Chapter 3. Research methodology

3.1. Number and distribution of sample plots

A 1:20 000 scale aerial photograph and a set of 1:10 000 ortho-photo maps obtained from Premier Mine were used to stratify the area into relatively homogenous physiographic-physiognomic units.

Sample plots were located , *pro-rata*, on an area / size basis, within each one of these units. Werger (1974) suggests that the number of sample plots in a given study area depends on the scale of the survey, the heterogeneity of the area and the required accuracy of the study. Eighty four sample plots were found to sufficiently cover the area concerned both in floristic composition and vegetation structure. At each of these sample plots vegetation and habitat surveys were conducted.

3.2. Vegetation survey and classification

The method of the Zurich-Montpellier (Braun-Blanquet) school of vegetation classification was used (Werger,1974; Westhoff & van der Maarel, 1980). The method is widely used in South Africa to describe and classify vegetation (Bredenkamp & van Rooyen, 1994), and is applied with great success in classifying vegetation in game reserves and conservation areas (Pauw, 1988). It has proved to be an efficient and reliable method for vegetation survey and classification in most countries (Werger, 1974). The Braun-Blanquet approach takes a practical, intermediate position that recognises the heterogeneity of species distributions but emphasises the interactions between plants in the community (Westhoff & van der Maarel, 1980).

The method was considered as exceptionally suitable for studying the vegetation of the Bynespoort Game Park, as it is based on the principles that;

- plant communities can be recognised by their floristic composition which reflects the best relationship between plants and their environment;
- that some plant species are more sensitive indicators of environmental gradients than others, and can be used as diagnostic species for a plant community; and
- that plant communities can be organised into hierarchical classes based on diagnostic species (Werger, 1974).

Data for the Braun-Blanquet survey were collected as follows:

In each sample plot all plant species and percentage cover were noted according to the Braun-Blanquet cover abundance scale (Werger, 1974)

Additionally the average height (in meters) of each stratum (tree, shrub, herbaceous) was noted.

Habitat data such as topography, aspect (true bearing), slope (degrees), soil depth (centimeters), % clay, erosion (present or absent) and utilisation (presence or absence) were also noted.

The data were analysed using the Turboveg software package (Hennekens, 1996). This is a software package designed for input, processing and presentation of phytosociological data (Hennekens, 1996). The package consists of routines to store, select, export and analyse vegetation data, and to present the results as tables.

The relevé data were captured into the program and a matrix of sample plots against plant species was obtained. This matrix was then subjects to a **T**wo **W**ay **In**dicator **Sp**ecies **An**alysis (TWINSPAN) (Hill, 1979), which is based on similarity indices, and where species with a similar distribution in the relevés and sample plots with the most similar species composition are grouped together. This is considered a first approximation of vegetation communities.

The Braun-Blanquet principles were then applied to the matrix in the software package MEGATAB (Hennekens, 1996). This program facilitates the manual rearranging of the matrix. The matrix is further refined into nodes of species with similar distribution and sample plots with similar species contribution (Bredenkamp *et.al,* 1989; Kent & Coker, 1996). The releve nodes represent plant communities, and the species nodes represent diagnostic species of the various plant communities. Species, which show a restriction to a community, are known as diagnostic species for the community concerned and are used to characterise the community (Westhoff & van der Maarel, 1980).

3.3 . Grazing Capacity and Veld Condition Assessment

3.3.1 Veld Condition

An assessment of the veld condition by studying the grass layer can provide valuable information on the utilisation potential of the veld.

The Ecological Index method (Van Oudtshoorn, 1994, Foran *et.al,* 1978, Verster, 1982) was used to classify grass species into Ecological Status Groups in relation to their reaction to grazing, tastiness, and preference by herbivores.

According to all these criteria all grass species can be classified into one of 9 groups

The groups are described as follows (Van Oudtshoorn, 1994):

Decreaser	A species which is abundant in a good veld, but decreases when the veld is mismanaged
Increaser I	A species which is abundant in a poorly managed veld, and increases with under-utilisation or selective grazing
Increaser Ia	A species which increases as a result of mild under-utilisation or selective grazing
Increaser Ib	A species which increases under conditions of extreme under-utilisation or selective grazing
Increaser II	A species which is abundant in a poor veld, and increases with over-utilisation
Increaser IIa	A species which increases as a result of light overgrazing
Increaser IIb	A species which increases as a result of mild over-utilisation
Increaser IIc	A species which increases as a result of heavy over-utilisation
Invader	A species not indigenous to an area

3.3.2 Sample Method

The same 84 sites of the sample plots used for the Braun-Blanquet vegetation survey, were also used for the assessment of the grazing capacity. In each of these plots a 100 point step-point analysis was undertaken. This acts as a descending point from which the sample is taken (Mentis, 1981). At each point the closest grass species was noted. According to Mentis (1981) this method is adequate for rapid assessment and also saves manpower and equipment. Point data of the sample plots representing each plant community (determined by the classification) were pooled and veld condition was then calculated for each plant community (Vorster, 1982; Zieger, 1994).

3.3.3 Grazing capacity

The percentage contribution of each ecological class is multiplied by its respective forage values to give the veld condition index score as a percentage for each plant community (Zieger, 1994). The forage values according to Vorster (1982) are as follows:

Decreaser - 10

Increaser I - 7

Increaser II a and b - 4

Increaser II c - 1

The grazing capacity of a specific area of veld can be described as a specific production unit (ha) that has the potential to maintain one large stock unit (L.S.U.). This was calculated for each plant community by using the formula of Dankwerts (1989):

$$GC = -0.03 + 0.00289x_1 + [(x_2 - 419.7) \times 0.000633]$$

where:

G.C = grazing capacity

x_1 = % ecological index

x_2 = mean annual rainfall

The grazing capacities for each of the plant communities are then added to calculate a total grazing capacity for the entire Game Park.

The grazing capacity was calculated for three different scenarios, firstly for an average rainfall year (600 mm), secondly for a poor rainfall year (400 mm), and thirdly for an above average rainfall year (851 mm), which was recorded during 1996.

The size of each plant community was calculated in hectares from a scaled map. From the calculated grazing capacity (ha/L.S.U.) the number of L.S.U. that can be supported by each plant community was calculated.

The present game stocking rate was evaluated against the calculated grazing capacity while recommended game stocking rates were estimated for optimal utilisation of the veld.

These analyses were done by using the computer program GRAZE (Bredenkamp, 1995). This program combines the Ecological Index Method with the grazing capacity calculations for an efficient assessment of the data, doing all conversions including those to calculate L.S.U. for the different game species, and includes calculations for stocking rates of the different game species for the Game Park.

3.4. Woody structure and browsing capacity

The BECVOL model (Smit, 1996) was used to estimate the available browsing on the game park. This is an effective method that can quantitatively describe the woody component of a plant community, and determine available browse. BECVOL, or Biomass Estimate from Canopy VOLume provides estimates of actual biomass of woody vegetation by estimates of the volume of the vegetation (Smit, 1996). According to Smit

(1996), there are three main factors to take into consideration from an agro-ecological point of view. These are:

1. Competition with herbaceous vegetation for soil, water and nutrients
2. Food for browsers
3. Creation of sub-habitats suitable for desirable grass species.

With the above factors taken into account, the following are the quantitative descriptive units that are used in this model:

ETTE - Evapotranspiration tree equivalent, which is equal to the leaf volume equivalent of a 1.5 m single-stemmed tree.

BTE - Browse tree equivalent - the leaf mass equivalent of a 1.5 m single stemmed tree

CSI - Canopied subhabitat index - the canopy area of trees which facilitate associations with grasses such as *Panicum maximum*, expressed as a percentage of the total transect area.

A transect of 100 m was laid in each of the plant communities, by using a rope and using all woody plants touching it. The measurements of these plants were taken as follows:

For the calculation of the spatial canopy volume:

1. Tree height (a)
2. Height of the maximum canopy diameter (b)
3. Height of the first leaves, or potentially leaf bearing stems (c)
4. Maximum canopy diameter (d)

5. Diameter of the foliage at height c (e)

It is important to note that all measurements are based on live plant parts only. Because of the unsymmetrical dimensions of plants, the measurements are taken as an average of two perpendicular measurements.

From these measurements the spatial canopy volume is determined (Smit, 1996). It is done by using volume formulas for an ellipsoid, a right circular cone, a frustum of a right circular cone, or a circular cylinder. The formulas of any of these can be used singularly or in combination to determine the volume of the plants.

Once the canopy volume is determined the ETTE, BTE, and CSI can be calculated (Smit, 1996). The volume is multiplied by 1 000 000 to convert it to cm3. The spatial volume of the tree is substituted into the appropriate regression equation. From this regression a leaf volume (cm3) and leaf mass (g) can be read, and divided by 500 cm (1 ETTE) and 250 g (1 BTE).

The regressions were determined by harvesting at least 15 individuals of the most important South African savanna trees, drying and weighing them (Smit, 1996). The regression analyses were then applied.

The results of the BECVOL analysis are tabled, and compared between plant communities. From the BTE, and ETTE an available browse was determined, and the capacity was calculated for each community and the park as a whole.

The canopy spread area (CSI) is calculated as a percentage of the total area of the transect, above a specific critical height.

3.5. Ungulate habitat Survey

To investigate whether certain ungulates preferred and selected certain habitats, a data sheet was compiled and linked to a map of the area. Sightings of game numbers and species were recorded along a fixed route, as well as their position on the map. During this survey, care was taken that similar time periods were spent in each area of the park, and all times of day were covered in the sampling. Therefore, as few external factors as possible could influence the sightings of ungulate species. The survey was however done in the winter season, and selection patterns may change with seasons. Done to the logistics of the project, it was impossible to spread the analysis over a full set of seasons.

The plant communities were then superimposed over the map and the sightings were allocated to communities. These numbers were converted into Large Stock Units (Meisner, 1982) combined for each community and divided by the area of the plant community. The unit obtained is then L.S.U/S/ha where:

L.S.U. = Large stock unit,

S = sample,

ha = area of land (hectare)

This survey showed whether certain communities are utilised more than others, and this information could influence the management of the ungulates.

<u>3.6. Geographic Information System Analysis</u>

The Geographic Information System software packages of IDRISI and ARCVIEW were used for mapping and database purposes. Firstly the plant communities were mapped by tracing and digitising in the IDRISI package, this was done by using a 1 : 12 000 orthophoto map, and aerial photographs modified to the same scale. This was followed by a similar procedure for the Geology of the Game Park, as well as the road network. Hereafter information regarding the plant communities was tabled and incorporated into the program eg. Grazing capacity, area, habitat selection.

This program is then used to superimpose the different maps onto each other to identify any relationships . The program can now also be used as a database to monitor the conditions of the Game Park and predict any related problems. This database is also useful in collating information and making it available in a visual and easily understandable way. Information is stored in a uniform manner, that is easily shared between sources. Such accurately digitised analyses can be placed further in perspective by using a Global Positioning System (G.P.S.), this gives accurate co-ordinates of latitude and longitude, and place the analysis in context in a global sense.