# CHAPTER 1

## INTRODUCTION

African elephant (*Loxodonta africana*, Blumenbach 1797) impact on woody vegetation in reserves across Africa has received much attention in the literature over the past 50 years (Buss 1961; Agnew 1968; Laws 1970; Caughley 1976; Jachmann & Bell 1985; Mwalyosi 1987; Viljoen & Bothma 1990; Tchamba & Mahamat 1992; Ben-Shahar 1993; Whyte *et al.* 1998; Lombard *et al.* 2001). Research concerning elephant impact on vegetation has become more concentrated in recent years as human population growth has lead to a decrease in space available for conservation areas. This is important where elephants are concerned since limiting these megaherbivores (Owen-Smith 1988) to confined areas results in increased impact to the vegetation as their populations expand. The Kruger National Park (KNP) is one of the many reserves to experience this and the problem there was compounded by the suspension of elephant culling in 1995 (van Aarde *et al.* 1999). In an attempt to alleviate this problem, in 1994 KNP captured 148 elephants comprising a number of complete herds, and relocated them to various small game reserves in South Africa (du Toit unpubl.). The results of this were that as those populations numbers grew, the land owners began to notice the impacts the elephants were having on the vegetation in those reserves. One such reserve was Welgevonden Private Game Reserve (WPGR) in the Waterberg, Northern Province of South Africa, to which 50 elephants were introduced during May 1994.

On WPGR, the visible effects of elephant on the woody plants were evident and a cause of concern to management, landowners and tourists. Damage to woody vegetation is often simply attributed to elephant impact, but other possible causes should not be overlooked. Both wind and lightning are known to have a profound effect on, especially, the felling of trees (Spinage & Guinness 1971). Fire, combined with impact by elephants, also has a detrimental effect on savanna vegetation (Buss 1961; Dublin *et al.* 1990; Ben-Shahar 1996; Eckhardt *et al.* 2000). It is therefore important for landowners and managers of reserves to clarify the reasons for having elephants on a property and accept that a certain level of vegetation structure modification is going to occur. Ultimately, landowners and wildlife managers who are concerned about changes to the vegetation, have to set levels of acceptable change, and manage the elephant population numbers accordingly. Concerns regarding changes to the vegetation were the motivation for this research.

One approach to testing hypotheses regarding elephant impact on woody vegetation is to investigate sex differences in resource utilisation. If males and females are found to utilise the woody vegetation differently in relation to each other, one management option may be to adjust the sex ratio to reduce impact on the vegetation. Many studies have been done to investigate possible reasons why some ungulate species segregate into single sex groups outside of the breeding season. This phenomenon is known as sexual segregation (Main *et al.* 1996) and is most likely influenced by social, spatial and temporal factors such as the periodicity of mating opportunities, population densities, resource distribution and environmental conditions. Elephant family structure exists as a matriarchal society and the population forms bachelor and breeding groups (Douglas-Hamilton 1972; Poole 1996). Elephants, however, do not exhibit clear seasonal mating periods (Estes 1993), as has been recorded in other ungulate species. Sexual segregation has been well documented in many species of sexually dimorphic ungulates (see Main *et al.* 1996; Gross 1998; Mysterud 2000 and Ruckstuhl & Neuhaus 2000 for reviews). Sexual segregation has, however, only been investigated on a limited basis in one population of elephants in Botswana by Stokke (1999), Stokke and du Toit (2000; in press). They propose that investigations into sex related differences concerning forage and habitat use by elephants are relevant to evaluating the impacts of elephant populations on savanna vegetation.

Underlying mechanisms of segregation by sex are still poorly understood (Kie & Bowyer 1999; Ruckstuhl & Neuhaus 2000). From the literature it is possible to define two main explanations of sexual segregation, as defined from studies on various species of sexually dimorphic ungulates. Firstly, that which arises from the direct use of vegetation and secondly, that which arises as a result of other factors such as predator avoidance or social preference. Habitat segregation (Conradt *et al.*1999) may be a combination of these factors.

Ruckstuhl and Neuhaus (2000) provide a clear overview of the current hypotheses regarding sexual segregation. Three of the hypotheses defined in the literature may be considered as possible explanations for sexual segregation in elephants. Firstly, the forage selection hypothesis (Ruckstuhl & Neuhaus 2000), also termed the sexual dimorphism-body size hypothesis (Main *et al.* 1996) and the body size hypothesis (Stokke & du Toit 2000) is directly based on forage use by herbivores. It predicts that the sexes segregate because sex differences in body size lead to different energy requirements and therefore food selection, and hence their choice of habitat. The second hypothesis is the scramble competition hypothesis, which applies when resources are limited or plant height is greatly reduced, resulting in competitive interactions between sexes (Ruckstuhl & Neuhaus 2000). This hypothesis does not apply to browsers in the same way it would to grazers, because in large, sexually dimorphic browsers,

the competitive displacement would be vertical as opposed to horizontal (du Toit 1995). The taller body height of the bull elephants in bachelor groups therefore ensures that they would be able to utilise the upper strata of vegetation, while the breeding groups exploited the lower strata, when feeding in the same immediate patch, consequently, sexual segregation would not necessarily be spatial along the horizontal component. Main and Coblentz (1990) examine a third hypothesis to explain sexual segregation whereby males select habitats on the basis of optimal foraging opportunities, while females choose habitats based on their suitability for raising young. This hypothesis is based on energetics and the relative differences in the reproductive strategies of males and females of polygynous ungulates. Main *et al.* (1996) referred to this hypothesis as the reproductive-strategy hypothesis. This hypothesis includes the principle of predator avoidance, and therefore Ruckstuhl and Neuhaus (2000) later referred to it as the predation risk hypothesis.

This research project was not designed to test any of the above hypotheses, but rather to determine whether the elephants on WPGR display any sexual segregation in terms of their use of habitat or feeding patch. The data collected for this research have been analysed and assessed at two ecological scales. The first was the habitat scale, and the second was the narrower scale of feeding patch choice. Since large herbivores interact with forage resources at several levels of ecological resolution (Senft *et al.* 1987), it is often necessary to work at different scales when researching ecological concepts, since one scale is often too broad or too narrow in relation to the specific subject. When research focuses on a megaherbivore such as the African elephant, knowledge regarding habitat and vegetation utilisation by these large animals is of crucial importance in population control and habitat management (Afolayan & Ajayi 1980). This is because, as large-bodied animals, they have high dietary requirements, and therefore elephants have the potential to have a high impact on their environment. This can have both direct and indirect consequences for the population itself, as well as other species.

### 1.1 Objectives

In this study I focus on the elephant's use of the vegetation, their impact thereon, and the possible differences exhibited by bachelor and breeding groups within this framework. Elephant impact on woody plant species was the focal point of this project, as opposed to the grass or herb layer mainly because, on WPGR, both reserve managers and landowners are concerned about elephant impact on the woody component, due to the visible effect it has on the aesthetic value of vegetation to tourists. Woody plants in this study were defined as perennial plants whose stems do not die back at the end of the growing season (Van Wyk & Malan 1998). Elephant activity in conjunction with woody vegetation is referred to in this thesis as "impact"

rather than "damage" owing to the concern over the use of this term due to its implication of excessive vegetation destruction (Anderson & Walker 1974). The term impact, as used in this study, is intended to include all types of vegetation utilisation by elephants, whether excessive or not. Aspects such as population numbers, sex and age ratios, and individual identification of the elephants were investigated on a secondary basis to the main study.

### 1.2 Key questions

This study was designed around five key questions, combinations of which form the basis of each chapter in this thesis:

1 Do preferences for woody plants differ between elephant group types (breeding groups and bachelor groups) in each season?

2 Do bachelor and breeding groups differ with respect to the woody plant species they fell, barkstrip or uproot?

3 Do bachelor groups have a greater impact on the woody vegetation than breeding groups?

4 What are the main habitat types available to the elephants on WPGR?

5 What habitat types are preferred, and do habitat preferences differ between group types, in each season?

### 1.3 Approach

The major objectives for this study were to investigate sex differences in elephant resource utilisation at two ecological scales. Firstly, that of the local feeding patch scale (chapter three) which addresses key questions one, two and three. The two hypotheses tested in this chapter were defined from the research done by Stokke (1999) and Stokke and du Toit (2000; in press) in Chobe, Botswana concerning sexual segregation in elephants:

1. An elephant population can be divided into two functional groups with regard to their relative impact on the woody vegetation:
   a Bachelor groups
   b Breeding groups
2. Elephant bachelor groups have a greater impact on the woody vegetation than do breeding groups.

Secondly, chapter four addresses key questions four and five at the habitat scale. Chapter five presents a final discussion and brief implications of the results from data chapters three and four to reserve management.

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