.0	100

Table 4
Veld condition of the Eragrostis species - Chloris virgata *Grassland (VNP)*

	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
Total LSU (Vaalbos)	509	412	547	601	506
Decreasers %	9.5	1.8	3.5	11.8	6.5
Increasers I %	0	0	0	0	0
Increasers IIa %	0.0	0.5	0.0	0.0	0.0
Increasers IIb %	15.7	47.0	54.5	24.5	20.7
Increasers IIc %	74.8	50.7	42.0	63.7	72.8
Encroachers %	0	0	0	0	0
Bare soil %	0	0	0	0	0
Total	100	100	100	100	100

Table 5
Veld condition of the Rhus ciliata - Tarchonanthus camphoratus *Shrubland (VNP)*

	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
Total LSU (Vaalbos)	509	412	547	601	506
Decreasers %	62.5	[a]	[a]	77	74
Increasers I %	0	[a]	[a]	0.3	0
Increasers IIa %	0	[a]	[a]	0	0
Increasers IIb %	32	[a]	[a]	5.7	9
Increasers IIc %	5.5	[a]	[a]	17	17
Encroachers %	0	[a]	[a]	0	0
Bare soil %	0	[a]	[a]	0	0
Total	100	[a]	[a]	100	100

[a] The *Rhus ciliata- Tarchonanthus camphoratus* Shrubland was not monitored during this period.

In this study, the wheel-point method has been successfully used, to collect veld assessment data in plant communities, while the GRAZE model (Bredenkamp 1990) has proved successful in assessing the veld condition and determining the grazing capacity for each plant community monitored. This can be used to determine the maximum stocking rate after consideration of grass species composition, rainfall and current stocking rates.

However, monitoring of veld condition is a long term process. The period (1993-1997), although adequate to determine a benchmark, should be seen as part of a long term monitoring project. Monitoring will continue on an annual basis to determine trends in the veld condition and grazing capacity (Bezuidenhout 1997). It is recommended that the benchmark be re-assessed at five year intervals. This is also in line with the philosophy of ISO 14001, which is one of continual improvement, through monitoring and review.

The results of the vegetation monitoring indicate that the veld condition of Vaalbos depends on rainfall, soil texture and especially game movements. Due to the significant impact of rain and variation in rainfall, the year with the lowest rainfall should be used to determine a bench mark. The variation in grazing capacity in South Africa is

Table 6
Grazing capacity (ha/LSU) (GRAZE model) of the 5 plant communities monitored

Plant Community	1993	1994	1995	1996	1997
Ave. Rainfall (mm)	342	337	236	240	697
1.	11.2 [a]	11.4	16.8	20.1	4.5
	22.0 [aa]	22.6	43.7	64.5	7.1
2.	10.5	11.5	13.0	14.0	3.5
	22.3	25.8	32.4	37.2	5.6
3.	9.1	10.1	12.1	13.3	3.2
	19.0	22.7	31.1	38.1	5.0
4.	140.9	118.8	-63.7	-62.8	7.7
	-56.5	-64.3	-29.9	-29.4	14.0
5.	10.9	aaaa	aaaa	15.1	3.3
	23.2	aaaa	aaaa	42.5	5.2
TOTAL [aaa]	10.7	aaaa	aaaa	16.1	3.6

1 = *Schmidtia pappophoroides -Themeda triandra* Grassland, 2 = *Lycium hirsutum - Acacia erioloba* Woodland, 3 = *Grewia flava - Acacia erioloba* Woodland, 4 = *Eragrostis species - Chloris virgata* Grassland, 5 = *Rhus ciliata - Tarchonanthus camphoratus* Shrubland

[a] Upper Value = Grazing capacity in an average rainfall year [aa] Lower Value = Grazing capacity in a below ave. rainfall year [aaa] Total grazing capacity for the grasslands of Vaalbos. [aaaa] No value due to no data for *Rhus ciliata - Tarchonanthus camphoratus* Shrubland.

the result of various climatic conditions, with erratic rainfall being one of the most important factors (Brown 1997). The grazing capacity of Vaalbos should be set conservatively due to these erratic climatic conditions and difficulty to manipulate game movements. It can therefore be recommended that the grazing capacity bench mark for Vaalbos be set at 16 ha/LSU.

Browsing capacity did not fall into the scope of this study. Before the number of browsers is increased, a similar study should be undertaken to determine the condition of the browse and the browsing capacity.

The results from the *Eragrostis species-Chloris virgata* Grassland, indicate that urgent management intervention on the flood plain, is necessary. If a mechanism can be put in place to keep animals off the flood plain, the number of grazers in Vaalbos can probably be increased.

Brown (1997) stresses that management plans are not rigid and serve only as guidelines since changes in the veld occur continuously. The veld condition must be monitored constantly and the stocking rate adapted accordingly, in order to achieve the environmental goals set for Vaalbos.

This ties in well with the requirements of ISO 14001, an environmental management system, which requires that objectives and targets be set for managing an environmental impact (e.g. veld utilisation) and that these targets are regularly monitored and improved upon.

Finally, it can be stated that Veld Condition Assessment can be used to set environmental objectives and targets for an ISO 14001 environmental management system for Vaalbos National Park and also used to monitor the achievement of such objectives.

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