CHAPTER 3
GENERAL METHODS

3.1 Methodological approach

The general methodology discussed here are broad outlines of the methods employed in each of the chapters. For more details on specific methods, please refer to the respective chapters.

3.1.1 Phytosociology

Groups of species tend to occur in associations determined by their ecological tolerance of abiotic and biotic factors, combined with interspecific and intraspecific interactions. Phytosociological classification of syntaxa seeks to investigate the interrelationships between plant species and their distribution patterns. Classification procedures employed in the Braun-Blanquet method, and modified by Mueller-Dombois & Ellenberg (1974) and Bredenkamp (1982), have been used to indicate the correlation between specific environmental conditions and plant communities. Thus, by utilizing the Braun-Blanquet method, hypotheses of the relation between the vegetation and environmental factors can be generated, the end product being an ecological classification.

The Braun-Blanquet classification procedure consist of two phases. During the first or analytical phase, environmental and floristical data are collected during fieldwork. The second phase (synthetic phase) results in the delimitation of the plant communities based on the classification of the field data. These plant communities (syntaxa) are then organized along environmental gradients (Moore *et al.* 1970; Deall 1985; Matthews 1991; Westfall 1992) to determine the most important environmental factors contributing towards the differentiation of each vegetation assemblage (plant community).

3.1.2 Phytosociological sampling strategy

Subjectively versus objectively placed sample sites have been both criticised and endorsed (Coetzee 1974; Mueller-Dombois & Ellenberg 1974; Werger 1974). The approach taken in the present study was of a more objective based method, namely stratified random sampling (Coetzee 1974; Bredenkamp & Theron 1978; Deall 1985; Matthews 1991; Westfall 1992). This approach allows for efficient sampling in heterogeneous vegetation but relies a great deal on good reconnaissance of the area and aerial photograph analyses for the initial stratification. Using this sampling approach one is less likely to over- and under-sample as well as exclude certain vegetation types. The distribution of the sampling sites was based on the random stratification concept to ensure that all the different types of vegetation assemblages were sampled (Mueller-Dombois & Ellenberg 1974). The element of subjectivity was considered essential so as to place the sample plots in the most representative physionomically and floristically homogeneous vegetation stands to avoid ecotonal areas. This subjective placement would always be within proximity of the original sample placement.

3.1.3 Germination trails

The seedling emergence method was used as basis for all germination trails, using this method provided a standard by which all sample responses could be judged. By using this method different soil samples could be compared against each other based on the emergence and subsequent growth responses of a standard bioassay namely, lettuce (*Lactuca sativa* cv. Great Lakes) and wheat (*Triticum aestivum* cv. Inia).

3.1.4 Soil analyses

For most plant ecological field studies a basic understanding of the geomorphological and geological characteristics of a sample site is adequate. Soils, however, are one of the direct controls of plant distribution and performance, therefore requiring more detailed consideration. There is no single international terminology for soil classification and description. Most descriptions are variants, with more or less traits of the soil used in formulating the nomenclature. In the present study the more commonly used classification systems in South Africa and internationally are used, namely the FAO soil classification system (FAO-UNESCO 1974) and the South African soil classification (Soil Classification Working Group 1991).

Soil is an extremely complex medium and its variability causes many challenges in analysis and interpretation. Standard soil analyses were undertaken where appropriate. This included pH, electrical conductivity, as well as the nitrogen, phosphorus, calcium, potassium, magnesium and sodium content of the soil. Where additional chemical information was available for the soil of a site, it was also included in the data set. In the case of the bioassay investigation, a detailed soil chemistry analysis was undertaken which also include atomic absorption spectroscopy so as to give an indication of organic compounds present in the soil samples.

3.1.5 Elephant vegetation utilisation

Food selection has been studied in elephants using a wide range of techniques. The direct methods include field observation of feeding, animal gut content analysis and faecal analysis. Indirect field methods include counting of the frequencies of use of individuals of different plant species and estimates of the intensity of use of individuals of different species sampled in transects and quadrats. As one of the objectives of the elephant utilisation study was to determine the intensity of use of different species of plants in different vegetation/habitat types, a sample method was selected. Manpower and time are always constraints and because of this a plot-less sampling technique was chosen as they are usually less time consuming than plot-based ones (Walker 1970). The Point-centred-quarter [PCQ] method (Cottam & Curtis 1956) was selected as an appropriate strategy, but this was modified so that the sample sizes required for accurate estimates of density of each species and the intensity of utilisation could be reduced by reducing the sampling bias towards individuals in the smaller height classes. The PCQ method usually requires samples larger than 250 PCQ points for estimating the densities of species in a particular vegetation type (Heyting 1968). Because both the variance of distance measurements and the variation in relative abundance was decreased by sub-sampling in the five height categories, the sample size was considered adequate to obtain the estimates of density required.

Sample sites were distributed in a stratified random manner throughout the Tembe Elephant Park, in the seven broad vegetation/habitat types (Matthews *et al*. 2001) based on the Park's road network and aerial photographs.

Preference indices of various vegetation types which express the proportion that a plant species makes up in the diet as a fraction of the proportion that it makes up in the habitat, have been used in several studies on feeding in elephants, as well as in studies on food selection in a wide range of other animal species (Manly *et al*. 1993). Three different indices were calculated in this study (a) The Forage Ratio, (b) Manly's Alpha and (c) Ivlev's Electivity Index (Krebs 1989). The purpose of using preference ratios in this study is twofold i.e. to establish which plant species elephant feeding might threaten, and secondly to establish how both the absolute and relative abundance of a particular plant species in different habitats influenced the degree of selection. An index was therefore required which would allow comparisons between vegetation types. To determine the importance of any plant species to elephant and at the same time establishes what impact elephants might have on any particular species, the values for three parameters were used, namely the volume utilized from each different plant species, the preference for different plant species, and the density of each plant species.

3.1.6 Literature review

The literature study consisted of two parts. The first part focussed exclusively on the study area. This pertained to basic inventories, biological and environmental, and includes geomorphological studies. The second part focused on gaining an understanding of possible processes that are pertinent to the formation and functioning of the different habitats in the study area. Aspects of the ecological and geomorphogical processes of the region were analysed. The vegetation dynamics, evolutionary processes and related issues was also examined. All these biological inventory data, geomorphological and other processes were interpreted based on an understanding of the role time played. Some unpublished information was gained from current researchers working in the study area. Various books, reports, papers were consulted on appropriate topics.