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Rangeland condition in the Tembe Traditional Area, Maputaland, KwaZulu-Natal, South Africa

by

Johan Hendrik Potgieter

Submitted in partial fulfilment of the requirements for the degree

MAGISTER SCIENTIAE (WILDLIFE MANAGEMENT)

Centre for Wildlife Management
Faculty of Natural and Agricultural Sciences
University of Pretoria
Pretoria

Supervisor: Prof. Dr M.W. van Rooyen
Co-Supervisor: Prof. Dr J. du P. Bothma

November 2008

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ABSTRACT

This study, undertaken under the auspices of the Centre of Wildlife Management and the former Centre for Indigenous Knowledge (University of Pretoria) was conducted in Maputaland, with special reference to the Tembe Elephant Park, Sileza Nature Reserve and in the neighbouring traditional wards (*izigodi*) of Mbangweni, Bhekabantu, Kwandaba, Zama-zama, Tsokotho, Manqakulani (which includes the Tshanini Community Conservation Area), Lulwane, Mntikini, Ndlondlweni, Ndovu and Sibonisweni. The main objective of this study was to evaluate the range condition and grazing capacity of the natural veld. A management plan for the Tshanni Community Conservation Area is presented, which could potentially serve as template for similar areas. To accomplish these objectives a cattle as well as a vegetation survey were conducted. The cattle surveys were conducted among the local communities (mentioned above) to identify and to evaluate the role played by cattle in the everyday lives of the communal people and to identify the types of grazing regime (practices). The vegetation surveys were undertaken to evaluate the range condition, grazing capacity and grazing quality of the herbaceous vegetation. The study also included methods to determine the number, distribution and health status of cattle present in the study area.

The results indicated that social and religious values that were associated with cattle in the older Zulu culture have clearly faded in the Tembe Traditional Area. The current values of local communal

people regarding cattle were concentrated on utilization and investment for future uncertainties. Cattle were still seen as wealth and status symbols in the local communities and were highly prized possessions if they could be obtained. The official cattle numbers did not seem to reflect the actual cattle numbers in the study area at the time of study. It was also clear that cattle were distributed in areas where the water supply was sufficient. The main grazing areas were thus in the east of the study area in the hygrophilous vegetation to the east of Manqakulani and mainly in Ndlondlweni. No specific grazing management practices could be identified and the grazing system could be best described by a continuous grazing practice. Grazing was not restricted to any part or piece of land inside the specific *isigodi* as long as the cattle stayed out of other people's cultivated land. Overstocking the grazing area was not occurring at the time of the study as the stocking density was well below the area's capacity. The general perception of the majority of the cattle owners was that their cattle were in a good condition.

An analysis of the results obtained from the vegetation survey indicated that the herbaceous biomass yield did not vary noticeably among the management units within a site as well as among the different sites. The small fuel loads in the Tshanini Community Conservation Area did not necessitate burning and were probably below fuel loads needed for fires to spread. However, it was frequently observed that fire could be maintained in areas where the herbaceous biomass yield was below 2 000 kg/ha. The results represented in this study also indicated that the management units of the Tshanini Community Conservation Area were generally in a good condition and that the range condition of the Tshanini Community Conservation Area compared relatively well with the other reserves in the study area.

The modified Ecological Index Method was reliable and time saving, yet simplistic enough for assessing the range condition of the management units of the Tshanini Community Conservation Area and the entire Tembe Traditional Area.

The stocking density must be adaptable and based on the quantity and quality of grazing available at any time. The model that was used to calculate the stocking density of the study area allows for several elements to be modified to suit the conditions on a particular wildlife reserve at a particular time. For example, in future it may become necessary to adjust the percentage composition of graze and browse in the diet of some animal types for the calculation of Grazer Units (GU) and Browser Units (BU), mainly because the diet of the same type of animal may vary regionally. Finally, changes in the choice of the types of wildlife can be accommodated depending on the preferences and objectives of the management and steering committee of the Tshanini Community Conservation Area. This model can be applied as a tool for active adaptive management because it allows more control over the quantity and quality of available food plant resources and hence the stocking density of animal resources.

It is proposed that the results of the present study be combined and integrated into a Geographic Information System (G.I.S.) database that could form the ecological basis for future management planning of the Tembe Traditional Area as part of the Usuthu-Tembe-Futi Transfrontier Conservation Area.

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DECLARATION

I declare that the dissertation, which I hereby submit for the degree of Master of Science (Wildlife Management) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE: 

DATE: ……

ACKNOWLEDGEMENTS

So many people have contributed to the completion of this manuscript, that it would be unfair to try and give each contributor an own special place in the hierarchy of importance. In particular, however, my whole-hearted thanks and admiration to the following people and institutions:

First of all – *Soli Deo Gloria* – to the One who gave me the ability and grace to complete this study.

To my wife Lize and sons Henjo and Alwi, I owe many thanks for your unconditional love and support throughout my studies and research years, many weeks away from home as you stood by your promise - for the better or worse. Without your endurance and belief in my abilities this study would surely never have been completed.

My parents, Henk and Ann, for all your support and unselfish input, not only in regard to this dissertation but also helping me to achieve my dreams and passion throughout my life so far.

My sincere thanks to my supervisors Professors M.W. van Rooyen and J. du P. Bothma, for their friendly advice and guidance, commitment and invaluable constructive criticism of the dissertation.

A special thanks to the all the staff members and students of the Centre for Wildlife Management, especially Mrs Liset Swanepoel, a real understanding and patient mother figure who was always willing to give a helping hand and sympathetic ear.

To Mrs Catherine Hanekom for all your help, support and guidance during those hot and exhausting days while conducting veld assessments. Thank you also for your friendship and hospitability during my research.

To Mrs Ingrid Booysen to whom I am greatly indebted for providing me with the maps and G.I.S. information and interpretation needed to give that extra colour to the manuscript. I sincerely thank you.

Messrs Amos Tembe, Thabani Mthembo and Derrick Tembe, my dedicated and loyal field assistants, interpreters and guides, for your input and invaluable help. Not only have you helped me bridging local and cultural barriers but also my own preconceived notions and ideas of the rural South Africa and Maputaland in general.

I am also grateful to the management staff and other staff members of the Tembe Elephant Park, and Ezemvelo KwaZulu-Natal Wildlife for help on the logistical side, accommodation and access to the research facilities. It was here that Dr Wayne Matthews played a prominent role as co-ordinator as well as helping me with the interpretation and direction of the study in general, always willing and always available when help was most needed.

Other people who need mentioning and provided help, discussion and encouragement are: Dr Herman Els, Dr Roelie and Alison Kloppers, Jason Tarr, Danie van Eeden, Ben Orban, Bertie and Linda Booysen as well as Bertus and Suzanne Booysen for editing and proofreading the drafts.

Last of all a special thanks to the National Research Foundation under grant number 2047386 for providing the funding for this research.

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Chapter 1

INTRODUCTION

Community-based conservation and the participation of local communities is the present-day centre of attention in international and national conservation organisations (Pimbert & Pretty 1997, Boyd *et al*. 1999, Fabricius *et al.* 2001, Hulme & Murphree 2001). Community-based conservation can be seen as the process of helping people to participate in making decisions about the use of local natural resources, be this water, land, fauna or flora. The aim is to achieve social, economic and ecological sustainability (Milton 2000). Community participation as such, is emphasized by policy makers in all SubSaharan African countries due to the occurrence of poverty and the resulting absolute dependence of communal rural communities on their natural environment for continued existence (Els & Bothma 2000, Hulme & Murphree 2001). According to Milton (2000) interaction and linkages between environmental and socio-economic issues imply that access to benefits from the use of natural resources should lead to the improvement of the quality of human life. However, awareness should be created among rural communities of the value of natural resources and this should motivate them to conserve species and use limited natural resources more wisely and sustainably.

1.1 ORIGIN OF THE STUDY

Numerous community-based conservation projects have been initiated that involve local communities and seek to use economic incentives for the conservation and sustainable use of wildlife, protected areas, forests, wetlands, grasslands and other biodiversity-rich areas (for example CAMPFIRE 1990, Kiss 1990, Child 1991, Gibson & Marks 1995, Boyd *et al.* 1999, Fabricius *et al*. 2001). Furthermore, Kloppers (2005) and Easton (2004) argue that Community Conservation Areas (CCAs) play a crucial role in the consolidation of formal protected areas. This is especially relevant in the case of the Usuthu-Tembe-Futi Transfrontier Conservation Area. In the Usuthu-Tembe-Futi Transfrontier Conservation Area, the formal protected areas of the Ndumo Game Reserve, the Tembe Elephant Park and the Maputo Special Reserve are separated from one another by strips of sparsely populated traditional wards However, to achieve sustainable development these sparsely populated communal areas with a low agricultural potential, must become conservation corridors that link formal protected areas to allow wildlife to move freely between them and thus create a large continuous tourist attraction (Kloppers 2005).

The specific area that the present study focused on is situated in the Umhlabuyalingana Local Municipality (one of the five local municipalities in the Umkhayakude District Municipality). This

district has an estimated population of 504 000 residents and the total area covered is 12 819 km². The Umhlabuyalingana Local Municipality covers 29% (approximately 3 717.5 km²) of the area and houses 24% (approximately 120 930 people) of the population of the total Umkhayakude District Municipality (Rothaug Collaborative & Maseko Hlongwa Associates 2002).

The neighbours of the Tembe Elephant Park live in an ecologically sensitive region of Maputaland. **Maputaland** as referred to in this dissertation is a colloquial word that is used to refer to an area within South Africa with roughly the same boundaries as the Umkhayakude District Municipality. Maputaland is widely known for its botanical endemism (Van Wyk 1994, 1996, Van Wyk & Smith 2001).

From as early as the 16th century people in the study area have utilised their natural resources through the implementation of their local knowledge of the environment (Bruton *et al.* 1980, Goodman *et al.* 2002, Gaugris 2004). In the past, the effect of this utilisation was not as visible as today, mainly due to a stable rural community with a low population density. As of late, the growth in the population has increased the pressure on the renewable natural resource base, with negative effects on the sustainability of local livelihoods and increased pressure on the formal protected areas for development and subsistence (Brookes 2004, Gaugris 2004, and Kloppers 2005). Implementing sustainable integrated development projects has become necessary and work in this regard has led to a number of workshops and the drafting of a programme to rectify the situation through the establishment of development partnerships. The focus of these partnerships falls on integrated conservation-based rural development (Els 2000).

The Central Ingwavuma Integrated Rural Development Programme fits into the development framework that was created by the Lubombo Spatial Development Initiative. This initiative is focused on the participation of rural communities, through which they are to be enabled to participate in the economic opportunities that are created through the growing tourism industry in the greater uThungulu Region, now known as the Elephant Coast. The programme also formed part of and represented the southern section of the development framework to be initiated through the Lubombo Transfrontier Conservation Area, an initiative facilitated by the Peace Parks Foundation and driven by a trilateral ministerial commission from South Africa, Swaziland and Mozambique.

One such conservation-based rural development project was initiated to create sustainable livelihoods in the northern Umhlabuyalingana section of the Umkhayakude District of KwaZulu-Natal. This local development initiative was focused on building and implementing an integrated rural development programme among the neighbours of the Tembe Elephant Park. One of the objectives of the community-based projects was focused on the establishment of the Tshanini Community Conservation Area in the Manqakulane Ward of the Tembe Traditional Area. This initiative is still in

its infancy and it still has to be decided how it will be managed. It is envisioned that it will be managed as an economically and ecologically sustainable wildlife ranching and cultural tourism project through which the socio-cultural and economic needs of the inhabitants of the Manqakulane Ward can be addressed. Opportunities will be created whereby the people can raise their living standards. The project links with the broader objectives of the Lubombo Spatial Development Initiative and the Lubombo Transfrontier Conservation Area, which are being managed in the same region[1].

The establishment of the Tshanini Community Conservation Area was originally an initiative of the Manqakulane Development Committee. Since November 2000 the project has become a joint venture between the Tembe Traditional Authority, the Manqakulane Development Committee, the former Centre for Indigenous Knowledge of the University of Pretoria, the Centre for Wildlife Management of the University of Pretoria, the P.E.A.C.E. Foundation (**P**lanning, **E**ducation, **A**griculture, **C**ommunity and **E**nvironment) a non-government organisation, the W.K. Kellogg Foundation Integrated Rural Development Programme in southern Africa and Ezemvelo KwaZulu-Natal Wildlife.

1.2 APPROACH

An interdisciplinary approach was followed with three different phases that were integrated in the research project. All three phases are linked and should not be viewed independently. The first phase investigated the cattle and grazing systems of the Tembe Traditional Area adjacent to the Tembe Elephant Park. In this phase the research concentrated on the physical condition and distribution of cattle in the research area and the cattle husbandry at the time of the study. The second phase concentrated on assessing the veld[2] condition and the herbaceous phytomass production in certain wards of the Tembe Traditional Area, especially the Tshanini Community Conservation Area. In phase three the results obtained from the first two phases were used and integrated into a proposed development and management plan for the Tshanini Community Conservation Area.

1.3 RESEARCH OBJECTIVES

The main objectives of this study were to evaluate the ecological state of the natural veld at the time of the study and to establish to what extent the natural grazable rangeland was being utilised in the study

[1] See Lubombo Spatial Development Initiative at http://www.lubombo.org.za/ and at Lubombo Transfrontier Conservation Area http://www.peaceparks.org/

[2] The terms ***range*** and ***veld*** are regarded as synonymous and are both used in the text. Veld is a typical South African term, whereas range is used in the international literature. However, because most pasture scientists (Tainton 1999) in South Africa are more familiar with the term ***veld*** it was also used in the text.

area. The findings were then used to develop a management plan for the Tshanni Community Conservation Area. To accomplish these objectives a cattle and vegetation survey had to be conducted.

The cattle system survey comprised of the following:

- An assessment of the cultural significance of cattle in the everyday lives of the Tembe people of Maputaland.
- Determination of the number and distribution of the cattle in the study area.
- Evaluation of the physical condition and general health status of the cattle in the study area.
- Gathering baseline information on the cattle systems and management practices in the Tembe Traditional Area adjacent to the Tembe Elephant Park. This included the animal husbandry practices and management of grazing in the study area.
- Determination of the constraints regarding cattle and grazing management in the study area.
- Reporting on less common (not less important) cattle-related aspects in the Tembe Traditional Area.

The vegetation study comprised of surveying the total study area and assessing the range condition in different agro-ecological management units. This involved:

- Estimating the herbaceous biomass in different agro-ecological units.
- Investigating temporal changes in herbaceous biomass over a period of six years.
- Determining the frequency of occurrence of grass species in the respective agro-ecological units.
- Determining the grazing capacity for each agro-ecological unit.
- Comparing the grazing capacity of managed reserves, which included the Tembe Elephant Park and Sileza Nature Reserve with that of the neighbouring wards in the study area.
- Producing a baseline ecological (grazing and rangeland-related) database that will ultimately assist in developing a management plan for the Tshanini Community Conservation Area and eventually the whole study area.

Chapter 2

THE STUDY AREA

2.1 INTRODUCTION

The Tembe Traditional Area in the Umkhayakude District Municipality (administered by an Executive Committee) and local Umhlabuyalingana Local Municipality (administered by a municipal manager and major) falls under the traditional jurisdiction of *Inkosi* Mabhudhu Israel Tembe and his Royal Council, where his jurisdiction is restricted to traditional affairs. The Tembe Traditional Area is divided into 42 wards (zulu: p – *izigodi*, s – *isigodi*), each of which falls under the jurisdiction of its own *induna* (traditional leader for a specific *isigodi*) and his council. This area experiences political stability due to a good relationship between the Tembe Traditional Authority and its subjects the people of the district, and the uThungulu Regional Council (Els 2000).

According to Els (2002) and the Integrated Development Plan for the Umkhayakude District Municipality (2002) the realities of everyday life in the study area could be summarised by the following:

- Approximately 95% of the population resided in a rural communal area (Manguzi being the exception).
- An annual economic growth rate of 2.6%.
- The annual population growth rate was estimated at 4% for the town of Manguzi and 2.5% for the rural areas.
- Of the population, 21% in the district was older than 65 years and 57% younger than 19 years.
- Of the economically active population 38.4% was employed.
- Of the inhabitants in the district, 85% was dependent on subsistence agriculture and government subsidies.
- Old age pensions or government subsidies and grants comprised 30% of the annual income of the district's population.
- Of the population in the district, 81% earned below the national subsistence level of R 1 100 per month.
- The level of education in the population was 30.4% at the primary level, 16.8% at the secondary level, and 0.5% at the tertiary level.
- The illiteracy rate was 35%.

2.2 LOCATION

The study area is situated in Maputaland in the northeastern corner of KwaZulu-Natal (Figure 2.1). In South Africa Maputaland is bounded by the South African-Mozambican border to the north (26º52'S), the Lebombo Mountains to the west (27º00'E), and the Indian Ocean to the east. The southern boundary is a line extending from the southern termination of the Lebombo Range to the St. Lucia Estuary Mouth (Watkeys *et al.* 1993). The area covers approximately 12 819 km².

The core research area covered an area of approximately 850 km² (±85 000 ha) (Figure 2.1) and was comprised of the Tembe Elephant Park, Sileza Nature Reserve and neighbouring traditional wards (*izigodi*), which included Mbangweni, Bekhabantu, Kwandaba, Zama-zama, Tsokotho, Manqakulani, Lulwane, Sibonisweni, Mntikini, Ndovu and Ndlondlweni in the so-called Tembe Traditional Area.

The Manqakulane community adjacent to the Tembe Elephant Park has set aside approximately 2 420 ha of their communal grazing land for a wildlife conservation area (Gaugris *et al.* 2004). From this initiative the Tshanini Community Conservation Area was born. The Tshanini Community Conservation Area is the first of its kind to be established in a traditional communal ward in the northern parts of the KwaZulu-Natal province of South Africa. What makes this conservation area even more unique is that this initiative was taken by the people themselves (Van Eeden 2005.). Most other wildlife reserves that have been established in communal rural areas have been the result of the efforts and initiatives of conservation authorities. The net effect of those efforts is usually that the local inhabitants lose control over their land, and that few benefits accrue to them despite initial promises of job creation and income from tourism (Els 2000, 2002).

In contrast, the establishment of the Tshanini Community Conservation Area was an attempt to increase their own living standards through job creation supported by the enhancement of the tourism potential of Maputaland through the efforts of the Lubombo Spatial Development Initiative[3]. The efforts of this initiative were, however, mainly concentrated on tourism-based development projects along the scenic Maputaland coast stretching from the Isimangaliso Wetland Park (Greater St Lucia Wetland Park) in the south to Kosi Bay in the north.

The Tshanini Community Conservation Area is located 6 km south of Tembe Elephant Park's southern boundary. Both these conservation areas are situated in the core of the Maputaland Centre of Plant Endemism as described by Van Wyk (1996). A rare forest type, the Sand Forest, is one of the

[3] Lubombo Spatial Development Initiative– a trinational alliance and development agreement between the governments of South Africa, Mozambique, and Swaziland.

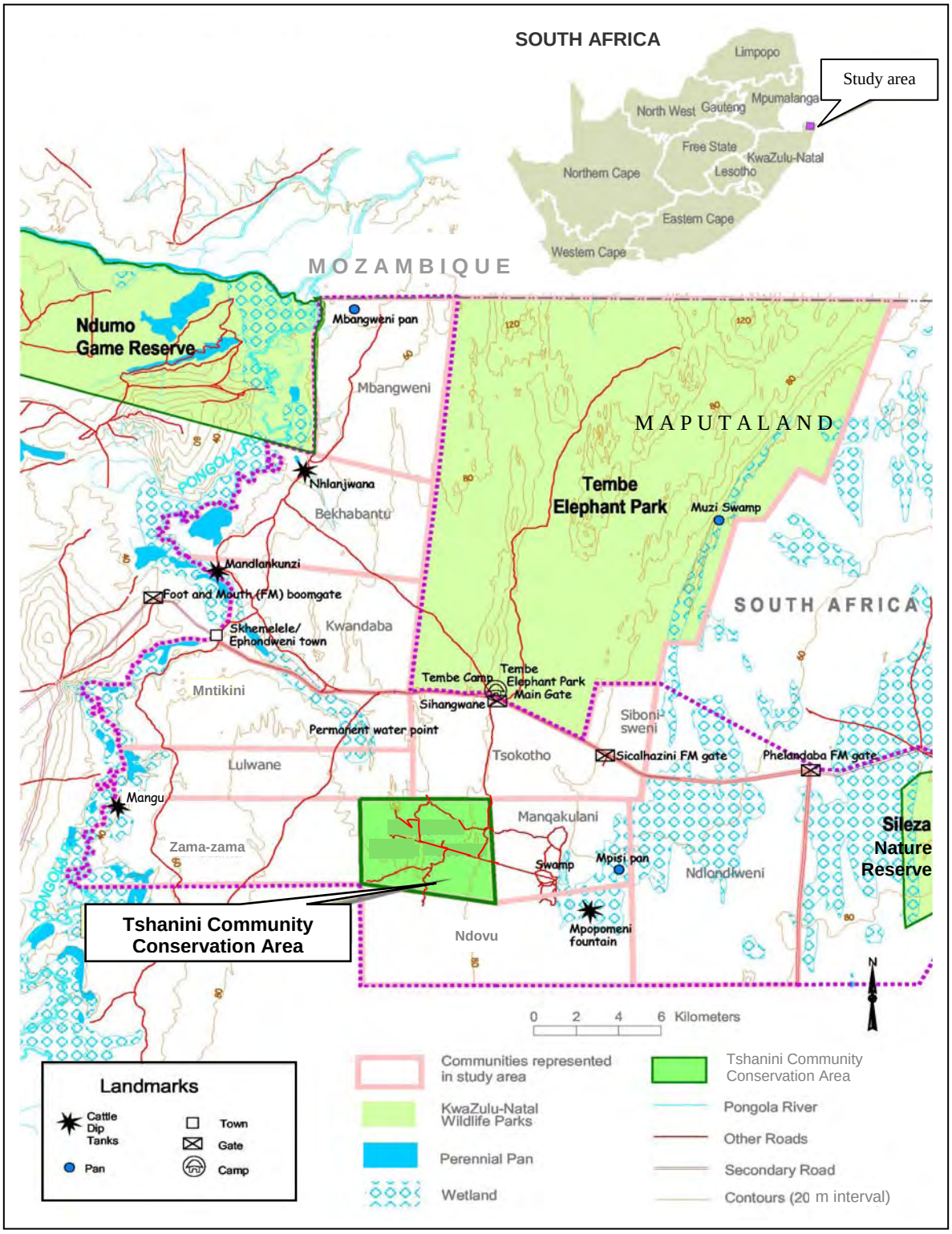

Figure 2.1: The study area and the Tshanini Community Conservation Area in Maputaland, northern KwaZulu-Natal.

most common and important features in this area, emphasising the need to conserve and utilise this jewel of Maputaland sustainably (Van Wyk 1996, Matthews *et al.* 2001, Van Wyk & Smith 2001, Gaugris *et al.* 2004). Sand Forests in South Africa cover a mere 354 km², of which 44% is conserved (McKenzie 1998). The Tshanini Community Conservation Area contains approximately 1 000 ha of Sand Forest (Gaugris *et al.* 2004). Gaugris *et al.* (2004) found that the three main plant communities (including the Sand Forest plant community) of the Tshanini Community Conservation Area were floristically similar to their equivalent plant communities of Tembe Elephant Park.

The area where the Tshanini Community Conservation Area has been established was previously utilised by the local people for wood harvesting, livestock grazing, hunting, fruit and honey gathering, and subsistence cultivation, at least for the last 20 years (Gaugris *et al*. 2004). The establishment of the Tshanini Community Conservation Area has many implications for the everyday livelihoods of the Manqakulane community. They have given up grazing land for their livestock, they also gave up the right to freely collect firewood in the forest for at least four years, and the right to freely hunt in the forest. They could furthermore lose the right to freely cut building material from the forest. The indigenous healers will be the only people to retain access to harvest medicinal plants in the forest. Only time will determine whether these actions of the community will ultimately benefit them.

The following description of the topography, hydrology, geology, soils, climate, vegetation and animals of the study area was based largely on research done by Bruton & Cooper (1980), Watkeys *et al.* (1993), Lubbe (1996), Matthews *et al.* (1999, 2001), Van Rooyen (2003), Gaugris *et al.* (2004) and Van Eeden (2005).

2.3 TOPOGRAPHY

The Tembe Traditional Area lies in the southernmost portion of the broad Mozambican Coastal Plain, which is bordered by the Lebombo Mountains in the west and the Indian Ocean in the east. Maputaland is almost entirely a flat low-level coastal plain with a maximum elevation of approximately 150 m above sea level and forms part of the Zululand Coastal Plain. To the west of the coastal plain the Lebombo Mountain Range rises to an elevation of over 600 m above sea level (Maud 1980).

The study area is characterised by undulating sand dune ridges trending linearly in a north-south direction, and interspersed with depressions. In the central part of the coastal plain these dunes may reach an altitude of 129 m. During seasons of high rainfall, pans or swamps may form as a result of the poor drainage (in clay richer areas) and high water table of the region.

Prominent natural landmarks in the study area are the Pongola River in the west, the Muzi Swamp in the Tembe Elephant Park, the Gonde-Tembe Pan and other pans in the Sileza Game Reserve, as well as the Sand Forest patches that occur throughout the study area.

2.4 HYDROLOGY

The movement of ground water and the height of the water table are major determinants of the vegetation patterns in most parts of Maputaland (Matthews *et al.* 1999, 2001). The depth of the water table ranges from ground level (the swampy areas) to as deep as 90 m, and it fluctuates seasonally. Annual rainfall is almost the only water source that contributes to the ground water system. Rainfall, apart from soils, is the most important factor affecting the ecology and the human population distribution in Maputaland (Maud 1980). The pans and marshes in the study area are mostly fed by the shallow water table, except in those areas where seasonal pans occur on duplex soils. Most of the seasonal pans dry up during the winter period, which ranges from April to September (Matthews *et al.* 1999, 2001).

2.5 GEOLOGY

Geologically the study area resembles the rest of the Maputaland and the southern Mozambican Coastal Plain (Matthews *et al.* 1999, 2001) (Figure 2.2). The underlying geological sequences of Maputaland are Mesozoic, Tertiary and Quaternary in origin. The main stratigraphic units are unconsolidated Quaternary grey aeolian sands and Quaternary yellowish redistributed sands, underlain by a multi-layered sedimentary sequence of Quaternary and more clayey consolidated sands (Port Durnford Formation), and Tertiary white sandy limestone with basal conglomerates (Maud 1980; South African Committee for Stratigraphy 1980). The underlying geology of the core study area consists of Cretaceous siltstone, which is uncomformably overlain by sediments of Miocene and Pleistocene origin. The Maputaland Group overlies the latter. The marine, littoral and coastal dune deposits lie on top of this Maputaland Group formation (Gaugris *et al.* 2004).

2.6 SOILS

In general the soils of Maputaland are complex, with a number of generations being preserved, some of which are exhumed palaeosols that are not related to the present climate. A strong relationship exists between soils and the underlying geology, geomorphology, position and hydrology. The parent material has an overriding influence over all other soil-forming factors (Watkeys *et al.* 1993). Most of Maputaland is covered by sandy Tertiary and Quaternary deposits, and the soils derived from these

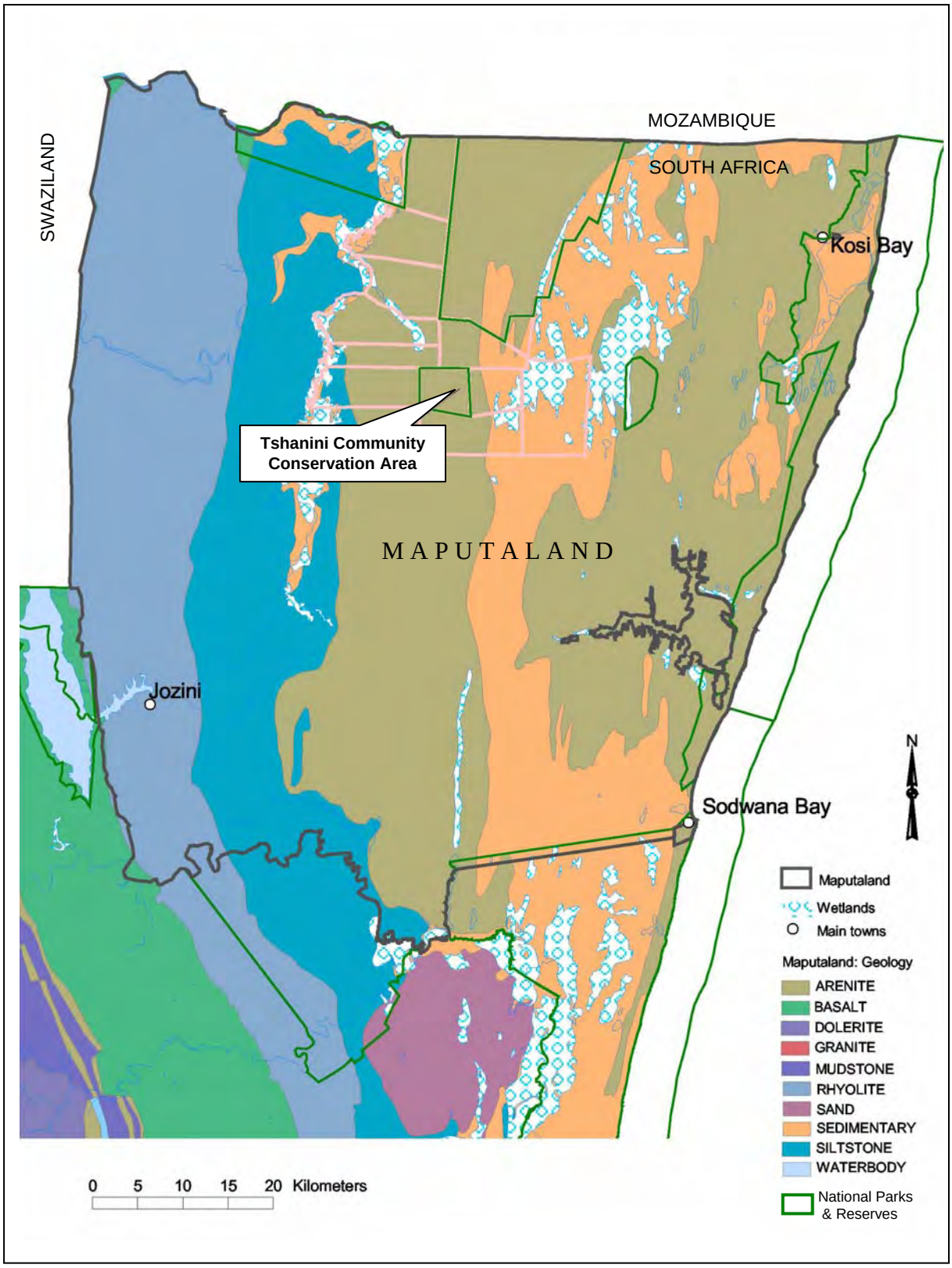

Figure 2.2: The geology of the study area in northern KwaZulu-Natal with the boundaries of the different wards indicated in pink and those of the conservation areas in green (ENPAT 2001).

substrates all have adverse physical and chemical properties, which render them infertile with a low agricultural potential (Maud 1980, Watkeys *et al.* 1993).

In the core study area there are typically red, yellowish or grey apedal soils with an incipient horizon development (see Land Type map Figure 2.3). The soil profile in the study area consists of a thin, organic-enriched A-horizon, which is underlain by sandy subsoil with illuviated lines. Intense weathering of labile minerals over a long period is the cause of a higher clay content in the red soil profiles. The high dunes consist of red to yellow, high base status soils and are differentiated from the surrounding lower relief areas where regic sands are dominant (Matthews *et al.* 2001).

The soils in these high dune areas have well-drained profiles with less than 5% clay, and are classified as Hutton or Clovelly Forms (Soil Classification Working Group 1991, Matthews *et al.* 2001). The interdune depressions or low gradient areas are characterised by sandy profiles with yellowish-brown or light grey subsoil horizons. The profiles are moderately well drained, although high water tables within low-lying interdune depressions result in bleached, grey soil profiles. These soils are referred to as yellowish Clovelly or grey Fernwood Form soils. These soils show a sharp reduction of organic carbon to levels of less than 0.5% within 300 mm of the surface (Soil Classification Working Group 1991, Matthews *et al.* 2001).

Underground water moving laterally towards the interdune depressions, and thus the Muzi Swamp base level, has resulted in the formation of clay-rich, slightly saline or calcareous duplex soils in the lower-lying areas (Matthews *et al.* 2001). Narrow areas of sodic Estcourt Form soils (Soil Classification Working Group 1991) with a prismatic subsoil structure are common where the dune sands border the Muzi Swamp. Where permanent swamps are present in the Muzi Swamp, gleying conditions with peat formation and the development of organic-rich histosols or soils of the Champagne Form are found (Soil Classification Working Group 1991, Matthews *et al.* 2001).

In the Hygrophilous Grasslands or Palm Veld surrounding the Sileza Nature Reserve, the soils have developed from the relatively homogeneous, grey, siliceous, aeolian sands. Soil types are limited, but soil patterns are intricate, though predictable, as a result of the relationship between topography and water table levels. Most of the soils show signs of high levels of leaching and are classified as dystrophic and relatively acidic with a pH (water) of ~6.1. The micro-nutrient boron is also present at above average levels, an unusual feature for this specific area (Matthews *et al.* 1999).

The most prominent soil types present in the Hygrophilous Grasslands or Palm Veld are dystrophic regosols (SA-Namib), histosols (SA-Champagne) and humic gleyosols. Dystrophic regosols that are moderate to well-drained acidic sands are found in elevated places. Histosols are acidic, organic soils

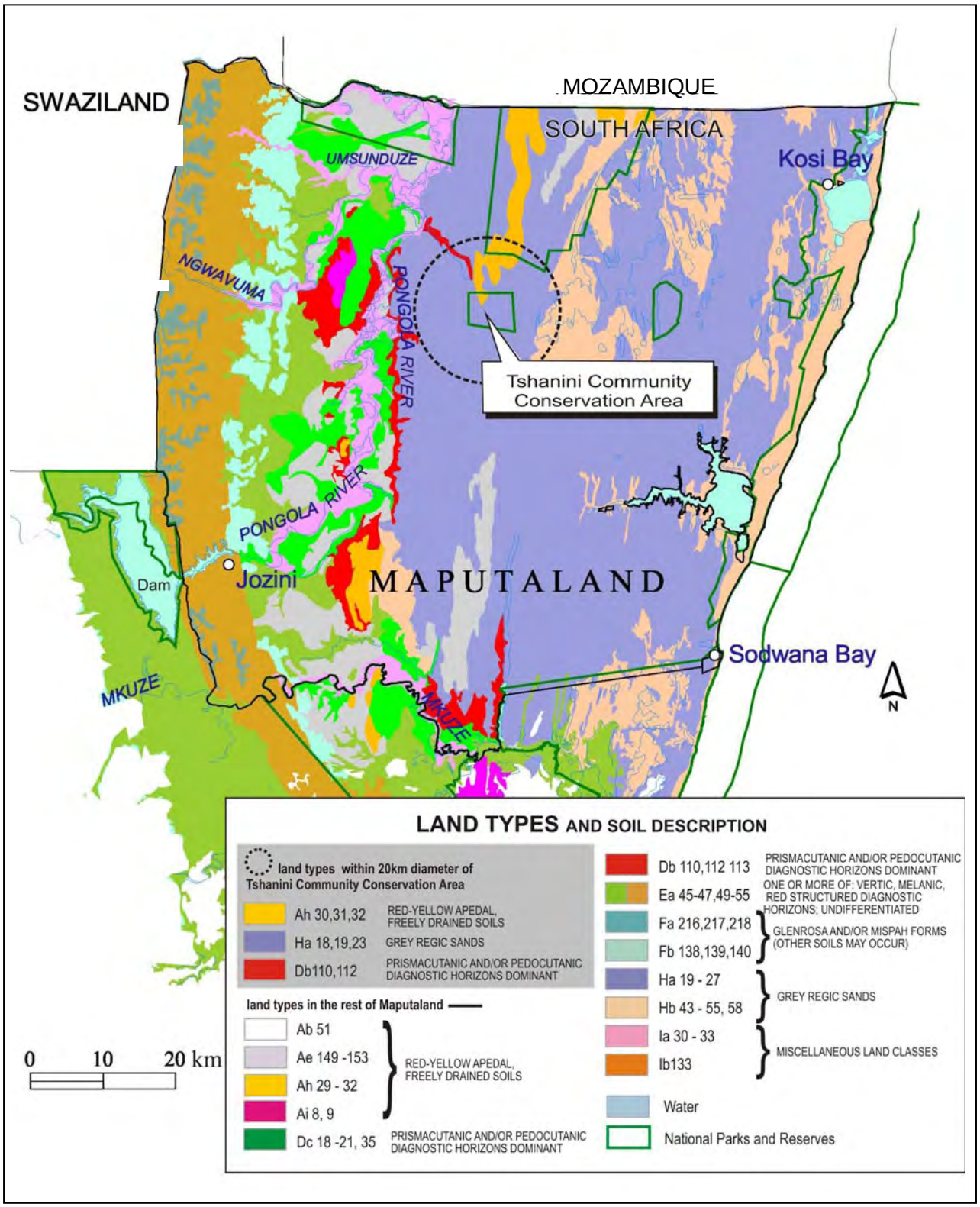

Figure 2.3: Land Types around the immediate vicinity of the Tshanini Community Conservation Area (adapted from South Africa, 2006. ARC - Institute for Soil, Climate and Water).

with an organic-rich A horizon which is thicker than 400 mm and are found in swampy areas and pans. Humic gleyosols are wet acidic sands with an abnormal accumulation of organic matter and are found in depressions with a high water table.

Due to high rainfall in the eastern part of Maputaland, the soils are leached and inherently infertile. On the other hand, the soils of the western Maputaland, particularly along the western bank of the Pongola River, are alluvial and are derived from cretaceous sediments. These soils are fertile to highly fertile, and thus suitable for agriculture (Maud 1980).

2.7 CLIMATE

Climatically, Maputaland is the southern end of the tropical region of Africa. The climate is warm to hot, and often highly humid, with no frost (Bruton & Cooper 1980, Schultze 1982). The mean annual temperature for various parts of this area varies from 21° to 24°C. This type of climate creates favourable conditions for many tropical plant species and is one of the reasons for the high levels of endemism and biodiversity in Maputaland (Van Wyk 1994, 1996; Lubbe 1996). Maputaland lies within the summer rainfall area, although rain is received throughout the year. The mean annual rainfall is 800 to 1 500 mm at the coast and it decreases rapidly towards the interior (Moll 1977). The Pongola region is the driest part with a mean annual rainfall as low as 500 to 600 mm, although these values are still fairly high in comparison to the rest of South Africa (Schultze 1982) (Figure 2.4).

Rainfall and temperature data for the core study area were taken from the Sihangwane Weather Station (E 32º 25’ 25”, S 27º 02’ 35”) in the Tembe Elephant Park (Figures 2.5 & 2.6). The fluctuation from the long-term mean of 721.5 mm was calculated from 1959 to 2002 (Figure 2.5). The rainfall data obtained from the Sihangwane Weather Station showed that the rainfall in 1999 (1020.5 mm), 2000 (1391.1 mm) and 2001 (904.6 mm) was well above the mean annual rainfall. The wettest year since the previous highest rainfall event of 1984 was in 2000. In 2001 when the study commenced the rainfall had therefore been above the mean for three consecutive years. In contrast, only 246.9 mm of rain was recorded for 2002. The rainfall recorded from January 2003 to May 2003 (98.4 mm), was approximately equal to that of 2002 for the same months with 95.4 mm of rain, but much lower than the rainfall of 2001 for the same months (447.9 mm). The above sequence of exceptional rainfall years that follow each other should be taken into consideration when interpreting and analysing the results in this study. In general the highest mean monthly rainfall was found to occur in February and March and the lowest in May and June. There does not seem to be a pronounced dry season as the lowest mean monthly rainfall still exceeded 35 mm. The mean annual temperature recorded for the Tembe Elephant Park was 23.1ºC, with temperatures ranging from an extreme minimum of 4ºC to an extreme maximum of 45ºC (Figure 2.6).

2.8 VEGETATION

The area of the present study lies within the core of the Maputaland Centre of Plant Endemism as described by Van Wyk (1996). It is covered mostly by grassland with relatively small patches of short or tall forest, usually bordered by woodland (Matthews *et al.* 1999, 2001). The Sand Forest and Wooded Grassland are two remarkable vegetation types endemic to Maputaland (Van Wyk & Smith 2001).

Moll (1977, 1980) described approximately 15 broad vegetation types for the KwaZulu-Natal region of Maputaland. These were the Lebombo Forest, Lebombo Range Vegetation, Mixed Bushveld, Thicket, Red-sand Bushveld, Floodplain Vegetation, Sand Forest, Pallid-sand Bushveld, Mosi Swamp Vegetation, Papyrus Swamp, Palm Veld, Coastal Grassveld, Swamp Forest, Mangroves and Dune Forest.

According to Low and Rebelo (1998), the vegetation in the study area belongs to the Forest Biome and the Savanna Biome. The Sand Forest is part of the Forest Biome, the smallest biome in South Africa (McKenzie 1998). The vegetation in other parts of the study area fall within the Sub-humid Lowveld Bushveld (Granger 1998) and the Coastal Bushveld Grassland (Granger *et al.* 1998) both part of the Savanna Biome (Low & Rebelo 1998).

According to the most recent vegetation classification and description (Mucina & Rutherford 2006) the study lies within three major biomes, the Indian Ocean Coastal Belt, the Savanna Biome and the Forest Biome. The vegetation units represented within the study area are the Tembe Sandy Bushveld (SVI 18), the Maputaland Coastal Belt (CB 1), the Maputaland Wooded Grassland (CB 2), the Sand Forest (FOz 8), the Subtropical Freshwater Wetlands (AZf 6) and the Subtropical Alluvial Vegetation (AZf 7) (Mucina & Rutherford 2006) (Figure 2.7).

The present study focused mainly on the grassland areas between the Sand Forest patches, which were described as Coastal Grassland and Palm Veld by Moll and White (1978).

A short discribtion of the different vegetation types in the study area is provided based on description by Matthews 1990, 1995, Matthews *et al.* 1999, 2001, Hanekom 1998a, 1998b, 1999a, 1999b, 2000, 2001, 2002a, 2002b, 2003a, 2003b, 2004a, 2004b, Gaugris 2004, Gaugris *et al*. 2004, Van Eeden 2005. In the present study the vegetation communities of the previous authors were simplified into structural vegetation types, which were termed management units. The structural classification was done according to Edwards's (1983) "broad-scale structural classification of vegetation for practical purposes".

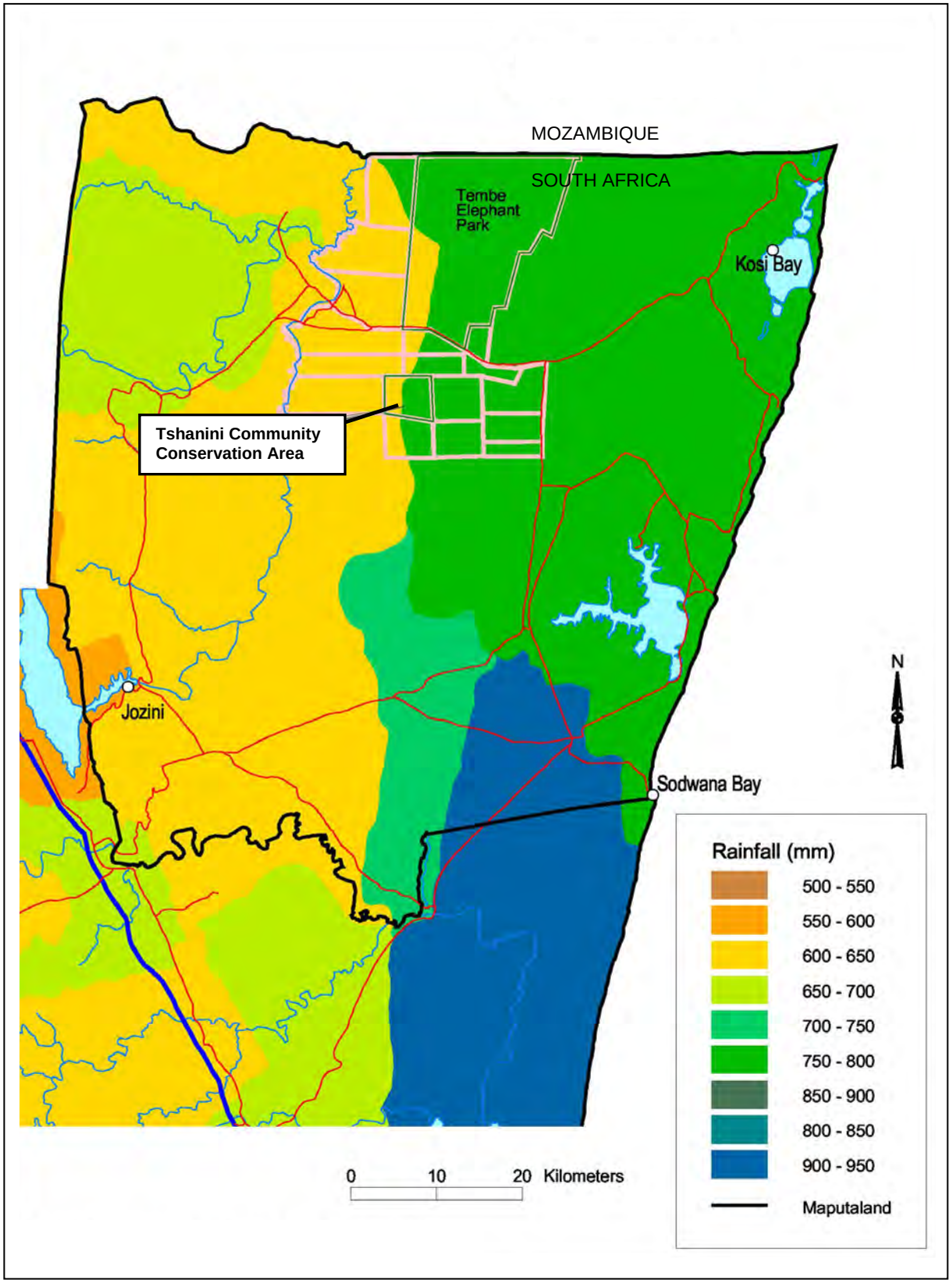

Figure 2.4: Rainfall map for Maputaland, northern KwaZulu-Natal. Ward boundaries of study area outlined in pink and conservation areas in green (ENPAT 2001).

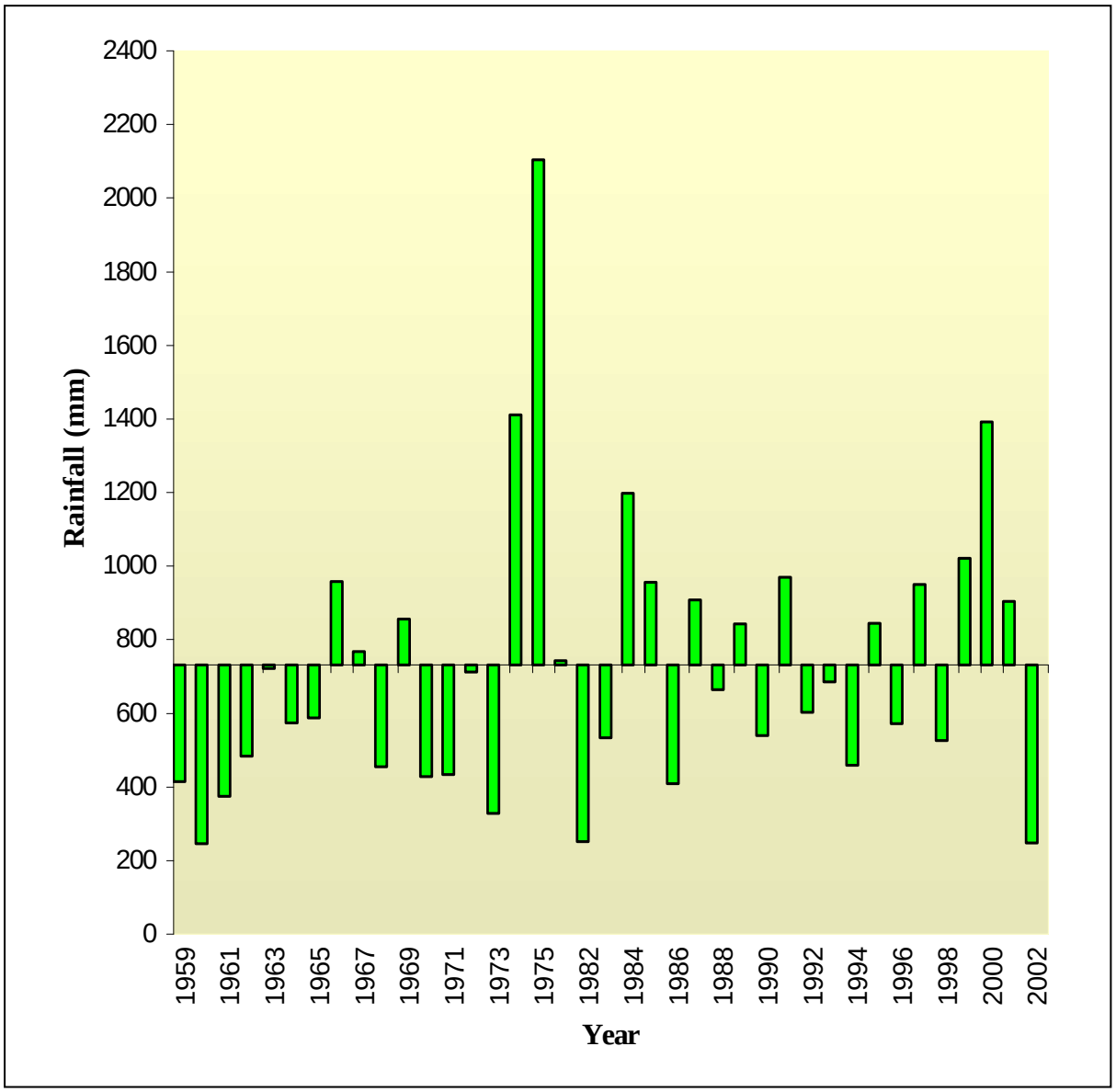

Figure 2.5: The annual rainfall (mm) for the Sihangwane Weather Station, Tembe Elephant Park, Maputaland, northern KwaZulu-Natal, from 1959 to 2002, indicating the fluctuation from the mean of 721.5 mm.

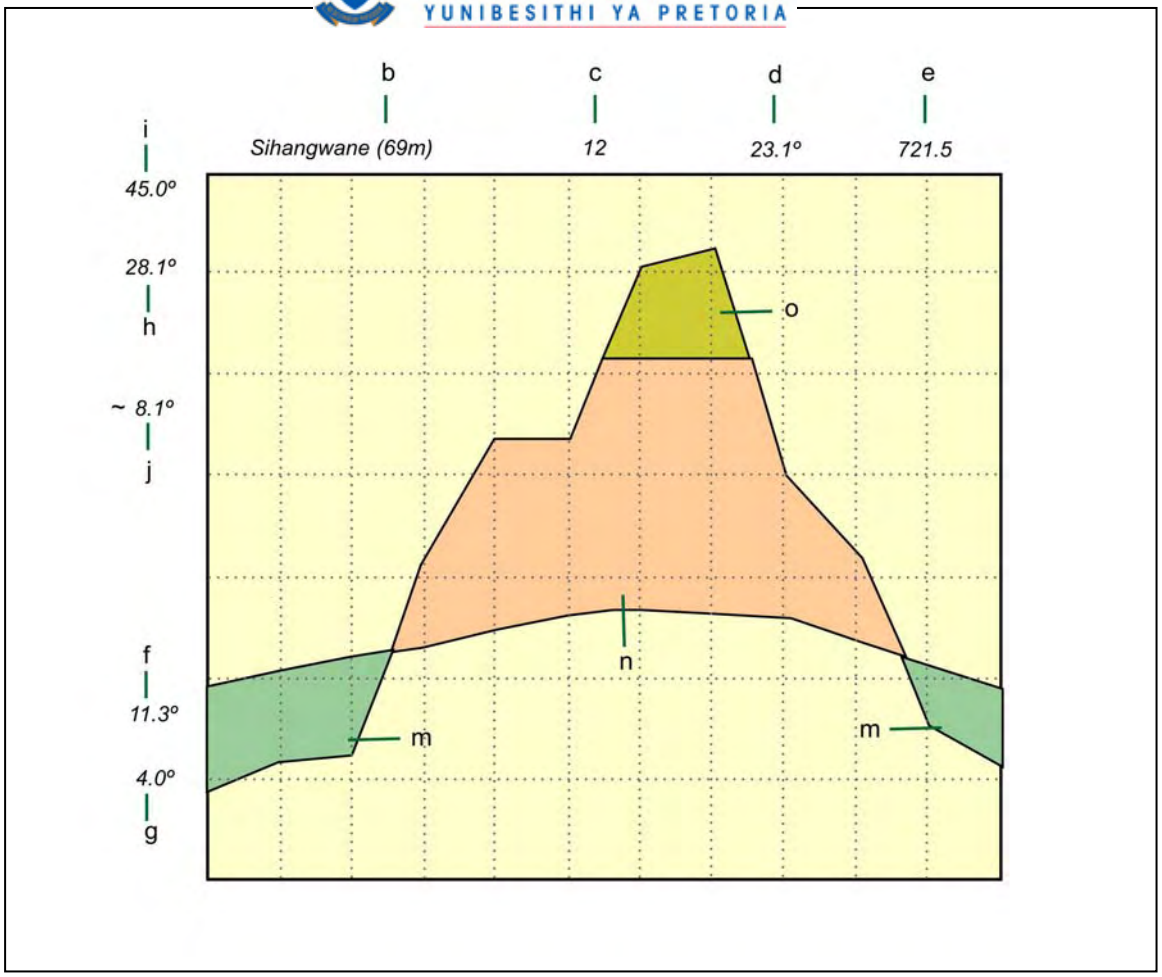

Figure 2.6: Climatogram of Sihangwane Weather Station, Tembe Elephant Park, according to the convention of Walter (Cox & Moore 1994). a = station name; b = height above sea-level in m; c = duration of observations in years; d = mean annual temperature in ºC; e = mean annual precipitation in mm; f = mean daily minimum of the coldest month; g = lowest temperature recorded; h = mean daily maximum of the warmest month; i = highest temperature recorded; j = mean daily temperature variation; m = relative period of drought; n = relative humid season; o = mean monthly rainfall > 100 mm (Tarr *et al*. 2004).

2.8.1 The Sand Forest - Grassland Mosaic management unit

This grassveld vegetation unit occurred as a mosaic with the Sand Forest patches and was characterised by the absence of trees and shrubs. It formed an open grassland zone around and between the Sand Forest patches. In some areas this unit was totally enclosed by the Sand Forest. The grass *Urelytrum agropyroides,* the forb *Indigofera inhamanensis,* the geophyte *Trachyandra* cf. *salti* and the sedge *Cyperus obtusiflorus* were the dominant species in the unit. Other grass species that were well represented in this management unit included: *Diheteropogon amplectens, Andropogon schirensis, Perotis patens, Panicum kalaharense* and *Aristida stipitata.* In the Tembe Elephant Park this vegetation type covered 47.9% of the area and in the Tshanini Community Conservation Area, 4% of the area (Matthews *et al.* 2001, Gaugris *et al.* 2004).

2.8.2 The Closed Woodland management unit

This management unit corresponded to the unit that was mapped as Woodland on Clay in the Tshanini Community Conservation Area by Gaugris *et al.* (2004). The dominant grass species encountered in this management unit were: *Panicum maximum, Digitaria eriantha* and *Eustachys paspaloides. Panicum maximum* had the highest frequency occurrence in the Tembe Elephant Park, Sileza Nature Reserve and Tshanini Community Conservation Area Perennial pans were also found throughout this vegetation type. The woody plant species that were abundant in this unit were the trees *Spirostachys africana, Berchemia zeyheri, Acacia burkei* and *Mystroxylon aethiopica* and the shrubs *Euclea natalensis, Grewia caffra, Catunaregam spinosa* and *Bridelia cathcartica.* The Woodland on Clay covered 2.5% of the Tembe Elephant Park, with an additional 15% covered by the Closed Woodland - Thicket Mosaic. In the Tembe Elephant Park this vegetation type occurred on the dune crests, slopes and interdune depressions throughout the park and could be distinguished on the basis of plant cover, which varied from closed to semi-closed and a canopy height that varied from approximately 8 to 12 m.

2.8.3 The Open Woodland management unit

This unit was associated with the dunes and interdune depressions on grey-brown to orange-grey dystrophic regosols (Matthews *et al*. 2001). It was a short, open woodland with only a few tall trees that reached a height of 6 to 8 m. The tree layer was underlain by a short to tall grassland up to 2 m tall (Gaugris *et al*. 2004). For the present study the Open Woodland management unit was represented by the *Antidesma venosum-Urelytrum agropyroides* Open Woodland and the *Fimbristylis complanata-Diheteropogon amplectens* Open Woodland of Gaugris *et al.* (2004). The prominent grass species included *Urelytrum agropyroides, Diheteropogon amplectens, Eustachys paspaloides, Perotis patens* and *Pogonarthria squarrosa*.

2.8.4 The Open to Sparse Woodland management unit

This management unit was represented by the two sparse woodland sub-communities as defined by Gaugris *et al.* (2004). The unit was found on the dune crest, slopes and interdune depressions of the western side of the Tshanini Community Conservation Area and occurred on the acidic orange-grey dystrophic regosols. Abundant grass species included *Diheteropogon amplectens, Urelytrum agropyroides, Perotis patens* and *Pogonarthria squarrosa* (Gaugris *et al.* 2004). The tree layer was underlain by a short to tall grassland up to a height of 2 m (Gaugris *et al*. 2004). In the Tembe Elephant Park this management unit occurred on the flat areas between the dunes, but also to a lesser degree on the dune slopes and crests and covered 4.2% of the park (Matthews *et al.* 2001).

2.8.5 The Hygrophilous Grassland or Palm Veld management unit

The vegetation in the Sileza Nature Reserve was used as basis to describe the Hygrophilous Grasslands of the unconserved Tembe Traditional Area. Although Matthews *et al*. (1999) stated that all the plant communities were easily distinguishable in the field on the basis of growth form, general species composition and character species, certain transitional zones were hard to distinguish. Especially during a dry year the waterlogged areas were not easily distinguishable from bordering hygrophilous areas. The term Hygrophilous grassland or Palm Veld were used in this dissertation to denote the vegetation described by Matthews *et al*. (1999) as plant community 3 the *Eragrostis lappula-Helichrysopsis septentrionale* Hygrophilous Grassland on humic gleysols (interdune depressions) and plant community 4 the *Ischaemum fasciculatum-Eragrostis inamoena* Hygrophilous Grassland on Champagne soils. Except for a few rare grass species all the other grass species encountered by Matthews *et al.* (1999) in their survey were also encountered in this current study (Appendix 6).

Forbs and sedges, especially *Cyperus sphaerospermus, Cyperus tenax, Cyperus obtusiflorus* and *Cyperus natalensis* were abundant in both the Sileza Nature Reserve and in the unconserved Tembe Traditional Area. The shallow water table (Matthews *et al.* 1999) and perennial waterlogged areas could possibly account for this phenomenon. Other grass species that were diagnostic and showed a high percentage frequency were *Themeda triandra, Trachypogon specatus, Diheteropogon amplectens, Ischaemum fasciculatum, Eragrostis lappula, Eragrostis inamoena* and *Monocymbium ceresiiforme.*

2.9 ANIMALS

The construction of fences around conservation areas in the region has lead to the exclusion of wild herbivores from communal rangelands and arable land. Free-roaming wild herbivores that still occur naturally in the communal areas are the smaller antelope such as the red duiker *Cephalophus natalensis*, grey duiker *Sylvicapra grimmia*, steenbok *Raphicerus campestris* and suni *Neotragus moschatus*.

The present study will focus on the grazing and browsing herbivore species that are to be re-established in the Tshanini Community Conservation Area. Only those species that occur naturally in the area or that have occurred historically in the area (Rautenbach *et al.* 1980, Van Rooyen 2003) were considered for re-establishment. A checklist of suitable types of wildlife for Tshanini Community Conservation Area appears in Appendix 1.

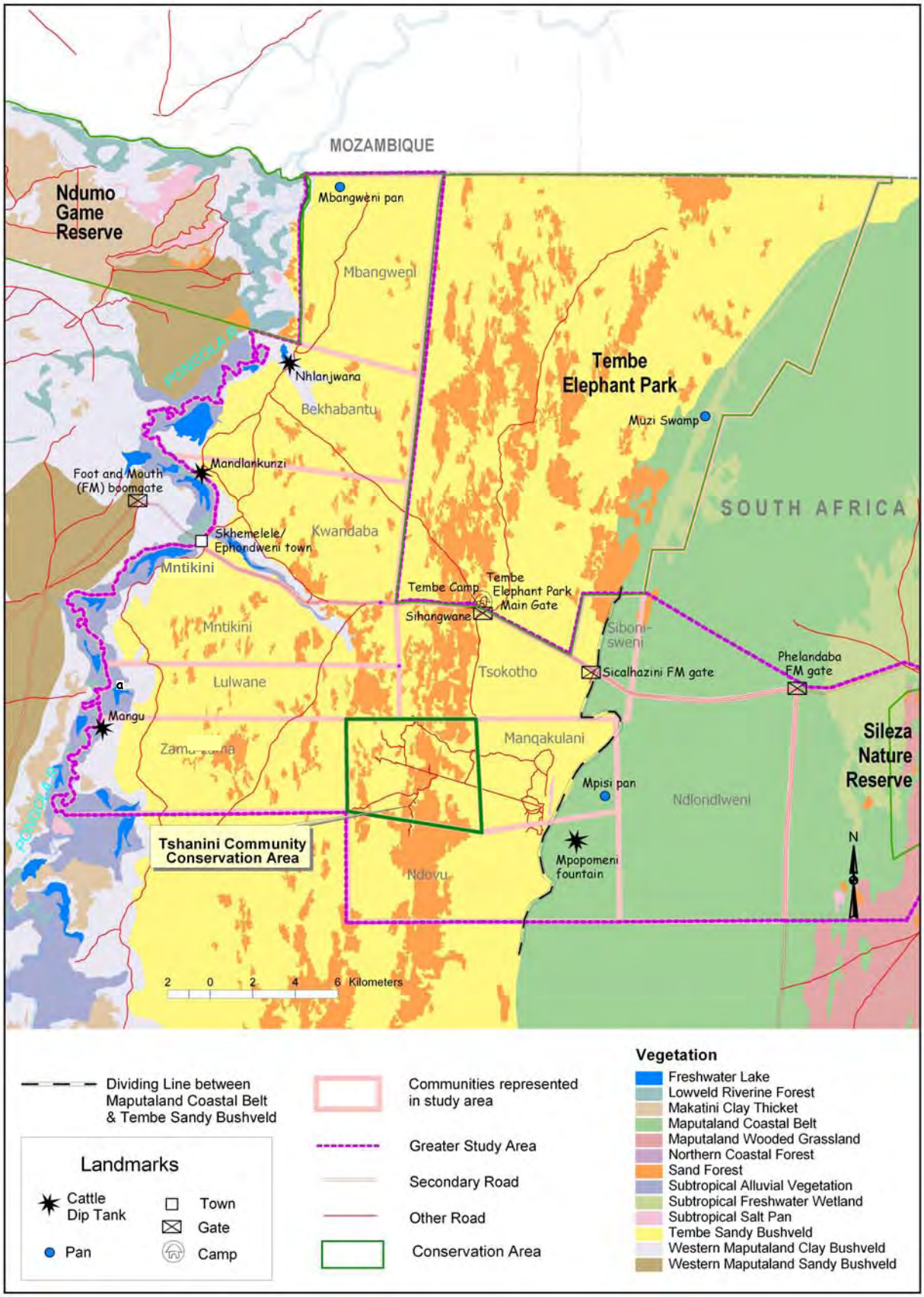

Figure 2.7: The vegetation map (Mucina *& Rutherford* 2006) of Maputaland, northern KwaZulu-Natal with the different study boundaries and landmarks as described in the text.

PHASE 1

Cattle-related aspects in the Tembe Traditional Area: focusing on Cattle systems and communal rangelands in the wards (izigodi) adjacent to the Tembe Elephant Park

Chapter 3

CATTLE SYSTEMS IN THE TEMBE TRADITIONAL AREA: FOCUSSING PRIMARILY ON THE WARDS ADJACENT TO THE TEMBE ELEPHANT PARK

3.1 INTRODUCTION

3.1.1 Communal livestock systems in southern Africa

In most African farming systems, animal husbandry is an essential economic activity. Approximately 70% of the ruminant livestock (cattle, sheep and goats) in southern Africa are kept under smallholder farming conditions based on communal grazing systems (Swanepoel *et al.* 2000). Livestock, especially cattle, have multiple production functions and therefore they are exceptionally important to smallholders, and resource-poor farmers. Most of these farmers believe that cattle have the capacity to serve as a buffer against moderate drought spells and socio-economic risk (Tapson 1990, Swanepoel *et al.* 2000). Hence they regard cattle as a form of "savings" (Els 1996).

Communal rangelands are those areas where subsistence-based agriculture is practiced and where rangelands are predominantly communally-owned and managed (Everson & Hatch 1999). Communal rangelands in South Africa are reported to support a quarter of South Africa's human population and a half of the livestock population. They are also commonly perceived to be badly degraded (De Bruyn & Scogings 1998). Only development programmes based on an understanding of the multiple functions of livestock, and how farmers actually use the resources available to them in communal lands, stand any chance of reconciling the conceptions of commercial farmers with communal farmers. In the past, most development initiatives and projects have aimed to achieve sustainability through the control of excessive livestock numbers. The failure of these efforts can be attributed to the fact that they clashed with the basic reasons why the people were keeping cattle. Unlike the commercial sector, cattle are not primarily raised for meat, but more as a means of investment (bank, savings or financial backdoor) and/or utilization (milk, draught power, skins, dung, manure) as well as social and ceremonial uses

like *ilobolo* (bride price) (Coertze 1986, Tapson 1990, Bembridge & Tapson 1993, Els 1996, Swanepoel *et al.* 2000).

It is a general perception by scientists that communal grazing areas are overgrazed due to high stocking densities of cattle and the absence of effective grazing management practices. The gross environmental destruction in conjunction with the low productivity from the cattle herds is an enduring comment on African agricultural systems, no less so in Maputaland (Tapson & Rose 1984). A vicious cycle of land and cattle deterioration has been initiated in southern and central Africa over the past decades by the expansion of arable areas and a rapid increase in human and livestock populations (Bembridge & Tapson 1993).

De Bruyn & Scogings (1998) stated that: *"Communal rangelands, which occur in the former homelands (and constitute ca. 12% of the country), supported a quarter of South Africa's human population and half the livestock population. These high population pressures have resulted in environmental changes (e.g. vegetation structure), which are widely interpreted as degradation. It is, therefore, the common perception of the public and the scientific community that the communal rangelands are degraded and, hence, unproductive and unsustainable. In order to achieve sustainable agriculture (in the communal rangelands in particular), land use has to be ecologically sound, economically viable and politically supported. Wide reformulation of policies is occurring in South Africa following the 1994 elections. Much of this legislation will also affect land users, including the occupiers and users of communal rangeland".*

The above authors continued by stating that: *"Recent scientific reports (Behnke* et al. *1993), however, stated that there was no need for concern about overgrazing or degradation of communal rangelands since the inherent variability of rainfall has such an impact on livestock that animal mortality allows the recovery of the rangelands while livestock populations return to pre-drought levels. The perception was thus created that grazing has no effect on the vegetation. Similarly, evidence has been put forward (Abel, 1993 & Scoones, 1993) that livestock numbers have remained reasonably constant over time, which is interpreted as proof that no degradation has occurred. These interpretations are now being questioned."*

The results of Tapson (1990) revealed that the grazing resource in the former Zululand was not threatened by imminent ecological collapse, and that soil erosion as a consequence of overgrazing was not as serious as is commonly assumed.

3.1.2 **Cattle ownership among the Zulu people**

The value of cattle among the Nguni-speaking people of South Africa, and especially among the Zulu people, has been well documented (e.g. Herskovits 1926, Bryant 1929, 1967, Binns 1975, Lugg 1964,

Sansom 1974 In: Els 1996) (Krige 1981, Coertze 1986, Tapson 1990). It is clear that these domestic animals fulfil an important economic, religious and social role in the lives of these people. Tapson (1990) distinguished three ways in which the value of cattle to the people could be assessed:

- the “monetary” role that states that cattle are held primarily as a store of wealth;
- the “numbers only” role where cattle numbers are still the primary objective and not necessarily the quality or physical condition of the animals; and
- the “custom and subsistence” role where cattle are sold to satisfy specific needs.

For the Zulu people, cattle have always meant status in social life (Coertze 1986). However, the point is often missed that the concept of status and wealth has always been interchangeable. Status can create situations of power for those in possession of status, and thus also, for those wealthy in cattle. On the other hand Sansom (1974 In: Els 1996) clearly stated that cattle served as real capital, money and consumption goods among the Nguni people: "...*cattle are the traditional equivalent of money. They are stores of value, standards of value and media of exchange. They provided ... the "big notes" rather than the "small change" in traditional transactions*" (Sansom 1974 In. Els 1996).

The research that was done by Els and Van der Walt (1996) in the Makatini Flats (close to where the present study was undertaken) indicated that the reasons why people kept cattle had not really changed from the customary practices, and that the socio-economic value attached to *ilobolo*, and *amasi* (sour milk), were still common. Both practices also had a largely "negative" effect on the decision to sell animals commercially, as well as on the slaughter of these animals to provide protein in the daily diet.

3.1.3 Typical constraints and problems in the study area

The following constrains and problems were encountered when the present study was initiated in July 2001:

- To get hold of the State Veterinarian was almost impossible, and when at last a meeting was arranged it became apparent that the position was on the verge of becoming vacant. The position for the region’s State Veterinarian stayed vacant for nearly 1.5 years. Although the person acting on behalf of the state veterinarian gave his full cooperation, his knowledge regarding the research theme was in most instances lacking.
- Communication and arranging meetings were complicated by distance and timing.
- Dipping logbooks and dip tank registers were either missing or incomplete.
- Long distance travel resulted in financial constraints.

- Two of the health technicians passed away during the research period. The technicians used to accompany the researcher and made communication and interaction with the different communities easier. The technicians also arranged dates for dipping days and general cattle health inspections.
- The dipping tanks were not always operational and getting the water into the dip tank was a problem, as were getting dipping chemicals available and ready in time for the dipping days.
- Great stumbling blocks for the local communal people were the lack of proper transport and roads, which could not be traversed for most vehicles.
- Many meetings were either postponed or delayed due to reasons beyond the communities' control.
- Factors like sporadic floods (broken bridges and rivers in flood), funerals and conflict within the community about the time schedules of dipping days all contributed to delays and cancelling of some of the dipping days.
- The representatives of the dipping committees were difficult to contact because of a lack of telephone or cellular phones.
- Due to incomplete, lost or unavailable dip tank registers, statistical analyses could not be done on the regularity of visits to the dip tank, the number of animals dipped and the herd size of individual owners. Manhlangunzi had the only dip tank that had a fairly complete register. However, the data stopped at the end of 1998, and no reliable comparisons could be made with the research results.

For the local people, however, it never seemed to be a problem whether or not these dipping occasions took place. Their outlook on life that tomorrow was another day was another dimension that the researcher had to accommodate and get accustomed to.

Towards the end of the study period and after a number of meetings between the local committees, the *indunas* (headmen of wards, also representatives of the *Inkosi*) of the local wards and the State Veterinary Department changes became evident. A new state Veterinarian was appointed, dipping facilities were renovated and upgraded and a new animal health technician brought some transformation into the communities' cattle system dilemma.

3.2 STUDY OBJECTIVES

To understand the theme of this study and thus the ecological state of the veld in the study area it was most important to have a background understanding of cattle systems and the way people do what they do with their cattle and thus their grazing land. Without this background information or understanding

of both aspects namely, local cattle management systems and range condition, no informed decisions can be taken. Because these aspects affect each other directly or indirectly they have to be viewed holistically. The research done in this phase was thus not to try and force an answer on whether or not, for example, overgrazing was or was not occurring but rather what driving forces were present that influenced both these aspects and eventually the ecological state (whether positive or negative) in the study area.

From what is stated above the main objective of this study was to gather information that could in the future contribute to the formulation of an appropriate cattle management policy and the implementation of a grazing management strategy that will enhance sustainable livelihoods. Such a policy should provide ecological sustainability of the natural resources for the people surrounding the Tembe Elephant Park. This can only be done by replacing presumptions and preoccupied opinions with facts.

The specific objectives of the present study were therefore:

- To determine the cultural significance of cattle in the everyday lives of the Tembe people of Maputaland.
- To determine the number and distribution of the cattle in the study area.
- To determine the physical condition and general health status of the cattle in the study area.
- To obtain baseline information on the cattle systems and management practices in the Tembe Traditional Area adjacent to the Tembe Elephant Park at the time of the study. This included the animal husbandry practices and management of grazing land in the study area.
- To determine the constraints experienced by cattle and grazing management in the study area at the time of the study.
- To report on less common cattle-related aspects in the Tembe Traditional Area.

3.3 STUDY AREA

3.3.1 Location

The research on cattle systems was done at and around the four dip tanks run by the state veterinarian for the Umkhayakude District and local Umhlabuyalingana Municipality previously known as the Ingwavuma District in Maputaland, KwaZulu-Natal. The four dip tanks were: Mangu (Zama-zama), Manhlangunzi (Kwandaba), Mpopomeni (Manqakulani) and Nhlanjwana (Mbangweni/Bhekabantu). All these wards are situated in the western and southern section of the Tembe Traditional Area (Table 3.1 and Figure 2.1).

The exact size of the area from which owners brought their stock to the four specific dip tanks, was not available. However, it was estimated that each dip tank served an area with a radius of 7 to 10 km. Any person in the general vicinity of a dip tank could bring cattle to it. This could have included cattle coming from wards outside the study area.

3.4 MATERIAL AND METHODS

The accepted method of qualitative research, according to the precepts of Coertze (1978) and Mouton and Marais (1989) was applied. Initial extensive and in-depth interviews on the research theme, by means of an open-ended subject sheet, were conducted with the state veterinarian and three of the animal health technicians for the district. In addition, extensive and in-depth interviews on the research theme were held with the cattle owners at the four dip tanks, i.e. Mangu, Manhlangunzi, Mpopomeni and Nhlanjwana. Personal, extensive and in-depth interviews on the research theme and an open-ended questionnaire were also conducted with individual cattle owners at their respective homes, as well as with members of their respective families. Members of the different dip tank committees were also interviewed. The open-ended questions were also attached to a questionnaire that was part of other in-depth scientific studies in the area (Appendix 4). These sheets were distributed in the four wards where this study was undertaken. The interviewer, fluent in English, was a *Zulu*-speaking community member of the Manqakulani ward. The interviewer was instructed on the meaning and interpretation of the questions and the study as a whole, to ensure no misinterpretation could bias the data.

A physical condition-scoring chart for cattle was compiled and developed from previous research done by the KwaZulu-Natal Department of Agriculture (Van der Merwe & Stewart 1995), the Animal Husbandry, Advisory and development Department (East of Scotland College of Agriculture 1973) and Edmonson *et al.* (1989). This physical condition-scoring chart was used to assess the body fat reserves of cattle relatively quickly and consistently. Although the assessment was subjective, experience has showed that consistent results are obtained with the same experienced operator. The questionnaires and the physical condition scoring sheets for cattle (Appendix 3) were used independently to counteract any bias that might occur.

Two scoring areas were involved, namely the loin and the tail juncture with the body (Appendix 2). The physical condition of the animal was assessed subjectively by judging each animal from a distance of approximately 2 m, and then by feeling by hand the amount of fat cover over the transverse processes (horizontal projections) of the lumbar vertebrae and around the tail juncture with the body. The animal was awarded a physical condition score on a scale of 1 (poor) to 4 (fat).

Table 3.1: The different dip tanks, their coordinates, the ward in which they occur, the specific day on which dipping takes place and the number of dipping days per month in the Tembe Traditional Area. Data obtained during the 2001 to 2003 seasons

Dip tank name and number	Location/ coordinates	Ward (Isigodi)	Dipping day	Number of dipping days per month
Mangu (802)	S 27.09912° E 32.26115°	*Zama-zama*	Monday	2 in summer 1 in winter
Manhlangunzi (803)	S 26.99067° E 32.30328°	*Kwandaba*	Thursday	2 in summer 1 in winter
Mpopomeni (682)	S 27.14222° E 32.45636°	*Manqakulani*	Wednesday	2 in summer 1 in winter
Nhlanjwana (320)	S 27.09912° E 32.26115°	*Mbangweni/ Bhekabantu*	Friday	2 in summer 1 in winter

Physical condition scoring was only done on cows and heifers and only scores of 0 to 3 were obtained during this study. Due to time constraints no distinction was made between cows and heifers. Bulls, oxen and calves were also counted but were not scored for physical condition.

3.5 RESULTS

3.5.1 General cattle related aspects

3.5.1.1 Value system of cattle in the Tembe Traditional Area

Apart from their important role in the customary practices, the people in the study area kept cattle as "insurance" or security in times of family need. Cattle were, according to respondents, sold to acquire school fees, to buy school clothing, to acquire cash when it was urgently required for payment of fines in court cases, to pay for family feasts, or for expenditure when no alternative funding was available. This result confirmed Tapson's (1990) findings.

Apart from these "unforeseen" expenditures, male respondents in the study area, indicated that the transfer of cattle as *ilobolo* was one of the most important reasons for their keeping of cattle, or for trying to acquire cattle, as no man was really a man if he could not deliver at least half of the *ilobolo* for his wife in cattle. For this reason young men acted as herd boys for other cattle owners, as they were then paid with a heifer for a year's service. In this manner they acquired cattle to pay *ilobolo* in the appropriate way.

Women respondents indicated that they would also feel slighted, as women if the *ilobolo* delivered for them were not in the form of cattle. The possession of cattle thus denoted status in the communities studied.

An *ilobolo* value of 11 head of cattle was customary in the study area as *ilobolo* for the daughter of an ordinary man, 16 for the daughter of an *induna* (ward headman) and 20 to 35 for the daughter of the *inkosi* (traditional chief). If the girl was educated, the number of cattle could increase considerably. In instances where the father of the bride to be wanted money or household goods for his daughter rather than cattle, cattle was sold by the bridegroom's people (usually his father) to obtain the necessary funds, with which to purchase the required goods.

Although any person could possess cattle among the people in the study area, the livestock were usually regarded as the possession of men. Women and children did, however, frequently own their

own cattle. Fathers would frequently give a daughter a cow to take as her possession to her family-in-law when she married.

The general concept that cattle were not kept primarily as consumptive goods among the people in the study area was also documented by Tapson (1990). Sansom (1974 In: Els 1996) made the same conclusion in respect of other Bantu-speaking people in South Africa, when he indicated that: "*Cattle management ... is the last stronghold of traditional modes. Cattle are managed by men, who are able to adjust the size of their herds by working in town for their wages. Herds are not managed to produce consumption goods. They are relevant in bride wealth transactions and as stores of value - the only long-term investment the tribesmen are likely to make".*

3.5.1.2 Cattle ownership in the Tembe Traditional Area

It was evident from the questionnaires as well as from the interviews that men owned and controlled the use of cattle in the study area. Men also took decisions relating to the disposal of cattle. Respondents indicated that in exceptional cases women also owned cattle through marriage. Children, especially herd boys (in the Zulu language herd boys are referred to as *abelusi*), owned cattle when they were rewarded for a year's work. Management tasks relating to cattle husbandry, mainly herding and milking, were performed by the herd boy, old men and in extreme cases women.

A summary of the various reasons, benefits and uses derived from cattle in the study area is presented in Table 3.2. The reasons why the majority of people in the study area kept cattle were not commercially motivated (Table 3.2). Most people interviewed regarded the benefits derived from cattle, in this case the utilization aspects (milk, draught power, meat, dung) as the major incentive to own cattle. The dung of cattle was still used for floors and to plaster raw brick walls. The use of cattle dung as manure in fields was seldom encountered, according to respondents. However in two of the *izigodi*, Manqakulani and Zama-zama, financial security ranked highest. Ranking third in all the mentioned wards were the social and ceremonial uses, which included *ilobolo* (bride's price), funerals and ceremonial functions.

The main reason why people in the study area did not own cattle was that they did not have the money to buy cattle (64.6% of the respondents), whereas 34.7% of the respondents said that their cattle had died in the past few years and only 0.7% of the people said that they did not want cattle (Table 3.3). These results underline the importance of cattle to the people in the study area, and the fact that poverty and related cattle mortalities were the main stumbling blocks for people to possess their own cattle.

Table 3.2: The main reasons why people own, previously owned or wanted to own cattle in the different wards. Data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Number of respondents	Response					
		Financial security		Utilization		Social and ceremonial uses	
		n	%	n	%	n	%
Bekhabantu	85	32	38.0	41	48.8	12	14.2
Manqakulani	40	21	52.5	13	32.5	6	15.0
Kwandaba	19	8	42.1	8	42.1	3	15.7
Zama-zama	32	10	31.3	14	25.0	8	25.0
Total	**176**	**71**	**-**	**76**	**-**	**29**	**-**
Mean	**-**		**40.3**	**-**	**43.2**	**-**	**16.5**

Note: **n** is the number of people who responded to the questionnaire. Not only the owners of cattle responded but also those wanting to own, or previously owning cattle.

Table 3.3: The main reasons why people did not own cattle in the different wards according to data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Number of respondents	Response					
		No money to buy cattle		Cattle died		Do not want cattle	
		n	%	n	%	n	%
Bekhabantu	225	129	57.3	94	41.8	2	0.9
Manqakulani	82	57	69.5	25	30.5	0	0.0
Kwandaba	111	72	64.9	39	35.1	0	0.0
Zama-zama	40	38	95.0	1	2.5	1	2.5
Total	**458**	**296**	-	**159**	-	**3**	-
Mean	-	-	**64.6**	-	**34.7**	-	**0.7**

Note: **n** is the number of people who responded to the questionnaire. Not only the owners of cattle responded but also those people wanting/or not wanting cattle or previously owning cattle.

3.5.1.3 Mean herd size and herd composition in the study area

It is a national tendency and a traditional goal of almost all communal livestock owners to boundlessly increase the number of livestock owned (Bembridge & Tapson 1993). The main objective of these farmers is therefore an increase in numbers and not necessary productivity.

The results of the in-depth questionnaires, census sheets and open-ended question sheets indicated that the total number of cattle in the study area was 1 030 (Table 3.4). However, according to the dip tank visits and the physical condition scoring sheets the total number of cattle in the study area was approximately 736 (Table 3.6) and according to the health technician's verbal and written reports the total head of cattle in the study area was approximately 6 062 (Xaba & Dikobe *pers.com.*)[1]. It was not clear what this discrepancy in the estimated cattle numbers could be ascribed to.

Only 14.9% of household owned cattle and the mean number of cattle per household was 11 (Table 3.4) with 44.8% of the 90 owners owning five or less head of cattle and only 19.4% owning more than 20 head of cattle (Table 3.5). Some of the cattle owners owned more than 30 head of cattle and one respondent even owned over 200 head of cattle. According to the questionnaires three of the cattle owners considered themselves to be commercial farmers. Bembridge and Tapson (1993) consider < 10 head of cattle per owner to be below the minimum number of animals necessary for the primary human needs of survival and subsistence. A herd of 10 head of cattle, comprising of three cows, three calves, one heifer, one bull and two oxen, is considered sufficient to supply 2 litres of milk per day, to plough 7 ha, to provide 5 tonne of manure (for flooring and fertilization) per year, while a single animal can also be sold every second to third year with a return on capital value of 20 to 25%.

The herd composition of the cattle in the study area was determined by using the information on the physical condition-scoring sheets and is presented in Table 3.6. Cows represented 58.0%, calves 19.8%, oxen 11.2% and bulls 11.0% of the total herd. This gives a ratio of approximately one bull for every five cows.

3.5.1.4 Physical condition and general health status of cattle

Figures 3.1 to 3.4 illustrate the typical appearance of cattle that are in the different physical condition scores classes and Appendix 2 explains how the tail juncture and the rib loin area were judged. The majority (80.3%) of the cattle owners indicated that according to their perception their cattle were in a

[1] *Both late* Messrs J.M. Xaba and G. Dicobe. Animal Health Technicians. State Veterinary Department, Makatini Research Station, Jozini 3969.

Table 3.4: The number of households, number of cattle owners, percentage of cattle owners in each ward and the mean number of cattle per household. Data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Number of households	Cattle data per ward			
		Number of people owning cattle	Percentage of households owning cattle	Mean number of cattle per household	Total number of cattle
Bekhabantu	260	30	11.5	9.0	269
Manqakulani	116	34	29.3	12.2	417
Kwandaba	118	7	5.9	15.0	105
Zama-zama	111	19	17.1	12.6	239
Total	**605**	**90**	-	-	**1030**
Mean	-	-	**14.9**	**11.4**	-

Table 3.5: The four different herd size categories as percentage of all herds for the different wards. Data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Number of people owning cattle in each ward	Herd size category as a percentage			
		≤5 animals	6-10 animals	11-19 animals	≥20 animals
Bekhabantu	30	53.3	16.7	20.0	10.0
Manqakulani	34	41.1	17.7	23.5	17.7
Kwandaba	7	42.8	28.6	-	28.6
Zama-zama	19	42.1	21.1	15.8	21.1
Total	**90**	**44.8**	**21.0**	**14.8**	**19.4**

healthy and "good" condition. Of the 2 165 cows and heifers that were examined by the researcher, the majority of the animals (57.4%) scored 2 on the condition-scoring sheet (Table 3.7). According to Van der Merwe and Stewart (1995) this is the ideal target condition. This score indicates that the animal is in a moderate physical condition. A total of 35.9% of the cows and heifers that were examined scored < 2 on the physical condition-scoring sheet, indicating that their condition was poor to moderate. The poorer the physical condition the more prone these animals are to tick-born diseases and other infections. This in turn will result in lower production and reproduction rates (Van der Merwe & Stewart 1995, Swanepoel *et al.* 2000).

3.6 CATTLE MANAGEMENT

3.6.1 Herding cattle

The respondents and spokespersons at the different dipping sites indicated that the herding of cattle, whenever possible, was done by the owner himself (usually the head of the household). The reason for this was that the *abelusi* suited for this job had to attend school according to new legislation.

The way in which the *abelusi* were paid depended on the contract that existed between them and the cattle owner. In some cases they were paid one head of cattle per year, while others were paid R1000 per year.

Cattle owners that were part of the migratory labour force had to hire *abelusi* to look after their cattle. *Abelusi* did not have any authority over what happened to the cattle, which they tended to. Their task generally entailed herding cattle to and from the grazing area, allowing cattle to drink fresh water daily and keeping them from trespassing on to cultivated lands, vegetable gardens and other forbidden areas. Decisions on any major aspect of animal health was therefore not taken by the *abelusi*. Some *abelusi* who were interviewed, indicated that it could take up to three months to get a decision from the cattle owner on a particular matter.

Personal observations indicated that cattle were often not actively herded, but were allowed to graze freely. According to the questionnaires, eight of the respondents indicated that no one was tending their cattle and that the cattle were thus free-ranging at that stage. Some of the spokespersons also indicated that when no one was available to tend to the cattle, a father or mother or even a cousin would help to look after the cattle, or at least try to do so. It could therefore, be deduced that the whole family eventually shared the responsibility of looking after the cattle at some or other stage.

Table 3.6: The herd composition according to the data entered in the physical condition scoring sheets. Data obtained in the Tembe Traditional Area from 2001 to 2003

Ward	Herd composition								
	Cows and heifers		Calves		Oxen		Bulls		Dipping days attended
	N	%	N	%	N	%	N	%	n
Bekhabantu	74.5	62.3	21.3	17.8	9.8	8.2	13.8	11.5	6
Manqakulani	133.9	51.1	61.1	23.3	46.0	17.6	20.4	7.8	7
Kwandaba	101.8	62.0	27.2	16.6	11.7	7.1	23.2	14.1	4
Zama-zama	187.0	56.2	71.0	21.3	39.5	11.9	35.0	10.5	2
Total	**497.2**	-	**108.6**	-	**107.0**	-	**23.1**	-	**19**
Mean	-	**67.5**	-	**14.8**	-	**14.5**	-	**3.1**	-

Note: **N** is the mean number per dipping session over a one-year period and **n** is the number of dipping sessions attended during the year 2001-2003.

Figure 3.1: A typical example of a cow with a physical condition score of 1 (poor). A cavity is presented around the tail head. No fatty tissue can be felt between the skin and pelvis but the skin is supple. The ends of the transverse processes are sharp to touch and the upper surface can be felt easily. There is also a deep depression in the loin area.

Figure 3.2: A typical example of a cow with a physical condition score of 2 (moderate). There is a shallow cavity lined with fatty tissue, which is apparent at the tail head. Some fatty tissue can be felt under the animal's skin. The pelvis can easily be felt. The ends of the transverse processes feels rounded but the upper surfaces can only be felt with pressure. There is a depression visible in the loin area.

Figure 3.3: A typical example of a cow with a physical condition score of 3 (good). The fatty tissue can easily be felt over the whole tail head area. The skin appears smooth but the pelvis can be felt. The ends of the transverse processes can be felt with pressure but a thick layer of tissue is visible on top. A slight depression is visible in the loin area.

Figure 3.4: A typical example of a cow with a physical condition score of 4 (fat). Folds of soft fatty tissue are present. Patches of fat are apparent under the skin. The pelvis can only be felt with firm pressure. The transverse processes cannot be felt even with firm pressure. No depression is visible in the loin area between the backbone and the hipbones.

Table 3.7: The total number of cattle that were examined during dipping sessions and the physical condition of the cattle given as a percentage according to the condition scoring sheets in each ward. Data were obtained in the Tembe Traditional Area from 2001 to 2003

Ward	Number of cattle examined	Physical condition scoring scale								
		0		1		2		3		
		n	%	n	%	n	%	n	%	N
Bekhabantu	447	12	2.7	176	39.4	243	54.4	16	3.6	6
Manqakulani	937	29	3.1	322	34.4	519	55.4	67	7.1	7
Kwandaba	407	11	2.7	115	28.3	249	61.2	32	7.9	4
Zama-zama	374	2	0.5	111	29.7	232	62.0	29	7.8	2
Total	**2165**	**54**	**-**	**724**	**-**	**1243**	**-**	**144**	**-**	**19**
Mean	**-**	**-**	**2.5**	**-**	**33.4**	**-**	**57.4**	**-**	**6.7**	**-**

Note: **N** is the number of dipping sessions attended and n is the total number of cattle examined and scored in each session.

According to the response to the questionnaires and that of the personal interviews 80.4% of the cattle owners took their animals to stock posts. Fixed times were set to herd cattle back to the homestead or the stock post, and to take them out to the communal grazing area. The majority of the respondents (76.8%) indicated that they took their cattle from the stock post from 05:00 to 07:00 and 70% indicated that their cattle returned from the grazing area from 16:00 to 18:00.

3.6.2 Animal selection

The best bulls were selected on the grounds of body size. Especially the size of the rump was used as a measure of quality as this indicates a bull with "*a lot of meat and power*". Some respondents used the scrotum size as an indicator of quality. Selected bulls were kept in the herd for breeding. The Zulu words that were used to describe the qualities of a bull were: strong = *inginile*, fit = *iscwele* and fat = *ikhuluphele*. These words were often heard when discussing the qualities of a good bull during dipping occasions.

As cattle herds grazed together in the commonage, almost any bull could service a cow in heat (oestrus). Breeding selection was therefore not intensively practised by owners, and it was not an issue which cattle owners regarded as being of utmost importance. Respondents indicated that it was usually the biggest and/or strongest bull that got its way, and that quality offspring were ensured in this manner. However, *abelusi* were sometimes instructed by herd owners to make sure that a cow in heat was kept close to a specific bull, whether it belonged to the owner or not, and to ensure that only that specific bull serviced the cow. Four respondents indicated that arrangements could be made, at a fee, for servicing a cow by such a bull. Such fees were usually not more than R50 per occasion. The two selected animals were kept together in the cattle stock post at one of the homesteads for a few days. According to respondents, good quality animals had the ability to withstand disease, retained a good physical condition during the drier months of the year, did not die easily, and gave birth to at least one calf every two years in the case of a cow.

The most common cattle breeds in the study area were the indigenous Nguni and Zebu breeds, with Nguni cattle constituting more than 90% of the observations. Exotic Brahman types were occasionally recorded.

Skin colour and horn form were no longer important criteria for animal selection as was previously the case (Nyembezi & Nxumalo 1966). Although skin colour *per se* was not a trait that was selected for any more, some of the respondents indicated that they still had special personal preferences. The most common and preferred colour patterns were black and white and red and white cattle. Skins were seldom privately utilised, but were occasionally sold to traders or leather workers.

3.6.3 Castration and related management tools

Respondents indicated that they castrated most of their bulls after these animals had been observed for 1 to 2 years to facilitate the choice of the best breeding animal. The most evident reason for castration according to the respondents was to prevent undesired mating after the bulls had reached puberty. Oxen were less vicious and easier to manage than bulls, especially when they were trained as draught and ploughing animals. According to local belief a castrated animal grew “bigger and stronger”.

Individuals who had the correct tool would castrate their bulls personally. Castration could also be done for a fee of R15 per bull (Els & Van der Walt 1996). Some respondents indicated that there were still some people who used a sharp knife for this operation. Coarse salt was applied to the wound that was usually made as small as possible. This was, however, not a popular practice, and respondents indicated that it could cause cattle losses.

Not all cattle were dehorned. When it was done, the method of burning was most often used. Some cattle owners preferred to dehorn all their calves. Some saw no reason why it should be done at all, while others only dehorned the aggressive animals. A perception among cattle owners was that dehorning caused the "growth" that would have gone into the horns, to go into the "shoulder" or hump, and that dehorned animals generally grew bigger and stronger than animals which had not been dehorned.

3.6.4 Cattle as ploughing and draught animals

Ploughing occurred from October to November, just before the rainy season commenced. Individuals who owned a plough and a span of oxen would either rent it out or did the ploughing themselves for a predetermined fee. This fee ranged from R50 per ha to R100 per day, depending on the distance to be travelled to the field and the area to be ploughed for that specific day.

Few mechanical farming implements were seen in the study area. Cattle were used as draught animals to pull wooden sledges (*isihlipi)* to transport household items, heavy objects such as wood and stone for building, as well as water containers. The sandy soil in the study area made the use of sledges easy and cost-effective. Cattle were, however, not used for pulling carts or for the transport of people.

3.6.5 Dipping and vaccination of cattle

The different dip tanks of each *isigodi* were situated approximately 7 to 23 km from each other (Figure 2.1). A dip tank consisted of a pen made from wooden tarred poles that funnelled or steered

the cattle through a sunken concrete water container and ended in a ± 20 m long crush-pen. The concrete, bath-like dip tank could hold up to 25 000 litres of water (Figures 3.5-3.8). Before the dipping actually started the dipping chemicals (Eco Traz 250®) were added to the water and stirred vigorously. One herd was dipped to ensure that the dipping concentrate was well dissolved in the water. This herd also had the privilege of going through the dipping process again, once the rest of the cattle attending the dipping day had passed through the dip tank. Traditionally, the herd going first was the herd that was the first to be at the dipping tank on that specific day. Cattle were brought from around the whole area surrounding a dip tank in that specific *isigodi*, in a radius of approximately 7 to 8 km. The cattle owners and *abelusi* gathered their cattle, and herded them to the dip tank. At the dip tank the herders with their cattle stood around in groups and kept their cattle separate, waiting for the dip tank chairperson to start the dipping activity. Once the chairperson or a member of the dip tank committee gave the right of way, the herders started to drive their herd towards the dip tank. Depending on the number of cattle, the dipping procedure could last anything from 2 to 4 hours. It usually took a whole morning to dip 1 500 cattle.

The majority (94.4%) of the respondents indicated that they took their cattle to be dipped on a regular basis, with 91.8% indicating that they dipped their cattle at least twice a month in the summer, as they had been instructed to do (Table 3.8).

Before the dipping day, the chairperson or the members of the dipping committee of the scheduled dipping occasion informed people of that specific ward. Only a minority of respondents (5.6%) indicated that they did not dip their cattle on every occasion, as they did not always have someone to herd the animals. *Abelusi* of larger herds of 50 to 100 animals also indicated that it was not always possible to take all the cattle for which they were responsible to the dip tank. The main reason, according to 82.4% of the respondents, for dipping their cattle was to combat tick infestation (Table 3.8). There were no legally binding regulations whereby a cattle owner could be forced to dip his cattle.

Halfway through the research period *Eco Traz 250*® was introduced and the cattle owners took well to the new product and it was easily accepted. The respondents at all four dipping tanks were sure that they wanted to continue receiving the dipping chemicals and service free of charge. Despite the above negatives, all the respondents were still positive that dipping held more advantages than disadvantages. Throughout discussions with the cattle owners it was clear that dipping was basically the only method that the majority of people owning cattle had to prevent their cattle from becoming diseased, and that dipping was the only preventative measure taken with regard to their animals' health.

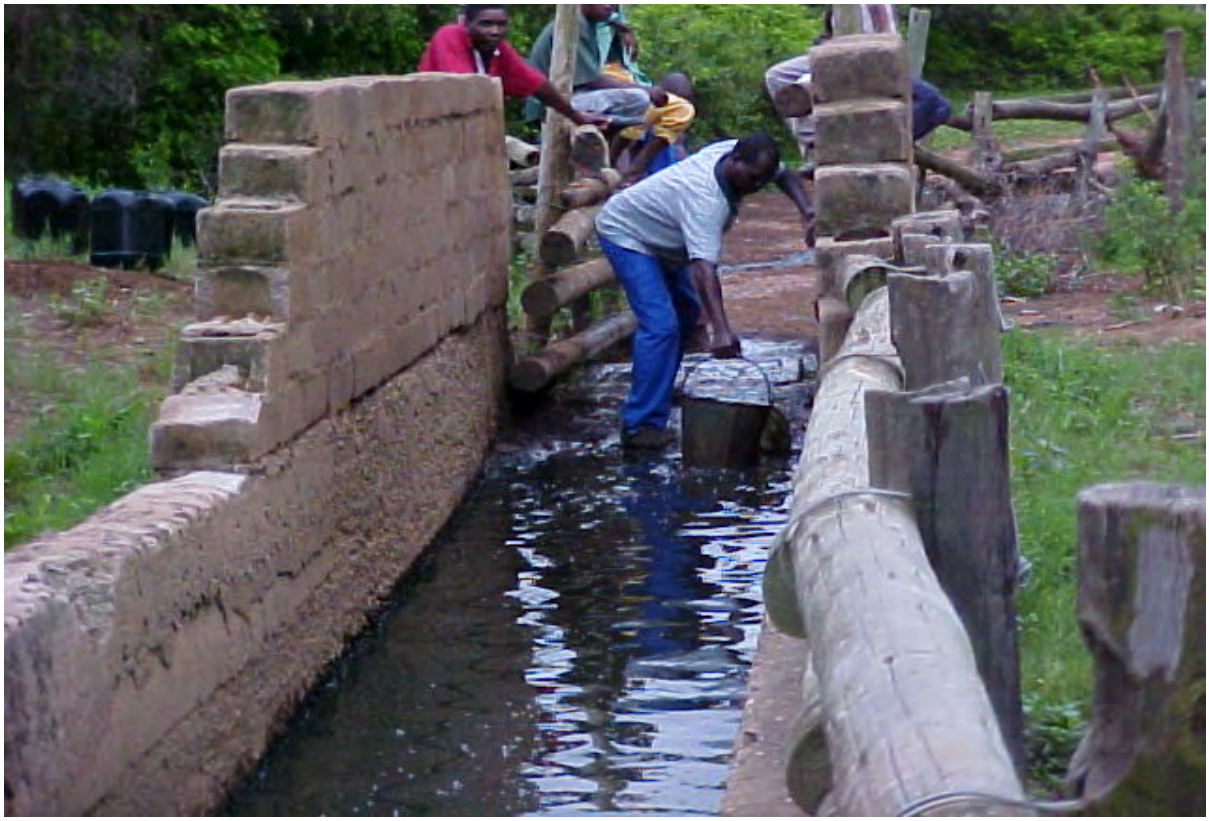

Figure 3.5: The Mangu concrete dipping tank at Zama-zama in, Maputaland, KwaZulu-Natal.

Figure 3.6: The Mpopomeni concrete dipping tank at Manqakulani in Maputaland, KwaZulu-Natal..

Figure 3.7: The Manhlangunzi concrete dipping tank at Kwandaba in Maputaland, KwaZulu-Natal.

Figure 3.8: The Nhlanjwana concrete dipping tank at Mbangweni in Maputaland, KwaZulu-Natal.

3.6.6 Dip tank committees

Although dip tank committees existed at each of the four dip tanks the duties of the committee members were vague. According to the animal health technicians their responsibilities had not been set out in detail. Their biggest function to date was to help the dip tank chairperson cleaning the dip tank, keeping it in a working condition, fixing the broken tar poles and mixing the dipping chemicals before the dipping session. No respondents were positive about becoming members of dip tank committees as they thought that the one that was elected had to do all the hard work. Some respondents who were interviewed were of the opinion that the dip tanks were the property of the government, and that the government should therefore pay the dip tank committee members for their work.

Most of the spokespersons acknowledged the necessity of a dip tank committee and most of the cattle owners knew who their dip tank committee members were. They also felt that they were doing their job well and had a big role to play in their communities. One of the most important functions of the dip tank committee members was to inform the people when the next dipping day would be, and whether for some or other reason the date had been changed or postponed.

3.6.7 Extension services

As already mentioned the extension services were in disarray. The area where the research was done had three different health technicians in only a few months time. The position of the region's state veterinarian also stayed vacant for nearly 1.5 years. Although the person acting on behalf of the state veterinarian gave his full cooperation, his knowledge on certain aspects was lacking.

According to the questionnaires only a few of the respondents had ever seen the state veterinarian. A notable number of respondents were not even aware of the existence of such a person. Those who knew of him, did not know where he was stationed or that they could take sick animals to him. It was, however, also clear that the workload of the state veterinarian was unrealistic. The mere extent of his large service area hindered him from working efficiently and was a topic that the department should address in the future.

3.6.8 Quality versus quantity

There seemed to be a growing awareness of the importance of the physical condition of cattle. Animals in good condition were seen to give stronger calves, to produce more milk, to attain higher quality meat and could fetch a higher price when sold than those in a poor condition. They were also

seen to survive winter months and droughts better (Bembridge & Tapson 1993). Some of the respondents indicated that they would keep animals that were in good physical condition for themselves and used those which were not in such a good condition for *ilobolo* or to slaughter for feasts and visitors. The respondents were thus not ignorant of animal quality, especially those with more than 20 animals in their herds. However, respondents with smaller herds indicated that quantity affected their decisions regarding herd composition or the utilisation of their animals. While quality of animals was thus acknowledged by the cattle owners, the majority still strived for quantity, because of the emphasis on the socio-economic values associated with cattle ownership (Bembridge & Tapson 1993, Els & Van der Walt 1996). Stockowners believe that there were benefits to increasing the total number of animals in their herd in communal grazing land. A large number of cattle per individual owner made economic sense and they believed that the more animals they owned the more likely it would be that at least some their animals would survive when conditions were adverse.

3.6.9 Slaughtering, meat consumption and sales

Despite the fact that so few people (14.9%) (Table 3.2) owned cattle, 98.8% of the respondents indicated that they did eat beef. The frequency of beef in their diet, was however low, and most people (63.2%) only ate it once a month (Table 3.9). Only 4.6% of the respondents indicated that they slaughtered their own stock for consumption, while 83.9% of the respondents indicated that they bought beef from local butcheries or the so-called *tree butcheries*, and 11.5% said that they received beef from family or friends (Table 3.10).

The majority (71.4%) of the respondents and spokespersons indicated that they preferred beef (*izimfuyo*) above the meat of wildlife (3.5%), or as they call it *iziyamanzane* (the meat of wild animals), although 66.5% of the respondents indicated that they did eat *iziyamanzane* when it was available.

The price for cattle when sold on the hoof ranged from R1000 to R3900 depending on the age, physical condition and the appearance of the specific animal. The price was based on the outcome of a bargaining and discussing process, giving both the buyer and the seller an opportunity to reach an agreement that was in the best interest of both parties.

3.6.10 Calving and weaning

Most of the respondents indicated that cattle owners and herders intervened when cows calved and calves were weaned. Where difficulty in calving occurred, assistance was given by pulling the unborn

calf from the cow's womb. Some respondents indicated that they kept a calf and its mother separated from the rest of the herd (in a kraal) directly after birth for up to three days.

3.7 GRAZING MANAGEMENT

3.7.1 Current grazing practices

No specific grazing system seemed to be practised, and continuous grazing may be the best way to describe the grazing system. Approximately half (48.2%) of the cattle owners indicated that they took their animals to specific grazing areas whether in the summer or in the winter. Cattle owners had many duties to perform each day and not only duties related to cattle. As a result the cattle were simply taken some distance from the homestead and allowed to graze on their own.

Compulsory education for children, and therefore the availability of herders, had changed traditional grazing practices. Previously, herders decided where they wanted to take their herd to graze and this decision was usually done in conjunction with other herders. Not only did this give the young boys an opportunity for conversation with friends during the day, but by consensus, also meant that they shared knowledge of the best possible grazing at any given time in a specific area. Obviously the distance from the homestead influenced the decision. The herders that were interviewed indicated that they did not necessarily take the cattle far from the homestead if the grazing was acceptable in the area where they stayed, or where the cattle which they looked after were kept.

The new compulsory education system forced cattle owners to take their cattle to the preferred grazing area themselves or by using underage or pre-school herders or other available family members.

Grazing was not restricted to any part of land inside the specific *isigodi* as long as the cattle stayed out of the croplands. According to respondents and spokespersons a fee could be levied by the local *induna* for grazing rights to people from another *izigodi*. This fee was approximately R1000 per year. Cattle were allowed to cross local borders under special circumstances, for instance to drink water and during drought periods.

Abelusi were surprisingly ignorant of the identity of grass species and of the grazing quality of different grass species. Although some spokespersons knew grass species quite well (especially at dip tanks during dipping days), a number of *abelusi* and cattle owners at all four dip tanks could only indicate three good quality grass species, and that after much discussion among themselves. These

Table 3.9: Frequency of beef consumption in the different wards according to the data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Beef consumption				Consumption of beef									
					Daily		Weekly		Monthly		Six monthly		Yearly	
	Yes		No											
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Bekhabantu	269	99.6	1	0.4	12	4.6	61	23.5	170	65.4	13	5.0	13	5.0
Manqakulani	113	98.2	2	1.7	-	-	28	24.1	76	65.5	6	5.1	3	2.6
Kwandaba	109	99.1	1	0.8	-	-	14	11.9	73	61.9	13	11.0	9	7.6
Zama-zama	104	97.2	3	2.7	-	-	37	33.3	57	51.4	10	9.0	-	-
Total	**595**	-	**7**	-	**12**	-	**140**	-	**376**	-	**42**	-	**25**	-
Mean	-	**98.8**	-	**1.2**	-	**42.0**	-	**23.5**	-	**63.2**	-	**7.1**	-	**4.2**

Table 3.10: The most common sources of meat according to the data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Source					
	Local butchery or tree butchery		Own animals		Friends or family	
	n	%	n	%	n	%
Bekhabantu	251	96.9	1	0.4	7	2.7
Manqakulani	114	98.3	26	22.4	52	44.8
Kwandaba	105	89.0	2	1.7	17	14.4
Zama-zama	98	88.3	2	1.8	2	1.8
Total	**568**	**-**	**31**	**-**	**78**	**-**
Mean	**-**	**83.9**	**-**	**4.6**	**-**	**11.5**

Note: **n** is the number of people who responded to the questionnaires.

Species included couch grass (*Cynodon dactylon),* Guinea grass (*Panicum maximum)* and red grass (*Themeda triandra*). According to Van Oudtshoorn (1999), couch grass is probably the most useful grass species in South Africa. This species can endure heavy grazing and remain green until late in the winter. Couch grass was especially noticeable at dipping tanks and other severely disturbed areas, for instance at artificial watering points and around pans. Couch grass is classified as an ecological class 3 species because it increases where high impact grazing is prevalent or disturbances occur. Red grass is considered to be the most important grazing grass species in the open grassland regions of southern and East Africa, and surprisingly enough also Australia. An advantage of this grass species is its resistance to fire, especially in Maputaland where veld fires are common and regular (Bruton *et al.* 1980). It normally increases when veld is burned regularly, provided that overgrazing does not occur (Van Oudtshoorn 1999).

The grass species that was identified as *ubabe* by the respondents, was identified as *Panicum maximum*. The common belief among the respondents was that the grazing value of this grass species was high and that cattle showed a high preference for it. Van Oudtshoorn (1999) rates the grazing value of this grass species as excellent, because it is palatable and has a high leaf production. *Abelusi* were usually instructed to take the cattle to areas with a good cover of *ubabe.* However, several other *Panicum* species were also referred to as *ubabe, i.e. Panicum natalense* (Natal panicum) and *Panicum deustum* (broad-leaved panicum) (Van Oudtshoorn 1999).

The mean grazing capacity for the unconserved Tembe Traditional Area and the grazing capacity for each management unit in the area is set out in Chapter 5 (Figures 5.13, 5.18 and 5.19). Using equation 1 of Danckwertz & Teague (1989) the total grazeble area of 33 242 ha around the Tembe Elephant Park (including the hygrophilous areas) will be able to sustain 6 746 LAU at 5 ha/LAU (when the short term rainfall of 514mm for the past two seasons is taken into account) and 10 903 LAU at 3ha/LAU (when the long term average rainfall of 721.5mm over the entire study area is taken into account). For wildlife, the grazeble areas could sustain 37.52 Grazing Units (GU)/100 ha (at 514mm) and 59.12 Grazing Units (GU)/100 ha (at 721.5mm) and 36.13 GU/100 ha (for 514mm) and 57.51 GU/100 ha (at 721.5mm) for the hygrophilous areas according to the equation of Bothma *et al.* (2004). One Large Animal Unit approximately equals 2 Grazer Units and 2.5 Browzer Units (Van Rooyen pers. Com.)[2]. If the grazing component of wildlife is converted to LAU the area could carry 6167 LAUs (when the short term rainfall of 514mm for the past two seasons is taken into account) or 9 750 LAUs (when the long term average rainfall of 721.5mm over the entire study area is taken into account). The equation that would be used or recommended in the future would depend on what the area is going to be stock with, either cattle or wild life.

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At the time of the study overstocking was therefore not the case, as the stocking density of 1 030 or even the 6 062 head of cattle presented by Xaba & Dikobe (*pers. Com.*)[1] was well below the area's capacity for both equations.

3.7.2 Burning practices on communal rangelands

The use of fire by local cattle owners to improve grazing, by farmers to clear agricultural plots, and by individuals involved in palm wine tapping (a custom to make a traditional alcoholic drink from the sap of the ilala palm *Hyphaene coriacea*) has apparently always been a common practice in the study area (Bruton *et al.* 1980, Els 1996). These practices have been recorded since the 1500s when the Portuguese explorers first sailed past Maputaland and named it *Terra dos Fumos* because of the smoke from the fires presumably lit by the local people (Bruton *et al.* 1980). However, no fire management was practised and there was no control over aspects such as fire intensity, fuel load, or the frequency and timing of a burn (Trollope 1999). A large proportion, 80.4%, of the cattle owners indicated that they burned the grazing areas at regular but unspecified intervals. However, a community meeting was attended during the study where the *Inkosi* personally condemned the irresponsible use of fire.

3.7.3 Supplementary feeding of cattle

The only supplementary food that the cattle in the study area could make use of was crop residues. The local people used no supplementary salt or minerals licks, or even pasture residues like hay or silage. According to the questionnaires 85.7% of the people indicated that they did not supply supplementary food to their cattle, the remainder (14.3%) gave access to crop residues to their cattle. The grazing of crop residues occurred at the end of the crop-harvesting season (June to July) in the study area. However, during the period of study crop yields were poor and the quantity of the crop residues available to the cattle was limited.

3.8 CONSTRAINTS TO CATTLE AND GRAZING MANAGEMENT

3.8.1 Water

Water resources in the study area were generally inadequate, especially in those *izigodi* that were situated far from permanent waterholes and rivers. The main source of water for cattle varied in the different *izigodi*. Water sources included water from boreholes, local dams and pans, rivers and streams or fountains. In Manqakulani the cattle obtained their water from the *Mpopomeni* fountain (S 27.14708° and E 32.46154°) and from *Mpisi* pan (S 27.12734° and E 32.47368°) (Figure 2.1). In

some areas where water was scarce during the dry period, wells have been dug. These wells were protected by structures made of thorny bushes and wooden poles to form an enclosure around the water source. Water provisioning in Zama-zama, Mbangweni and Bekhabantu wards is better than in the other wards, because the Pongola River flows through these *izigodi* or is in the close proximity to them Most of the dip tanks also got their water from these water sources.

3.8.2 Cattle deaths

The respondents responded somewhat vaguely as to the cause of cattle mortalities (Tables 3.11 & 3.12). It seemed as if the reasons given for cattle deaths did not truly reflect the actual causes of death. It was not clear if the questionnaire was misunderstood in terms of the time period over which cattle had been dying. A factor that had to be taken into account was that no autopsies had been done to establish the real medical reason for any of the deaths. For this reason no absolute conclusions could be drawn. Most of the respondents (30.4%) indicated that they did not know the reason for the death of their cattle, followed by respondents indicating that disease (17.9%), drought (14.3%) and ticks (3.6%) were the main causes of death. Many other reasons were given which were lumped into one category (other) because each single reason contributed such a small percentage to the total number of deaths that were recorded. Other reasons for mortalities, as indicated by the respondents and spokespersons, included:

- the floods of the 2000 to 2001 rainy season;
- poisonous plants;
- worms;
- wounds caused by jealous people and
- *umbendeni* (redwater)

3.8.3 Travel distances and time

The distances that people had to travel to dip tanks were an issue for some of the respondents, as they indicated that it would take the whole morning to travel to the dip tank. One of the cattle owners lived 8 km from the dip tank. This meant a 16 km round trip for the owner and his cattle per dipping day. On the whole, however, the time spent and distances travelled for dipping did not seem to be a major issue with the majority of the respondents.

3.8.4 Diseases and internal parasites

The major reasons documented for cattle deaths in communal areas are diseases and internal parasites (Swanepoel *et al.* 2000). The causes are attributed to poor veterinary extension services, and to the unavailability and the high cost of drugs for proper treatment. Tick-borne diseases due to high infestation rates and poor dipping services are the primary reasons for the high percentage loss of cattle in communal areas.

There was a lack of knowledge among the majority of cattle owners as to the causes of animal diseases. However, the four diseases that were well-known, were: redwater (*umbendeni*) for which *Teramycin*® is used as a medication; gall-sickness (*inyongo*) for which *Teramycin*® or *Hi-tet*® was used; liverfluke for which *Pro-inject Yellow*® is used and blackquarter (*unkonyana*) for which the traditional remedy of pricking the affected area with a spear and pouring hot water over it, is used.

One individual prided himself to be a commercial cattle owner (farmer), and indicated that he knew most of the cattle diseases. This farmer had all the common medicines available and gave it to the researcher to be examined. These medicines included: *Hi-tet*®, *Teramycin LA*®, *Volpazine*®, *Dectomax*® and *Vitamin B-complex*®. This farmer indicated that one animal was sold each year to cover the cost of these medicines.

Some cattle owners bought medication to cure sick animals from the pharmacies at the towns of Pongola, Mkuze or from the health technicians. As a result of the poverty of the people they often bought expired medication at a reduced price. This could possibly mean a decrease in the effectiveness of such medication. The most frequently used medicine was *Teramycin*®.

The effect of intestinal parasites on cattle health was poorly understood by the cattle owners in the study area, and for all practical purposes was not part of their knowledge base. The respondents indicated that worms were noticed by some people when cooking the intestine. Little knowledge was available on different kinds of worms, and few of the symptoms caused by infestation were attributed to these parasites. The most common medication used against worms was *Valbazin*®, which was also bought at pharmacies. An indigenous cure for worm infestations was also known and it was commonly used. It entailed boiling aloe leaves and making a liquid extract thereof. A litre or two of this liquid extract was then poured down the animal's throat with a 750 ml beer bottle. According to the respondents, this was a good, trusted remedy. In some cases it was also used to cure gall-sickness (*inyongo*).

Table 3.11: The presumed reasons for cattle deaths in three wards according to the data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward		Most common reasons for cattle mortalities									
		Drought		Ticks		Disease		Unknown		Other	
	N	n	%	n	%	n	%	n	%	n	%
Bekhabantu	38	4	13.3	1	3.3	7	23.3	12	40.0	14	46.6
Kwandaba	7	1	14.3	-	-	-	-	3	42.8	3	42.8
Zama-zama	11	3	15.8	1	3.3	3	15.8	2	10.5	2	10.5
Total	**56**	**8**	**-**	**2**	**-**	**10**	**-**	**17**	**-**	**19**	**-**
Mean	**-**	**-**	**14.2**	**-**	**3.6**	**-**	**17.9**	**-**	**30.4**	**-**	**33.9**

Note: **N** is the number of people who responded to the questionnaire and **n** is the number of cattle that died because of a specified reason.

Table 3.12: Cattle mortalities and the percentage thereof as well as the mortalities during the past two years of the study, according to the data obtained from a survey conducted in the Tembe Traditional Area from 2001 to 2003

Ward	Number of cattle owners per ward	Number of cattle per ward	Cattle deaths in each ward (2002-2003)	Percentage cattle deaths in each ward	Cattle deaths for the past 3 years in each ward (2001-2003, questionnaires)
Bekhabantu	30	269	27	10.0	304
Kwandaba	7	105	7	6.7	17
Zama-zama	19	239	10	4.2	32
Total	-	-	**44**	-	**353**
Mean	-	-	-	**7.2**	-

Although a number of respondents were aware of the existence of different kinds of ticks, the ticks were all known as *amakhizane* (singular: *ikhizane*) and they did not differentiate between the various species. It was, however, general knowledge among all the respondents that cattle had to be dipped to eradicate ticks. The general perception was also quite clear that ticks and internal parasites had a negative effect on the physical condition of cattle. The majority of the cattle owners (73.2%) agreed that ticks and parasites could cause severe sickness and even death in cattle.

All the respondents were familiar with the disease *unagane* (nagana) and its symptoms, but again there was little knowledge as to the causes and treatments.

All the respondents indicated that they would appreciate a card printed in Zulu that indicated the most important animal diseases, their causes, symptoms, and cures.

3.9 OTHER RELEVENT CATTLE-RELATED ASPECTS

3.9.1 Tree butcheries

A tree-butchery is a place where cattle are slaughtered and sold piece by piece. This was normally under a tree, hence the name. When the present study was started, tree-butcheries were a common sight in the study area, especially at the end of a month and on pension payment days. The piece of meat that was sold was usually as big as a grown man's hand. From the foot-and-mouth disease boom gate at the Shemula Water Scheme up to the Phelendaba gate (± 20 km), six tree butcheries were counted. Each of these butcheries consisted of a wooden structure under a tree where one or two cattle carcasses could hang. The meat was sold at R5 for a piece of approximately 500-550 g. Randomly selected pieces of meat (2 to 4 portions per tree-butchery) were bought from four tree butcheries and weighed at a nearby commercial butchery (mean 535 g; n = 9). All the pieces had a mass between 500 and 550 g per piece. In 2002, beef was sold at R18-79 to R19-95 per kg at the local commercial butcheries and at R23-50 per kg in Pretoria. The tree-butcheries were therefore by far the cheapest source of meat.

An analysis of the open-ended questions in the questionnaire showed that:

- The most popular piece of meat was the fillet or the softer rump area around the loin.
- It took 2 to 4 days to sell a whole carcass.
- Men were the most frequent buyers of meat, followed by old women who bought meat on pension payment days.
- Between two and 10 carcasses were sold per month per tree-butchery.

- A butcher paid from R1700-00 to R3700-00 per animal depending on its mass.

According to the relevant health regulations on butcheries and similar institutions, tree butcheries constituted a health hazard and were forced to shut down. Although not all tree butcheries adhered to this enforcement, huge fines could be incurred. During the entire research period, the tree-butcheries were still fully operational. Not a single case of illness could be traced back to meat bought from any of these butcheries, nor could any previous such cases be traced back to meat bought at tree butcheries.

3.9.2 Foot-and-mouth disease barrier

The foot-and-mouth disease barrier or so-called “red line” divided the study area into two sections, north and south of the main tar road from Jozini to Manguzi. From the main boom gate at the Shemula Water Scheme the red (wire fence) line is visible from the road on the right-hand side when coming to Manguzi from Jozini. There are approximately 14 gates, with two to four gate guards attending and regulating access through each gate.

These gates were not permanently operational and cattle could often pass through these gates unhindered. Broken fences and gates were a common occurrence, and some fences stayed broken and gates were unattended for more than two weeks at a time. The researcher was never checked for meat or cattle-related products at any time, and never witnessed other people being checked during the entire study period of three years.

3.9.3 Food supply

According to Swanepoel *et al.* (2000) most production systems, but especially cattle owners, fail to feed their animals adequately throughout the year. Particularly during the dry season and drought periods the quantity and quality of food often falls short of what is needed by cattle. Malnutrition inevitably leads to a number of deaths. In the Tembe Traditional Area the infrastructure, processing and marketing of food for cattle was not developed at all.

3.9.4 Animal health

Animal diseases reduce livestock productivity. High mortalities resulted from the lack of systems that aim to decrease the incidence of disease (Els 1996, Swanepoel *et al.* 2000). Although vaccines have been developed for many animal diseases, the cost of purchasing and administering them are very high, making them unaffordable and in effect unavailable to the communal cattle owner. In the case of

the Tembe Traditional Area, where Ndumo Nature Reserve and Tembe Elephant Park are located in the close vicinity of communal rangelands, wild animals are a source of infection for many diseases.

Parasitic, internal parasites and viral diseases, which are mainly vector transmitted, cause cattle mortalities and an economic loss of livelihood to the communal rural people who can ill afford such setbacks. There are measures to control these diseases, but due to underfeeding, poor management, and in some cases the use of non-adapted genotypes many of these diseases become severe problems (Swanepoel *et al.* 2000). There is also a lack of effective diagnostic capacity, including functional veterinary services. The need for effective animal health support structures and services, to control disease remains vital. Those veterinary services which have been provided to date have proven to be ineffective and mostly unsustainable. Fortunately restructuring and new approaches from the Department of Agriculture and Environmental Affairs were being put in place (Sikhakhane pers.com)[3].

A livestock disease survey in the rural areas of the whole KwaZulu-Natal province was initiated in 2003 to determine the health status of the livestock populations. The aims of the survey were:

- to determine the animal health status with respect to certain trace element deficiencies;
- to determine the incidence of controlled diseases and other economically important diseases on a provincial scale. The diseases surveyed for were: Rift Valley fever, tick-borne diseases, leptospirosis and foot-and-mouth disease;
- to inform local communities of the results of the survey with respect to each type of livestock (cattle, sheep, goats, horses, donkeys, pigs and chickens);
- to identify where the focus on animal health, advice, control and help should be; and
- to identify where to focus future veterinary research and training.

At the time of the field work of the present study the results of the above survey were not yet available.

3.9.5 Genotype

Indigenous animals are well adapted to areas in which they occur naturally, being disease resistant, heat tolerant and able to utilise low quality food. Poor genotypes fail to produce adequately, even in environments where food is available, because diseases are not controlled and management systems are not in place and not satisfactory. Crossbreeding of introduced genotypes with indigenous animals

[3] Dr T. A. Sikhakhane 2003. Department of Agriculture and Environmental Affairs. Private Bag X 004, Jozini 3969

whereby the latter loose their genetic advantages over exotic breeds can also occur (Bembridge & Tapson 1993, Swanepoel *et al. 2000*).

In 1992, the United Nations member states adopted the Convention on Biological Diversity, which encouraged member countries to conserve their indigenous cattle genotypes and to use them in a sustainable manner.

3.9.6 Resource management

In South Africa's communal cattle systems there is a growing need to increase the efficiency of resource utilisation for sustained livestock production. According to Swanepoel *et al.* (2000) a careful assessment and analysis of the production environment is required to formulate proper livestock (here cattle) developmental strategies. These strategies will eventually lead to the better use of local resources, contribute more effectively to food security, improve the living standards of poor communal people and ensure the sustainable development of the total livestock production system. To develop a successful livestock strategy, the formulation of resource management plans that complement the wider economic, ecological and sociological objectives is required (Swanepoel *et al.* 2000). Such a strategy should consider all the social, cultural, political and institutional elements that affect the management and use of renewable natural resources. To implement these action programmes they must be technically and institutionally supported by the government.

3.10 SUMMARY

Cattle were still seen as wealth and status symbols in the local communities and were highly prized possessions if only they could be obtained. Poverty or financial inability as well as cattle mortalities were the main reasons why most households did not have cattle. However, social and religious values that were attached to cattle in the older Zulu culture have clearly faded in the Tembe Traditional Area. At the time of the study the local communal people emphasized the utilitarian value of cattle and their potential as investment for future uncertainties. It was clear that values people adhered to, like in most communal areas of southern Africa, were increasingly orientated towards the capital value. Capital value did not necessarily mean commercial value. Unlike the commercial sector, cattle were not primarily raised for meat, but more as a means of investment and/or utilization (milk, draught power, skins, dung, manure, fertilizer, fuel and flooring) although social and ceremonial uses like *ilobolo* (bride price) were still important.

It was evident that men owned and controlled the uses of cattle. Women and children did in exceptional cases own cattle, but that was clearly the minority. The absolute majority of cattle owners

in the study area could not be described as cattle farmers. Farming with cattle does not only lie with the possession of these animals, but is directly related to the manner in which one utilises cattle to be able to make a direct living out of these animals. It is generally accepted by animal husbandry experts that a cattle farmer needs to have at least 25 head of cattle to be able to make a sustainable living from their produce, given that such a farmer has control over all factors that may influence production. The fact that 80% of the cattle owners in the study area possessed less than 20 head of cattle, indicated that cattle were only part of the subsistence economy of the people.

Official cattle numbers in the study area did not match the cattle numbers recorded by the in-depth questionnaires, census sheets and open-ended question sheets. The latter indicated that the total amount of cattle in the study area added up to 1 030. According to the dip tank visits and the physical condition scoring sheets the mean number of animals visiting the dipping tanks across the area was 736, but according to the Health Technician's report the total number of animals in the study area was approximately 6 062 in 2002.

It was also clear that cattle were distributed to the areas where water supply was sufficient. The main grazing areas were thus to the east of the study area in the hygrophilous plant communities to the east of Manqakulani and mainly in Ndlondlweni. Favoured grazing was also found to the south-western side of the study area close to the Pongola River in Zama-zama and partially Mtikini, Lulwane and Kwandaba. Mbangweni and Bekhabantu had fewer cattle, as did the Tsokotho and Sibonisweni wards.

The general perception of the majority of the cattle owners was that their cattle were in a good condition and this was borne out by the physical scoring of the animals with only 2.5% of the animals being in a poor physical condition.

Herding of cattle was mainly done by the owner himself. Previously herding was done by the *abelusi* but the new law states that all children over the age of five and under the age of sixteen have to attend school. Cattle owners away with migratory labour have to hire *abelusi* (boys younger than five or older men) to look after their cattle. *Abelusi* did not have any authority on what happened to the cattle they have to look after, as their task generally entailed only that they should look after the cattle. Decisions on any major aspect of animal health, could therefore, not be taken by the *abelusi*. Personal observations indicated that cattle were often not herded, but allowed to graze freely. Kraaling cattle was commonly practised. Fixed times on herding cattle back and from the homestead were also a common procedure.

Animal selection was done in a random manner and not on observant production and genetic potential, as it is the case on commercial farms. External appearance (fitness, fat and strength) and thus body size were used to indicate good quality, according to communal cattle owners. Bulls of indigenous breeds were preferred, especially black Nguni bulls with rump size as a measure of quality as this indicated a bull with a lot of “meat and power”.

Respondents indicated that castration was still a common practice as they castrated most of the male calves. Male animals were left for two years so that the best and strongest bull could be selected. The most evident reasons for castration according to the respondents were to prevent undesired mating after males reached puberty and oxen were less vicious and easier to manage, especially when training them as draught and ploughing animals. Very few mechanical farming implements were seen in the study area. Therefore oxen were used as draught animals to pull wooden sledges (*isihlipi)* to transport household items, heavy objects such as wood and stone for building as well as water containers. Ploughing, another usage of oxen occurred just before the rainy season commenced (October to November). Individuals who owned a plough and a span of oxen would either rent them out or did the ploughing themselves for a predetermined fee.

The dipping of cattle was seen as an important activity. The majority of the respondents indicated that dipped their cattle at least twice a month in summer, as they had been instructed to do. The main reason according to the majority of the respondents for dippinge their cattle was to control tick infestation. Throughout discussions it was very clear that dipping was basically the only preventative measure taken in regards to their animals' health.

Although dip tank committees existed at each of the four dip tanks, the duties of the members were vague. Their biggest function up to date was to help the dip tank chairperson to clean the dip tanks, keep it in a working condition, fix the broken tar poles when it was necessary and mix the dipping chemicals before the dipping could commence. Most of the spokespersons indicated that they saw the necessity of a dip tank committee and most of the cattle owners knew who their dip tank committee members were. They also felt that they were doing their job well and had a big role to play. One of the most important functions of the members was to inform the people when the next dipping day would be, or whether if for some or other reason the date had been changed or postponed.

When this study commenced the extension services were in disarray. Within the study area three different health technicians followed one another in only a few months time. The position for the region’s State Veterinarian stayed vacant for nearly one and a half year. The veterinary services, which were provided, were ineffective and there was a lack of effective diagnostic capacity.

Fortunately, restructuring and new approaches from the State Veterinarian Department and the Department of Agriculture and Environment Affairs were being set up.

Quality of animals was acknowledged by owners, but the majority still preferred quantity. According to stockowners, they gained more by increasing the size of their herd on communal grazing land. Large numbers for the individual owner made more economic sense and provided a buffer in dry and difficult periods.

In the study area most of the respondents indicated that they ate beef. The frequency of this occurrence was low but it was still common to eat beef once a month. Beef was preferred above venison (*iziyamanzane*).

Most respondents owning cattle as well as some *abelusi,* intervened and helped when cows was calving and calves were to be weaned as well as the herding of calves. Barren cows were either slaughtered or sold after two consecutive years without calving.

No specific grazing management practices or system could be identified. The difference in summer and winter grazing areas also did not seem to be of great importance. Compulsory education has changed herd management considerably. Previously the *abelusi* were left to decide where they wanted to take their herd to graze. These decisions were made in conjunction with other *abelusi* and provided the opportunity to young boys to interact socially. It also meant that they shared knowledge of the best possible grazing at any given time. As a result of compulsory education the cattle owners had to herd their cattle themselves or had to make use of underage or pre-school *abelusi* or other family members when available.

There was no indication that *abelusi* or cattle owners understood the principles of grazing management, or were able to practice any grazing management in the communal grazing regime. The fact that grass species of good grazing quality were not really known, or that some of these grass species were not abundant in the study area, made the principles of sustainable utilisation of grazing irrelevant to cattle owners. Grazing was not restricted to any piece of land inside the specific *isigodi* as long as the cattle stayed out of other peoples cultivated land.

The total grazeble area of 33 241 ha around the Tembe Elephant Park (including the hygrophilous areas) is able to sustain 6 746 LAU at 5 ha/LAU (when the short term rainfall of 514mm for the past two seasons is taken into account) and 10 903 LAU at 3ha/LAU (when the long term average rainfall of 721.5mm over the entire study area is taken into account). For wildlife, the grazeble areas could sustain 37.52 Grazing Units (GU)/100 ha (at 514mm) and 59.12 Grazing Units (GU)/100 ha (at

721.5mm) and 36.13 GU/100 ha (for 514mm) and 57.51 GU/100 ha (at 721.5mm) for the hygrophilous areas according to the equation of Bothma *et al.* (2004). If the grazing component of wildlife is converted to LAU the area could carry 6167 LAUs (when the short term rainfall of 514mm for the past two seasons is taken into account) or 9 750 LAUs (when the long term average rainfall of 721.5mm over the entire study area is taken into account). The equation that would be used or recommended in the future would depend on what the area is going to be stock with, either cattle or wild life. Overstocking of the grazing area was not occurring as the stocking density of 1 030 animals is well below the area's capacity.

Indigenous people in the study area have practiced the burning of grazing land for centuries. One of the advantages of such a practice for cattle owners is that it opens up vegetation and regenerates new growth (Trollope 1989). Management of fire, if occurring at all, is not planned with uncontrollable and irresponsible outbreaks of fire frequently occurring.

Crop residues were the only supplementary feed the people in the study area were aware of. Grazing of crop residues occurred at the end of the harvesting season (June to July). During the study period the crop yields were poor and the quality and quantity of crop residues available were limited.

Some typical cattle related problems in the study area were the lack of permanent water sources in some *izigodi*, cattle mortalities, transport problems, diseases and parasites. These hardships and constraints were aspects local people were accustomed to. The lack of permanent water prevented cattle from occurring in areas with good quality grazing and could be one of the reasons why good grazing and low deterioration of vegetation was prevalent in those areas.

Major reasons for cattle mortalities in communal areas were diseases and internal parasites. Often such mortalities could be attributed to poor veterinary extension, unavailability and the high cost of drugs. Tick borne diseases due to high infestation rates and poor dipping services were also reasons for this high percentage loss of cattle in the communal areas. However the majority of cattle owners in the study area were ignorant as to the causes of animal diseases. The effect of intestinal parasites on animal health was poorly understood, little knowledge existed on different kinds of worms and related internal parasites, and very few of the symptoms caused by infestation were attributed to these parasites.

The general lack of knowledge regarding diseases of cattle, their causes and possible cures, plus the fact that the influence of ticks on animal health was poorly understood, indicated a lack of ability to manage animal health properly, and accrue real benefits through their possession. This has a direct effect on animal production, whether that be calving percentage or milking ability or on draught

power. Respondents were unaware of the existence of different kinds of ticks and they were all known as *amakhizane* (sing. *ikhizane*). It was, however, recognised among respondents that cattle were dipped to get rid of ticks. The general perception was quite clear that ticks and parasites had a negative effect on cattle and their physical condition.

Tree butcheries played a very important role in the local economy. Not only did they create jobs and business but they also made meat available to local people that live far from towns and commercial butcheries.

The foot-and-mouth barriers seemed to be ineffective, except to be in place in case of an outbreak.

3.11 CATTLE MANAGEMENT: PRACTICAL AND POLICY PROPOSALS

The presented study has highlighted several deficiencies and the following improvements in cattle management are suggested:

- Projects on cattle related aspects should in future strive to take a holistic view to develop sound animal husbandry practices in the study area. A multi-disciplinary approach through participation by various scientists from various relevant fields of expertise should be undertaken to help with these projects.
- Every effort should be made to improve the existing communication between the relevant authority and the cattle owners, so that the cattle owners understand the decisions that are taken by the authority. Communication is also important to enhance the authorities' understanding of the needs of the cattle owners and to give attention to such needs. Transparency in discussions and a will to co-operate with the local people to improve their socio-economic living conditions are imperative and should be strived for in all instances.
- Efforts should be made to supply the cattle owners with brochures in Zulu, indicating the different diseases, their causes and symptoms, and their medicinal cures. This includes tick-borne diseases as well as internal parasites. This will not only indicate a willingness on the part of government to assist the people in their needs, but will have the effect that the people will start to evaluate causality in animal health in an informed manner.
- That the dip tank committees should be given clear and tangible responsibilities to determine when dip occasions will be held for their ward, and they should exercise effective control over the dip tank assistant's functioning. Cattle owners should share the responsibilities of making the dipping tank fully functional.

- The state veterinarian should be more visible to the people whom he serves, so that he can become aware of their problems, and they become aware of the services that he might be able to render to their benefit.
- An effort should be made to transfer knowledge on grazing management and value of different grass species to the cattle owners to enhance sustainable utilisation.
- Should the cattle health in the area be improved, it is imperative that a support system is in place to facilitate marketing opportunities. People should be encouraged to sell at least a set percentage of their herd annually because the long-term improvement of animal health would lead to a higher stocking density. This is another reason for conducting the project in a multi-disciplinary and holistic manner.

In conclusion, although a detailed cattle census had not been conducted and no statistical analyses were performed, valuable baseline information was gathered in the present study, which could be used for future research projects, as the groundwork is been laid.

PHASE 2

Rangeland related aspects in the Tembe Traditional Area: focussing on biomass production, range condition and stocking densities

The next three chapters will expand on the work that was done by Matthews *et al.* (1999 & 2001) and Gaugris (2004) and will focus on the state of the rangeland in the Tembe Traditional Area surrounding the Tembe Elephant Park. The scientific information gathered should inform the management of the Tshanini Community Conservation Area so that it can be managed in a professional and profitable manner, ensuring that both the local community and the natural environment benefit.

Chapter 4

ESTIMATION OF THE HERBACEOUS BIOMASS PRODUCTION

4.1 INTRODUCTION

The herbaceous biomass of an area is the total yield of the herbaceous component of that area, or the total mass of herbaceous living plant material that is present in a specific area at any given time. It is measured in kg per hectare (Trollope *et al.* 1990). According to Hale *et al.* (1995) the herbaceous biomass can be measured as either wet or dry mass per unit area. The herbaceous biomass production can be used to adjust and calculate grazing capacity and stocking density, to estimate forage intake and to study animal-plant selection patterns (Bransby & Tainton 1977, Danckwerts & Trollope 1980). It can also be used to determine fuel loads for veld burning and thus fire management practices (Du Plessis 1997, Trollope & Potgieter 1986, Van Wilgen & Scholes 1997). The fuel load in an area is directly proportional to the herbaceous biomass and gives an indication of the ability of an area to sustain a fire (Trollope *et al.* 1989, Trollope 1999).

The use of fire as a management tool is considered important for the following reasons (Trollope 1980, Trollope *et al.* 1989):

- removal of moribund material;
- control of bush encroachment;

- keeping veld in an intermediate stage of succession;
- changing the grass species composition because burning on a rotational basis can result in the establishment of more palatable species; and
- rotational resting of veld by attracting cattle and wildlife to newly burned areas and consequently giving unburned areas the chance to rest.

4.2 OBJECTIVES

The aim of this study was to estimate the herbaceous biomass production in the Tshanini Community Conservation Area in the different management units (see Chapter 2 for a description of the management units) It will be used to determine fuel loads for veld burning and thus fire management practices, should it become necessary. The herbaceous biomass production also provides a rapid assessment of the grazing capacity and stocking density. Comparisons of the standing herbaceous biomass were made between Tembe Elephant Park, Sileza Nature Reserve, the surrounding wards in the Tembe Traditional Area, as well as the Tshanini Community Conservation Area. Data gathered from 1998 in the conserved areas were used to detect trends or fluctuations in veld condition.

The objectives of this part of the study were therefore to:

- Estimate the herbaceous biomass in the different management (agro-ecological) units in the Tembe Traditional Area.
- Compare previous estimates of the herbaceous biomass with the data from the present study's estimates and to investigate any observed temporal changes in herbaceous biomass.

4.3 METHODS

The most practical and efficient techniques that have emerged to estimate dry biomass production are those involving the use of various types of disc pasture meter (Castle 1976, Bransby & Tainton 1977, Danckwerts & Trollope 1980, Hardy & Mentis 1985, Trollope & Potgieter 1986, Trollope *et al.* undated, 1989). The disc pasture meter is an inexpensive method to make rapid yield estimates of standing forage. It is used to determine the mean settling height of the disc for each homogeneous vegetation unit and from the mean settling

height, the herbage yield can be determined by applying linear regression equations of settling height against herbage yield. In areas where no regression equations have been developed, it is necessary to first calibrate the disc pasture meter before taking any measurements.

In the KwaZulu-Natal region, calibration of the disc pasture meter has been done and linear regression equations of fuel loads are available *inter alia* for the Eastern Shores of Lake St Lucia (Conlong 1986), the Lowveld, the Southern Tall Grassveld and Natal Sour Sandveld (Turner 1990), the Zululand Coastal Plain (Brockett 1996), the Kosi Bay Coastal Forest Reserve (Lubbe 1996) and the Sileza Nature Reserve (Matthews 1995, Hanekom 1998a, 1999a, 2000a, 2001a, 2002a, 2003a, 2004a) and Tembe Elephant Park (Hanekom 1998b, 1999b, 2000b, 2001b, 2002b, 2003b, 2004b). Other calibrations that have been done in southern Africa include the False Thornveld of the Eastern Cape, Transvaal Bushveld, the Midmar Rye Grass areas of Honeydale, the Kruger National Park and some savanna areas of southern Africa as described by Trollope (1980), Trollope and Potgieter (1986) and Trollope *et al*. (undated).

Because of the non-destructive nature, the availability of regression equations and the ease of determining herbaceous biomass with a disc pasture meter this method was chosen for the present study (Castle 1976, Bransby & Tainton 1977, Trollope & Potgieter 1986).

Sampling was done at the same sites and at the same time as the range condition assessments (Chapter 5). The five management units that were sampled were the Closed Woodland, the Open Woodland, the Open to Sparse Woodland, the Sand Forest-Grassland Mosaic and the Hygrophilous Grassland or Palm Veld. The delineation of these units was based on information derived from Gaugris *et al.* (2004) although the terminology follows the structural classification of Edwards (1983). While conducting a veld condition assessment with the step point method (Mentis 1981) (Chapter 5), the disc pasture meter was dropped at every second step and the settling height of the disc was recorded. Three transects per management unit were sampled in each of the four different study areas, except for the Tembe Elephant Park and the Sileza Nature Reserve where in some management units four transect were evaluated. These transects, where possible, were placed in a north-south direction and 100 measurements were taken per transect as Trollope and Potgieter (1986) found that there was no statistically advantage in taking more than 100 measurements per

homogeneous plant community. The disc was released from a standard height of 600 mm above ground level. When taking measurements, care was taken not to place the rod in a hole or on top of a tuft of grass (Bransby & Tainton 1977). The mean settling height was calculated for each management unit.

4.3.1 Calculation of the herbaceous biomass

The regressions developed for the Tembe Elephant Park and Sileza Nature Reserve (Matthews 1995, Matthews *et. al.* 1999, 2001, Hanekom 1999a, b, 2000a, b, 2001a, b, 2002a, b, 2003a, b) were used in this study because of the similarities in rainfall and vegetation type across the study area. These regressions have been successfully used for management purposes for more than five years in these conservation areas. It was decided not to use the regression equations that were developed by Conlong (1986), Turner (1990), Lubbe (1996) and Brockett (1996) because of differences in rainfall regime and vegetation type. However, some comparisons are provided between the different regression equations. The regression equations that were used were:

1. Tembe Elephant Park $Y = 35.9(X) + 724.7$ ($r^2 = 0.6784$) (Hanekom 2004b)
2. Sileza Nature Reserve $Y = 506.3(X) + 601.5$ ($r^2 = 0.673$) (Hanekom 2004a)
3. Kosi Bay Coastal Reserve $Y = 483.3(X) – 733.1$ (Lubbe 1996)
4. Zululand Coastal Plain $Y = 998.7 + 313.7(X)$ (Brockett 1996)
5. Natal Sour Sandveld $Y = 882 + 271(X)$ (Turner 1990).

where:

Y = estimated herbage yield (kg/ha)

X = mean disc height (cm)

For the purpose of the present study the vegetation of the Sileza Nature Reserve was considered to represent the Hygrophilous Grassland or Palm Veld. The mean biomass production for the whole of Sileza Nature Reserve was therefore compared to the hygrophilous vegetation present in the Tembe Traditional Area to the west of the Sileza Nature Reserve.

4.4 RESULTS AND DISCUSSION

4.4.1 The Tshanini Community Conservation Area, Tembe Elephant Park and unconserved Tembe Traditional Areas

The 2002 and 2003 rainfall season's herbaceous biomass estimates for the four management units in the Tshanini Community Conservation Area, Tembe Elephant Park and unconserved Tembe Traditional Area are presented in Table 4.1 and Figure 4.1. In general, biomass yield in the different management units of the Tshanini Community conservation Area compared well with comparable units in the Tembe Elephant Park and the unconserved traditional area when using Hanekom's (2004a) regression equation. Biomass yield was consistently lower in 2003 than in 2002. The mean estimated biomass yield for all four management units in the Tshanini Community Conservation Area was 1 086 kg/ha in 2002 and 914 kg/ha in 2003. The 2003 value is below the minimum fuel load requirements of 1 000 to 1 500 kg/ha to sustain a fire (Van Rooyen 2002a, b). The highest recorded herbaceous biomass for the Tshanini Community Conservation Area (1 120 kg/ha) was recorded in the Open to Sparse Woodland in 2002, and the lowest (897 kg/ha) in the same unit in 2003. The biomass yield did not vary considerably among the four management units. Reasons for this phenomenon could possibly be the low level of utilization by large herbivores, especially cattle, in the reserve. Fire could also have affected the biomass production. However, no records were kept of fires in the years preceding the present study. Burned tree stumps in the Tshanini Community Conservation Area were the only testimony of previous fires.

Biomass yield estimates derived by the regression equation of Turner (1990) for the Lowveld region (Acocks 1988) were compared to those derived by the equation currently used in the Tembe Elephant Park (Hanekom 2004b) (Table 4.1). A notable difference was observed between the two estimates, with the estimates derived when using Turner's (1990) equation more than double those when using Hanekom's equation. However, Turner did his research on deep, clay soils, which could have produced a denser grass sward for the same disc height than the sandy areas in the Tembe Traditional Area.

Calibration curves for disc pasture meters should preferably have correlation coefficient values of $r^2 \geq 0.8$ (Hanekom 2003a, b). The low correlation coefficient value that was obtained for the regression equation in the Tembe Elephant Park is cause for concern and

should be redone. A separate calibration curve should preferably be developed for each vegetation community.

The close resemblance of the vegetation in Tembe Elephant Park and the Tshanini Community Conservation Area (Gaugris *et al.* 2004) allows herbaceous biomass production data from the Tembe Elephant Park (Table 4.2) and Sileza Nature Reserve (Table 4.3) to be used to investigate trends over the past five years. The data in Figure 4.2 showed that the effect of rainfall on herbaceous biomass production in the Tembe Elephant Park was overall minimal. It was therefore assumed that rainfall would have the same effect in the Tshanini Community Conservation Area. However, the effect of free-roaming cattle as apposed to wildlife has not been investigated. Other factors that could influence grass biomass yield include the influence of the water table on the grass sward, different stocking densities of both cattle and wildlife, and even the role of fire both in the short- and in the long-term.

4.4.2 The Hygrophilous Grasslands or Palm Veld in the Sileza Nature Reserve and the unconserved Tembe Traditional Areas

Four different regression equations were used to compare the herbaceous biomass yield of the Hygrophilous Grasslands in the Sileza Nature Reserve and the Tembe Traditional Area (Table 4.4). A small difference was observed between the two localities, with the Sileza Nature Reserve (2 335 kg/ha) giving a marginally higher yield per hectare than the communal areas outside this reserve (2 219kg/ha; equation 2). One reason for this could possibly be the higher stocking density outside the Sileza Nature Reserve. Values derived with the other equations (Matthews 1995, Lubbe 1996, Hanekom 2004a) also showed a slightly lower biomass yield in the communal areas.

4.5 CONCLUSIONS

When comparing the results obtained from the total study area it was noticeable that the herbaceous biomass yield did not vary among the management units within a site as well as among the different sites (Tables 4.1 to 4.3, Figures 4.1 & 4.2). With the exception of one excessively high value (2 186 kg/ha) in the Tembe Elephant Park's Closed Woodland in the 1999 season, all other values were relatively similar (Table 4.2).

Table 4.1: The herbaceous biomass (kg/ha) in the Tshanini Community Conservation Area, Tembe Elephant Park and the Tembe Traditional Area, estimated from disc pasture meter measurements using two different regression equations for the 2002 and 2003 seasons (measured in kg/ha). The equations used where those of (1*) Hanekom (2004) (y = 35.9(X) + 724.7) and (2*) Turner (1990) (y = 882 + 271(X), with Y= herbaceous biomass (kg/ha) and X = mean disc height (cm)

Area and year						
Management Unit	**Tshanini Community Conservation Area**		**Tembe Elephant Park**		**Tembe Traditional Area**	
	2002	**2003**	**2002**	**2003**	**2002**	**2003**
Sand Forest-Grassland Mosaic						
1*	1023	929	1059	940	-	927
2*	3129	2421	3402	2505	-	2408
Closed Woodland						
1*	1115	915	993	904	1055	990
2*	3828	2318	2909	2229	3372	2771
OpenWoodland						
1*	1085	913	1014	964	1066	950
2*	3603	2302	3064	2684	3457	2652
Open to Sparse Woodland						
1*	1120	897	1154	976	-	949
2*	3866	2183	4123	2782	-	2581
Mean						
1*	**1086**	**914**	**1055**	**946**	**1061**	**954**
2*	**3607**	**2306**	**3375**	**2550**	**3415**	**2603**

Table 4.2: The herbaceous biomass (kg/ha) in the Tembe Elephant Park, as measured from 1999 to 2004 with a disc pasture meter

Management Unit	**Year**					
	1999	**2000**	**2001**	**2002**	**2003**	**2004**
Sand Forest-Grassland Mosaic	973	1160	993	1059	940	933
Closed Woodland	2186	1010	964	993	904	878
Open Woodland	1051	1320	993	1014	964	987
Open to Sparse Woodland	1077	1218	1075	1154	976	1009
Rainfall for the preceding 12 months (mm)	596	1221	1034	621	264	454

Table 4.3: The herbaceous biomass (kg/ha) in the Sileza Nature Reserve, as measured from 1998 to 2003 with a disc pasture meter

Management Unit	Year					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**
Woodland	5039	3796	-	-	3507	2672
Grassland	2986	3398	-	-	2874	1935
Eragrostis lappula grassland	3191	4039	-	-	3092	2231
Ischaemum fasciculatum grassland	3862	5319	-	-	4694	1669
Rainfall for the preceding 12 months (mm)	361	561	1207	937	608	405

Table 4.4: The herbaceous biomass yield in the Hygrophilous Grassland of the Sileza Nature Reserve and the unconserved Tembe Traditional Area using four different regression equations for the 2003 season (measured in kg/ha). The equations used were those of (Equation 1) Matthews (1995) (y = 426.6(X) – 417.3), (Equation 2) Hanekom (2004) (y = 506.3(X) – 601.5), (Equation 3) Lubbe (1996) (y = 483.3(X) – 733.1) and (Equation 4) Brockett (1996) (y = 998.7 + 313.7(X)) with Y = herbaceous biomass (kg/ha) and X = mean disc height (cm)

Herbaceous biomass (kg/ha)				
Area	**Equation 1**	**Equation 2**	**Equation 3**	**Equation 4**
Sileza Nature Reserve	2057	2335	2070	2818
Tembe Traditional Area (outside conservation areas)	1959	2219	1959	2746

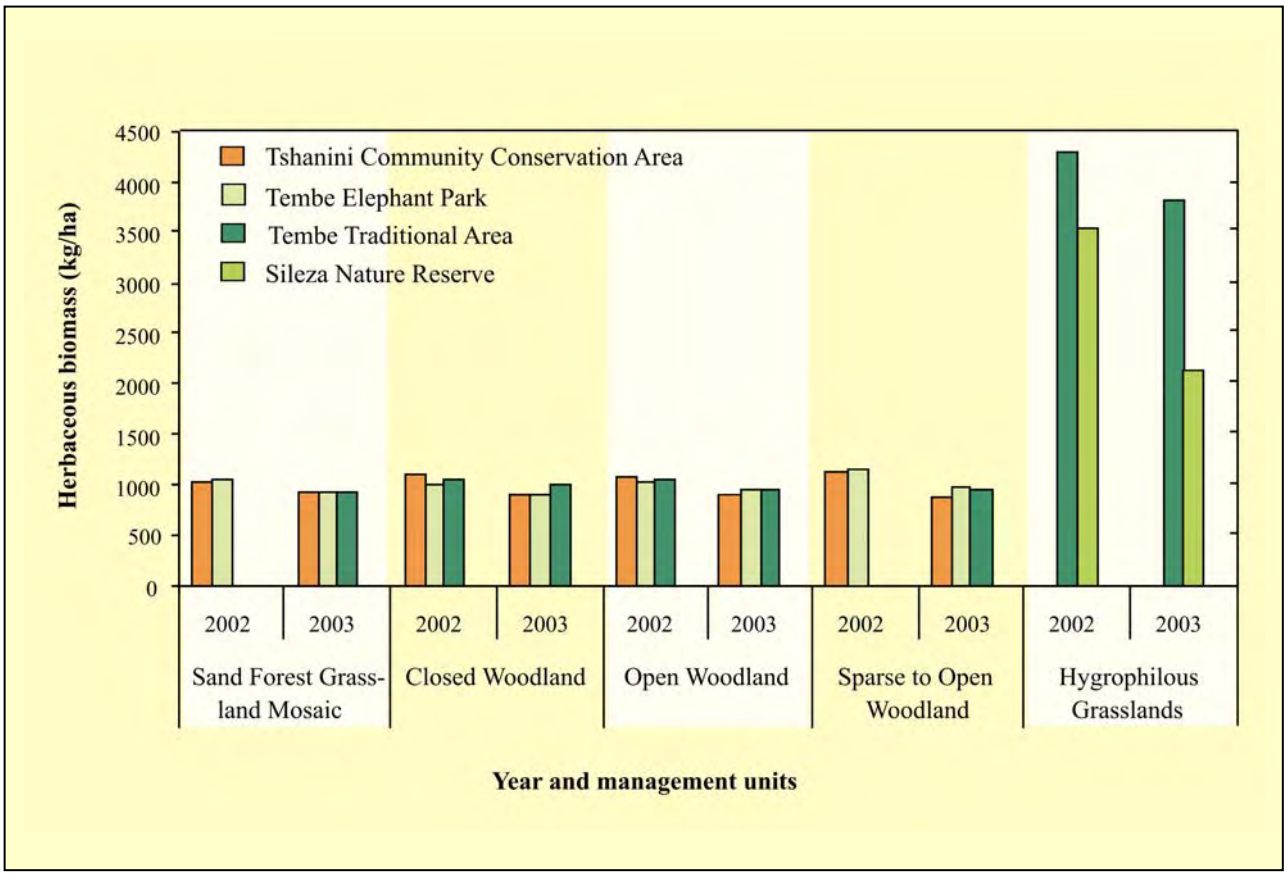

Figure 4.1: The mean herbaceous biomass as determined with a disc pasture meter in the five different management units of the Tshanini Community Conservation Area, the Tembe Elephant Park, the unconserved Tembe Traditional Area and the Sileza Nature Reserve.

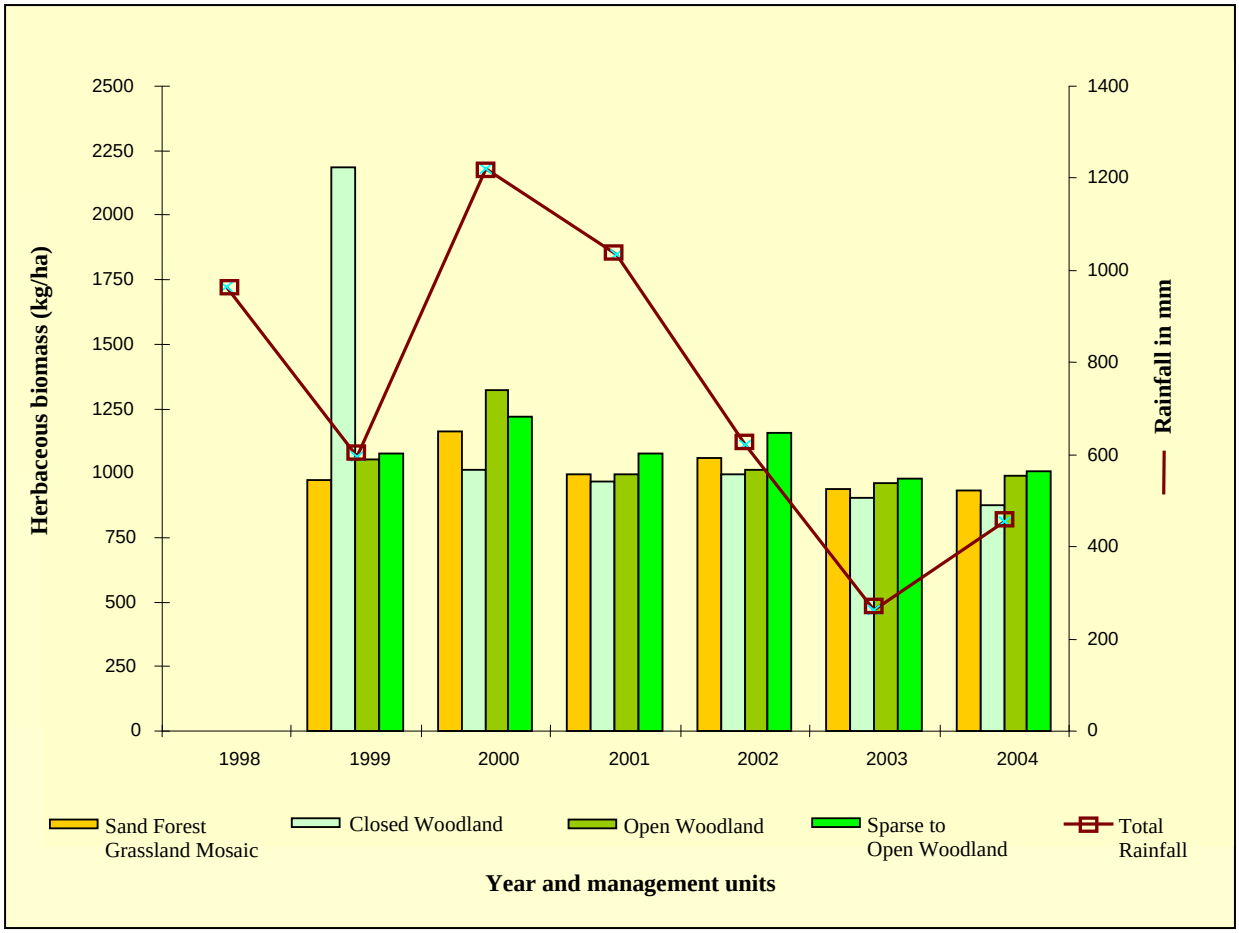

Figure 4.2: The mean herbaceous biomass as determined with a disc pasture meter for the Tembe Elephant Park in relation to the total rainfall from 1998 to 2004.

The mean herbaceous biomass yield for the Tshanini Community Conservation Area, Tembe Elephant Park, and the surrounding unconserved Tembe Traditional Area were similar, irrespective of the plant community type involved. In general, the herbaceous biomass of the Hygrophilous Grassland was higher than for the other vegetation types. Furthermore, the biomass yield showed only slight annual variation that was not related to annual rainfall. As no literature was available of exactly when, where and how the currently used calibration curve was derived for the Tembe Elephant Park and the Sileza Nature Reserve it is recommended that new calibration curves should be developed by using the method described by Trollope and Potgieter (1986) and Trollope *et al.* (undated) for each separate community.

In the Tshanini Community Conservation Area as well as in the entire unconserved Tembe Traditional Area, it was a common sight to see rangeland being burned by the local community members or cattle owners and palm wine harvesters. The small fuel loads in the Tshanini Community Conservation Area did not necessitate burning and were probably below fuel loads needed for fires to spread. However, fires were frequently observed and it was clear that fire could be maintained in areas where the herbaceous biomass yield was below 2 000 kg/ha.

Chapter 5

RANGE CONDITION AND GRAZING CAPACITY

5.1 INTRODUCTION

According to Stuart-Hill (1989) and Tainton (1999) there are several reasons for conducting a veld condition assessment in an area for example to determine species composition of the herbaceous layer of the vegetation, to establish a reference point for grazing capacity, and to determine the effect of management practices on rangeland condition.

Veld condition assessment is a convenient way of making comparisons, either over time or in relation to some or other functional characteristic (Trollope 1990). These characteristics can be food production, wildlife or livestock production, resistance to soil erosion, physiognomic structure or the production of fuel for fire (Trollope *et al.* 1989). An assessment presents a way to quantify and observe spatial and temporal changes within a particular community or vegetation type (Tainton 1999). Factors influencing the dynamics of any plant community include human imposed fire management and the stocking density of domesticated animals.

Van Rooyen *et al.* (1996) stated that the first step in the formulation of a veld management programme is the determination of veld condition in each agro-ecological unit. The grazing value and ecological status of different grass species differs and the determination of range condition therefore depends on the plant species composition, especially of the grass species of each agro-ecological management unit (Van Rooyen *et al.* 1996). Plant species composition is a characteristic, which is sensitive enough to determine the potential for food production as well as to determine changes in range condition. Most grass species are well adapted to specific growing conditions, but their numbers may decline if these conditions change. This sensitivity regarding growing conditions makes grasses suitable as indicators of range condition (Van Oudtshoorn 1999).

Different techniques for determining plant species composition have been evaluated by various authors (e.g. Walker 1970, Mentis 1981, Barnes *et al.* 1982, Gillen & Smith 1986, Everson & Clarke 1987, Friedel & Shaw 1987, Novellie & Strydom 1987, Everson *et al.* 1990). Factors to consider when selecting a specific technique include the objectives of the

study, the type of grass species involved, the herbaceous cover, the type and accessibility of the terrain, the researcher's experience as well as the time constraints (Hin 2000).

Grazing capacity must strike a balance between plant production and animal production (Van Hoven 1996). The grazing capacity of an area of land is expressed in Large Animal Units per hectare or hectares per Large Animal Unit. A Large Animal Unit (LAU) is the equivalent of a bovine of 450 kg, whose mass increases by 500 g per day on grassland with a mean energy digestibility of 55% Meissner (1982). A distinction can be made between the grazing capacity for the livestock industry and that for the wildlife ranching industry. Grazing capacity for wildlife is often expressed as Grazer Units with a Grazer Unit (GU) being the equivalent of a blue wildebeest *Connochaetes taurinus taurinus* of 180 kg (Dekker 1997, Bothma *et al*. 2004).

For the purpose of this study the step-point method which was modified to the rod method (Hurt & Bosch 1991, Du Plessis 1992) was used for determining plant species composition and the modified Ecological Index Method (Vorster 1982), as described by Van Rooyen *et al.* (1996) was used, to assess range condition and grazing capacity. These techniques were at that time also used by the research technician[1] in Tembe Elephant Park, Sileza Nature Reserve and surrounding areas.

5.2 OBJECTIVES

The objectives of this survey were to:

- determine the frequency occurrence of grass species in the respective management units (agro-ecological units);
- assess the condition of the veld for each management unit (agro-ecological unit);
- determine the grazing capacity for each management unit (agro-ecological unit);
- assess the ecological factors contributing to the current range condition; and
- compare range condition and grazing capacity between the Tshanini Community Conservation Area and the Tembe Elephant Park, Sileza Nature Reserve and the unconserved Tembe Traditional Area.

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5.3 METHODS

The vegetation of the Tshanini Community Conservation Area was classified into three major plant communities and eight subcommunities by Gaugris *et al. (*2004). In the present study the Tshanini Community Conservation Area was divided into the following five management units: Sand Forest, Sand Forest-Grassland Mosaic, Closed Woodland, Open Woodland, and Open to Sparse Woodland (Figure 5.1). The names given to these units follow the structural classification system of Edwards's (1983). The Sand Forest management unit is a dense vegetation type, and it was not regarded as a potential grazing area for cattle or other grazing species and therefore it was not assessed in this study. However, grassland patches associated with the Sand Forest and mapped as Sand Forest-Grassland Mosaic (Gaugris *et al.* 2004) were assessed because this unit does offer grazing. The Sand Forest-Grassland Mosaic covered 97.5 ha of the Tshanini Community Conservation Area. The Closed Woodland management unit corresponds to the Woodland on Clay of Gaugris *et al*. (2004) (Fig. 5.1), which has a surface area of 227 ha. The rest of the Closed Woodland community as described by Gaugris *et al.* (2004) was considered to be part of the Sand Forest Community in the present study. For the present study the Open Woodland management unit corresponded to the *Antidesma venosum-Urelytrum agropyroides* Open Woodlands and the *Fimbristylis complanata-Diheteropogon amplectens* Open Woodlands of Gaugris *et al.* (2004) and covered a surface area of 272 ha. The Open to Sparse Woodland management unit represented the two sparse woodland subcommunities of Gaugris *et al.* (2004), i.e. the *Albizia versicolor-Diheteropogon amplectens* Sparse Woodland and the *Indigofera podophylla-Albizia adianthifolia* Sparse Woodland, which combined cover a surface area of 639 ha of the Tshanini Community Conservation Area.

Except for the vegetation classification in Sileza Nature Reserve as was done by Matthews (1995) and Matthews *et al.* (1999), no other vegetation studies have been done in the immediate vicinity of the Sileza Nature Reserve. The area outside and to the west of the Sileza Nature Reserve was therefore regarded as similar to the vegetation within the Sileza Nature Reserve and classified as Hygrophilous Grassland and or Palm Veld.

Except for the Sand Forest community, the plant communities do not have sharp boundaries. It was especially difficult to map the boundaries for the Open and Closed woodlands as they formed mosaics that graded into each other.

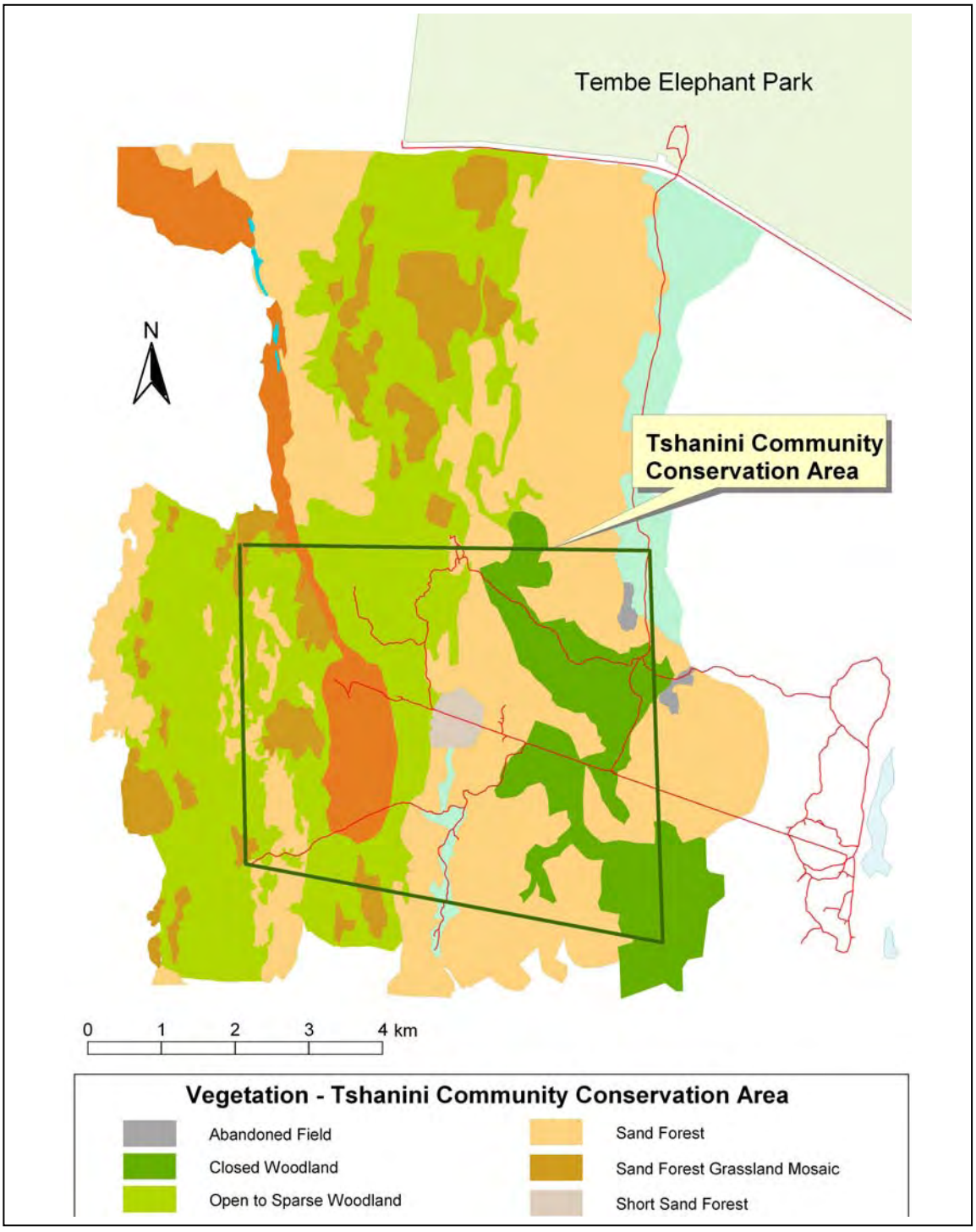

Figure 5.1: The management units in the Tshanini Community Conservation Area in Maputaland, KwaZulu-Natal (adapted from Gaugris *et al*. 2004).

Figure 5.2: A grassland patch within the Sand Forest-Grassland Mosaic management unit in the Tshanini Community Conservation Area during the summer of 2003.

Figure 5.3: The Closed Woodland management unit in the Tshanini Community Conservation Area during the summer of 2003.

Figure 5.4: The Open to Closed Woodland management unit in the Tshanini Community Conservation Area during the summer of 2003.

Figure 5.5: The Open to Sparse Woodland management unit in the Tshanini Community Conservation Area during the summer of 2003.

Figure 5.6: The Hygrophilous Grassland or Palm veld management unit adjacent to the Tshanini Community Conservation Area during the summer of 2003.

5.3.1 Range condition assessment technique

The range condition assessment techniques currently applied in southern African grasslands are based on estimates of proportional species composition. An adaptation of the step-point method of Mentis (1981) was used here to determine the grass and other plant species composition of the herbaceous layer. A thin rod instead of a marker on a shoe was used and it is commonly referred to as the rod method (Du Plessis 1992). At each sample site, a line transect running in a north-south direction was surveyed. Three to four sample sites per management unit were evaluated. These sites were selected randomly in each management unit, by comparing them visually to photographic examples in the Tembe Elephant Park. At every second step along the line transect, the rod was released without looking down, at that specific point. Point observations were made by identifying the grass species nearest to the rod. The grass species under dense trees and shrubs were also recorded. Du Plessis (1992) suggested that the rod method might give more accurate results than the step-point method. A 100 observation points were recorded at each transect.

At each sample site it was necessary to determine a cut-off distance for a plant record (Mentis 1981, Snyman *et al.* 1990). The cut-off distance, is the distance (radius) around the point of the rod in which a grass species must be rooted for it to be recorded. Should there be no grass species rooted inside the cut-off radius, that observation would be recorded as a bare patch. In badly degraded areas bare patches often constitute a high percentage of the 100 surveyed points. Mentis (1981) suggested that the maximum cut-off radius in the savanna areas of southern Africa should be approximately 15 to 30 cm and in the case of the present study a 30 cm cut-off distance was used. The grass plants were identified to species level. Sedges and forbs were also recorded.

5.3.2 Range condition index

A modification of the Ecological Index Method (Vorster 1982) or veld condition index as described by Van Rooyen *et al.* (1996), Van Rooyen (2002a,b) and Bothma *et al.* (2004) was used to determine the grazing capacity of each management unit. This is a reliable method for the determination of range condition and can be used with ease.

Because of differences in the ecological status and grazing value of different grass species, the Ecological Index Method uses grass species composition to determine range condition. Generally, there is a relationship between the ecological status of different grass species and their grazing value and their reaction to grazing (Van Rooyen *et al*. 1996, Van Rooyen 2002a). The following ecological status classes (ecological categories) are generally used (Vorster 1982, Van Rooyen *et al.* 1996):

Decreaser: A grass species, which is dominant in veld which is well managed, but which decreases when veld is mismanaged, overgrazed or underutilised.

Increaser 1: A grass species which occurs naturally in veld, but increases when veld is selectively utilised or underutilised.

Increaser 2a: A grass species which is dominant in poor veld and increases as a result of light overgrazing.

Increaser 2b: A grass species which is dominant in poor veld and increases as a result of moderate overgrazing.

Increaser 2c: A grass species which is dominant in poor veld and increases as a result of heavy overgrazing.

A modification of the above classification method, which takes grass productivity and forbs into account, is given below. The classes are based on the plant's perceived grazing value, phytomass production and palatability (Tainton 1999, Van Oudtshoorn 1999). These modified ecological classes are the following (Bothma *et al.* 2004):

Class 1: Valuable and palatable tufted and stoloniferous grass species with a high productivity and a high grazing value.

Class 2: Tufted grass species with an intermediate productivity and a moderate grazing value.

Class 3: Tufted grass species with a high productivity but a low grazing value.

Class 4: Generally unpalatable and perennial tufted and stoloniferous grass species with an intermediate productivity and a low grazing value.

Class 5: Unpalatable annual grass and forb species with a low productivity and a low grazing value.

The ecological status of most species is constant over a wide range of conditions but exceptions do occur (Van Rooyen *et al.* 1996, Van Oudtshoorn 1999). The ecological status of a species can be influenced by differences in environmental and habitat conditions. It is

therefore necessary for managers or herders to determine in which ecological category a species belongs in order to determine the range condition of a specific area.

To calculate a range condition score a grazing value is allocated to each of the ecological categories (Van Rooyen *et al.* 1996, Camp & Smith 1997, Tainton 1999, Van Rooyen 2002a, b, Bothma *et al.* 2004). The weighting applied to the ecological classes in the present study was as follows:

• Decreaser	Ecological class 1	=	10
• Increaser 1	Ecological class 2	=	7
• Increaser 2a	Ecological class 3	=	4
• Increaser 2b	Ecological class 4	=	4
• Increaser 2c (or Increaser 3)	Ecological class 5	=	1

Wherever possible the classification of a grass species into an ecological category was based on research done in the KwaZulu-Natal province (Turner 1990, Gibbs-Russel *et al*. 1991, Lubbe 1996, Camp and Smith 1997, Hardy *et al.* 1999) (Appendix 5). Where no consensus could be reached, grass species were classified into those ecological categories currently used in the Sileza Nature Reserve and Tembe Elephant Park's range assessments (Hanekom 1998a & b, 1999a & b, 2000a & b, 2001a & b, 2002a & b, 2003a & b, 2004a & b). However, the ecological categories for Tembe Elephant Park and Sileza Nature Reserve combined the increaser 2a and 2b categories as increaser 2 (multiplying them with the factor 4). The increaser 2c category then became the increaser 3 category. Previous range assessments of the Sileza Nature Reserve and Tembe Elephant Park also assigned the ecological status of increaser 2 or class 4 to forbs and sedges and not class 5 as suggested by Bothma *et al.* (2004). To allow for comparisons with Hanekom's data this practice was continued.

After allocating the species to the relevant ecological categories the percentage composition (obtained from the 100 points in the rod-point survey) of each of the ecological categories was multiplied with the specific grazing value (weighting) of each category. The sum of these values represents the range condition score. This score is a quantitative measure of the grazing potential of the herbaceous layer, reflecting the ability of that area to support grazing herbivores and has a maximum value of a 1 000 points.

The range condition score can be expressed as an index by converting it to a percentage of a similar score of a reference site where the veld is in excellent condition (benchmark site). The range condition score can also be expressed as an index by calculating it as a percentage of the maximum score of 100. The range condition index was interpreted as follows (Van Rooyen *et al*. 1996): any veld with an index > 80% was considered to be in an excellent condition; a range condition index from 60% to 80% represented veld in good condition; and veld with an index value from 40% to 59% indicated veld in a moderate to poor condition. An extremely poor and degraded veld was indicated by a condition index value < 40%.

It would have been possible to consider those sample sites with the highest range condition index within management units as benchmarks. However, considering the fact that the range condition index was used in the determination of grazing capacity, such an approach could lead to an overestimation of the grazing capacity of the area.

5.3.3 Grazing capacity

Grazing capacity can be determined in a number of different ways (Bothma *et al*. 2004). Some methods, only use the rainfall data for an extended period of time, while in other methods vegetation data collected at a specific time are used (Schmidt *et al*. 1995). Nevertheless, rainfall is considered to be one of the most important environmental factors affecting veld condition and therefore grazing capacity (O'Connor 1994).

Three different equations were used to draw comparisons between the grazing value of the Tembe Elephant Park, the Sileza Nature Reserve, the Tembe Traditional Area (communal rangeland outside conservation areas) and the Tshanini Community Conservation Area. The first equation used the Combined Veld and Rainfall Method of *Danckwertz (1989)*. In Chapter 3 this method was also applied to determine the grazing capacity and stocking density.

Equation 1:

Grazing Capacity (in LAU per ha) = $[(-3.03 + 0.00289)(X_1)] + [(X_2 – 419.7)(0.000633)]$

Where:

X_1 = Range condition index

X_2 = Mean annual rainfall in millimetres.

The grazing capacity that was calculated for domestic stock (cattle) with this equation should be reduced by between 30% and 50% when working with wildlife (Peel *et al*. 1991). This is done to compensate for the inability to induce wildlife to graze rotationally.

Danckwertz's (1989) original equation was however adapted by Ezemvelo KwaZulu-Natal Wildlife_to determine the grazing capacity for the Tembe Elephant Park, Sileza Nature Reserve and Tembe Traditional Area outside conservation areas.

Equation 2:

Grazing Capacity (in LAU per ha) = $0.7\{[(-3.03 + 0.00289)(X_1)] + [(X_2 – 419.7)(0.000633)]\}$

Where:

X_1 = Range condition index

X_2 = Mean annual rainfall in millimetres.

The equation of *Bothma et al. (2004)* was used to estimate the grazing capacity for wildlife in the Tshanini community Conservation Area.

Equation 3:

Grazer Units per 100 ha = $0.547\ \{[c + (r – 419) \times 0.23] \times a \times f\ (\log_{10} g – 1)^{0.4}\}$

Where:

c	=	range condition index
r	=	mean annual rainfall in millimetres
g	=	percentage grass cover
a	=	accessibility of habitat to plains wildlife on a scale of 0.1 to 1, with 0.1 inaccessible and 1 = totally accessible
f	=	fire factor on a scale of 0.8 to 1, with 1 = absence of fire
419	=	standard mean annual rainfall in millimetres for savanna areas

5.4 RESULTS AND DISCUSSION

The frequencies of the most important herbaceous species in the different management units during the 2002/2003 season are presented in Tables 5.1 to 5.5 and the percentage contribution of the ecological classes in these management units is summarised in Tables 5.6 to 5.11 and Tables 5.7 to 5.11. Tables 5.12 to 5.15 set out the calculations for the grazing capacity for the different management units in the conservation areas and the unconserved

communal rangeland. Finally, the grazing capacities derived by applying different equations and different rainfall scenarios are compared in Tables 5.16 to 5.20.

5.4.1 The Sand Forest Grassland-Mosaic management unit

In the Tshanini Community Conservation Area the Sand Forest-Grassland Mosaic management unit represented the smallest area (4% of the reserve) and covers 97.5 ha. This unit was an open grassland zone around and between the Sand Forest patches and was characterised by the absence of trees and shrubs (Figure 5.2). *Urelytrum agropyroides* (42.1%) followed by forbs and sedges (28.3%) dominated this management unit (Table 5.1) in the Tshanini Community Conservation Area as well as in the unconserved Tembe Traditional Area. Two other grass species that were present in high frequencies in the Tembe Elephant Park were *Aristida stipitata* (19.9%) and *Perotis patens* (18.99%) (Table 5.1). Other grass species that were generally well-represented in this management unit included: *Diheteropogon amplectens*, *Andropogon schirensis* and *Panicum kalaharense*. The herbaceous cover of 68.8% (Table 5.6 & 5.12) was dominated by the class 2 species (50.1% in Table 5.6 and Figure 5.7) and with a range condition index of 60.7% (Table 5.6) this unit presents veld in a good ecological state. Furthermore, this management unit had the highest herbaceous biomass production (929 kg/ha) of all four the management units inside the Tshanini Community Conservation Area (Table 4.1).

Four different rainfall values were used to compare the grazing capacity of this management unit by means of three equations in Table 5.16. When the mean long-term rainfall was taken into account, the comparative values obtained were 0.34 LAU/ha (equation 1), 0.23 LAU/ha (equation 2) and 59.59 GU/100ha (equation 3) and which is approximately equivalent to 0.29 LAU/ha. A summary was also given in Table 5.12 with the mean rainfall calculated for the previous two years. The grazing capacity for the Tembe Elephant Park was appreciably lower than that for the Tshanini Community Conservation Area, and the value for the Tembe Traditional Area was intermediate between the two (Tables 5.17 & 5.18).

5.4.2 The Closed Woodland management unit

The Closed Woodland management unit extended over 227 ha and represented 9.3 % of the Tshanini Community Conservation Area (Figure 5.3). The dominant grass species

encountered in this management unit were: *Panicum maximum*, *Digitaria eriantha* and *Eustachys paspaloides* (Table 5.2). In the Tshanini Community Conservation Area this unit had both the highest range condition index (88%) and class 1 abundance (78.8%) (Tables 5.6, 5.8, Figure 5.8). The range condition index of this unit was also higher in the Tshanini Community Conservation Area than in the rest of the study area (Table 5.8).

The four different rainfall values that were used to compare the grazing capacity of this management unit were incorporated by means of three equations in Table 5.16. When the mean long-term rainfall was taken into account, the comparative values obtained were 0.41 LAU/ha (equation 1), 0.29 LAU/ha (equation 2) and 72.24 GU/100ha (equation 3. A summary was also given in Table 5.12 with the mean rainfall calculated for the previous two years. The grazing capacity for the Tembe Elephant Park was appreciably lower than that for the Tshanini Community Conservation Area, and the value for the Tembe Traditional Area was intermediate between the two (Tables 5.17 & 5.18).

This management unit also had the highest grazing capacity of all units in the whole presented study area at the time of study (72.24 GU/100ha at 721.5mm) (Table 5.16). Great care should therefore be given to this management unit when planning a burning practice, as it would probably support the highest stocking densities for wildlife in the whole reserve.

5.4.3 The Open Woodland management unit

The Open Woodland management unit (Figure 5.4) covered an area of 273 ha which represented 11.3% of the Tshanini Community Conservation Area. This community is associated with the dunes and interdune depressions on grey-brown to orange-grey dystrophic regosols (Matthews *et al*. 2001). According to the classification of Edwards (1983), this sub-community is a short, open woodland with only a few tall trees that reach a height of 6 to 8 m. The tree layer is underlain by a short to tall grassland up to 2 m tall (Gaugris *et al*. 2004). The most abundant grass species was *Urelytrum agropyroides* (24%) followed by forbs and sedges (22.2%) (Table 5.3). *Diheteropogon amplectens* (11.4%), *Eustachys paspaloides* (9.7%) and *Panicum kalaharense* (8.7%) also showed a high percentage frequency for both the Tshanini Community Conservation Area and the unconserved Tembe Traditional Area (Table 5.3). The contribution made by the species in the Tembe Elephant Park differed considerably from that in the Tshanini Communal Conservation Area (Table 5.3). This could

possibly be attributed to a more selective grazing habit by wildlife than by cattle. Class 1 (35.6%) had the highest frequency of abundance in this management unit (Figure 5.9) and the range condition index of 64.0% indicated veld in a good condition (Tables 5.6 & 5.12). The biomass yield of this unit in the Tshanini Community Conservation Area was relatively low (913 kg/ha) compared to the other study areas (Table 4.1).

The grazing capacity for this unit in the Tshanini Community Conservation Area (40.1 GU/100ha) was more or less the same as that for both the Tembe Elephant Park (40.3 GU/100ha) and the unconserved Tembe Traditional Area (36.4 GU/100ha) (Tables 5.12, 5.13 & 5.14). Taking the mean annual rainfall of the previous two years during the study period (514 mm) the Open Woodland Management Unit in the Tshanini Community Conservation Area could be stocked at 0.21 LAU/ha (equation 1) or 0.15 LAU/ha (equation 2) or 0.20 LAU/100 ha (equation 3).

5.4.4 The Open to Sparse Woodland management unit

The Open to Sparse Woodland management unit was the largest of the management units and represented 26% of the Tshanini Community Conservation Area and covered 639 ha (Figure 5.5). This management unit was represented by the two sparse woodland subcommunities as defined by Gaugris *et al.* (2004). These subcommunities were found on the dune crest, slopes and interdune depressions of the western side of the Tshanini Community Conservation Area on the acidic orange-grey dystrophic regosols. Abundant grasses included: *Diheteropogon amplectens, Urelytrum agropyroides, Perotis patens* and *Pogonarthria squarrosa* (Gaugris *et al.* 2004). The species with the highest frequency of abundance in the Tshanini Community Conservation Area was *Urelytrum agropyroides* (32.8%), forbs and sedges (25.7%) and *Aristida stipitata* (16.9%) (Table 5.4). The herbaceous cover for this management unit in the Tshanini Community Conservation Area was 63.8% and it was dominated by class 2 species species (Figure 5.10 & Table 5.12). With a range condition index of 49.2% this management unit represented an area in a relatively poor to moderate ecological state.

The Open to Sparse Woodland had the lowest grazing capacity (32 GU/100ha) of the all units in the Tshanini Community Conservation Area. Possible reasons for the poor veld condition could be that fires occurred in this unit, before this study was conducted. The unit also provides easy access to it for cattle from the neighbouring Zama-zama rural community.

Although dominated by class 2 species (33.3%), indicating grasses abundant in underutilized veld, the relatively high occurrence of class 3 to 5 species (54.5%) on the other hand indicates high to overutilized vegetation. This management unit also had the lowest biomass production of 897 kg/ha. Overall, this management unit in the Tshanini Community Conservation Area had the lowest ecological index compared to all the other study areas of the same vegetation type (Table 5.12). The long-term grazing capacity of this management unit was respectively 0.17 LSU/ha (equation 1), 0.21 LSU/ha (equation 2) and 53.42 GU/100ha (equation 3 which is equivalent to 0.26 LSU/ha). The values for the Tembe Elephant Park and unconserved Tembe Traditional Area were slightly higher than those of the Tshanini Community Conservation Area (Tables 5.12 – 5.14).

5.4.5 The Hygrophilous Grassland of the unconserved Tembe Traditional Area

The Sileza Nature Reserve was taken as reference point to compare to the Hygrophilous Grasslands of the unconserved Tembe Traditional Area. The total mean values derived for Sileza Nature Reserve were used for the Hygrophilous grassland outside conservation areas. Although Matthews *et al*. (1999) stated that all the plant communities were easily distinguishable in the field on the basis of growth form, general species composition and character species, certain transitional zones where hard to distinguish. Especially during a dryer year when the waterlogged areas where not distinguishable from the bordering hygrophilous areas. Most of the surveys were done in the grasslands (Figure 5.6) representing the communities described by Matthews *et al*. (1999) as the *Eragrostis lappula-Helichrysopsis septentrionale* Hygrophilous Grassland on humic gleysols (interdune depressions) and the *Ischaemum fasciculatum-Eragrostis inamoena* Hygrophilous Grassland on Champagne soils. Except for a few rare grass species, all the other grass species encountered by Matthews *et al.* (1999) in their survey were also encountered in this current study (Appendix 6).

Forbs and sedges both the Sileza Nature Reserve and in the unconserved Tembe Traditional Area showed a high percentage frequency occurrence of 32.10% and 19.51% respectively (Table 5.5). The shallow water table (Matthews *et al.* 1999) and perennial waterlogged areas could possibly account for this phenomenon. Other grass species that were abundant included: *Themeda triandra*, *Trachypogon spicatus*, *Diheteropogon amplectens* and *Eragrostis lappula* (Table 5.5). These two areas showed high frequency values for class 3 and

4 species of 50.25% (Sileza Nature Reserve) and 48.27% (Hygrophilous Grasslands of the unconserved Tembe Traditional Area) respectively (Figure 5.11). The possible reason that the Sileza Nature Reserve had a higher Class 2 value could be because of the absence of high concentration bulk grazers compared to the communal grazing land outside this reserve (Hanekom pers. com.)[1]. The range condition index of the Sileza Nature Reserve indicated a veld in a good state whereas the range condition index of the unconserved Tembe Traditional Area indicated veld in a moderate state. Unmanaged veld fires and higher stocking densities could account for the lower ecological index value in the unconserved communal land (Table 5.15).

The three equations that were used to compare the grazing capacity for the two study areas (Tables 5.15 & 5.19) indicated no great differences in the values. The Sileza Nature Reserve could be stocked at 41.0 Grazer Units per 100 hectare and the Hygrophilous Grassland outside the reserve could be stocked at 36.1 Grazer Units per 100 hectare at 514mm per annum or at 62 GU/100ha and 58 GU/100ha respectively at 721.5mm per annum (the long term mean rainfall for the study area) (Table 5.15).

5.5 CONCLUSION

The results represented in this chapter indicated that the vegetation in the management units of the Tshanini Community Conservation Area were generally in a good condition and except for the Open to Sparse Woodland management unit were in a better condition than the equivalent units in the Tembe Elephant Park and unconserved Tembe Traditional Area.

The “modified” Ecological Index Method combined with the equation of Bothma *et al.* (2004) proved to be a reliable and time saving method to determine the veld condition in the Tshanini Community Conservation Area. The grazing capacity estimates for wildlife obtained by the method seemed to be a fair reflection of the potential of the different management unit to sustain wildlife.

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Table 5.1: The percentage frequency of the herbaceous plant species in the Sand Forest-Grassland Mosaic management unit of the three described areas during the 2002/2003 season. The nine most frequent grass, sedge and forbs species occurring in the Tshanini Community Conservation Area were compared to the same species occurring in the Tembe Elephant Park and the rest of the Tembe Traditional area

Plant species/types	**Frequency of occurrence (%)**		
	Tshanini Community Conservation Area	**Tembe Elephant Park**	**Tembe Traditional Area**
Urelytrum agropyroides	**42.1**	17.3	28.6
Forbs and sedges	**28.3**	20.0	15.6
Diheteropogon amplectens	**9.1**	2.8	9.9
Andropogon schirensis	**8.1**	5.4	1.2
Perotis patens	**6.0**	18.9	12.7
Panicum kalaharense	**2.3**	9.2	3.5
Aristida stipitata	**2.1**	19.9	11.5
Digitaria eriantha	**1.0**	0.3	2.9
Panicum maximum	**1.0**	0.6	1.1

Table 5.2: The percentage frequency of the herbaceous plant species in the Closed Woodland management unit of the three described areas during the 2002/2003 season. The eight most frequent grass, sedge and forb species occurring in the Tshanini Community Conservation Area were compared to the same species occurring in the Tembe Elephant Park and in the rest of the Tembe Traditional area

Plant species/types	**Frequency occurrence (%)**		
	Tshanini Community Conservation Area	**Tembe Elephant Park**	**Tembe Traditional Area**
Panicum maximum	**39.4**	19.2	40.4
Digitaria eriantha	**13.9**	4.5	6.0
Eustachys paspaloides	**13.9**	0.5	3.6
Forbs and sedges	**13.9**	15.4	9.6
Sporobolus fimbriatus	**8.0**	1.8	2.3
Urelytrum agropyroides	**4.0**	1.6	9.2
Diheteropogon amplectens	**1.2**	1.6	5.9
Panicum kalaharense	**1.2**	4.7	2.0

Table 5.3: The percentage frequency of the herbaceous plant species in the Open Woodland management unit of the three described areas during the 2002/2003 season. The nine most frequent grass, sedge and forbs species occurring in the Tshanini Community Conservation Area were compared to the same species occurring in the Tembe Elephant Park and in the rest of the Tembe Traditional area

Plant species/types	**Frequency occurrence (%)**		
	Tshanini Community Conservation Area	**Tembe Elephant Park**	**Tembe Traditional Area**
Urelytrum agropyroides	**24.0**	4.2	15.7
Forbs and sedges	**22.2**	25.2	8.2
Diheteropogon amplectens	**11.4**	2.9	11.8
Eustachys paspaloides	**9.7**	5.2	0.9
Panicum kalaharense	**8.7**	4.2	2.9
Pogonarthria squarrosa	**7.0**	4.4	8.9
Aristida stipitata	**6.2**	5.2	4.3
Perotis patens	**3.6**	11.2	6.9
Panicum maximum	**2.8**	4.6	4.4

Table 5.4: The percentage frequency of the herbaceous plant species in the Open to Sparse Woodland management unit of the three described areas during the 2002/2003 season. The nine most frequent grass, sedge and forbs species occurring in the Tshanini Community Conservation Area were compared to the same species occurring in the Tembe Elephant Park and in the rest of the Tembe Traditional area

Plant species/types	**Frequency occurrence (%)**		
	Tshanini Community Conservation Area	**Tembe Elephant Park**	**Tembe Traditional Area**
Urelytrum agropyroides	**32.8**	12.2	28.4
Forbs and sedges	**25.7**	27.5	14.2
Aristida stipitata	**17.0**	7.5	2.2
Diheteropogon amplectens	**8.2**	4.8	14.0
Perotis patens	**7.3**	5.8	1.6
Panicum kalaharense	**4.0**	6.5	2.4
Pogonarthria squarrosa	**2.8**	6.8	14.5
Elionurus muticus	**1.7**	---	5.4

Table 5.5: The percentage frequency of the herbaceous plant species in the Hygrophilous Grassland management unit of the two described areas during the 2002/2003 season. The seven most frequent grass, sedge and forb species occurring in the Sileza Nature Reserve were compared to the same species occurring in the Tembe Traditional Area

Plant species/types	**Frequency occurrence (%)**	
	Sileza NatureReserve	**Tembe Traditional Area**
Forbs and sedges	**32.1**	19.5
Themeda triandra	**10.2**	6.7
Trachypogon spicatus	**9.1**	3.0
Diheteropogon amplectens	**8.2**	7.4
Eragrostis lappula	**8.2**	14.4
Urelytrum agropyroides	**3.9**	2.1
Monocymbium ceresiiforme	**3.4**	2.1

Table 5.6: The relative abundance of the ecological classes, range condition index and assessment for four management units of the Tshanini Community Conservation Area, Maputaland, KwaZulu-Natal for the 2002/2003 season

Management unit	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
1. Sand Forest-Grassland Mosaic	13.5	50.1	28.3	8.1	60.7	Good
2. Closed Woodland	78.8	4.8	13.9	2.4	88.0	Very good
3. Open Woodland	35.7	25.3	22.2	16.8	64.0	Good
4. Open to Sparse Woodland	12.2	33.3	27.4	27.1	49.2	Moderate
Mean	35.0	28.4	22.9	13.6	65.5	Good

Table 5.7: A comparison of the relative abundance of the ecological classes, range condition index and assessment for all the Sand Forest-Grassland Mosaic management units of the entire study area in Maputaland, KwaZulu-Natal in 2002/2003 season

Study area	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
Tshanini Community Conservation Area	13.5	50.1	28.3	8.1	60.7	Good
Tembe Elephant Park	13.2	21.7	22.4	42.7	42.0	Moderate
Tembe Traditional Area	18.8	36.1	15.7	29.4	53.3	Moderate

Table 5.8: A comparison of the relative abundance of the ecological classes, range condition index and assessment for the Closed Woodland management unit of the entire study area in Maputaland, KwaZulu-Natal for the 2002/2003 season

Study area	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
Tshanini Community Conservation Area	78.8	4.8	13.9	16.3	88.0	Very good
Tembe Elephant Park	40.1	10.3	45.2	4.3	66.0	Good
Tembe Traditional Area	61.6	17.1	11.4	9.9	69.6	Good

Table 5.9: A comparison of the relative abundance of the ecological classes, range condition index and assessment for the Open Woodland management unit of the entire study area in Maputaland, KwaZulu-Natal in the 2002/2003 season

Study area	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
Tshanini Community Conservation Area	35.7	25.3	22.2	16.8	64.0	Good
Tembe Elephant Park	29.1	23.3	26.8	20.8	58.0	Moderate
Tembe Traditional Area	33.8	31.5	10.7	24.0	58.3	Moderate

Table 5.10: A comparison of the relative abundance of the ecological classes, range condition index and assessment for the Open to Sparse Woodland management unit of the entire study area in Maputaland, KwaZulu-Natal in the 2002/2003 season

Study area	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
Tshanini Community Conservation Area	12.2	33.3	27.4	27.1	49.2	Moderate
Tembe Elephant Park	33.7	19.4	27.9	19.0	60.0	Good
Tembe Traditional Area	26.5	31.1	22.5	19.8	59.3	Moderate

Table 5.11: A comparison of the relative abundance of the ecological classes, range condition index and assessment for the Hygrophilous Grassland or Palm Veld management unit of the Sileza Nature Reserve and unconserved Tembe Traditional Area in Maputaland, KwaZulu-Natal in the 2002/2003 season

Study area	Percentage frequency (%)				Range condition index	Range condition assessment
	Class 1	Class 2	Classes 3 & 4	Class 5		
Sileza Nature Reserve	32.6	14.7	50.3	2.4	63.3	Good
Tembe Traditional Area	30.8	5.8	48.3	15.1	55.7	Moderate

Table 5.12: Parameter estimates used to calculate the range condition index and ecological grazing capacity in Grazer Units (GU) (Bothma *et al.* 2004) for the Tshanini Community Conservation Area, Maputaland, KwaZulu-Natal, based on the condition of the vegetation in the 2002/2003 season and using the last two years' rainfall values

Characteristics	1	2	3	4	Total
Size (ha)	97.5	273.0	227.0	639.0	**1 236.5**
Contribution of ecological classes (%)[b]					
Class 1	13.5	35.7	77.5	12.2	
Class 2	50.1	25.3	4.8	33.3	
Classes 3 & 4	28.3	22.2	14.0	27.4	
Class 5	8.1	16.8	2.4	27.1	
Bare soil	0	0	0	0	
Range condition score (maximum 1 000)	607.3	639.5	880.2	491.5	
Range condition index (%)	60.7	64.0	88.0	49.2	
Herbaceous cover (%)	68.8	75.0	69.4	63.8	
Mean rainfall (mm/year) for previous two years:	514.0	514	514	514	
Topography index of accessibility[c]	1.0	1.0	1.0	1.0	
Fire factor[d]	0.9	0.9	0.9	0.9	
Ecological grazing capacity at rainfall for past two years:					
Grazing Units per 100 ha	37.9	40.1	50.5	32.0	
Total Grazing Units for management unit	37	109	234	204	**584**
Mean ecological grazing capacity (GU/100 ha)					**39.7**

[a] Management units:
1. Sand Forest-Grassland Mosaic
2. Open Woodland
3. Closed Woodland
4. Sparse to Open Woodland

[b] Ecological classes: Classes were defined in methods.
[c] Topography index of accessibility: 0.1 = Inaccessible to plains wildlife; 1.0 = Fully accessible to plains wildlife
[d] Fire factor: 0.8 = Recent fires; 1.0 No recent fires

Table 5.13: Parameter estimates used to calculate the range condition index and ecological grazing capacity in Grazer Units (GU) (Bothma *et al.* 2004) for the unconserved Tembe Traditional Area, Maputaland, KwaZulu-Natal, based on the condition of the vegetation in the 2002/2003 season and using the region's long term rainfall value

Characteristics	1	2	3	4	Total
Size (ha)	2006.6	15415.9	4389.9	3271.7	**25084.1**
Contribution of ecological classes (%)[b]					
Class 1	18.8	33.8	61.6	26.5	
Class 2	36.1	31.5	17.1	31.1	
Classes 3 & 4	15.7	10.7	11.4	22.5	
Class 5	29.4	24.0	9.9	19.8	
Bare soil	0	0	0	0	
Range condition score (maximum 1 000)	532.7	582.6	695.9	593.0	
Range condition index (%)	53.3	58.3	69.6	59.3	
Herbaceous cover (%)	60.0	65.5	68.0	65.0	
Mean long-term rainfall (mm/year):	721.5	721.5	721.5	721.5	
Topography index of accessibility[c]	1.0	1.0	1.0	1.0	
Fire factor[d]	0.9	0.9	0.9	0.9	
Ecological grazing capacity at mean long-term rainfall:					
Grazing Units per 100 ha	33.5	36.4	43.5	36.8	
Total Grazing Units for management unit	671	5 605	1 909	1 203	**9 388**
Mean ecological grazing capacity (GU/100 ha)					**37.4**

[a] Management units:
1. Sand Forest-Grassland Mosaic
2. Open Woodland
3. Closed Woodland
4. Sparse to Open Woodland

[b] Ecological classes: Classes were defined in methods.
[c] Topography index of accessibility: 0.1 = Inaccessible to plains wildlife; 1.0 = Fully accessible to plains wildlife
[d] Fire factor: 0.8 = Recent fires; 1.0 No recent fires

Table 5.14: Parameter estimates used to calculate the range condition index and ecological grazing capacity in Grazer Units (GU) (Bothma *et al.* 2004) for the Tembe Elephant Park, Maputaland, South Africa, based on the condition of the vegetation in the 2002/2003 season and using the last two years' rainfall values

Characteristics	**1**	**2**	**3**	**4**	**Total**
Size (ha)	1 200	7 500	7 500	3 000	**19 200**
Contribution of ecological classes (%)[b]					
Class 1	13.2	29.1	40.1	33.7	
Class 2	21.7	23.3	10.3	19.4	
Classes 3 & 4	22.4	26.8	45.2	27.9	
Class 5	42.7	20.8	4.3	19.0	
Bare soil	0	0	0	0	
Range condition score (maximum 1 000)	416.2	582.2	658.8	603.3	
Range condition index (%)	41.6	58.2	65.9	60.3	
Herbaceous cover (%)	70.0	65.6	66.3	67.0	
Mean rainfall (mm/year) for the previous two years	514	514	514	514	
Topography index of accessibility[c]	1.0	1.0	1.0	1.0	
Fire factor[d]	1.0	1.0	1.0	0.9	
Ecological grazing capacity at past two years rainfall:					**9 817**
Grazing Units per 100 ha	29.4	40.3	44.4	41.5	
Total Grazing Units for management unit	353	3 022	3 331	3 111	
Mean ecological grazing capacity (GU/100 ha)					**38.9**

[a] Management units:
1. Sand Forest-Grassland Mosaic
2. Open Woodland
3. Closed Woodland
4. Sparse to Open Woodland

[b] Ecological classes: Classes were defined in methods.
[c] Topography index of accessibility : 0.1 = Inaccessible to plains wildlife; 1.0 = Fully accessible to plains wildlife
[d] Fire factor: 0.8 = Recent fires; 1.0 No recent fires

Table 5.15: Parameter estimates used to calculate the range condition index and ecological grazing capacity of the Hygrophilous Grassland management unit in Grazer Units (GU) (Bothma *et al.* 2004) for the Sileza Nature Reserve and the unconserved Tembe Traditional Area, Maputaland, South Africa, based on the condition of the vegetation in the 2002-2003 season and using the last two years' rainfall values

Characteristics	Sileza Nature Reserve	Total area	Unconserved Tembe Traditional Area	Entire grazeable area
Size (ha)	1 914.8	**1 914.8**	8 157.1	**8 157.1**
Contribution of ecological classes (%)[b]				
Class 1	32.6		30.8	
Class 2	14.7		5.8	
Classes 3 & 4	50.3		48.3	
Class 5	2.4		15.1	
Bare soil	0		0	
Range condition score (maximum 1 000)	681.8		557.2	
Range condition index (%)	68.2		55.7	
Herbaceous cover (%)	63.3		70.0	
Mean rainfall (mm/year) for the previous two years	514.0		514.0	
Topography index of accessibility[c]	1.0		1.0	
Fire factor[d]	0.9		0.9	
Ecological grazing capacity at mean annual rainfall:		**785.0**		**2947.0**
Grazing Units per 100 ha	41.0		36.1	
Total Grazing Units for management unit	785.0		2947.0	
Mean ecological grazing capacity (GU/100 ha)		**41.0**		**36.1**

[b] Ecological classes: Classes were defined in methods.
[c] Topography index of accessibility: 0.1 = Inaccessible to plains wildlife; 1.0 = Fully accessible to plains wildlife
[d] Fire factor: 0.8 = Recent fires; 1.0 No recent fires

Table 5.16 A comparison of three different equations for determining grazing capacity in the Tshanini Community Conservation Area, Maputaland, KwaZulu-Natal using four different rainfall scenarios

Management unit	Size in ha	Equation 1 (GU/100 ha) 1	2	3	4	Equation 2 (LAU/ha) 1	2	3	4	Equation 3 (GU/100 ha) 1	2	3	4	TOTAL LAU 2.1	2.2
Sand Forest-Grassland Mosaic	97.5	0.21	0.34	0.34	0.03	0.14	0.23	0.24	0.02	37.86	59.59	60.90	9.50	14	23
Open Woodland	273	0.21	0.34	0.35	0.04	0.15	0.24	0.25	0.03	40.05	62.16	63.49	11.17	41	66
Closed Woodland	227	0.28	0.41	0.42	0.11	0.20	0.29	0.30	0.08	50.47	72.24	73.55	22.05	45	66
Open to Sparse Woodland	639	0.17	0.30	0.31	0.00	0.12	0.21	0.22	0.00	32.04	53.42	54.71	4.12	77	134
Total	**1236.5**													**177**	**289**

Mean annual rainfall figures in millimeters:

1 = 514 mm for the previous two years
2 = 721.5 mm, mean long term
3 = 732.4 mm for an above average year
4 = 245 mm for a below average year

Table 5.17 A comparison of three different equations for determining grazing capacity in the Tembe Elephant Park, Maputaland, KwaZulu-Natal using four different rainfall scenarios

Management unit	Size in ha	Equation 1 (LAU/ha) 1	2	3	4	Equation 2 (LAU/ha) 1	2	3	4	Equation 3 (GU/100 ha) 1	2	3	4	Total LAU 2.1	2.2
Sand Forest-Grassland Mosaic	1200	0.15	0.28	0.29	-0.01	0.10	0.20	0.20	-0.02	29.21	51.02	52.33	0.74	120	240
Open Woodland	7500	0.20	0.33	0.34	0.03	0.14	0.23	0.24	0.02	40.30	64.30	65.74	9.18	1050	1725
Closed Woodland	7500	0.22	0.35	0.36	0.05	0.15	0.25	0.25	0.03	44.35	68.30	69.75	13.07	1125	1875
Open to Sparse Woodland	3000	0.20	0.33	0.34	0.03	0.14	0.23	0.24	0.02	41.64	65.65	67.10	10.29	420	690
Total	**19200**													**2715**	**4530**

Mean annual rainfall figures in millimeters:

1 = 514 mm for the previous two years
2 = 721.5 mm, mean long term
3 = 732.4 mm for an above average year
4 = 245 mm for a below average year

…

Table 5.18 A comparison of three different equations for determining grazing capacity in the Tembe Traditional Area, Maputaland, KwaZulu-Natal using four different rainfall scenarios

Management unit	Size in ha	Equation 1 (LAU/ha) 1	2	3	4	Equation 2 (LAU/ha) 1	2	3	4	Equation 3 (GU/100 ha) 1	2	3	4	Total LAU 2.1	2.2
Sand Forest-Grassland Mosaic	2006.6	0.18	0.31	0.32	0.01	0.13	0.22	0.23	0.01	33.45	54.55	55.82	5.90	261	442
Open Woodland	15 415.9	0.20	0.33	0.34	0.03	0.14	0.23	0.24	0.02	36.36	57.87	59.16	8.28	2158	3546
Closed Woodland	4389.9	0.25	0.38	0.38	0.07	0.17	0.26	0.27	0.05	43.48	65.79	67.09	15.81	746	1141
Open to Sparse Woodland	3271.7	0.20	0.33	0.34	0.03	0.14	0.23	0.24	0.02	36.77	58.25	59.54	8.74	458	753
Total	**25 084.1**													**3623**	**5882**

Mean annual rainfall figures in millimeters:

1 = 514 mm for the previous two years
2 = 721.5 mm, mean long term
3 = 732.4 mm for an above average year
4 = 245 mm for a below average year

…

Table 5.19 A comparison of three different equations for determining grazing capacity in the Sileza Nature Reserve and Hygrophilous Grassland area of the Tembe Traditional Area, Maputaland, KwaZulu-Natal using four different rainfall scenarios

Management unit	Size in ha	Equation 1 (LAU/ha)				Equation 2 (LAU/ha)				Equation 3 (GU/100 ha)				Total LAU	
		1	2	3	4	1	2	3	4	1	2	3	4	2.1	2.2
Sileza Nature Reserve	1915	0.21	0.31	0.39	0.14	0.15	0.22	0.28	0.10	40.97	61.90	63.16	12.69	**287**	**435**
Tembe Traditional Area	8157	0.19	0.29	0.38	0.12	0.14	0.21	0.26	0.09	36.13	57.51	58.82	7.23	**1142**	**1713**

Mean annual rainfall figures in millimeters:

1 = 514 mm for the previous two years
2 = 721.5 mm, mean long term
3 = 732.4 mm for an above average year
4 = 245 mm for a below average year

Table 5.20 A comparison of three different equations for determining grazing capacity in the study area, Maputaland, KwaZulu-Natal using four different rainfall scenarios

Study Area	Size in ha	Equation 1 (LAU/ha) 1	2	3	Equation 2 (LAU/ha) 1	2	3	Equation 3 (GU/100 ha) 1	2	3	Total LAU 2.2
Tshanini Community Conservation Area	1237	0.35	0.22	0.05	0.25	0.15	0.03	63.16	40.11	11.71	185.48
Tembe Traditional Area	25084	0.35	0.21	0.04	0.25	0.15	0.02	60.40	37.52	9.68	3762.62
Tembe Elephant Park	19200	0.33	0.19	0.02	0.23	0.13	0.10	63.73	38.90	8.32	2496.00
Sileza Nature Reserve	1915	0.39	0.21	0.14	0.28	0.15	0.10	63.16	40.97	12.69	287.22
Hygrophilous Grasslands	8151	0.38	0.19	0.12	0.26	0.14	0.09	58.82	36.13	7.23	1141.14

Mean annual rainfall figures in millimeters:
1 = 732.4 mm in an above average year
2 = 514 mm for the previous two years
3 = 245 mm in a below average year

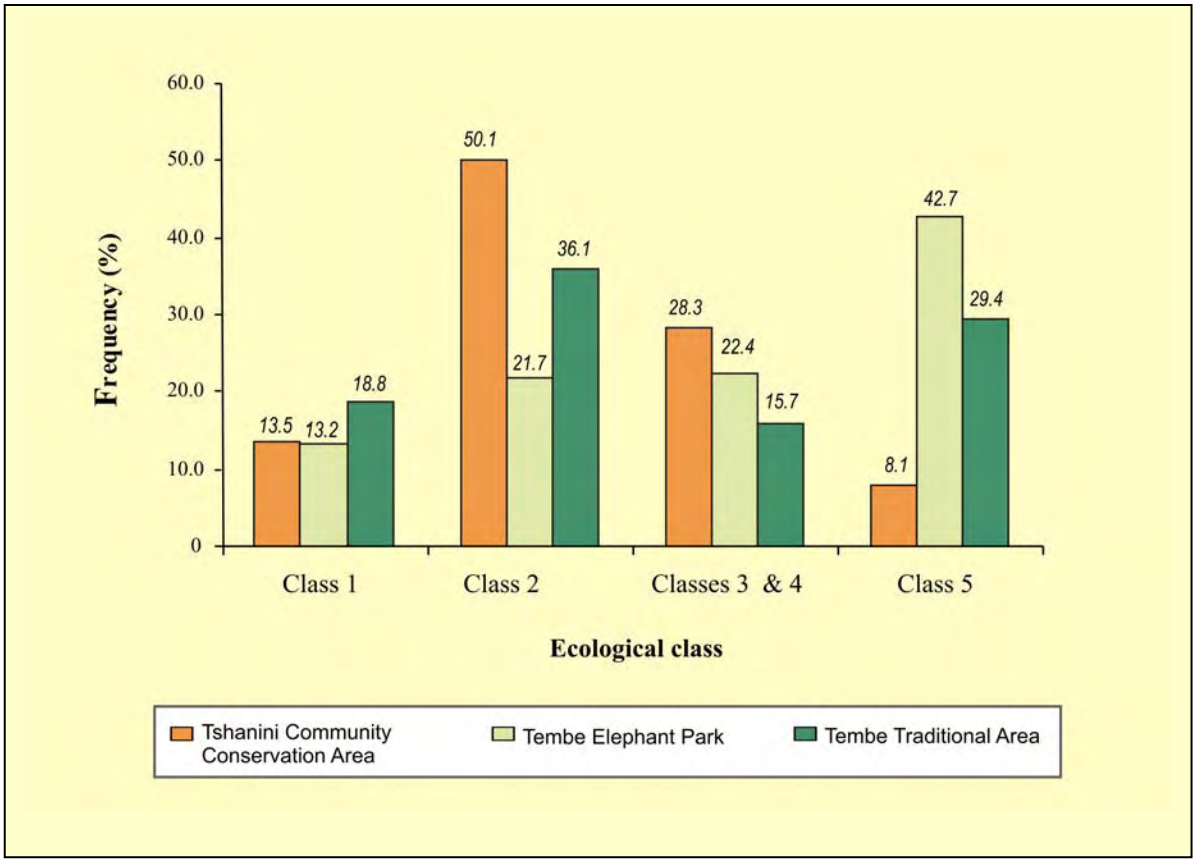


Figure 5.7: The relative contribution of ecological classes in the herbaceous stratum of the Sand Forest-Grassland Mosaic management unit, Maputaland, KwaZulu-Natal, in the 2002/2003 season.

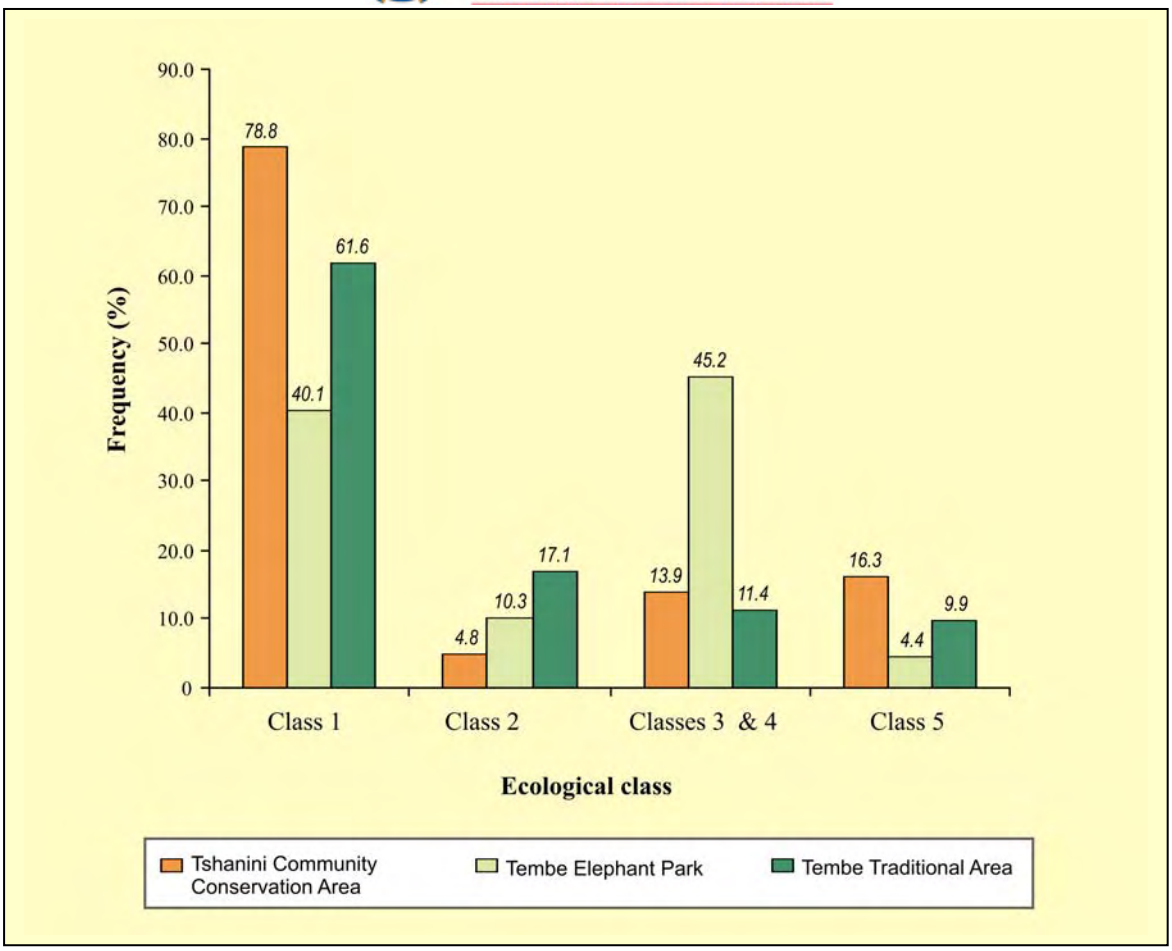


Figure 5.8: The relative contribution of ecological classes in the herbaceous stratum of the Closed Woodland management unit, Maputaland, KwaZulu-Natal, in the 2002/2003 season.

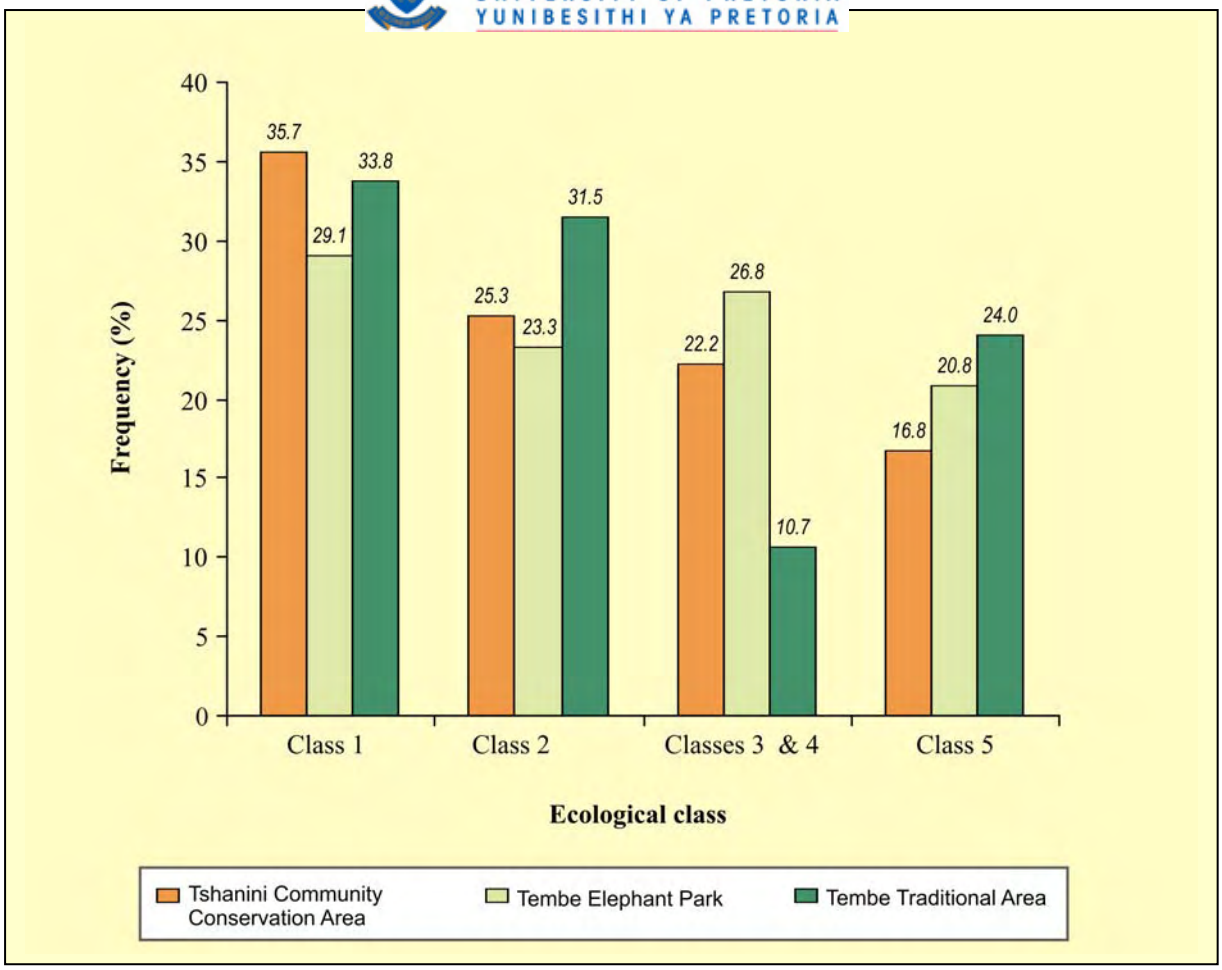


Figure 5.9: The relative contribution of ecological classes in the herbaceous stratum of the Open Woodland management unit in Maputaland, KwaZulu-Natal, in the 2002/2003 season.

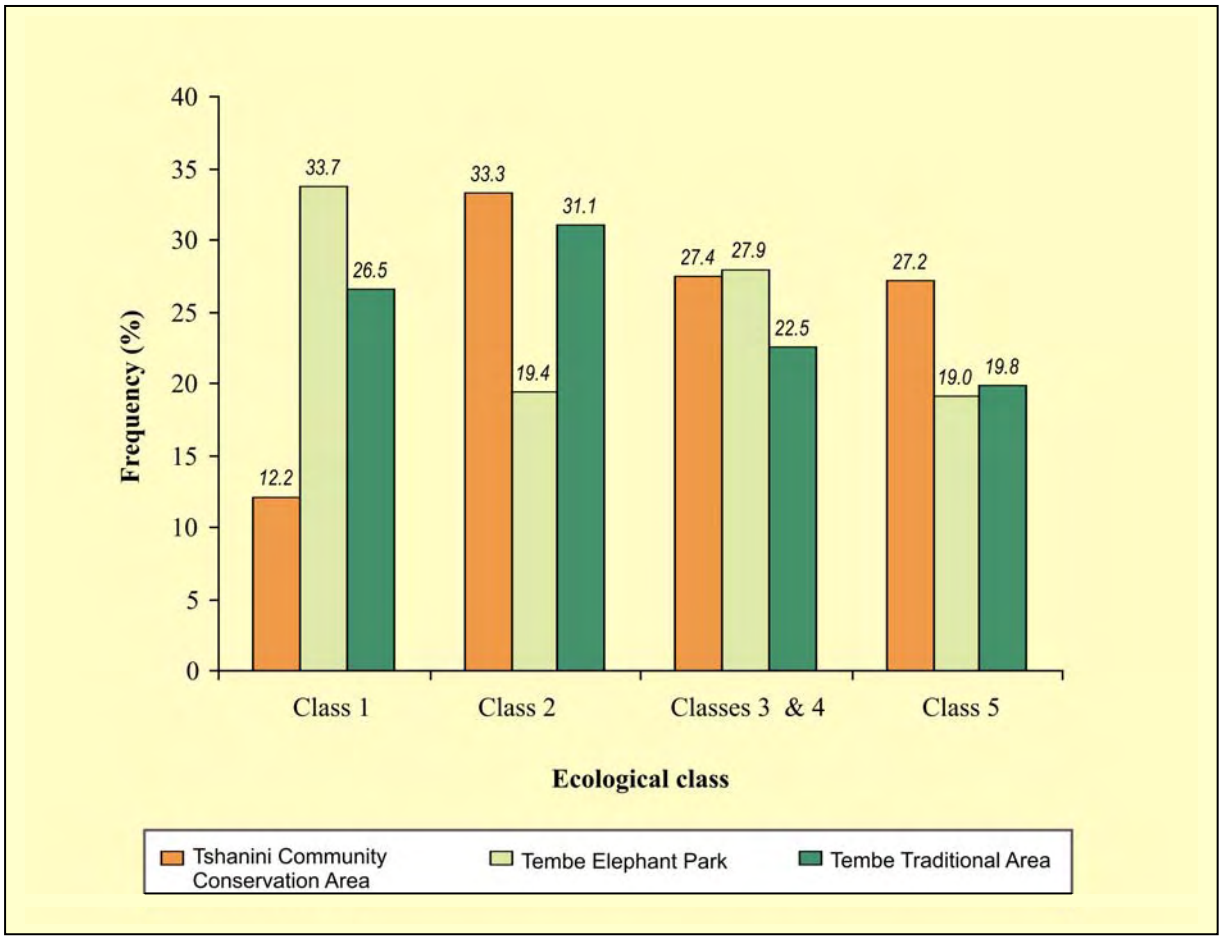


Figure 5.10: The relative contribution of ecological classes of the herbaceous stratum in the Open to Sparse Woodland management unit in Maputaland, KwaZulu-Natal, in the 2002/2003 season.

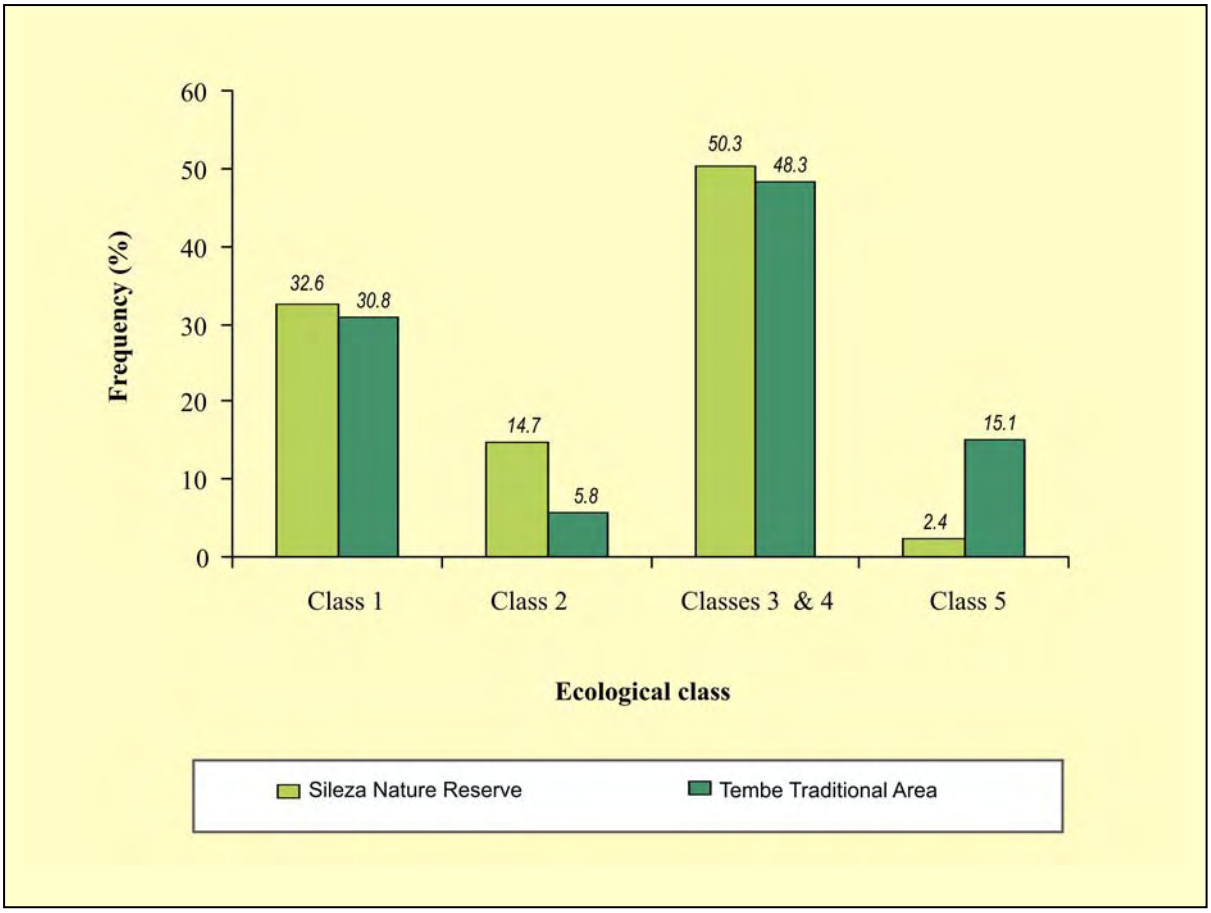


Figure 5.11: The relative contribution of ecological classes of the herbaceous stratum in the Hygrophilous Grassland management unit in Maputaland, KwaZulu-Natal, in the 2002/2003 season.

Chapter 6

DETERMINING THE STOCKING DENSITY FOR WILDLIFE OF THE TSHANINI COMMUNITY CONSERVATION AREA

6.1 INTRODUCTION

When wildlife populations are translocated to and re-established in the Tshanini Community Conservation Area and they start to increase in numbers, it will become necessary to set limits to their population size. This is an important management practice as it will keep these animals in balance with their food resources and provide for their social needs (Furstenburg 2002, Bothma *et al*. 2004). The conservation status of large herbivores, their ecological requirements and information on habitat preferences are the cornerstones of management programmes to determine stocking densities on reserves (Dekker *et al.* 1996). The density at which a plant community is stocked with herbivores is therefore the most important single factor in grazing management that affects animal production from the veld (Edwards 1981).

Stocking density refers to the number of wild animals of various types that are kept on a given unit of land (Tainton 1999). It is a management decision based on the objectives for the specific area, but it must be done within the ecological capacity of the habitat to support wild grazing and browsing herbivores (Bothma *et al*. 2004). Previously, poor estimation of the grazing or browsing capacity of veld for wildlife and the haphazard restocking of wildlife ranches has lead to unproductive animal systems, deteriorating vegetation and valuable topsoil loss (Dekker 1997). When calculating stocking densities it should always be remembered that nature is dynamic and reacts too many factors. This implies that the ecological condition of a specific habitat type should be monitored continually to check and adapt the stocking density on a reserve or wildlife ranch on the basis of an active adaptive management approach (Van Hoven 2002). Experience, effective monitoring and a sound knowledge of the habitat and the animals that occur, or might eventually occur, on a reserve will determine the success of the grazing and browsing capacity estimates that are calculated. The natural requirements of the animals should also be taken into account. Among the most important aspects to consider in this content is the natural distribution of the animal species, whether they are browsers, grazers, selective feeders or bulk feeders, and whether they

require a particular type of vegetation for food, cover or reproduction. Their social behaviour should here also be taken into consideration (Van Hoven 2002).

Allowing certain animal species to attain high densities may impact negatively on other more ecologically sensitive species. If the management objective is to increase species diversity, it is important to control the numbers of the aggressively competitive species (Bothma 2002a).

Applying the carrying capacity norms as developed by agriculturalists initially set stocking densities of wildlife in the African savannas. The term carrying capacity was borrowed from the agricultural sector, and refers to domesticated grazers (Meissner 1982, Dhondt 1988, Schmidt *et al*. 1995, Dekker 1997, Van Hoven 2002, Bothma *et al*. 2004). Bothma *et al*. (2004) rightly state that from the onset the concept of carrying capacity ignores the browsers and does not make provision for the wide variety of diets that is found in wild herbivores. A simplified classifications of the four basic types of feeding classes was set out by Bothma *et al*. (2004): low-selective grazers with wide mouths where > 80% of their diet is grass, the high-selective grazers with narrow mouths and where > 70% of their diet is grass, the mixed feeders that use from > 30%-70% grass or browse, and the browsers that eat > 80% browse and wild fruits. These ratios of the different classes must be considered when establishing the stocking density of the Tshanini Community Conservation Area.

Previouly, carrying capacity for wildlife was based on a comparison with the metabolic energy requirements of an adult steer (one Large Stock Unit) that is primarily a grazer (Meissner 1982). According to Bothma *et al*. (2004) calculating carrying capacity on the basis of domestic grazers through the conversion of this capacity to wildlife is flawed and of little use in the practical management of African wildlife. A refined method was introduced by Bothma *et al.* (2004), which requires quantitative data on the capacity of the plant resources to support herbivores and the diet of the herbivores. The available quantity and quality of browse and grazing in each plant community is then related to the ability of each plant community to sustain different types of wild herbivore under different rainfall regimes.

6.2 OBJECTIVES

The aim of this part of the study was to determine the stocking density for the Tshanini Community Conservation Area and to apportion this stocking density to different types of

wildlife in such a way that optimal wildlife viewing, maximum species diversity and trophy quality are attained and maintained.

6.3 METHODS

Low stocking densities relative to the ecological capacity of the habitat are aimed at maximum production per animal unit (kg/animal), whereas high stocking densities are aimed at maximum production per habitat unit (kg/ha). In current agricultural use in South Africa, the term carrying capacity refers to the area of land that is required to maintain a Large Animal Unit (LAU) to achieve maximum profit in the short-term, while maintaining the condition of the vegetation and soil in such a way as to be able to fulfil the needs and aspirations of future land users (Danckwertz 1989).

Carrying capacity is usually expressed as ha/LAU. Grazing capacity for wildlife reflects the ecological production potential of the grazeable portion of a homogeneous unit of vegetation and represents the area of land (ha) that is required to maintain a single Grazer Unit (GU) over an extended number of years without deterioration of the vegetation or the soil. A blue wildebeest *Connochaetes taurinus taurinus* with a mean mass of 180 kg is commonly taken as 1 GU in South Africa because it is an abundant, large herbivore with a mainly grazing diet. The grazing capacity for wildlife is expressed as GU/100 ha, and conversion factors are used to convert the relative metabolic mass of different grazer to that of a blue wildebeest. Browsing capacity for wildlife reflects the ecological production of the browseable portion of a homogeneous unit of vegetation and represents the area of land (ha) that is required to maintain a single Browser Unit (BU) over an extended number of years without deterioration of the vegetation or the soil. A greater kudu *Tragelaphus strepsiceros* with a mass of 140 kg is commonly taken as 1 BU in South Africa because it is an abundant, large herbivore with a mainly browsing diet. The browsing capacity for wildlife is expressed as BU/100ha, and conversion factors are used to convert the relative metabolic mass of different browsers to that of a kudu.

In essence, the ecological grazing and browsing capacity for herbivores of a habitat is the maximum number of grazers and browsers that a given area of land can sustain, based on the biophysical resources of the area. Together they form the ecological capacity of the habitat to support wild herbivores (Bothma *et al.* 2004).

Proposed stocking densities are seldom as high as the ecological grazing and browsing capacities. For optimal wildlife production on a reserve, an economic grazing or browsing capacity is therefore usually set conservatively at 20% to 30% below the ecological grazing or browsing capacity (Van Rooyen 2002a, b). This is because wildlife ranges over the whole reserve, and rotational grazing cannot be practiced as with livestock.

Most herbivores combine grazing and browsing in their diets and for some herbivores there is also a seasonal shift in the contributions of grazing and browsing to the diet (Van Eeden 2005). Stocking densities therefore have to be set by using the percentage of grazing and browsing in a herbivore's diet. The GU and BU equivalents also have to be calculated for each type of herbivore based on its relevant diet (Bothma *et al.* 2004). The calculation of a conversion factor for each type of wildlife into GU/ animal and BU/ animal is based on the diet and the relative metabolic (body) mass of each type of animal (Meisner 1982, Van Rooyen 2002a, b).

For example, if a stocking density of 120 Burchell's zebra *Equus burchellii* with a diet of 93% grass was recommended, then the grazing component of these 120 zebras would convert to 120 x 93% = 111.60 grazing animals of the size of a zebra. The conversion factor for grazing, taking a Burchell's zebra as an example, can be calculated as follows:

$$\text{Burchell's zebra (GU/animal)} = \frac{(\text{mass of the zebra in kg})^{0.75}}{(\text{mass of 1 GU in kg})^{0.75}}$$

For the Burchell's zebra the GU/animal will therefore be $(260)^{0.75} \div (180)^{0.75} = 1.32$ GU/animal. Consequently, 111.60 animals of the size of a Burchell's zebra will be equivalent to 111.60 x 1.32 GU = 147.31 blue wildebeest.

The browse component in the diet of a Burchell's zebra can be calculated in a similar way. A Burchell's zebra with a diet, which contains 7% browse, can be taken as an example. The recommended 150 Burchell's zebras are therefore equivalent to 120 x 7 % = 8.40 browsing animals of the size of a Burchell's zebra. The conversion factor for browse will be:

$$\text{Burchell's zebra (BU/animal)} = \frac{(\text{mass of zebra in kg})^{0.75}}{(\text{mass of 1 BU in kg})^{0.75}}$$

Therefore, for every Burchell's zebra the BU/animal would be $(260)^{0.75} \div (140)^{0.75} = 1.59$ BU/ animal. Therefore, 11 animals of the size of a Burchell's zebra would be equivalent to 8.40 x 1.59 BU = 13.35 greater kudu (Bothma *et al*. 2004).

All calculations for the other herbivores recommended for the Tshanini Community Conservation Area were based on the above approach.

6.4 RESULTS

The recommended stocking density and species composition of wild herbivores for the Tshanini Community Conservation Area is presented in Table 6.1. The range condition index of each of the four management units, as described in chapter 5, varied from 49.2 to 88.0% (Table 5.6), indicating an overall moderate to excellent veld condition. The ecological grazing capacity was calculated for each management unit, using the rainfall data of the past two years, and set out as Grazing Units per 100 ha. The ecological grazing capacity of the reserve is 39.7 GU/100 ha. However, a grazing capacity of 70% of ecological capacity is recommended which equals 28 GU/10 ha. At this capacity the reserve could therefore support a maximum of 350 Grazing Units.

Based on the dietary composition of the four main feeding classes the grazing and browsing capacity of the Tshanini Community Conservation Area could be apportioned to various types of wildlife. The generalised ratio used in the bushveld regions of South Africa is 25% of the ecological capacity apportioned to low-selective grazers, 30% to by high-selective grazers, 25% to by mixed feeders (grazers and browsers) and 20% to browsers. The ratio recommended for the Tshanini Community Conservation Area was 24: 28: 25: 22.

The ecological browsing capacity was not determined in the present study for the Tshanini Community Conservation Area. Information gathered in the Tembe Elephant Park was used to set the browsing capacity within conservative limits. It will in future be necessary to evaluate the browsing capacity for the Tshanini Community Conservation Area and if necessary adjust the proposed stocking densities. Great responsibility is thus placed on the management of the reserve to apply an active adaptive management strategy to evaluate and manage the browsing spectrum.

Table 6.1: The recommended ecological capacity in Grazer Units (GU) and Browser Units for herbivores that are to be re-located in the Tshanini Community Conservation Area, KwaZulu-Natal, based on the condition of the vegetation in the 2002 and 2003 season

Type of wildlife	Recommended No. of animals	Grasses in diet (%)	Mean mass (kg)	No. of grazing animals	Grazer Units (GU/animal)	Recommended No. of GU	Brows in diet (%)	No. of browsing animals	Browser Units (BU/animal)	Recommended No. of BU
Low selective grazers:										
Burchell's zebra	120.00	93	260	111.60	1.32	147.31	7	8.40	1.59	13.36
Bushpig	60.00	80	55	48.00	0.40	19.20	20	12.00	0.52	6.24
Percentage of total GU and BU	24.06					47.53				10.05
High-selective grazers:										
Blue wildbeest	100.00	87	180	87.00	1.00	87.00	13	13.00	1.21	15.73
Southern Reedbuck	90.00	95	55	85.50	0.41	35.14	5	4.50	0.50	2.23
Waterbuck	20.00	84	205	16.80	1.10	18.52	16	3.20	1.33	4.26
Percentage of total GU and BU	28.07					40.15				11.40
Mixed feeders:										
Impala	130.00	45	41	58.50	0.33	19.31	55	71.50	0.40	28.46
Warthog	60.00	70	30	42.00	0.26	10.96	30	18.00	0.31	5.67
Percentage of total GU and BU	25.40					8.64				17.51
Browsers:										
Giraffe	12.00	1	830	0.12	3.15	0.38	99	11.88	3.80	45.14
Grey duiker	12.00	12	19	1.44	0.19	0.27	88	10.56	0.22	2.36
Red duiker	12.00	12	12	1.44	0.13	0.19	88	10.56	0.16	1.67
Greater Kudu	50.00	15	140	7.50	0.83	6.21	85	42.50	1.00	42.50
Nyala	50.00	20	73	10.00	0.51	5.08	80	40.00	0.61	24.54
Steenbok	20.00	34	10	6.80	0.11	0.78	66	13.20	0.14	1.82
Suni	12.00	1	5	0.12	0.07	0.01	99	11.88	0.08	0.98
Percentage of total GU and BU	22.46					3.69				61.04
Total	**748.00**					**350.35**				**194.97**
Total area available for grazers (ha)		1236.50								
GU's/100 ha		**28.33**								
Total area available for browsers (ha)		2420.00								
BU's/100 ha		8.06								

6.5 DISCUSSION

The approach followed in the present study was based on extensive plant ecological work that was done by a number of leading scientists in this field in South Africa (e.g. Dankwerts 1989, Snyman 1991, Peel *et al.* 1994, Smit 1996, Camp & Smith 1997, Dekker 1997, Van Rooyen 2002 b, Van Rooyen *et al.* 1994) and refined by Bothma *et al.* (2004). The latter refined model can be used with confidence in savannas and grasslands of South Africa with an annual rainfall range from 300 to 700 mm (Bothma *et al.* 2004). The model was still considered suitable for the Tshanini Community Conservation Area, with its mean long-term rainfall of 721.5 mm. To use the diversity in the vegetation resources optimally, separation of the grazing and browsing components in the diet of wildlife was needed. The recommended stocking density for the Tshanini Community Conservation Area's proposed grazing population was calculated to be approximately 350 GU (Table 6.1). The constant monitoring of rainfall, veld condition as well as the physical condition of the animals are of vital importance and the stocking density must be adaptable and based on the quantity and quality of grazing available at any time. The model allows for several elements to be modified to suit the conditions on a particular wildlife reserve at a particular time. It may become necessary to adjust the percentage composition of graze and browse in the diet of some animals for the calculation of GU and BU, mainly because of the diet of the same type of animal may vary regionally. The ratio of low-selective grazers, high-selective grazers, mixed feeders, and browsers is also not fixed and should be adjusted depending on the vegetation types and structure on a particular reserve (Bothma *et al.* 2004). Finally the choice of the types of wildlife can also vary, depending on the preferences and objectives of the management and steering committee of the Tshanini Community Conservation Area.

According to Bothma *et al.* (2004) wildlife stocking densities can be based on the ecological capacity of the range in such a way that it optimally supports the herbivores. Quantitative and clearly defined parameters exist on which to develop these wildlife management decisions, by using the quantity and quality of grazing and browsing that are available to estimate the optimum population size of each type of wildlife for the study area. In doing so, it helps the wildlife to survive during the late winter critical period, and even during periodic droughts.

PHASE 3

Management guidelines for the Tshanini Community Conservation Area

Chapter 7

GENERAL MANAGEMENT GUIDELINES

7.1 INTRODUCTION

To manage anything at any given time is to have a specific situation or cause under effective control by means of a predetermined plan. This definition also applies where wildlife and wildlife resources have to be managed. Clear and precise objectives are key components of any management plan. Wildlife management according to Thomson (1992) is the science and art of changing the characteristics of habitats, wild animal populations, and human resources in order to achieve specific objectives by means of the wildlife resources. These objectives may be for ecological or economic reasons and include various activities such as: hunting, wildlife viewing, hiking, bird-watching, and other recreational activities (Hin 2000). A wildlife management plan on the other hand is the product of an ecological process, and the development of such a plan can consist of the following steps (Bothma 2002a):

- a comprehensive description of the ecosystem(s) involved;
- determination of the available manpower, expertise and finances;
- determination of land-use patterns in the surrounding areas;
- a definition of the permissible limits of any change;
- the current needs of the area and its users, and a prediction of future trends;
- the compilation of a timetable or schedule for implementing the management plan;
- a description of each realistic option in order to attain the stated wildlife management objectives;
- a choice of preferred options and a description based on the management plan;
- a comprehensive monitoring system for determining the impact of the management actions on the ecosystem; and
- a constant re-evaluation and readjustment of the management plan and the set of objectives.

As soon as an area has been demarcated as a nature reserve, national park or wildlife reserve and has been fenced, wildlife management has commenced (Bothma 2002a). It then becomes imperative to manage the impact of the continuous presence of animals on the natural vegetation.

The aim of this section is to provide broad management recommendations, suggestions and specific guidelines for the Tshanini Community Conservation Area based on the results and conclusions of the present study on the utilization of natural veld in the Tembe Traditional Area, Maputaland, KwaZulu-Natal. The objective is therefore to create a practical, user-friendly manual for the people of Manqakulani. It has to be kept in mind that the people of Manqakulani cannot freely access the internet or other literature sources, and this document will probably be their only source of information. An attempt was therefore made to summarise all the relevant information for them, even if this would seem redundant to the informed reader.

7.1.1 Options for the functioning of the Tshanini Community Conservation Area

The following statements and suggestions of the author do not necessarily represent the point of view of the Manqakulane people or even the opinion of the conservation and tourism authorities. They are guidelines in the context of the present study and a starting point from which the community may develop their own wildlife management plan further. The Tshanini Community Conservation Area could then be managed as a commercially sustainable business while fulfilling the following functions where and if possible:

- To be a conservation area where the local people make a concerted effort to conserve the endemic and rare plant species growing in the Sand Forest of the region.
- To be a conservation area where the sustainable utilisation of plant and animal species would be the main economic drivers. This could be achieved through nurseries that will serve as sources for indigenous trees, and through auctioneering of surplus wild animals.
- To be a conservation area where bird-watching of the highest standard will be presented, by introducing a canopy walkway, constructed 3 to 5 m above the ground.
- To be a conservation area with the focus on the extensive production of the rare suni *Neotragus moschatus*, red duiker *Cephalophus natalensis*, and nyala *Tragelaphus*

angasii, which are in demand by national and international bowhunters. Other types of wildlife, selected on the basis of the principles of grazing capacity and endemism, should also be included into the management plan of the conservation area.

- To be a conservation area where controlled low impact bow hunting of surplus ungulates will be allowed to deliver an additional source of income for the community.
- To be a conservation area where ecological and cultural tourism will play a major role in income generation for trained guides of the Manqakulani community. These activities should be linked to the conservation activities at the Tembe Elephant Park, the Ndumo Game Reserve, the Sileza Nature Reserve, and the Kosi Bay Coastal Forest Reserve, while at the same time linking to tourist routes through local villages.
- To serve as a centre where indigenous knowledge on locally manufactured crafts can be developed and managed, and from where the marketing of such products at national and international level can be undertaken.
- To serve as a centre from where other linked development projects in the Manqakulani community, as well as in other neighbouring communities can be facilitated, co-ordinated and managed.
- To serve as a pilot project and a focus to convince neighbouring wards to participate in similar endeavours, in order to reap the same benefits from the Sand Forests in their wards. This will create a ripple effect in conservation and rural development initiatives.

7.1.2 Possible management principles

The management principles of the Tshanini Community Conservation Area could be based on the following principles:

- To benefit the people through the creation of the Tshanini Community Conservation Area is the first and foremost focus of the whole development programme around the conservation area. Despite the inherent development potential of the Tshanini Community Conservation Area, it is recognized that it will not benefit the Manqakulani community as a whole. During the initial construction phases, approximately 40 part-time jobs will be created. Tshanini is the main development focus in the Manqakulani ward and it is important to create additional development

projects in the ward as well as in the adjacent wards. Such additional development projects have to be launched simultaneously in order to benefit from the momentum provided by the conservation support. However, these alternative development projects should not compete with the establishment of the Tshanini Community Conservation Area.

- The success of the sustainable management of the Tshanini Community Conservation Area will create incentives for external developers to become involved in new projects. These projects could amongst others include the production of marula jam, oil and jelly, the harvesting of wild honey, indigenous fresh water fisheries, nurseries for rare and endangered plant species or nurseries for indigenous medicinal plants.
- From the income generated through the Tshanini Community Conservation Area, a Trust could be created where people living in Manqakulani could apply for scholarships for their children to attend centres for tertiary education. In that manner the whole of the Manqakulani community could benefit from the Tshanini Community Conservation Area, albeit on a long-term basis.
- The biggest and most important advantage of the project to the people will be that the principles of sustainable utilisation of renewable natural resources will be imbedded in the community.

7.2 ECONOMICS AND FINANCIAL VIABILITY

To develop and manage wildlife reserves is a capital-intensive business. According to ABSA (2002) a successful wildlife ranch needs at least R4 in capital outlay for every R1 of revenue generated annually. Development cost is calculated to be at least twice the cost of land. In the case of the Tshanini Community Conservation Area the initial cost of land cannot be calculated as expenditure but rather as an investment on behalf of the people of Manqakulani who gave the tribal land towards the incentive of making profit by means of sustainable utilisation. The development cost of this community-based natural resource management project is furthermore supported by the Kellogg Foundation.

For any enterprise to be considered a viable economic unit, three particular levels of expenditure have to be taken into consideration: the initial capital outlay and development costs, the current expenditure, and maintenance (Van Zyl & Sartorius von Bach 2002):

7.2.1 Initial capital outlay and development costs

The following division of capital is needed for developing a wildlife reserve:

- Land and wildlife purchase (80%);
- Accommodation, abattoir facilities, cooling facilities and outside buildings (6 to 12%);
- Wildlife-proof fencing (6%);
- Water provision (2%).

Capital items include the following:

- Vehicles (two- or four-wheel-drive pick-up truck, hunting or wildlife viewing vehicles, tractor, trailer, lorry, road grader, water carrier, motorcycles or bicycles and fire extinguishers);
- Machinery (power generators, pumps, implements, and workshop tools);
- Construction (roads, fences, loading ramps, firebreaks, boreholes, water pipelines, dams, tanks and troughs);
- Pens, bomas, lookout towers and hides.

7.2.2 Current expenditure

Many items can be listed for current expenditure depending on the scope of the wildlife reserve. The most important items are:

- Salaries, wages and rations;
- Insurance, medical aid scheme, interest and banking costs;
- Electricity, fuel, oil and lubricants;
- Helicopter and transport costs and services;
- Wildlife capture aids and equipment;
- Supplementary feeding and mineral licks;
- Medicines, vermicides, and dipping fluids;
- Veterinary and information services;
- Hunting licences and permits;
- Advertisements, brochures and pamphlets;
- Telephone, cell-phone, fax, e-mail and internet facilities, postage and stationary;
- Other diverse items such as ammunition, knives, salt, vehicle licences and insurance;

7.2.3 Maintenance

Investing in good habits through timely and regular maintenance will certainly prevent excessive costs later. Maintenance costs include:

- Roads and firebreaks;
- Wildlife-proof fencing;
- Water and power provision;
- Buildings and visitor facilities;
- Vehicles and machinery;
- Capture and transport equipment and facilities;

7.3 ADAPTIVE WILDLIFE MANAGEMENT

The concept of adaptive management is indispensable and extremely important in the management of natural areas. The term “adaptive management” is used to describe a system of making management decisions by lessons learned from mistakes, successes and experiences attained in the past (Stuart-Hill 1989). Certain priorities have to be taken into consideration when adaptive management is opted for. These priorities include: a series of management related hypotheses, implementation of specific and relevant management actions, the monitoring of the outcome of such actions, and the evaluation of results obtained against what was originally expected (Grossman *et al*. 1999). If the obtained results agree with the predictions, the attained results and knowledge base are deemed to be adequate and reliable. Should this not be the case, further research and hypothesis generation as well as change in management action are required (Grossman *et al.* 1999, Hin 2000).

In any natural environment there are key components of the habitat and animal spectrum that give a reliable indication of how healthy the entire system is. These key components should be monitored on a regular basis in order to implement an adaptive management approach. Typical key components will include the monitoring of rainfall, temperature, soil erosion, permanent natural surface water, fire, aspects of vegetation structure, plant biomass production, vegetation cover and composition, and the growth rate, numbers, sex and age ratios as well as the productivity of the animal population. Discerning trends in relation to an optimal benchmark is the ultimate aim of any monitoring approach. Therefore reliable measurements that will repeatedly give the same results are strived for, rather than accurate

measurements (Bothma & Van Rooyen 2002). In short, by monitoring aspects like animal performance, vegetation and environmental conditions, and acting on changing trends according to past and present knowledge, adaptive management has been applied.

7.4 VELD MANAGEMENT

Veld management refers to the management of natural vegetation for specific objectives related to different forms of land-use (Trollope 1990). According to Van Rooyen *et al.* (1996) veld management is the science, which deals with the utilisation and conservation of the natural veld to ensure maximum animal production without affecting the vegetation detrimentally. Management of the natural vegetation is the first and foremost factor to be considered on a nature reserve. Without conserving this natural resource the other components cannot develop to their full potential. Management, which is only aimed at the animal component, is doomed.

7.4.1 Range Condition

The vegetation of the management units of the Tshanini Community Conservation Area was generally in a good condition at the time of the present study and compared well with the condition in the rest of the study area. The results that were obtained through the present study provides baseline data on the herbaceous stratum of the Tshanini Community Conservation Area and a monitoring programme should be initiated to provide long-term data. These data should then be used to recommend applicable management practices.

Data on the range condition in the Tshanini Community Conservation Area was derived by the modified Ecological Index Method, which is a relatively quick method to assess the range condition. Because the same method is used in the Tembe Elephant Park and Sileza Nature Reserve results from the Tshanini Community Conservation Area can be compared to other formally conserved areas in the Tembe Traditional Area.

7.4.2 Grazing Management

The approach endorsed in the present study was based on the extensive plant ecological work that was done by a number of leading scientists in this field in South Africa (e.g.: Snyman 1991, Peel *et al.* 1994, Van Rooyen *et al.* 1994, Smit 1996, Dekker 1997, Van Rooyen 2002 b) and refined by Bothma *et al.* (2004). The refined model that was used to calculate the recommended stocking density and the recommended animal types for the Tshanini Community Conservation Area can be used with confidence in savannas and grasslands of South Africa with an annual rainfall of approximately 300 to 700 mm. The model is therefore suitable for the Tshanini Community Conservation Area, with its mean long-term rainfall of 721.5 mm.

To use the diversity in the vegetation resources optimally, separation of the grazing and browsing components in the diet of wildlife is needed. According to Bothma *et al.* (2004) wildlife stocking densities should be based on the ecological capacity of the range in such a way that it optimally supports the herbivores. Quantitative and clearly defined parameters exist on which to develop these wildlife management decisions, using the available grazing and browsing to estimate the population size of each type of wildlife. In doing so, it helps the wildlife to survive during the late winter critical period and even during periodic drought periods. On the other hand when a population is maintained below the ecological capacity by either cropping or selling of excess animals, the net growth of the population is positive. The population is then said to be at economic capacity (Van Rooyen 2002b).

The recommended stocking density for the Tshanini Community Conservation Area's proposed grazing population was calculated to be approximately 350 GU. Table 7.1 sets out the types of wildlife recommended for the reserve and the number of animals for each type. However, the stocking density of herbivores must be adaptable and based on the quantity and quality of grazing and browse available and consequently the constant monitoring of rainfall, range condition as well as the physical condition of the animals are of vital importance. The choice of the types of wildlife depends on the preferences and objectives of the management and steering committee of the Tshanini Community Conservation Area.

Table 7.1: The recommended number of animals and specific species that could to be relocated to the Tshanini Community Conservation Area

Type of wildlife	Grazer Units	Browser Units	Recommended number of animals
Low selective grazers:			
Burchell's zebra	147.31	13.36	120
Bushpig	19.20	6.24	60
High-selective grazers:			
Blue wildebeest	87.00	15.73	100
Southern Reedbuck	35.14	2.23	90
Waterbuck	18.52	4.26	20
Mixed feeders:			
Impala	19.31	28.46	130
Warthog	10.96	5.67	60
Browsers:			
Giraffe	0.38	45.14	12
Grey Duiker	0.27	2.36	12
Red Duiker	0.19	1.67	12
Suni	0.01	0.98	12
Greater Kudu	6.21	42.50	50
Nyala	5.08	24.54	50
Steenbok	0.78	1.82	20
Total	**350**	**195**	**748**

7.5 FIRE MANAGEMENT GUIDELINES

7.5.1 Introduction

Fire is a decisive factor in the dynamics of almost all global ecosystems (Van Wilgen & Scholes 1997). Fire, as natural environmental factor, can either be destructive or it can be used in such a way that it serves as a management tool (Trollope 1989, Camp 1997, Tainton 1999). Trollope (1989) expressed the dual role of fire as follows: “fire, a bad master but a good servant”. The incorrect use of fire could lead to serious deterioration in range condition and plant biomass production. Trollope (1989) stated that man has used fire in Africa for centuries to modify the vegetation for grazing by livestock and continues to do so to the present day.

Fire is certainly not a rare occurrence in Maputaland, and some of the earliest Portuguese explorers described this area as “Terra dos fumos” based on the endless grass fires that were lit by the amaThonga (Bruton *et al.* 1980). Except for lightning-caused veld fires, fire is used in slash–and-burn practices by the local inhabitants of Maputaland to clear a piece of land for cropping, or fire is used to stimulate new and more palatable grass growth for cattle grazing. The local palm wine makers also light fires around the ilala palm *Hyphaene coriacea* to clear away all dead leaves to harvest this local delicacy that is called *uBusulu*. These fires often do often get out of control in the study area (Smedley & Ribeiro-Tôrres 1979).

Fire management for the Tshanini Community Conservation Area today should primarily focus on prevention of fire rather than on the implementation of a fire regime. The guidelines provided below outline the effects of frequency, season, intensity, and the type of fire that prevails at a given time. However, in times of above mean rainfall or the accumulation of moribund material a fire strategy should be in place either as a precautionary measure or as a management program.

7.5.2 Objectives of a fire management programme

It is commonly accepted in South Africa (Trollope 1989, Camp 1997, Tainton 1999, Van Rooyen 2002b), that fire can be used as a management tool to:

- Remove moribund (overburden of dead) plant material that has accumulated from previous seasons and to stimulate new, nutritious and more palatable grazing;
- To control and manage undesirable invasive alien and indigenous woody vegetation (bush encroachment);
- To make fire-breaks and to burn portions of an area in a mosaic to stimulate grazing in underutilized areas.

7.5.3 Types of fire

Three basic types of fire can be distinguished based on whether the vegetation burns under the ground, on the surface or in the crown or canopy. Ground fires usually smoulder in thick layers of organic plant debris on the soil. A surface fire burns mostly in the grass or herbaceous layer, while a crown or canopy fire burns at levels higher than that of the surface fire. Head fires burn with the prevailing wind direction, while backfires burn against the wind direction. Backfires are also warm fires that can cause severe damage to the mycorrhiza which are valuable for a healthy ecosystem. Head fires are recommended when burning open grassy areas because they cause the least damage to the grass sward (Van Rooyen 2002b).

7.5.4 Prescribed guidelines before burning

To ensure a safe and effective burning programme it is essential that the following equipment for controlling veld fires be in place and immediately available: fire hydrants, readily available water (including reservoirs), fire swatters, fire-breaks and man power. Local people should be trained in fire management skills and practical fire fighting. Regular training and simulation of the real situation should be practised well in advance, and any mistakes made must be eliminated. Water hydrants and other equipment have to maintained. When a fire management plan is drawn up specific tasks should be assigned to specific people.

Important measures to consider when planning a prescribed burn are: obtain an accurate weather forecast, burn only if conditions are ideal (temperatures < 20ºC and the relative air humidity of at least 50%), create fire-breaks (where possible), monitor wind direction the whole time, keep fire-fighting equipment in safe zones (either at the back of a fire or on a pre-burned area).

7.5.5 Determining fuel load

The disc pasture meter can be used to estimate the standing crop of grass and thus to determine the fuel load present in kg per ha. Most of the research and experience on fire regimes indicates that a sufficiently intense fire will be obtained to destroy the aerial growth of bush to a height of 2 m with a grass fuel load of > 4 000 kg/ha (Trollope 1989) and that fire will not spread readily with a fuel load of 2 000 kg/ ha or less (Trollope & Potgieter 1985, Du Plessis 1997).

7.5.6 Principles of a fire management plan

The following guidelines should be considered when implementing a fire management plan:

- *Type of fire:* Head-fires that burn with the wind should be used in controlled burning because the minimum damage is done to the grass sward in this way (Trollope 1989, 1999, Camp 1997).
- *Frequency of burning.* The rate at which grass material accumulates and becomes moribund will determine the frequency of burning and will therefore vary according to the rainfall received, the grazing capacity and the grazing intensity of a specific area (Trollope 1989). Field experience has shown that natural veld should be burned when a fuel load of not more than 4 000 kg/ha is reached, so that optimum productivity is sustained (Van Rooyen 2002b). Depending on the reason for burning, the frequency of burning will have to be adapted accordingly. To control undesirable plant species, the frequency of the burn will depend on the species to be controlled. For some plant species, a single intense burn is sufficient while other species require a sequence of fires to prevent them from producing seed (Trollope 1999).
- *Fire intensity:* The intensity of a fire refers to the amount of energy that it releases. Should the motive to burn be to remove accumulated moribund and unpalatable grazing material, cool, low intensity fires of less than 1000 kJ s^{-1} m^{-2} intensity are recommended. The ideal circumstances to achieve this would be when the air temperature is less than 20ºC and the relative air humidity is greater than 50%. When burning to control bush encroachment and undesirable plants, high intensity fires of at least 2000 kJ s^{-1} m^{-2} intensity are required. To achieve this requisite, the grass fuel load should be in excess of 4000 kg/ha, the air temperature from 25ºC to 30ºC and the

relative air humidity less than 30%. Such a fire should cause a top kill of trees and shrubs up to 2 m tall. The wind speed in all cases should not exceed 20 km/h (Trollope 1999).

- *Season of burning:* Burning practices should be adapted to fall in the natural occurrence of fire in a specific region. The veld should be able to recover as soon after a burn as possible, which makes timing critical. Research in the Kruger National Park has indicated that lightning fires occurred most frequently during the late spring and summer from October to January when thunderstorms are most frequent. This questions the traditional prescribed burning season that usually starting before the spring rains which occur from July to October in the study area (Van Wilgen & Scholes 1997, Van Rooyen 2002b).

7.5.7 Management of grazing after a fire

Trollope (1989) states that the grazing regime after a fire has a greater effect on the vegetation structure, composition and production of the next season than any other aspect of veld burning, and emphasised the serious damage that heavy grazing can cause when applied too soon after burning. In sour veld regions the grass sward has to be re-grown to at least a height of 150 mm before it is grazed and in sweet veld it should not be grazed until the full bloom stage. After a burn the following precautions should be taken: apply conservative stocking densities to minimize the potential harm to the veld, licks may also be removed from recently burnt areas and water points can be closed until the veld has sufficiently recovered. Animals that take advantage of burned areas include: blue wildebeest, Burchell's zebra, blesbuck, impala, sable antelope, buffalo and white rhinoceros (Van Rooyen 2002b).

7.5.8 Legislation and veld burning ethics

According to the National Veld and Forest Fire 1998 (Act No. 101 of 1998)[3] on veld and bush fires in South Africa it is compulsory for any wildlife rancher who wants to burn veld to be a member of an official fire protection committee. Firebreaks should also be in place and be maintained annually before grassed areas become too dry. In communal grazing areas where fire protection committees are not deemed necessary or compulsory as yet, conditions under

[1] Mr L. Qwabe. Department of Water Affairs and Forestry, Republic of South Africa. Waterbron Building, 191 Schoeman St, Pretoria. Tel: 012 336 8978. E-mail: qwabel@dwaf.gov.za.

which the veld may be burned are incorporated in the Regional Plan for Soil Conservation[1]. The relevant Minister can also declare fire protection areas and thus enforce legislation on a community to have an action plan in place should it be required. In the case of the Tshanini Community Conservation Area it would be ethical and wise to inform all the neighbouring wards as well as the Tembe Elephant Park when a controlled burn is being planned.

7.5.9 Prescribed fire regime for Tshanini Community Conservation Area

It will be essential to monitor fuel loads and the accumulation of moribund plant material. This will determine whether a management unit should be burned. To justify any decision-making it should firstly be measurable, secondly responsible and thirdly accountable. This can be done by drawing up a decision making model or criteria against which decisions can be tested. These criteria should be flexible yet firm, so that the objective for the area is not compromised or contradicted. The following background information should be considered:

- Veld should be burned at a stage when the leaf canopy will be able to recover rapidly.
- Long-term weather records should be studied for the region. These should indicate when the temperature increases and when the major rains are most likely to occur.
- When any given grazing area has an ungrazed section greater than 30%, burning the area should be considered.
- When the plant material has accumulated to at least 2 000 kg/ha, burning should be considered.
- The atmospheric conditions will determine the type and intensity of the burn.

The following is a typical criterion-based decision-making model which could be applied to the Tshanini Community Conservation Area (adapted from Camp 1997, Hin 2000):

1. Does bush encroachment pose a problem?
   Yes……3
   No…….2
2. Is the grass fuel load >2 000 kg/ha
   Yes……5
   No…….4
3. Burn the veld under the following conditions: Air temperature >25ºC; relative humidity of the air < 30%

4. Wait until >2 000 kg/ha of grass material has accumulated before burning.
5. Is moribund grass material present and is it smothering fresh green growth?
   Yes……6
   No…….7
6. Burn the veld under the following conditions: Air temperature < 20ºC; relative humidity of the air > 50%
7. Burning is not necessary.

There is a high probability and risk that the local people will burn grazing to stimulate green re-growth for grazing purposes. Firebreaks where possible, should be made around the Tshanini Community Conservation Area to protect the vulnerable Sand Forest and the associated grasslands**.**

Only once current unplanned and irresponsible burning practices have been changed into calculated decision-making practices can any improvement be made in the grazing regimes of Maputaland. Inkosi Tembe, when addressing the Manqakulani ward in February 2003, voiced his discontent over fires being made without any precautionary measures and left to burn freely. Such practices expose homesteads and endanger people's lives and also destroy valuable natural resources.

7.6 ANIMAL MANAGEMENT

The following section describes the types of wildlife that can be established in the Tshanini Community Conservation Area. For recommended animal numbers Table 7.1 should be consulted.

7.6.1 The greater kudu - *Tragelaphus strepsiceros* (Table 7.2)

7.6.1.1 Habitat requirements and preferences

The greater kudu occupies a wide range of vegetation types, which includes savannas woodlands, fynbos, eastern highveld grasslands, evergreen forests and coastal dune thickets (Mills & Hes 1997, Skinner & Chimimba 2005, Furstenburg 2006). This antelope is one of the few types of wildlife that has survived over time and thrived in the presence of

development, whether urban expansion or livestock and other agricultural activities. The wide distribution of these animals indicates a high degree of adaptability (Furstenburg 2006). Greater kudu are water dependent and require 7 to 9 liters of water per day. However, in years of good rainfall the kudu can obtain most of its moisture requirements from its diet (Skinner & Chimimba 2005, Furstenburg 2006). The highest recorded densities of this species occur in the succulent evergreen thickets of the Valley Bushveld in the Eastern Cape region (Skinner & Chimimba 2005). Trees and shrubs are an essential part of the habitat for a greater kudu as it provides, browse, shelter and protection against predation (Furstenburg 2006).

In the Tembe Elephant Park, the greater kudu is most often found in the Open Woodland (43.7% of observations) and the Sand Forest-Grassland Mosaic (29.3%) (Van Eeden 2005). The Open Woodland and Sand Forest-Grassland Mosaic in the Tshanini Community Conservation Area will therefore offer favourable and preferred habitat to the greater kudu.

7.6.1.2 Diet and feeding

The greater kudu is classed as a concentrate selector (Skinner & Chimimba 2005), and is predominantly a non-selective browser, favouring leaves, forbs, creepers, fruit, pods and succulents (Mills & Hes 1997, Furstenburg 2006). Within its wide distribution range the greater kudu prefers a variety of habitats. The diet of the kudu will therefore differ from region to region, in terms of browse and grass, and also in terms of the plant species eaten (Furstenburg 2006). The greater kudu consumes leaves of a wide variety of trees and shrubs, but especially of *Acacia* and *Combretum* species (Mills & Hes 1997). Van Eeden (2005) reported that *Strychnos madagaskariensis* (20.9%), *Combretum molle* (12.8%), *Strychnos spinosa* (11.6%) and *Acacia burkei* (9.3%) were the plant species most commonly eaten by kudu in the Tembe Elephant Park.

On nature reserves and wildlife ranches in South Africa the general population structure for the greater kudu consists of 47% socially mature cows of 3 to 9 years of age, 7% heifers of >2 to 3 years of age, 7% heifers of <2 years of age, 18% bulls of 1 to 8 years of age, 4% trophy size bulls of >8 years of age, 9% male calves of <1 year of age and 8% female calves of <1 year of age (Furstenburg 2006).

Table 7.2: Basic characteristics and information on the greater kudu regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Bothma & Van Rooyen 2005, Furstenburg 2005a, 2006, Swan *et al*. 2000)

Cows per bull at adulthood in the wild:	2
Cows per bull recommended for a wildlife ranch:	4
Minimum breeding herd size:	7
Mean percentage annual population growth in the wild:	14 to 19
Feeding spectrum: Percentage of diet	Grass and forbs: 13 Browse and fruit: 87
Grazer Units per animal:	0.8
Animals per Grazer Unit:	1.3
Browser Units per animal:	1
Animals per Browser Unit:	1
Territoriality:	Not territorial
Range size in ha:	Bull: 90 to 600 Cow: 90 to 600
Minimum habitat size required in ha:	3 kudu per 100
Rowland Ward: Minimum trophy size of horns:	1.37 m (53.875 inches)
Safari Club International minimum trophy size:	121 points
Mean auction live sale price for the 2006 season[1:]	R 2 641-00
Mean hunting price for a trophy animal[2:]	Male: R 6 000-00
Mean hunting price for a nontrophy animal[2:]	R 2 250-00
Meat price per kg:	R 8-00 to R13-00 per kg
Dressing percentage:	57
Maximum stocking density per ha:	13 ha per animal. 80 animals per 1000 ha (350 to 450 mm rainfall)
IUCN Red Data Category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

7.6.1.3 Status and value

Both old and mature cows should be harvested to prevent the population from exceeding the browsing capacity. To maintain a productive sex ratio, sub adult bulls should also be harvested, otherwise the sex ratio will increase in favour of bulls and the population growth will decrease to below 8% per year (Furstenburg 2005a). It is also important to cull older bulls to reduce their abundance in the population. The population size is not fixed and should be adapted during high and low production years in relation to the rainfall received and the resultant browse production (Furstenburg 2006).

The reproduction cycle and other social characteristics should be taken into consideration when hunting kudu. The best time to hunt cows would be from August to September at the end of the rut and before any advanced development of the foetus. The best time to hunt bulls for meat is in March or April. The hide of the kudu has no particular curio value although its leather is popular for the manufacturing of shoes, belts, handbags and clothing (Furstenburg 2005a).

7.6.2 The nyala - *Tragelaphus angasii* (Table 7.3)

7.6.2.1 Habitat requirements and preferences

The nyala is associated with areas with dense thickets and low-lying frost-free savannas or woodlands (Pfitzer & Kohrs 2005, Skinner & Chimimba 2005). Riverine woodland with thickets and dry forest also provide suitable habitat to this species (Skinner & Chimimba 2005). The nyala *Tragelaphus angasii* has recently been translocated to numerous private reserves and wildlife ranches in southern Africa, with Ezemvelo KwaZulu Natal Wildlife translocating more than 8 000 nyala over the past 25 years. Newly introduced nyala have the ability to displace bushbuck by competitive exclusion for food, and through aggression. It is therefore the responsibility of management to control their numbers as well as their influence on bushbuck in areas where these two species co-occur (Mills & Hes 1997).

Table 7.3: Basic characteristics and information on the nyala regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Bothma & Van Rooyen 2005, Furstenburg 2006, Pfitzer & Kohrs 2005, Swan *et al.* 2000)

Ewes per bull at adulthood in the wild:	1 to 2
Ewes per bull recommended for wildlife production:	8 to 10
Minimum breeding herd size:	12 to 15
Mean percentage annual population growth:	20
Feeding spectrum: Percentage of diet	Grass and forbs: 20 Browse and fruit: 80
Grazer Units per animal:	0.5
Animals per Grazer Unit:	2.0
Browser Units per animal:	0.6
Animals per Browser Unit:	1.6
Territoriality:	None
Range size in ha:	Ewe: 65 ha Bull: 390 ha
Minimum habitat required size	60 ha
Rowland Ward: minimum trophy size:	686 mm (27 inches)
Safari Club International: minimum trophy size:	63 points
Mean auction live sales price for the 2006 season[1]:	Male: R 5 480-00
Mean hunting price for a trophy animal[2]:	R 8 000-00
Mean hunting price for nontrophy animal[2]:	R 3 500-00
Meat prize per kg:	R 8-00 to R 12-00
Dressing percentage:	55
IUCN Red Data Category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

According to Van Eeden (2005) the nyala in Tembe Elephant Park showed a preference for the *Acacia borleae* Shrubland, Bush Clump Mosaics on clay and the Closed Woodlands on clay. Open Woodlands were used in proportion to their availability. The Tshanini Community Conservation Area offers suitable habitat for the nyala with specifically the Closed Woodland on Clay occupying an area of 227 ha.

7.6.2.2 Diet and feeding

Nyala are predominantly browsers. They will consume the leaves, flowers and fruit of a wide variety of plant species (Pfitzer & Kohrs 2005, Skinner & Chimimba 2005) and they will graze young green grass in the wet season. The ratio of graze to browse in the wet season is around 20:80 but it is 10:90 in the dry season. This antelope species is water dependent and its water consumption is determined by factors such as the moisture content of the food and the ambient temperature. The nyala requires about 3.5 liters of water per animal per day during the winter months (Pfitzer & Kohrs 2005).

7.6.2.3 Status and value

Nyalas have become fashionable and popular in the wildlife and hunting industries in recent years. By promoting this animal as a desirable and rare trophy, it has found popularity with foreign hunters, but especially in bowhunting circles. In 2002 a record price of R26 000 was paid at the Ezemvelo KwaZulu-Natal Wildlife auction for a live nyala trophy bull, and the mean trophy price paid by hunters then was about R10 000 (Pfitzer & Kohrs 2005).

It is also far more lucrative to sell a nyala for breeding or as a trophy animal than to cull it for its meat value. At a meat price of R8.00 to R12.00 (whole carcass) per kg with a mean mass of 110 kg per bull and a 55% dressing percentage, one can expect to earn in the region of R605.00 per nyala carcass for its meat.

7.6.2.4 Legislation

Permits have to be obtained from the relevant conservation authorities to hunt, capture, transport, export or import the nyala between provinces. The conservation authorities might also demand to inspect the new habitat before import and holding permits are granted. When animals are to be captured or moved within areas of foot-and-mouth disease or any other

controlled disease it has to be reported to the state veterinarian of the specific area, and a veterinary permit will have to be applied for. If a wildlife capture operation is planned it should be taken into account that issuing permits may take several weeks. In the IUCN red data list the nyala is listed as least concerned, conservation dependent and no CITES permits are required when handling, culling or hunting these animals (Friedmann & Daly 2004).

7.6.3 The impala - *Aepyceros melampus* (Table 7.4)

7.6.3.1 Habitat requirement and preferences

The impala favours savannas and open woodlands with an understorey of shrubs and grasses. Therefore it prefers light, open vegetation associations (Mills & Hes 1997, Skinner & Chimimba 2005). Cover, shade and the availability of surface water are essential as they seldom occur more than 8 km away from the water source (Mills & Hes 1997). Habitat preferences change seasonally based on the dietary needs and energy requirements of the impala (Furstenburg 2006). According to Van Eeden (2005) impala in the Tembe Elephant Park showed a preference for the *Acacia borleae Shrubland-Bush Clump Mosaics* on clay, the Closed Woodlands on clay and the Open Woodlands.

7.6.3.2 Diet and feeding

The impala is a mixed feeder that browses and grazes, therefore selecting leaves of woody plant species and grasses. Normally the graze:browse ratio is 45:55, although this ratio does vary seasonally and depends upon rainfall and the type of habitat (Mills & Hes 1997, Furstenburg 2006). Impala are highly selective regarding the plant species and plant parts that they eat (Mills & Hes 1997).

The Open Woodlands of the Tembe Elephant Park had the highest occurrence of impala (42.7%) in the study of Van Eeden (2005). Abundant grass species in this vegetation type and with a high grazing value include *Andropogon gayanus*, *Panicum maximum* and *Digitaria eriantha*, all of which also occur in the Tshanini Community Conservation Area. Abundant trees in those habitats, which are common in the diet of impala elsewhere, include *Albizia versicolor*, *Strychnos madagascariensis*, *Combretum molle and Terminalia sericea* (Matthews *et al*. 2001).

7.6.3.3 Status and value

The harvesting rate of trophy rams can be 3% to 4% of the total population. Some 11% to 16% of the population can be harvested annually as ewes older than 6 years of age for meat, or the ewes can be harvested at any age for live animal sales. From 8% to 12% of the population can also be harvested annually as 2-year old subadult rams for meat (Furstenburg 2005b).

Impala meat has a moderately dark texture and is acceptable for cooking, roasting, pastries, sausages and biltong (Bothma *et al*. 2002). The impala is popular as an animal in extensive wildlife production enterprises. According to Furstenburg (2005b) the reason for this phenomenon is the largescale conversion from livestock production to wildlife production because of socio-economic pressures that make stock farming less profitable.

7.6.4 The grey duiker *Sylvicapra grimmia* (Table 7.5)

7.6.4.1 Habitat requirement and preferences

The grey duiker is one of the most widely distributed antelope species in Africa, occurring all over South Africa, from sea level to altitudes over 4 307 m (Pfitzer & Colenbrander 2005, Skinner & Chimimba 2005). The grey duiker occurs in most savanna types, grasslands and woodlands with ample shrub cover, but they avoid open and short grasslands (Mills & Hes 1997).

7.6.4.2 Diet and feeding

Grey duikers are browsing concentrate selectors. Their diet consists mainly of leaves, herbs, nuts, flowers, freshly sprouted grass, fungi and even resin and the bark of *Acacia* trees (Mills & Hes 1997, Pfitzer & Colenbrander 2005; Skinner & Chimimba 2005).

Depending on the availability and the moisture content of their food, grey duikers can survive without water for weeks, but in captivity they tend to drink regularly (Pfitzer & Colenbrander 2005). They occasionally consume meat such as caterpillars, lizards, insects and even small birds and rodents (Skinner & Chimimba 2005).

Table 7.4: Basic characteristics and information on the impala regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Bothma & Van Rooyen 2005, Furstenburg 2005b, Swan *et al.* 2000)

Ewes per ram at adulthood in the wild:	3
Ewes per ram recommended for wildlife production:	4 to 7
Minimum breading herd size:	15 to 150
Mean percentage annual population growth:	23 to 35
Feeding spectrum:	Grass and forbs: 45 Browse and fruit: 55
Grazer Units (GU) per animal:	0.3
Animals per grazer Unit:	3.3
Browser Units (BU) per animal:	0.4
Animals per Browser Unit:	2.5
Territoriality:	Ram: 4 to 10 ha Ewe: No
Range size:	Ram: 200 to 400 ha Ewe: 250 to 700 ha
Rowland Ward: Minimum trophy size	600 mm (23.625 inches)
Safari Club International: minimum trophy size:	54 points
Mean auction live sales price for 2006 season[1]:	R 754-00
Mean hunting price for a trophy animal[2]:	R 1 500-00
Mean hunting price for a non-trophy animal[2]:	R 440-00
Meat price per kg:	R 10-60
Dressing percentage:	58
IUCN Red Data Category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

Table 7.5: Basic characteristics and information on the grey duiker regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Pfitzer & Colenbrander 2005, Swan *et al.* 2000, Furstenburg 2006)

Ewes per ram at adulthood in the wild	1
Ewes per ram recommended for wildlife production	2 to 3
Minimum breading herd size	6 to10
Mean percentage annual population growth	20
Feeding spectrum:	Grass and forbs: 12 Browse and fruit: 88
Grazer Units (GU) per animal	0.2
Grazing animals per Grazer Unit	5.0
Browser Units (BU) per animal	0.2
Animals per Browser Unit	4.5
Territoriality	Ram: Overlapping territories Ewe: No overlapping
Range size:	Ram: 1.9 to 21 ha Ewe: Larger than ram
Rowland Ward: minimum trophy size	114 mm (4.5 inches)
Safari Club International: minimum trophy size	4 Points
Mean auction live sales price for 2006 season[1:]	R 1 503-00
Mean hunting price for a trophy animal[2]:	R 1 500-00
Mean hunting price for a nontrophy animal[2]:	R 350-00
IUCN Red Data Category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

7.6.4.3 Status and value

Grey duiker does not offer great wildlife viewing potential because they are small, fast and are not often spotted (Pfitzer & Colenbrander 2005). They do, however, have recreational value around lodges and campsites where they can become quite tame. Grey duikers have fast growing horns that can reach trophy size at an early age.

7.6.5 The red duiker - *Cephalophus natalensis* (Table 7.6)

7.6.5.1 Habitat requirements and preferences

The red duiker is a sturdily built, thickset, small antelope, which is associated with indigenous forests with dense underbrush and forest clumps (Mills & Hes 1997, Skinner & Chimimba 2005). They will venture beyond forest margins into grasslands to forage, but will run for cover at the slightest disturbance (Mills & Hes 1997). Due to deforestation and burning practices, the red duiker's habitat has been fragmented and has declined drastically (Pfitzer & Colenbrander 2005). In the Tembe Elephant Park the red duiker was most often found in the Sand Forest-Grassland Mosaics (31.9% of observations) and the Open Woodlands (30.4%) by Van Eeden (2005). Pfitzer and Colenbrander (2005) also considered the Coastal Sand Forest of northern KwaZulu-Natal as ideal habitat for the red duiker.

7.6.5.2 Diet and feeding

The red duiker favours freshly fallen leaves, fruit and flowers from forest canopy trees (Skinner & Chimimba 2005). These extreme concentrate selectors are not water dependent. In Tembe Elephant Park the red duiker showed an affinity for *Afzelia quanzensis* (8.1% of all sightings) and *Strychnos spinosa* (8.1%) (Van Eeden 2005). These values support to the observation made by Bowland (1997 In: Mills & Hes 1997) that *Strychnos spinosa* was one of the species favoured by the red duiker.

7.6.5.3 Status and value

Duikers in general, but especially the red duiker, are not high on the priority list of trophy hunters. Not only is the red duiker small, but its favoured habitat diminishes the chances of hunting success. Even the meat has little value in relation to the time that it takes to hunt this animal, and furthermore the meat to whole body ratio is low (Pfitzer & Colenbrander 2005). On the other hand, for the rural human population these animals have a high bush meat value and are a major protein source. The duiker is easily snared and trapped. Pfitzer and Colenbrander (2005) stated that red duiker breed well in captivity and are fairly easy to rear. Moreover, they adapt well to human handling. They also mature quickly and are resistant to most tropical diseases such as heartwater and redwater (Pfitzer & Colenbrander 2005).

7.6.5.4 Legislation

Red duikers are classified as protected animals in KwaZulu-Natal, and were classified rare animals in the South African Red Data Book of 1986 (Pfitzer & Colenbrander 2005). Currently they are listed as near threatened in the red data list of the IUCN (Friedmann & Daly 2004). Should red duiker breeding in intensive wildlife production systems become an option in the Tshanini Community Conservation Area, it would be advised to make sure that the necessary permits to hold and breed these duikers can and are obtained from the provincial conservation authorities before embarking on such a project.

7.6.6 The Steenbok - *Raphicerus campestris* (Table 7.7)

7.6.6.1 Habitat requirements and preferences

Steenbok select open country but with adequate cover in the form of tall grass, scattered bushes or shrubs as habitat (Mills & Hes 1997). They seem to avoid rocky slopes, deserts, thickets and forest (Furstenburg 2006). Their feeding habits on forbs cause them to utilize overgrazed and highly disturbed areas such as old fields and road verges (Mills & Hes 1997, Skinner & Chimimba 2005). In Tembe Elephant Park they were found in the Open Woodlands and Open to Sparse Woodlands plant communities (Van Eeden 2005).

Table 7.6: Basic characteristics and information on red duiker regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Pfitzer & Colenbrander 2005, Swan *et al.* 2000, Furstenburg 2006)

Ewes per ram at adulthood in the wild:	1
Ewes per ram recommended for wildlife production:	1 to 2
Mean breeding herd size:	10
Mean percentage annual population growth:	20
Feeding spectrum:	Grass and forbs: 1 Browse and fruit: 99
Grazer Units (GU) per animal:	0.13
Grazing animals per Grazer Unit:	7.69
Browser Units (BU) per animal:	0.16
Animals per Browser Unit:	6.3
Rowland Ward: minimum trophy size:	64 mm (2.5 inches)
Safari Club International: minimum trophy size	8 points
Territoriality:	Ram: Overlapping territories Ewe: Overlap, but does not defend it
Range:	7.3 to 11.6 ha
Mean auction live sales price for 2006 season[1]:	R 4 500-00
Mean hunting price for a trophy animal[2]:	Male: R 6 500-00
Mean hunting price for a nontrophy animal[3]:	Male R 300-00 Female: R 150-00
Dressing percentage	55
Special protection :	Schedule 2: Protected
IUCN Red Data category:	Near threatened

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.
[3] Pongola Game Reserve. P.O. Box 767, Pongola, 3170 Tel: +27034 435

Table 7.7: Basic characteristics and information on the steenbok regarding population biology, habitat requirements**,** hunting and economic aspects (Bothma *et al.* 2004, Bothma & Van Rooyen 2005, Furstenburg 2005c, Swan *et al.* 2000)

Ewes per ram at adulthood in the wild:	1
Ewes per ram recommended for wildlife production:	1.5 to 2
Mean percentage annual population growth:	27
Feeding spectrum:	Grass and forbs: 34 Browse and fruit: 66
Grazer Units (GU) per animal:	0.2
Grazing animals per Grazer Unit:	5.0
Browser Units (BU) per animal:	0.14
Animals per Browser Unit:	7.14
Territoriality:	Ram: Yes Ewe: Yes
Range:	Ram: 6.30 ha Ewe: 6.30 ha
Rowland Ward: minimum trophy size	114.3 mm (4.5 inches)
Safari Club International: minimum trophy size:	11 points
Mean auction live sales price for the 2006 season[1]:	R 1 666-00
Mean hunting price for a trophy animal[3:]	R 950-00
Mean hunting price for a nontrophy animal[3:]	R 450-00
Dressing percentage:	55
Maximum stocking density:	3 ha/animal (400 to 800 mm rain)
IUCN Red Data Category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[3] Pongola Game Reserve. P.O. Box 767, Pongola, 3170. Tel: +27034 435 1123

7.6.6.2 Diet and feeding

Steenbok are almost exclusively browsers, preferring easily digestible forbs to which their stomachs are adapted (Skinner & Chimimba 2005). They are highly selective for green material and prefer young leaves, shoot tips, flowers and fruits of various plant species (Mills & Hes 1997). This little antelope species is quite a mobile feeder, digging up bulbs, tubers and roots that are widely dispersed in its territory (Skinner & Chimimba 2005). With the Open to Sparse Woodlands representing such a large portion of the Tshanini Community Conservation Area (52.0%) the steenbok will surely adapt and thrive in this reserve.

7.6.6.3 Status and value

Only the rams have horns and can serve as trophy animals. The steenbok is the only antelope that has virtually parallel horns. Bowhunters will occasionally hunt these animals when available but because they are not water dependent, walking and stalking would be the only way to hunt these cunning little animals.

7.6.7 The suni - *Neotragus moschatus* (Table 7.8)

7.6.7.1 Habitat requirements and preferences

The suni is habitat-specific, relying on evergreen vegetation with a closed canopy and a low ground cover (Mills & Hes 1997, Skinner & Chimimba 2005). Its presence and abundance are negatively affected by factors which modify forest structure such as the feeding behaviour of cattle, the nyala and elephant, the harvesting by people of a variety of forest plants, and the impact of fire on forest margins and understorey (Mills & Hes 1997).

7.6.7.2 Diet and feeding

Suni prefer freshly fallen leaves but will also eat fallen fruits, flowers and the growing tips of shoots (Mills & Hes 1997). They are independent of drinking water as they obtain their moisture requirements from their food (Skinner & Chimimba 2005).

Table 7.8: Basic characteristics and information on the suni regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al*. 2004, Swan *et al.* 2000, Furstenburg 2006)

Ewes per ram at adulthood in the wild:	1
Ewes per ram recommended for a wildlife ranch:	1 to 2
Minimum breading herd size:	-
Mean percentage annual population growth in the wild:	15 to 18
Feeding spectrum:	Grass and forbs: 1 Browse and fruit: 99
Browsers Units (BU) per animal:	0.08
Animals per Browser Unit:	12.5
Territoriality:	Yes, 0.5 to 1.2 ha
Range size:	4 to 15 ha
Maximum stocking density:	2 ha/animal to 4 ha/breeding pair
Rowland Ward: minimum trophy size:	76.mm (3 inches)
Safari Club International: minimum trophy size:	9 points
Mean annual live auction sale price for the 2006 season[1]:	-
Mean hunting price for trophy animal[2]:	R 7 500-00
Mean hunting price for nontrophy animal[2]:	-
IUCN Red Data category:	Vulnerable
Special protection:	*Protected game: Schedule 2

*Nature Conservation Ordinance 15/1974
[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

7.6.7.3 Status and value

Skinner & Chimimba (2005) stated that in north-eastern KwaZulu-Natal, outside conservation areas the suni has disappeared as a result of habitat destruction and excessive hunting. The nyala in some areas has caused a decrease in the density of the shrub layer which has also lead to the decrease or even disappearance of suni in those areas. Suni are classified as protected animals under Schedule 2 of the Nature Conservation Ordinance 15/1974 of Ezemvelo KwaZulu-Natal Wildlife.

7.6.8 The southern reedbuck - *Redunca arundinum* (Table 7.9)

7.6.8.1 Habitat requirements and preferences

Southern reedbuck occur patchily and discontinuously in southern Africa. They have specialized habitat requirements which include tall grass or reed beds with some woody elements, vleis, grasslands adjacent to streams, rivers or other areas of permanent water (Bothma *et al.* 2002, Skinner & Chimimba 2005). These animals also adapt well to planted pastures where there is cover nearby (Mills & Hes 1997).

7.6.8.2 Diet and feeding

Southern reedbuck are almost exclusively grazers, primarily selecting grass. However, small quantities of herbs and even browse will be consumed when required (Mills & Hes 1997). Like the sable antelope *Hippotragus niger*, reedbuck are able to utilize tall grasses. They are water dependent and cannot survive long without it. Studies in the Kruger National Park have indicated that reedbuck show a preference for the following grass species: *Hyperthelia dissoluta, Trachypogon spicatus, Panicum maximum, Heteropogon contortus, Leersia hexandra, Hemarthria altissima, Imperata cylindrica,* the reed *Phragmites australis* and *Chloris gayana* (Skinner & Chimimba 2005). Some of these species also occur in abundance in the Tshanini Community Conservation Area and this reserve should therefore easily be able to cater for reedbuck.

Table 7.9: Basic characteristics and information on the reedbuck regarding population biology, habitat requirements**,** hunting and economic aspects (Van Rooyen 2002b, Bothma *et al.* 2004, Swan *et al.* 2000, Furstenburg 2006)

Ewes per ram at adulthood in the wild:	1:1
Ewes per ram recommended for a wildlife ranch:	1 to 2.5
Mean breeding herd size:	10
Mean percentage annual population growth:	18 to 25
Feeding spectrum:	Grass and forbs: 95 Browse and fruit: 5
Grazer Units (GU) per animal:	0.21
Grazing animal per Grazer Unit:	4.76
Browser Units (BU) per animal:	0.5
Animals per Browser Unit:	2.02
Territoriality:	Ram: Yes, 35 to 60 ha Ewe: Yes, 35 to 60 ha
Range:	Ram: 50 to 100 ha Ewe: 50 to 135 ha
Rowland Ward: minimum trophy size	335 mm (14 inches)
Safari Club International: minimum trophy size	21 points
Mean auction live sale price for 2006[1]:	R 3 462-00
Mean hunting price for a trophy animal[3]:	R 3 500-00
Mean hunting price for a nontrophy animal[2]:	Female (local): R 650-00
Dressing percentage:	55
Maximum stocking density:	5 ha/reedbuck (500 to 800 rainfall)
Minimum habitat size required:	70 ha
IUCN Red Data category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.
[3] Pongola Game Reserve. P.O. Box 767, Pongola, 3170 Tel: +27034 435 1123

Many observations of the southern reedbuck were made in the Open to Sparse Woodlands in the Tembe Elephant Park. Reedbuck could therefore occupy this habitat in the Tshanini Community Conservation Area where it represents 18.0% of the total available grazing area.

7.6.8.3 Status and value

The southern reedbuck is primarily nocturnal and lives in monogamous pairs. Like the reedbuck's habitat, its distribution is patchy. When populations become too isolated, natural hazards and environmental changes such as fire and drought can have a detrimental effect on the reedbuck. Genetic diversity is also important for long-term survival. Proliferation of irrigated pastures in KwaZulu-Natal has favoured the reedbuck to the extent that its numbers have to be controlled there. Unfortunately this does not hold for the whole of southern Africa. The eastern shores of the Isimangaliso Wetland Park maintain a population of > 5 000 reedbuck. It is the highest concentration of reedbuck within any conservation area in South Africa (Mills & Hes 1997).

It has been estimated that as a grazer, the bulk of southern Africa's reedbuck population will be concentrated in regions where livestock are concentrated, sharing pastures and adjacent cover. According to Mills & Hes (1997) the custodianship rests with the private sector and conservancies will play a major role in the conservation of the species.

Because of this animal's nature and low activity levels, the meat of reedbuck has a soft and fine texture and is therefore in great demand (Furstenburg 2006). This is said to be one of the most piquant and tasty types of African wildlife meat. The dressing percentage of the carcass is 55% and the carcass weighs from 28 to 44 kg. Hunting this animal can be exacting because of its excellent eyesight and vigility.

7.6.9 The giraffe - *Giraffa camelopardalis* (Table 7.10)

7.6.9.1 Habitat requirements and preferences

The giraffe occurs in a wide variety of dry and semi-dry savannas, preferring *Acacia* savanna, which ranges from shrubland to woodland (Mills & Hes 1997). Waterholes will be visited

frequently if available, but due to the moisture content in their food, water is not always essential (Skinner & Chimimba 2005).

7.6.9.2 Diet and feeding

Giraffe are classified as concentrate or selective feeders (Skinner & Chimimba 2005). They are predominantly browsers but they may occasionally graze on fresh sprouting grasses. Some preferred tree species include *Acacia* species, especially *Acacia nigrescens*, *Combretum* species, *Terminalia* species, *Dichrostachys cinerea* and *Ziziphus mucronata.* The leaves are pulled into the mouth with the long prehensile tongue and are then stripped from the stem with spatula incisor teeth (Mills & Hes 1997).

The population structure on wildlife reserves and ranches tends to be 55% adults of which 13% to 22% are males and 14% to 23% females, 38% subadults and 7% calves. Mortalities in calves younger than 1.5 years old can be as high as 55%. The stocking density suggested for giraffe varies from one giraffe per 50 to 500 ha with a minimum habitat size of 900 ha, depending on the habitat (Bothma *et al.* 2002, Furstenburg 2006).

7.6.9.3 Status and value

The giraffe is not high on the priority list of local hunters, but it is still in demand with foreign hunters (Furstenburg 2006). This unique ungulate does not compete with domestic stock for grazing space, and can thus be successfully integrated on livestock production units, if available browse allows for it. The meat of the giraffe is generally of high quality and very tasty, except in old bulls. The dressing percentage is 58% and the mean carcass mass of an adult bull is 770 kg and 460 kg for adult cows and sub adults (Bothma *et al*. 2002). The giraffe has a high ecotourism value. Spotting this docile and gentle creature is always a highlight when visiting a wildlife reserve or ranch. It must be noted, however, that giraffe are carriers of foot-and-mouth disease and great care should be taken when capturing and handling these animals.

Table 7.10: Basic characteristics and information on the giraffe regarding population biology, habitat requirements**,** hunting and economic aspects (Bothma *et al.* 2004, Swan *et al.* 2000, Furstenburg 2006)

Cows per bull at adulthood in the wild:	2 to 4
Cows per bull recommended for a wildlife ranch:	5 to 6
Mean breading herd size:	8
Mean percentage annual population growth in the wild:	12
Feeding spectrum:	Grass and forbs: 1 Browse and fruit: 99
Grazer Units (GU) per animal:	3.2
Grazing animals per Grazer Unit:	0.3
Browser Units (BU) per animal:	3.80
Animals per Browser Unit:	0.26
Territoriality	None
Range: size	Bulls 3000 to 16 000 ha Cow: 2000 to 7000 ha
Maximum stocking density:	80 ha/animal (400 mm)
Minimum habitat size required:	900 ha
Mean auction live sale price for 2006[1]:	R 15 498-00
Mean hunting price for a trophy animal[3]:	R 12 000-00
Meat price per kg.	-
Dressing percentage:	58
IUCN Red Data category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[3] Pongola Game Reserve. P.O. Box 767, Pongola, 3170 Tel: +27034 435 1123

7.6.10 The blue wildebeest - *Connochaetes taurinus taurinus* (Table 7.11)

7.6.10.1 Habitat requirements and preferences

Blue wildebeest are associated with savanna habitats that have open grassy plains with scattered trees. Shade and drinking water are essential habitat requirements. In northern KwaZulu-Natal open woodlands dominated by the knobthorn *Acacia nigrescens* is the favoured habitat (Skinner & Chimimba 2005). With the Open Woodland management unit making up 22% of the Tshanini Community Conservation Area the blue wildebeest would definitely add to ecotourism and hunting value of the reserve. The habitat preferences of the blue wildebeest on small nature reserves under artificial circumstances where predation is not a population control factor was investigated by Helm (2006).

7.6.10.2 Diet and feeding

The blue wildebeest feeds on grass, shorter that 150 mm and is a selective grazer. They show a high affinity for fresh sprouting grass on burned areas or fresh green grass sprouting after rain (Skinner & Chimimba 2005). With their selective grazing ability and preference towards sweet grass species, these animals can have a high impact on their environment, especially after burning an area. Management guidelines should therefore be put in place to prevent veld degradation where the blue wildebeest occurs.

Family groups of 10 to 180 animals, consist of cows, one year old calves and sub adults of both sexes. Bull groups of 6 to 20 animals, consist of social sub adult bulls of 2 to 4.5 years of age, and non-active, dominant, adult bulls. Single bulls are normally the territorial, dominant and breeding bulls. No hierarchy dominance occurs within cows and family groups or within bull herds (Furstenburg 2006).

Both blue and black wildebeest are carriers of bovine malignant catarrhal fever. Commonly known as “snotsiekte”, this disease is an acute and deadly viral disease affecting cattle and some other ruminants (Du Toit 2002). Nature reserves and game ranches keeping wildebeest no longer have to obtain permission to do so from their neighbours, but it is still advised to make provision and take precautionary measures in this regard, to avoid unnecessary conflict.

Table 7.11: Basic characteristics and information on the blue wildebeest regarding population biology, habitat requirements**,** hunting and economic aspects (Bothma *et al.* 2004, Swan *et al.* 2000, Furstenburg 2006)

Cows per bull at adulthood in the wild:	2 to 3
Cows per bull recommended for a wildlife ranch:	6 to 10
Minimum breeding herd size:	12
Mean percentage annual population growth in the wild:	30
Feeding spectrum:	Grass and forbs: 95 Browse and fruit: 5
Grazer Units (GU) per animal:	1.0
Grazing animals per Grazer Unit:	1.0
Browser Units (BU) per animal:	1.21
Animals per Browser Units:	0.83
Territoriality:	Bull: 0.5 to 1.5 ha Cow: None
Range size:	Bull: 600 to 1800 ha Cow: 1000 to 2500 ha
Mean auction live sale price for 2006[1]:	R 1 783-00
Mean hunting price for trophy animals[2]:	R 5 000-00
Mean hunting price for nontrophy animals[3]:	R 2 950-00
Dressing percentage:	56
Rowland Ward: minimum trophy size:	724 mm (28.5 inches)
Safari Club International: minimum trophy size:	70 points
Maximum density:	67 animals/1000 ha (300 to 400 mm rainfall)
Minimum habitat size required:	300 ha
IUCN Red Data category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.
[3] Pongola Game Reserve. P.O. Box 767, Pongola, 3170 Tel: +27034 435 1123

7.6.10.3 Status and value

Blue and black wildebeest should under no circumstances be combined on a wildlife ranch or nature reserve as they can interbreed with fertile offspring. The blue wildebeest is not known to crawl underneath fences or jump over them except when they are put under pressure or chased excessively.

7.6.11 The Burchell's zebra - *Equus burchellii* (Table 7.12)

7.6.11.1 Habitat requirements and preferences

Burchell's or plains zebra is one of Africa's most adaptable and successful grazers and utilizes a broad range of savanna habitats (Estes 1997). They are found from treeless short grasslands to tall grasslands and open woodlands. They do not occur in forests or desert dunes and avoid areas of dense woodland (Skinner & Chimimba 2005). Zebras are able to feed on both tall, tough stems and the early growth stages of a flush and are often the pioneers preparing the pasture for the species that follow (Estes 1997). They are totally dependent on drinking water frequently (Kingdon 1997, Estes 1997) and are among the most water dependent of the plains wildlife. As a result, they are seldom found more than 10 to 12 km away from water (Skinner & Chimimba 2005). They prefer firm ground underfoot and may move away from swamplands in the wet season or during floods (Kingdon 1997).

7.6.11.2 Diet and feeding

Burchell's zebra are predominantly grazers, but will browse occasionally. It will also feed on herbs at times (Skinner & Chimimba 2005). They eat the most available grass species (Kingdon 1997). Based on observations in the Kruger National Park, 50 different grass species have been listed as being utilized by them. They have strong, sensitive and mobile upper lips, which they use to push the herbage between their incisor teeth to cut it free. They are partial to feeding on areas of short grass, and find new grass growth after a burn or recent rains extremely attractive (Skinner & Chimimba 2005).

Table 7.12: Basic characteristics and information on the Burchell's zebra regarding population biology, habitat requirements**,** hunting and economic aspects (Bothma *et al.* 2004, Swan *et al.* 2000, Furstenburg 2006)

Mares per stallion at adulthood in the wild:	1.5
Mares per stallion recommended for a wildlife ranch:	6
Mean breeding herd size:	10
Mean percentage annual population growth in the wild:	15 to 29
Feeding spectrum:	Grass and forbs: 93 Browse and fruit: 7
Grazer Units (GU) per animal:	1.32
Grazer animals per Grazer Unit:	0.75
Browsers Units (BU) per animal:	1.59
Animals per Browser Unit:	0.63
Territoriality:	None
Range size:	100 to 260 km^2
Minimum habitat size required:	800 ha
Mean annual live auction sale price for the 2006 season[1]:	R 5 025-00
Mean hunting price for a trophy animal[2]:	R 5 000-00
Mean hunting price for nontrophy animal[2]:	Male/Female: R 2 850-00
IUCN Red Data category:	Least concern

[1]Game & Hunt Vol. 13/2 2007, pp. 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

7.6.11.3 Status and value

While the cause of their decline in prehistory is not known, their incompatibility with modern agriculture and cattle production has lead to their extermination over many areas (Kingdon 1997). In South Africa, naturally occurring populations are found only in wildlife reserves in northern KwaZulu–Natal, Mpumalanga and Limpopo (Mills & Hes 1997). Although they are still by far the most abundant and widespread of all Africa's equids, several subspecies occur at low population levels and several are declining (Skinner & Chimimba 2005). Given the uncertain future of small, isolated populations of the Burchell's zebra, some populations may well become vulnerable or endangered in the near future (Kingdon 1997).

The Burchell's zebra has a beautiful and uniquely striped hide that has been an interior decorating commodity in recent history. Probably their most important current value is in terms of wildlife ranching and tourism.

7.6.12 The bushpig - *Potamochoerus larvatus* (Table 7.13)

7.6.12.1 Habitat requirement and preferences

The bushpig can survive in almost any kind of habitat that provides concealment and food, including marshes and swamps (Estes 1997). They are associated particularly with forest, thickets, riparian undercover, reed beds or a heavy cover of tall grass provided that water is not too far away. Dense cover and water are among their most essential habitat requirements (Skinner & Chimimba 2005). They are serious agricultural pests that will increase in farming areas in spite of intensive control measures because of reduced predator numbers and increased food supply in the form of cultivated food crops (Estes 1997, Skinner & Chimimba 2005). Relatively little is known about the biology of the bushpig (Mills & Hes 1997).

7.6.12.2 Diet and feeding

Bushpigs are omnivorous but roots, bulbs and fallen fruits are their main food source (Estes 1997, Kingdon 1997, Skinner & Chimimba 2005). They use the hard upper edge of the snout to root in much the same manner as warthogs, but tend to favour damper places or litter in which to root (Skinner & Chimimba 2005). They are considered to be a major pest and are attracted to most agricultural crops (Mills & Hes 1997, Skinner & Chimimba 2005).

Table 7.13: Basic characteristics and information on the bushpig regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Swan *et al.* 2000, Furstenburg 2006)

Sows per boar at adulthood in the wild:	2 to 4
Sows per boar recommended for a wildlife ranch:	4
Minimum breading herd size:	-
Mean percentage annual population growth in the wild:	65
Feeding spectrum:	Grass and forbs: 80 Browse and fruit: 20
Grazer Units (GU) per animal:	0.4
Grazer animals per Grazer Unit:	2.5
Browsers Units (BU) per animal:	0.52
Animals per Browser Unit:	1.92
Territoriality:	None
Range size:	400-1000 ha
Minimum range size:	150 ha
Mean stocking density	16 animals/100 ha
Rowland Ward: minimum trophy size:	139 mm (5.5 inches)
Safari Club International: minimum trophy size:	11 points
Mean annual live auction sale price for the 2006 season[1]:	-
Mean hunting price for a trophy animal[2]:	R 2 000-00
Mean hunting price for a nontrophy animal[2]:	R 300-00
Dressing percentage:	55
IUCN Red Data category:	Least concern
Special protection:	Restricted transportation and permits for swine fever

[1]Game & Hunt Vol. 13/2 2007, pp. 23.

[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999. Bushpigs will occasionally browse (Mills & Hes 1997) and in addition to the herbage already mentioned they also will eat fungi and various small animals, root for larvae and beetles, snails, amphibians and reptiles (Kingdon 1997) and have been reported to scavenge from time to time. They will even eat carrion in its most putrid form (Estes 1997, Kingdon 1997, Mills & Hes 1997, Skinner & Chimimba 2005).

7.6.12.3 Status and value

The bushpig has the ability to thrive in close proximity to human settlement, and even with active control, the bushpig is not currently thought to be under any threat (Mills & Hes 1997). In terms of economic importance to humans, bushpigs are a potential source of food. The possibility of domesticating them should be investigated further. Bushpigs have been known to crossbreed with domestic pigs (Skinner & Chimimba 2005). The increase of bushpigs in farming areas has a negative effect because large groups can wreak havoc on crops. They will also kill and eat livestock and can be carriers of diseases like African swine fever (Du Toit 2002). Furthermore they are extremely cunning and exceedingly difficult to trap.

7.6.13 The warthog *Phacochoerus africanus* (Table 7.14)

7.6.13.1 Habitat requirements and preferences

The warthog is the only type of pig that is adapted for grazing in savanna habitats (Estes 1997) and it is associated with open ground, grasslands, floodplains, vleis and open areas around waterholes and pans. However, it will also utilize open woodlands and open shrub veld. They avoid thick bush, forests and deserts. They are not dependent on water and occur in areas where water is only available seasonally, but where and when it is available they drink it regularly (Skinner & Chimimba 2005). Warthogs are great mud wallowers and will roll in mud daily when it is warm (Estes 1997). The mud covering that forms on the hide serves as a protection against biting flies and it helps in thermoregulation (Skinner & Chimimba 2005). They are highly diurnal but usually rest during the midday heat (Mills & Hes 1997) and lie up in holes in the ground during the night (Skinner & Chimimba 2005). Large burrows with multiple entrances such as aardvark burrows and erosion gullies are preferred over simple chambers (Estes 1997) and the presence and abundance of such holes assist them to achieve high densities (Kingdon 1997).

7.6.13.2 Diet and feeding

In general, warthogs are vegetarians, living on perennial grasses that grow in lawn-like swards (Skinner & Chimimba 2005). They are selective feeders and can be seen pushing aside unwanted grass in order to get at the more preferred new shoots close to the ground.

Table 7.14: Basic characteristics and information on the warthog regarding population biology, habitat requirements, hunting and economic aspects (Bothma *et al.* 2004, Furstenburg 2005a, b, Swan *et al*. 2000)

Sows per boar at adulthood in the wild:	1.5
Sows per boar recommended for a wildlife ranch:	1
Minimum breeding herd size:	10 to 12
Mean percentage annual population growth in the wild:	65 to 120
Feeding spectrum:	Grass and forbs: 70 Browse and fruit: 30
Grazer Units (GU) per animal:	0.30
Grazer animals per Grazer Unit:	3.33
Browsers Units (BU) per animal:	0.51
Animals per Browser Unit:	1.96
Territoriality:	None
Range size:	60 to 370 ha
Mean stocking density	7 ha/animal (450 mm rainfall)
Rowland Ward: minimum trophy size:	330 mm (13 inches)
Safari Club International: minimum trophy size:	30 points
Mean annual live auction sale price for the 2006 season[1]:	R 661-00
Mean hunting price for a trophy animal[2]:	R 2 000-00
Mean hunting price for a nontrophy animal[2]:	Local: R 440-00
Meat price per kg:	-
Dressing percentage:	54
IUCN Red Data category:	Least concern
Special protection:	Restricted transportation and permits for swine fever

[1]Game & Hunt Vol 13/2 2007, pp 23.
[2] Natural Resource Trade Manager. P.O. Box 13053, Cascades, 3202 Tel: +27033 845 1999.

They also strip the flowering and seeding heads of grasses by pulling the stems through their mouths (Kingdon 1997, Skinner & Chimimba 2005). Warthogs are partial to freshly sprouting grasses after a burn and also to rooting on the underground rhizomes of grasses, especially in damp areas where the grasses remain fresh and their rhizomes succulent and full of moisture (Skinner & Chimimba 2005). Although they prefer to graze on short grass, they will also eat sedges, herbs, shrubs, wild fruits, carrion, earthworms, insects, scorpions, centipedes and bones (Mills & Hes 1997, Skinner & Chimimba 2005). Mason (1982: In. Skinner & Chimimba 2005) recorded warthogs in KwaZulu-Natal to graze on *Urochloa mosambicensis, Panicum maximum, Panicum coloratum, Chloris virgata, Digitaria argyrograpta, Sporobolus nitens, Sporobolus smutsii, Cynodon dactylon* and *Dactyloctenium australe.* They also take fallen fruits from trees like those of the wild figs *Ficus* spp., marula *Sclerocarya birrea,* and wild monkey orange *Strychnos* spp. (Skinner & Chimimba 2005).

7.6.13.3 Status and value

Warthogs have been eliminated from all intensively farmed areas, because they are regarded as a nuisance and act as a reservoir for livestock diseases (Kingdon 1997). They are presently not threatened in southern Africa (Mills & Hes 1997). Warthogs are carriers of African swine fever, a disease which is deadly to domestic pigs and care should be taken in this regard when selling and transporting meat from one area to another.

Their economic importance to humans lies in their tusks that have a denser and superior quality of ivory than elephant tusks. Warthogs are also often hunted for their meat, which is lean and tasty. They fulfil an important role in sport hunting, especially bow hunting (Cheney 2005). As with the bushpig, the possibility of domesticating the warthog could be investigated further.

7.6.14 General legislation

The various conservation ordinances specify and issue the relevant wildlife permits. Permits are required to keep wild animals in captivity, or/and to capture, transport, import, export and hunt them. These permits can be obtained from the provincial conservation authorities. The policies on the issuing of permits differ from province to province and applications may take

up to 3 weeks to be processed (Pfitzer & Colenbrander 2005). Translocation within the same province is not regulated, except that the removal certificate must be issued by the wildlife producer for both meat and live animals as required by the Livestock Theft Act (Conroy 2005). When moving wildlife between provinces, one must apply for an import permit from the province to which the animals are going. On receipt of the import permit, an export permit must be obtained from the province from where the animals originated.

For the permit applications the relevant information required is the name, address and ID number of the buyer and seller, as well as the reserve or farm names and districts to which the animals are going. A veterinary permit will be required if capture is carried out in an area which is under state veterinary surveillance, for example a foot-and-mouth disease surveillance zone, as for example the Tshanini Community Conservation Area (Pfitzer & Colenbrander 2005). Veterinary quarantine is necessary when animals originate from foot-and-mouth disease areas.

7.7 WILDLIFE COUNTS

One of the most important practical management aspects in the Tshanini Community Conservation Area will be the regular monitoring and counting of wild animals. Thomson (1992) stated that although it is important for any wildlife manager to know the size of any animal population which he intends to manipulate, it is a meaningless statistical value unless he can relate this value to a population trend. That is why precise counts are needed. Precise counts are repeatable and give the same result for the same number of animals. The primary objective of any wildlife count is to obtain a respectable estimate of the population size in a given area, although it may be inaccurate (not done to the actual population size). From these counts, reliable growth rates can be calculated and harvesting quotas can be determined. Wildlife counts can thus be used in conjunction with range condition assessments to detect undesirable trends timely, and to remedy these in order to manage the natural resources in a responsible and sustainable manner (Bothma 2002b).

It is important to take note that wild animals are normally distributed unevenly across the landscape. This is because they assemble in areas of preferred habitat. Therefore, it would be advisable to divide the reserve on the basis of the habitat preferences of the animals, covering all the available habitat types in the survey to count them. The information on the specific

habitat types can be obtained from the vegetation analysis of Gaugris *et al.* (2004) and data from Van Eeden's (2005) research in the Tembe Elephant Park.

Wildlife counts can either be total counts where the objective is to count all the animals in a given area, or they can be sample counts whereby the number of animals in a small representative sample is extrapolated to the entire surface area (Bothma 2002b). Sample wildlife counts should be done for the Tshanini Community Conservation Area every year, supported by an aerial count every third year. If possible, it would be time- and cost-effective to arrange with the management of the Tembe Elephant Park to do aerial wildlife counts in the Tshanini Community Conservation Area immediately after they have done their own counts and to share costs and provide assistance from experienced park officials.

No single counting technique is flawless. Because of the type of vegetation, terrain, and visibility, and the impenetrability of some Sand Forest patches, it is advised that a combination of counting techniques be used for the Tshanini Community Conservation Area. The techniques that will most probably yield the best results are road strip counts, field strip counts, known group or individual counts supported by aerial counts every three years.

Aspects to consider before a final selection of the counting techniques is made would include: the cost involved, the size of the area, the type of animals to be counted, the experienced manpower available, and the purpose of the count (Bothma 2002b).

7.7.1 Road strip counts

For the road strip counts all existing roads, including tourist roads, firebreaks, management and service roads are used (Young 1992). It is important before starting with the count to determine the mean visibility distance of a herbivore in the area. The mean visibility distance can be measured by letting a person dressed in brown overalls walk away perpendicularly to the road. The person should walk until disappearing from the sight of the viewer. This must be repeated at 100 m intervals along the entire road, until all habitat types have been covered. From these measurements a mean visibility distance of animals is calculated for each habitat type. Where the habitat is open, a fixed visibility distance can be used. This is usually determined by experience. The strip to be counted should be marked out in advance with small flags or something similar. According to Young (1992) and Bothma (2002b) this will

prevent one from counting animals that occur outside the predetermined strip. The total length of the road multiplied by the mean visibility distance on either side of the road gives the surface area that is being surveyed. It is important that a fixed route is used for counting and that counting is done at the same time every year. Aspects such as starting points, type of vehicle, starting time and a driving speed of about 30 km/h (for the road conditions and vegetation structure in Tshanini it would rather be recommended to drive more in the range of 15-20km/h) should be kept as constant as possible. Wildlife should be accustomed to vehicles so that they do not flee long before they can be counted. Counts should preferably start early in the morning, about an hour after sunrise (Bothma 2002b).

In the Tshanini Community Conservation Area, where various types of habitat frequently change over short distances, the transition from one habitat to another can be marked along the road with some form of indicator, such as a ribbon or even a plastic cattle eartag. The animals are then counted for each habitat type and the total distance driven through each habitat type is measured. With the mean visibility distance known, the surface area of the counting strip for each habitat type can be calculated. These calculations can be converted to the total surface area for each habitat type and the totals for the entire reserve are calculated. By calculating the density of each type of animal in a specific habitat a broad indication of habitat preference can be obtained (Bothma 2002b).

The following equation can be used to determine the number of animals in the entire counting area:

$$N/n = H/h \text{ or } N = nH/h$$

Where N = the number of a specific animal on the whole reserve

n = the numbers of that animal counted in the strip(s)

H = the surface area of the entire reserve

h = the surface area of the counting strip(s)

This estimate can be improved by repeating a specific type of count in the same strip a number of times, usually moving in opposing directions along the strip at alternate days, to obtain a mean density estimate (Bothma 2002b).

7.7.2 Field strip counts

The field strip count differs from the road strip count in that the routes are marked out in advance through the habitat, and a GPS instrument is used to maintain direction. The route can either be done on foot or on horseback by at least two observers. All the animals are counted on either side of the route that is travelled in the same way as for the road strip count. Animals should be given frequent chances to settle down. This can be done by stopping briefly every 100 m. The observers should then use the time to look and listen carefully for animals in the vicinity. Fields strips are usually not longer than 2 km and each habitat type should be covered effectively and representatively over the whole counting area. An important aspect to consider is that all field strips in the same habitat should be counted simultaneously by various counting teams. Counts should preferably start soon after sunrise and be done from east to west with the sun behind the counters. Calculation of the visibility distance and population size is done in the same way as for the road strip count. An electronic range finder can be used to judge the distance of wildlife away from the counting strip and will add to the precision of the count.

7.7.3 Known group or individual count

This method is only used as a means of monitoring animal herds of known size and herd structure. It can be done by regularly recording the number and composition of every herd that is encountered, especially during mating season. Animals with unique characteristics and recognisable skin patterns, spots or stripes can be identified either by drawings or photographs. Photographing these animals on a regular basis has the advantages of creating a photographic database. This record system can facilitate in estimating population size over a period of time. Bothma (2002b) also emphasises the fact that both sides of every individual should be photographed because the hide pattern of an animal is not bilaterally symmetrical. Good photographs can be taken from vehicles, hides and at waterholes for this purpose.

Another way of counting animals is by using a Webcam device at a waterhole or popular wildlife viewing hide. Knowledge of the drinking patterns of different animal types is essential to obtain such population sizes. Some animals such as the impala are able to go without water for at least a week, but rams in the mating season are likely to visit the same waterhole several times a day (Young 1992). Other factors such as the moisture content of the

grazing and browse, the amount of dew on the grazing during the night and early morning hours, as well as availability of water in the veld, cause animals to drink less frequently, making waterhole counts then unreliable.

7.7.4 Aerial counts

Counting wild animals from a helicopter or a fixed wing aircraft can be expensive. When several areas or reserves can be counted at the same time, sharing the cost can make this option attractive and affordable. It would be in the best interest for the management of the Tshanini Community Conservation Area to negotiate with the Ezemvelo KwaZulu-Natal Wildlife staff of Tembe Elephant Park and Ndumo Game Reserve regarding such an option. An effort could be made to obtain sponsorships for such an endeavour. Using information obtained from the above less intensive counting techniques makes it unnecessary to do aerial counts every year. It is, however, preferable to do a thorough count from the air before a large number of animals are to be harvested or captured.

7.8 MANIPULATION OF WILDLIFE NUMBERS

7.8.1 Harvesting as a management factor

As the wildlife numbers increase in the Tshanini Community Conservation Area, it will become necessary to manipulate the dynamics of the populations. This can be attained by changing the availability of water, food and shelter, and a more direct action would be hunting or live capture and sales (Bothma 2002c). To develop a harvesting strategy precise counts are important to provide repeatable estimates. The main purpose of a sustained harvesting programme, whether the animals are utilized on a commercial basis to yield meat or as a source of hunting or live sales, is to remove a fixed annual quota or sustained yield from the population without causing a continual decline in the population as a whole. According to Bothma (2002c) an ideal harvesting system should meet the following criteria:

- The system should allow the manipulation of the population structure without disrupting the population growth negatively.
- Such a system should cause the minimum ecological and physiological disruption, and also to the behaviour of the animals in terms of their reproductive ability.

- The system should be flexible and allow different forms of manipulation to be performed together.
- It should be economically viable and be carried out in as short a time as possible.
- The system should be applicable to a variety of animals and objectives for a specific wildlife reserve.
- The terrain often determines the type of system to be used.
- It should leave the minimum number of injured or wounded animals and limit the spread of contagious diseases.

The system should be ethically and aesthetically acceptable. The importance of using a scientifically correct and properly planned approach based on reliable data that were obtained from precise animal counts, cannot be overemphasized. The ultimate objective is the harvesting of wild animals that yield quality products for both trophy and meet hunting as well as for live animal sales.

It will be in the best interest for the management of the Tshanini Community Conservation Area to determine harvesting quotas in the near future. The assistance of wildlife consultants or the ecologists of the Tembe Elephant Park in setting up the protocols is strongly advised.

7.9 BOW HUNTING

7.9.1 Introduction

Bow hunting is a possible option to generate additional income for the Tshanini Community Conservation Area. Besides the fact that this activity generates extra income it complements ecotourism, bird watching, hiking and eco-cultural tourism. Bow hunting can be used to take off surplus animals and will thus help with the adaptive management and the maintenance of the ecological capacity of the reserve.

Bow hunting has advanced rapidly in popularity, both in the hunting industry and as the sport of archery. The reason for this increase in popularity is that it appeals to those searching for a greater hunting challenge and personal satisfaction. Bothma (2002d) sums up this statement with the following phrase "*The ultimate feeling of accomplishment is not the kill; it is knowing that one could kill without taking the opportunity to do so. Being so close to one's*

target that you can almost touch and feel it and holding the balance of life and death in one tight string bow …"

The renewed interest in bow hunting as an alternative to conventional rifle hunting can be ascribed to the following reasons (Cheney 2005):

- Bow hunting is an environmentally friendly activity because it is silent and thus does not disturb and frighten other animals and even people in the nearby vicinity.
- Archery equipment is highly efficient and humane when used correctly.
- This form of hunting is completely compatible with other forms of ecotourism and can be practiced at the same time, but in different areas, in the reserve.
- Arrows, unlike bullets, cause little damage to meat and therefore create less wastage.
- A bow and arrow are short range weapons and do not pose the dangers that are associated with firearms through stray bullets.
- The high probability of full recovery in animals that are wounded with archery equipment (flesh wounds) makes bow hunting more forgiving than rifle hunting.
- Resources stretch further because of the lower harvesting rate. Bow hunting occupies more hunting days because of the time that it takes to set up and do the hunt.

However there are some limitations and pitfalls in bow hunting and the management of the Tshanini Community Conservation Area should be well informed of them. Before any hunting can start on the reserve, bow hunters should be evaluated on their shooting skills. A hunter should be able to hit an 8" (15 cm) diameter target at 30 m in at least eight out of ten shots (Cheney 2005). Incompetent hunters can lead to unacceptably high wounding rates. Because of the nature of bow hunting it will be in the interest of both the hunter and the management of the reserve to stipulate that no shot may be attempted beyond 35 m. With bow hunting the margin of error when it comes to shot placement, is much higher than that of firearms. Therefore it is recommended that only broadside and quartering away heart and lung shots be taken (Cheney 2005).

7.9.2 Suitability of the hunting venue

To market the Tshanini Community Conservation Area as a bow hunting destination properly will largely depend upon the availability and variety of wildlife species as well as the

quantity and presence of trophy animals. The most popular bow hunting species include the impala, kudu, warthog, blue wildebeest and Burchell's zebra. These species are easy to come by, are relative affordable and can be purchased from any wildlife auction countrywide. These will also be the species that will be available for hunting in the Tshanini Community Conservation Area, together with nyala, waterbuck and reedbuck if their numbers permit. According to Cheney (2005) there is a definite correlation between harvesting success rate, hunting technique, vegetation type and density, water availability and topography. Taking these facts into consideration the Tshanini Community Conservation Area fits most of the bow hunter's needs. Another factor to consider is the accessibility of the reserve to the potential bow hunter. Time is valuable and expensive, and therefore potential clients must be able to get to their destination as quickly, safely, and easily as possible. An airfield or landing strip near the reserve will be a great advantage, as the client can then fly in and spend less time in travelling and more in hunting. Both Tembe Elephant Park and Ndumo Game Reserve have landing strips and they could be used for this purpose with proper agreements.

Before any hunting or capturing of wildlife commences on the Tshanini Community Conservation Area it is strongly advised that the management acquaint themselves with all the aspects and sections of the hunting regulations as set out by the Convention of International Trade in Endangered Species (CITES), the Ezemvelo KwaZulu-Natal Wildlife's Ordinance 15/1975[4], and the regulations of the Department of Environmental and Tourism Affairs that were promulgated in February 2007.

7.9.3 Minimum requirements for guests and potential bow hunters

Some basic requirements any hospitality operation has to meet are set out as follow:

- Most hunters want to experience Africa with a "safari type" bush atmosphere. Cheney (2005) said that "Afford your client the privilege of experiencing the bush firsthand – avoid ostentatious luxury which will deprive them of the real thing".
- Always provide clean ablution facilities, with a washbasin, bath and shower, including hot and cold water, a flush toilet and a mirror.
- Prepare good food with enough for a second helping.
- Professional, personal and good service must be uncompromised.

[4] The Natural Resource Trade Division, Room 2-16, Queen Elizabeth Park, Pietermaritzburg, South Africa. Tel. +27 33 845 1652/4. Fax: + 27 33 845 1462. E-mail: hunting@kznwildlife.com

- Any medical precautionary measures should be discussed well in advance of the travel date.
- Travel arrangement should be made with great care.
- Hunting time should be put to the most productive use.
- Explain the type of hunt and hunting conditions well in advance, including the hunting technique that would be required as well as the equipment that the client should bring along.

To be geared for bow hunting the reserve must be equipped with:

- a practice range with a cleared range of 40 m, and target butts or three-dimensional animals for hunters to sight in their equipment and for the professional hunter to test the competency of the client;
- archery tools, basic spares;
- well-trained staff that are experienced in bow hunting;
- hides, blinds and platforms that are well-constructed, productive and aesthetic; and
- game animals that are not overly skittish.

The blinds, hides and platforms that are used should be constructed well in advance of the proposed hunt so that the animals can get accustomed to the new structures. Slaughter facilities should also be neat and hygienic for the proper treatment of meat, skins and trophies. The skinners and capers must be well-trained to prepare a top-class trophy mount.

7.9.4 Staff requirements

Employees can either be an asset to the bow hunting venture or an expensive liability. It is therefore important to employ quality professional staff who are experts in their different fields. However, also employ novices that are apt and eager to learn. The staff interact with the clients on a direct and daily basise and must be well-trained, neatly dressed, courteous and always friendly. The staff of a bow hunting venture includes: the administrative personnel (booking clerk and receptionist), the professional hunter, the camp staff which will include the cooking, cleaning and maintenance personnel, skinners and trackers or guides. It will be of great benefit to contract a professional hunter that specializes in bow hunting. Camp staff must be trained in such a manner that the client’s needs are met 24 hours a day. This creates a good impression and can assure the development of a long-term relationships

and good marketing by word of mouth. Keep the staff up to date and send them to relevant training courses. In the case of the Tshanini Community Conservation Area it is important that the people understand the fact that they should take ownership of this venture, and that after all it is their own initiative. Skinners and trackers should always know where their loyalty lie and bribes for missed or injured game should not even be negotiable. They should always respect the client but even more their job and the environment in which they work.

7.9.5 Hunting techniques

Of the five commonly known bow hunting techniques only three are suited for the habitat in the Tshanini Community Conservation Area. These will be discussed briefly with their different pros and cons. The choice of technique depends on the type of vegetation and terrain restrictions, the species to be hunted and the proficiency level of the hunter.

7.9.5.1 Walk and stalk

For this method, the hunter must wear camouflage clothing and constantly take wind direction into consideration. Slow and silent movement is of the utmost importance because most wildlife have excellent sensing abilities. This method requires absolute patience and concentration, as it involves frequent stopping, listening, looking and smelling of the animals. In the Tshanini Community Conservation Area the Open and Closed Woodlands would favour this technique. These areas have sufficient cover and a clear shooting range. This technique is by far the most rewarding as it challenges all the human endurance and skill that there is to offer. Where animal movement is random and unpredictable, especially after heavy rains, this technique would be preferred. Mental and physical fitness is essential, as long spells of concentration and tension can lead to rapid fatigue. Fatigue in turn leads to misjudgement of distance and eventually to either missing the target totally or wounding the hunted animal.

7.9.5.2 Elevated stands

Where there is frequent movement or activity of wildlife, like paths, waterholes and mineral licks an elevated stand can be erected. Elevated stands can be temporary or permanent structures that are mounted in trees or constructed on platforms on stilts. This method suits a

wide variety of terrains and is not physically demanding. Detection by wildlife is not likely if the stands are well-camouflaged. This can also be a pleasant way to pass time. What makes this technique even more appealing are the clear shooting lanes and distances, which can be determined in advance or by using an electronic range-finder.

7.9.5.3 Permanent hides at watering points

In South Africa many bow hunting expeditions make use of permanent hides that are erected at waterholes (Cheney 2005). Features that are commonly used in conjunction with waterholes include mineral licks, baiting stations, lures or even decoys to entice animals within shooting range. There are numerous advantages to this technique. The hunter can be left on his own, but be provided with a two-way radio to contact the professional hunter when an animal is shot. Wounding rates are lower compared to other techniques because of the open shooting lanes and knowing the shooting distances. This technique is also time-efficient at a productive site, it provides exiting wildlife viewing and requires minimum physical effort. This technique also has its deficiencies, because when a hide at a waterhole is used too frequently, the hunted animals shy away from it or even change their drinking patterns. Another disadvantage is that during the rainy season when water is freely available the waterholes become less attractive (Cheney 2005). In the case of the Tshanini Community Conservation Area this will not necessarily be the case as the sandy nature of the soil makes the possibility of standing water elsewhere nearly impossible.

In conclusion, there should preferably be several hides for the bow hunters to choose from and rotation should be promoted to prevent stereotyped situations. Offering three hunting techniques is to the advantages of the hunting venture in the Tshanini Community Conservation Area and should assure hunting success and cater for specific and personal needs. Knowing the time that the hunter will have available for the hunting trip will also help to choose the right technique. When considering the efficient harvesting and low wounding rates, stands at waterholes provide the best option and are thus the most efficient all-round hunting technique. However, for the experienced hunter the walk and stalk hunting technique will still be more challenging and satisfying.

7.9.6 Marketing

Marketing is a way of introducing your enterprise and your product on the purchasing-shelf of the hunting world. As is any other product in a competitive market, bow hunting as a viable, sustainable and ecologically acceptable management tool is doomed to failure without a good marketing strategy (Cheney 2005). However, marketing can be expensive and should from the onset of the bow hunting venture be included into the business plan and total budget. Cheney (2005) set out the following helpful hints on marketing bow hunting:

- Choose a specific market right from the start. Advertise in such a way that the target market is reached. This can be done through hunting-specific magazines and shows. Do not waste money on so-called "general marketing".
- The marketing strategy should be accurate, informative and to the point. State the type of facilities that are available, the type of wildlife on offer as well as the hunting techniques that will be most likely to succeed. Know your client's expectations.
- Use what is available in the area to the advantage of the enterprise. For example, market the Tshanini Community Conservation Areas as a neighbour of the Usuthu-Tembe-Futi Transfrontier Conservation Area.
- Do not overprice the expected client base as a newcomer. Target the foreign "average wage earner" or local market with an affordable hunting package. This market segment is a growing market and as yet underexploited. These hunters do not require all the luxury that is so often erroneously associated with foreign trophy hunters.

Different media can be used for marketing. They include:

- Magazines: General magazines can be an expensive marketing tool and are not always cost-effective. However, to advertise in an appropriate popular magazine a wide variety of potential clients can be reached.
- Hunting shows: A stand at a hunting convention can also be expensive, but it allows for personal contact with prospective clients.
- Brochures: The cost of this form of marketing depends on the quality of the brochure.
- Compact disks: These items are an effective option and are relatively cheap to produce, light, cheap to post and interactive. It can also be updated regularly.

- Internet websites: Websites are effective, easily accessible and can reach a wide audience. However a good, professional website can also be expensive.
- Marketing agency or hunting outfitter: This strategy might be the easiest and most cost-effective way for the Tshanini Community Conservation Area.

7.9.7 Daily rates and hunting packages

The bulk of the income generated by bow hunting comes from daily rates. The daily rates include accommodation, refreshments and meals. Rates should be competitive and the service must be of a good quality to insure customer satisfaction no matter what income classes are represented and catered for. The return customer is the best marketing tool.

Before the hunting season starts a decision has to be made on what will be offered to prospective clients. This decision must be based on knowledge of the numbers, sexes and age classes of the different types of wildlife on the reserve. Classify these animals into packages which are then sold as units to the client. It is also important to specify whether the animals are only good representatives of a specific type of animal or are of trophy quality. The former refers to an average adult animal the trophy of which does not meet the minimum requirements for inclusion in an official record book (Tables 7.2 - 7.14). In contrast a trophy quality animal is an animal that will qualify for inclusion in one of the official record books such as the Rowland Ward or Safari Club International.

7.10 MONITORING

Due to the dynamic nature of ecosystems the outcome of management planning and strategies cannot be predicted with certainty. Monitoring of the ecological processes of any natural area or reserve aims at the purposeful and repeated examination of the state or condition of that reserve in relation to the external factors that are working in on it at a specific time. Monitoring the ecological environment emphasizes changes in its biotic and abiotic components.For any management and utilization practice to be successful, regular and repeatable ecological data have to be obtained first, and be analised regularly. Data that have been obtained can be used to determine trends in the habitat and the animal populations, which can be again used as guidelines for future planning. Monitoring is essential to

determine whether goals and objective have been reached and optimal conditions can be calculated against which the progress being made is measured. Monitoring programmes are also early warning systems because they can detect changes or trends timely that occur as a result of management actions or natural events (Hin 2000, Bothma & Van Rooyen 2002).

The ideal for the Tshanini Community Conservation Area would be if the future managing personnel undertook, analysed and interpreted their own monitoring system and built up a database that could be compared to that of the Tembe Elephant Park and baseline data collected in this study. It should be stressed that it is fruitless to invest a great deal of money and energy on monitoring without analysing the results and incorporating them into the management plan.

7.10.1 Environmental monitoring

Numerous components of the abiotic environment can be monitored in the Tshanini Community Conservation Area, but they should at least include the following:

- Rainfall: Rainfall is the most important and basic aspect to be monitored. Accurate measurements, preferably on a daily basis, can be obtained with inexpensive equipment. Long-term rainfall data should also be obtained from the official weather station closest to the reserve. For the Tshanini Community Conservation Area it would be Shihangwane weather station in the Tembe Elephant Park. Rainfall data are especially important for the estimation of the ecological capacity of natural areas. Mean annual rainfall trends are useful indicators of the production potential of the vegetation, but at least 20 years of rainfall data are required to make reliable deductions about the rainfall for a specific area. A standard rain gauge on a grid pattern of 2 x 2 km can be used, with one rain gauge in each block (Bothma & Van Rooyen 2002).
- Temperature: By using a simple and inexpensive thermometer, the minimum and maximum temperatures can be measured. Daily measurements at 08:00 and at a standard height of 1 to 2 m above ground in a shaded and well-ventilated area should be efficient. The measurement can be taken at one location on the reserve (Bothma & Van Rooyen 2002).

- Relative humidity of the air: The relative humidity and temperature of the air have a major effect on fire intensity (Trollope 1999). The negative effect of fire can be minimised if the thresholds of these two factors are considered. A hygrometer is recommended to measure the relative humidity of the air in the Tshanini Community Conservation Area.

7.10.2 Habitat monitoring

The following components of the habitat need monitoring:

- Veld condition trends: Veld condition trends and grass species frequency and composition changes should be recorded by means of the rod-point method.
- Herbaceous biomass production and annual plant yields: Herbaceous biomass yield should be measured annually with a disc pasture meter. The herbaceous biomass is used to estimate the available combustible grass biomass to support a fire and to calculate the grazing capacity and thus stocking density.
- Fire: Burned areas should be recorded annually on a map of the reserve. A note of the date and the cause of the fire should be precisely and specifically recorded (Bothma & Van Rooyen 2002). With the information attained from herbaceous biomass yield and thus the available fuel load, a burning programme can be applied, managed and monitored.

To monitor the habitat the following methods are suitable:

- **Fixed-point photography:** Although a subjective way of evaluation, it stays a cheap, reliable, easily applicable and essential component of vegetation monitoring. A series of photographs must be taken from the same point and at the same time every year. Visual records are obtained that can provide qualitative and rapid information on short and medium-term trends in the vegetation. It also provides permanent records for re-examination when required as well as additional evidence for evaluating and interpreting the impact of various external influences on the vegetation, such as fire and excessive grazing practices (Bothma & Van Rooyen 2002).
- **Monitoring vegetation plots:** It is recommended to establish permanent evaluation sites within each of the plant communities that were identified during the phytosociological study (Gaugris *et al.* 2004). It would be advisable to plot the coordinates of the evaluation sites onto the vegetation map (Gaugris *et al.* 2004) for future reference. A galvanized ½ inch pipe set in a concrete base should permanently mark the evaluation

sites. Markers or tags can be used to assist in the relocation of the site; these tags or markers can be nailed into a prominent tree or bush. These evaluation sites should be set out as transects, mostly in a north–south direction. At each site a fixed-point photograph must be taken with a digital camera in the direction of that specific transect. Comparing records taken from other sample sites within the same vegetation type, as well as previous surveys, changes in species composition of the vegetation could be detected over time.

7.10.3 Monitoring animal population numbers and structures

An important and vital part of any management programme is the determination of animal population trends (Bothma 1996). This goes hand in hand with monitoring their habitats. Monitoring wildlife numbers is fundamental to the successful management of the reserve in terms of correct stocking densities.

As said earlier wildlife counts should be done on a regular basis, at least once a year. These counts should be repeatable, and give the same estimate for the same number of wildlife each time it is done. In conjunction with conducting the wildlife counts, age and sex classification of wildlife should also be done. This will assist in determining population trends.

The natural rate of mortality should also be determined annually, and the reason for any deaths recorded. The condition, disease and parasite infections of wildlife must also be recorded and if possible the external parasites must be counted on all fresh carcasses (Bothma 1996). The condition of wildlife can be determined visually as done for cattle (Chapter 3 and Apendix 2)

To reduce the growth rate of an animal population, the removal of the most productive females and often the mature males is an option. This must be done in close balance with existing social behavioural parameters. The extent of animal population and habitat monitoring input performed on the Tshanini Community Conservation Area, and the quality of the ecological analysis, will determine the extent to which the animal population management objectives will be optimised.

7.10.4 Other key components to be monitored

Records should also be kept of the following aspects:

- droughts, indicating dates and intensity;
- collection of plant material for medicinal uses;
- erosion;
- water quality and quantity;
- tourism impacts (hiking, driving, littering, trampling, noise and erosion).

The outcomes of management actions that have been implemented in the Tshanini Community Conservation Area should also be monitored, for example:

- fire management plan;
- water provision (especially artificial waterholes);
- control of bush encroachment;
- habitat reclamation measures;
- collection of plant material for medicinal uses;
- tourism impacts.

The effects are to be measured in terms of the veld condition and the grazing and browsing capacity which in turn will involve recording plant species composition, the plant density and/or plant cover, and the plant biomass production.

7.11 SUPPLEMENTARY FEEDING

Because wildlife no longer have the freedom to move or migrate over large areas to select the best and most nutritious food in fenced areas, supplementation has become an important management option. Supplementing food, especially the mineral and energy requirements of wildlife, becomes necessary when the available forage composition falls below the metabolic needs of grazing animals. Supplementation prevents metabolic deficiencies, but also stimulates food intake (Meissner 1999, Schmidt & Snyman 2002).

Factors affecting supplement choice include, the quantity and quality of the grazing, the type of grazing (sweet, sour, or mixed veld), type of animal and the production status of the grazing animal (for example is the female lactating or not). Different types of supplements

are currently available on the market and the most common products come in two forms, either as a lick block or as game pellets. Licks can either be mineral, transitional, production or energy licks.

In the case of the Tshanini Community Conservation Area the best option for food supplementation would be in the form of a lick block. The advantages of lick blocks are that they are easy and convenient to handle, they do not take up much space in buckets and troughs and no weighing, mixing, and adding ground elements are required. Licks have been developed in such a way that weather and other elements, such as grain-eating animals, have little or no effect on the lick block itself. Even excessive intake of salt and ureum has been eliminated by the composition of lick blocks. Lick blocks should be placed near watering-points and be accessible to all grazing animals. For the Tshanini Community Conservation Area the best time of the year to start feeding supplementation licks would be in the late summer, at the stage when the natural grazing starts to lose palatability. Thus as the nutritive value of the forage decreases, the lick stimulates intake. A high-energy protein lick with the correct mineral composition would be the preferred option. This option would supplement the protein- and energy deficient grazing, it will also prevent mass loss and increase production and reproduction. The disadvantage of supplementary feeding is that it is very expensive. Care should also be taken that the ecological capacity of the veld is not exceeded by the supplementation.

7.12 DISEASE AND PARASITE MANAGEMENT

7.12.1 Introduction

A healthy or disease-free environment is one of the key objectives in any wildlife management enterprise. To maintain an optimal productive environment, prevention rather than the cure of disease and parasitic infestation should be strived for. Ecological disturbances are often the reason for disease outbreaks. These disturbances occur when animals are stressed due to malnutrition, overpopulation or confinement into small spaces (Meltzer 1993, Du Toit 2002). Diseases of epidemic proportion are generally rare in naturally occurring wildlife populations. Most wild animals have evolved together with their natural parasites and are not severely affected by them. In many instances a symbiotic relationship or interdependence between host and parasite is found (Meltzer 1993).

For any disease to break out there must be a susceptible host, the infecting agent and a vector to carry the agent to the host. The essential disease control lies in the fact that one of the links in this triangle has to be broken (Du Toit 2002). Fortunately many of the pathogenic organisms are host-specific and do not constitute a threat to other species.

In southern Africa, livestock and wildlife are often in close contact, which creates the ideal situation for the transfer of multi-host pathogens (Meltzer 1993). Consequences can be devastating for both populations. This underlines the importance of a proper disease management strategy, which should include preventing the spread of disease between wildlife and domestic livestock.

7.12.2 Disease control measures

Approaches to manage diseases among wild animals as discussed by Du Toit (2002) are summarised here to highlight the essence and importance of disease management.

Quarantine: In South Africa, quarantine periods are applied mainly to control foot-and-mouth disease. This system is based on the principle of isolating the carrier and subjecting it to a series of blood tests at the point of origin and introduction. This approach is expensive and requires specialized knowledge and experience to manage animals in quarantine bomas.

In the case of the Tshanini Community Conservation Area, the actual presence of foot-and-mouth disease makes it highly recommendable to translocate and introduce foot- and-mouth free animals from areas where they have been certified and approved by the State Veterinary Department for the specific area. Such areas would probably include other KwaZulu-Natal Parks such as Mkuzi Game Reserve, Ithala Nature Reserve or Hluhluwe-Imfolozi Park.

Fences: In the case of the Tshanini Community Conservation Area fences will separate the wild ungulates from the domestic livestock. If blue wildebeest are to be introduced to the Tshanini Community Conservation Area, malignant catarrhal fever is a factor to keep in mind. All types of wildebeest are carriers of this acute viral disease that is fatal to cattle. This disease is characterised by severe inflammation of the nasal passage and eyes. It manifests itself as fever, diarrhoea, swollen eyes and a nose that runs, resulting in death after one to two

days (Mönnig & Veldman 1989). The ideal would be to have a double fence with at least a 3 to 5 m buffer zone between the inner and outer fence. Wildlife-proof fences, especially *Bonnox or Veldspan fences*, will also help in preventing rabies carriers (feral dogs) from entering the fenced area. However, such fences also have disadvantages because they cut off natural migration routes, limit genetic flow and individual animals can be caught, strangled or electrocuted in the fences (Du Toit 1996).

Eradication: Eradicating disease carriers by means of poison, shooting, or burning carcasses of animals with anthrax also have some constraints. Some examples are provided below:

- Shooting disease carriers can disturb the balance in wild animal populations and indirectly in plant communities.
- Removal of carcasses puts pressure on scavengers.
- Outbreaks of anthrax and botulism can be prevented if carcasses are burned.
- When bones are removed or burned, supplementary licks should be provided to alleviate a possible calcium deficiency during winter.
- When poison is used it should be noted that harmless non-target animals are also exterminated.
- Long-term effects may occur, due to accumulation of toxic substances.

Immunization: The best time to inoculate animals is when they are off-loaded onto the property. Before starting the inoculation process information is needed on which animals are most susceptible to disease, are rare species, and on the different ages and sexes of the animals. Immunization from helicopters is also an option, but must only be seen as a last resort and done by qualified people. The latter option is specialized and expensive.

7.12.3 Parasites

Wildlife are not immune to ecto- and endoparasites and act as carriers and hosts as in the case of domestic livestock (Oberem & Schröder 1993, Meltzer 1993, Boomker & Horak 2002). As with the management of disease, parasite management and control are integral parts of wildlife management. Neglecting these aspects could have negative ecological and economic consequences. Fortunately wildlife are more tolerant and less susceptible to parasitic infestation than domestic livestock. However, there are factors that contribute to a loss of tolerance and which lead to the increase of the parasitic load in wild animals (Meltzer 1993).

These factors include: overpopulation, poor nutrition, poor environmental adaptability following translocation, introduction of infested animals and cattle that act as parasite reservoirs.

Parasites are not only dependent upon a host, but in most instances they are host specific. The parasites of wild animals can be divided into two major groups. Ectoparasites live on the host's skin, and include two groups of arthropods namely the Acarina (the ticks, tampans and mites) and the Insecta (the lice, fleas and flies). Endoparasites on the other hand live in the organs of the host and are represented by roundworms, tapeworms and flukes (Meltzer 1993, Du Toit 2002).

Parasites can either have a direct or indirect effect on their host (Oberem & Schröder 1993). Direct effects include:

- anaemia from blood sucking;
- irritation to the host by modifying behaviour such as reducing grazing and resting and thus affecting the conversion efficiency of the host;
- toxins produced by the saliva of the ticks cause paralysis and sweating sickness; and
- bacterial, fungal and other parasitic infections of bite wounds can result in septicaemia and abscessation and eventually even loss of body parts.

Indirect effects of ectoparasites, especially ticks, are the transmission of disease. Important diseases transmitted by ticks include: redwater, anaplasmosis, heartwater, East Coast fever and corridor-disease (Mönnig & Veldman 1989). The people in the area surrounding the Tshanini Community Conservation Area know that ticks affect animal health and production. It is therefore important to give more specific guidelines to the upcoming Tshanini Community Conservation Area's management on how to control and manage such parasites.

The only practical way to decrease the incidence of internal parasites would be to use anthelmintics in licks and to allow animals access to these licks for two to four weeks, to ensure proper contact.

7.12.4 Tick control

Ticks have an uncomplicated life cycle. The fully distended, adult female tick drops from the host and lays her eggs in the ground. When the eggs hatch, the larvae, commonly known as pepper ticks, climb onto the grass stems to await the arrival of a host. Most tick species have a preferred attachment site on the host. Ticks also show a seasonal pattern of occurrence and most larvae occur during autumn and winter. The nymphs occur mainly during the winter and spring and the adults during the summer (Boomker & Horak 2000).

To control ticks efficiently in wildlife seems virtually impossible as most wild animals cannot be rounded up and dipped like domestic stock. However, there are some control measures that can be applied.

- Cattle as a measure through alteration

  With cattle all around the Tshanini Community Conservation Area this option can be investigated. Although, allowing cattle and wild ungulates to forage in the same area could distract visitors from experiencing unspoiled nature. The method involves cattle and wild ungulates to forage in the same area during the season when ticks are active. In this way the cattle act as “vacuum-cleaners” to attract as many ticks as possible in a relatively short time. During autumn and winter, when cattle become infected with nymphs and larvae they need to be exposed only for short periods. During summer, the exposure period can be longer to allow enough adult ticks to attach themselves to the cattle. In this time period cattle should be dipped at maximum intervals of 5 days, since longer intervals will allow adult ticks to engorge and drop off before the cattle are dipped again. It is important however to incorporate the grazing capacity for cattle in the grazing capacity equation for the Tshanini Community Conservation Area if this method is to be used, even if cattle are only present for a short while. Cattle are selective grazers and have a large effect on the consumption of the plant biomass on the reserve.

- Stocking density and concentration of wildlife

  High stocking densities create the ideal situation for parasites to multiply and tick problems are prone to occur as long as high stocking densities of wildlife are

maintained. As long as animal numbers are kept at prescribed ecological capacities, the chances of ticks finding suitable hosts are considerably reduced. Areas where management should focus on controlling tick numbers are around watering points, feeding structures and licks (Zieger 1998).

- Wildlife spectrum

  Surveys have shown that most wild animals in southern Africa carry a variety and varying numbers of ticks (Boomker & Horak 2000). Blue wildebeest and smaller antelope are carriers of ticks in their immature stage, while large animals, such as the greater kudu, eland, buffalo and giraffe carry large numbers of ticks in both their immature and adult stages. The blue wildebeest appears to have an inherent resistance towards tick infestation and usually has a low tick load. These animals attract large amounts of ticks, which fail to complete their life cycle, thereby benefiting other animals in their vicinity. Impala on the other hand are more susceptible to tick infestation than other wildlife species. Thus, knowing how each species reacts to tick infestation, species ratios and numbers can be selected accordingly.

- The use of fire to control tick numbers

  It is generally believed that fire directly causes mortalities among ticks, and also makes the microclimate less favourable for their survival. However, according to Zieger (1998) there is no marked difference in the number of adult ticks on burnt and unburned sites. Burned areas with resprouting graze attract a high concentration of host animals, which introduce fresh tick infestations, leading to an increased number of ticks. To achieve the best results, a burn should coincide with the peak activity period of the particular tick population. If a long-term reduction in tick numbers is the objective, animal numbers in burned areas should be reduced. This can only be achieved if the overall stocking density is maintained at or below ecological capacity.

- Use of chemicals (acaricides) and various tick applicators

  Effective tick control is achieved by applying acaricidal chemicals to livestock, thus reducing the number of free-living ticks overall (Oberem & Schröder 1993). Wild ungulates can be dipped before their release on the wildlife reserve. In a holding facility, wild animals can be dipped or treated with the same compound as that being

used on cattle, provided that the directions for use are followed carefully (Boomker & Horak 2000). Animals can either be sprayed with an ordinary hand pump or by pouring on the chemical, like Drastic Deadline™ (Bayer®, S.A.) or Amipor™ (Virbac®). The active ingredient of Drastic Deadline is Flumetrien 1% (a pyrethroid). Amipor's three active ingredients include: 1% Amitraz, 1% Supermitrin and 5% Piperonil Butokside. Amipor is oxpecker *Buphagus erythrohynchus* friendly and can be applied in areas where ticks have built up an immune response towards pyrethroids (Strydom 2005).

Two types of applicators have been developed to treat wild animals with acaricides, i.e. the Duncan Applicator® and the Tick-Off Applicator®. The Duncan Applicator has been used successfully on certain wildlife species (especially the eland) during the rainy season. This applicator is filled with feed concentrate or licks, which then lure the animals to the applicator. While eating from the lick the animals rub their necks, heads and ears, which come in contact with the pole from which a pour-on dip flows. This direct contact with the dip ensures that a sufficient number of ticks are exposed to the toxin and are killed (Strydom 2005).

The Tick-Off Applicator® is a hydraulic, pressure sensitive appliance. It is buried underground and the wildlife are totally unaware of its presence. The spray nozzle is installed so that it points upwards towards the belly of an animal stepping onto the plate. When an animal puts enough pressure on the appliance, it self-activates and the animal is sprayed with the acaricide. The appliance should be installed in an area where activity is insured, such as at a waterhole or lick. An entrance must be constructed to force the animal to pass the area where the pressure plate is buried (Strydom 2005).

- Natural or biological control of ticks

  When the term biological control of ticks comes to mind an immediate association occurs which includes the red-billed oxpeckers *Buphagus erythrohynchus* and the yellow-billed oxpeckers *Buphagus africanus*. Due to the livestock dipping chemicals with which domestic stock such as cattle were dipped in the past, a considerable decrease in the distribution of these birds has occurred. This has lead to a reduced distribution range of these birds, and confined them mainly to larger nature reserves

in South Africa. It is also here where ticks are abundant on larger mammals and especially the rhinoceros. Over the years these birds developed a symbiotic relationship in nature with the rhinoceros (especially the black rhinoceros). For the rhinoceros the birds act as a early warning system in case of intruders such as poachers and for the birds the ticks on these animals are a feast, they also help to keep the tick load on the animal to a bearable minimum (Du Toit 2002).

It is estimated that an oxpecker can consume 408 ticks per day. However, a female blue tick *Boophilus decoloratus* and bont tick *Amblyomma hebraeum* can lay from 2 500 to 18 000 eggs respectively (Du Toit 2002).

According to Du Toit (2002) the following factors are important when oxpeckers are to be re-established on a wildlife reserve:

- The area has to be at least 100 to 200 km² in size.
- Mammals that are suitable tick hosts have to occur in the area, such as rhinoceroses, giraffe, eland and impala.
- The following dipping chemicals should be used on cattle and wildlife in the area: pyrethroid components such as: Bayticol, Triatix, Curatix, Decatix, Drastic Deadline, Ektoban or Sumatix.
- The introduction of birds should take place in the winter so that brooding birds are not removed from their original area.
- At least 20 birds from the same flock should be re-established to serve as a viable population.
- The birds should be re-established in the early morning, near large mammals and waterholes.

7.13 INFRASTRUCTURE

7.13.1 Buildings and camping amenities

When starting a new wildlife reserve, it is important that the buildings and their locations are planned in such a way that they blend in with the environment, cause minimum disturbance to plants and animals, and are easily accessible. Generally, the most important building complexes on a reserve are the manager's home, the hunting camp and the labourers' accommodation. These three complexes should be far enough from each other so that there is

minimum disturbance. Labour accommodation should be at least 1 km away from the hunting camp. The manager's house may be a bit closer to the hunting camp, especially if other buildings and amenities such as an abattoir, cool room, fuel and telephone are linked to it. These buildings should be as close as possible to the border and entrance of the reserve to leave the rest of the area as undisturbed as possible, to control unnecessary traffic and pedestrians, and to make the connection of power and telephone lines easier (Van Rooyen *et al.* 1996).

7.13.2 Bomas and holding pens

If it is necessary to handle wildlife on the reserve or to keep them in a pen or holding camp for a long time, it would be advantageous to build semi-permanent holding pens or camps on the reserve (Ebedes 2000).

Ebedes (2000) provide the following guidelines on the construction of holding pens:

- The pens must be constructed on level terrain and soil should drain easily in order to prevent a pen from becoming a mud bath. SABS-approved creosote material should be used where termites are a problem and where the creosote will not adversely affect the wildlife being held.
- A neat, solid and practical set of pens should be constructed. This will simplify the handling and care of wildlife and creates a good impression.
- There should be sufficient space for heavy vehicles to turn to load or unload wildlife. A suitable loading ramp against which the vehicle can park is important. Any space between the vehicle and ramp should be closed (using old tyres or old conveyer strips) to prevent leg injuries while wildlife negotiate the gap. A canvas or plastic sheet should be used to close gaps on the sides and roof of the loading pen, so that it is partially dark and the animals cannot see the movement of people.
- A wooden walkway above the passage of the pens eases handling, loading, unloading and supervision. The animals also become tame more quickly if the walkway is regularly used while they are in the pen.
- Sorting and loading zones should be planned to form a slight curve. This will simplify the loading process.
- Sliding doors at the start of the passage will ease the loading, sorting, selection and classification of wildlife. Sliding doors on rollers are easily opened and closed. The

doors of the pens must be slightly wider than the passage so that the doors will press against the opposite wall of the passage when open to form passages. The door and passage should form a funnel to ensure that animals can move out easily. Strong heavy-duty slide-lock bolts should be used on the doors of the pens.

- If the environment around the holding pens is suitable for a capture pen, the pen can be planned in such a way that the animals can be brought directly from the field to the pen.
- Provision must be made for ladders at various places on the inside of the passage in case any problems occur and the assistants have to escape in a hurry.
- Wooden poles for the walls of the pens must be packed tightly and every third or fourth pole must be firmly attached to cross-wires or cable. Wooden poles above troughs must be fixed with staples so that the poles do not hang in the water. Any sharp protruding objects that can scratch or damage the animals must be removed or flattened.
- Stone and cement water troughs must be constructed in one corner of each pen. A trough of 0.5 x 0.5 x 1 m (inner measurement) will be adequate. The top of the trough should be about 10 cm above ground level. About two thirds of the trough should be inside the pen, with the protruding part just large enough that the trough can be scrubbed and refilled from the outside.
- The size of the pens will depend on the type of animal or the family unit to be held. According to Ebedes (2000) the suggested minimum size of any pen is 9 m^2, or 3 x 3 m.

7.13.3 Hides and lookout towers

Lookouts towers can be used to view animals and birds, take photos, capture (immobilize) wildlife, or to do wildlife counts at waterholes. According to Du Toit and Van Rooyen (1996) the lookout tower should be located in such a way that when one looks at the waterhole, the sun should be behind the observer and the prevailing wind should blow away from the waterhole towards the lookout tower. It is also important that the tower does not impair the natural beauty of the environment.

Hides or lookout towers must be large enough to allow approximately four people to move around in it comfortably, and if necessary to allow them to sleep there. Measurements of 4 x 4 x 2 m (height) should be adequate for four people. A reed passage should be built from the parking area to the tower to ensure that people can enter the lookout tower without disturbing the wildlife near the waterhole. The height of the sides of this passageway should be 2 m, and it must have a width of 2 to 3 m. Wooden posts with a minimum top diameter of 125 mm can be planted 750 mm deep and joined by means of an upper and lower wire or cable. Reeds can then be used to form a solid structure. The hide can be constructed of concrete, poles and grass or reeds (Du Toit & Van Rooyen 1996).

7.13.4 Walking trail and canopy walkway

Hiking is a common form of nature-based tourism in South Africa. According to Hugo & Bewsher (1995) there were approximately 1 000 hiking trails in South Africa in 1995. These authors calculated that a further 3 000 trails would be needed before 2005 in order to satisfy the then existing needs. Hiking is no longer an activity only for the strong men with heavy backpacks, but has changed into a family activity for everyone to enjoy.

The Centre for African Tourism has developed a new scientific approach to trail planning. The concept includes mountain bike trails, 4 x 4 drives, diving trails, horse trails, and trails for the disabled, and therefore no longer caters only for hiking trails. When taking people through a landscape to enjoy the environment, it must be done with great care so as not to disturb the basic resource, which you want the people to appreciate. According to Hugo and Bewsher (1995) hiking is a state of mind, and much more that just a physical accomplishment. It is not just a matter of walking between point A and B, but also of being able to enjoy the environment surrounding you while you do so. A trail also has to be audited after opening in order to ensure that the environment is actually benefiting from it and is not being degraded.

When hiking in forest vegetation, the treetops are the environment where animal life is most abundant and diverse. Anyone who has gone birding in a forest knows the frustration of hearing a bird in the treetops and not being able to identify it. One way in which to solve this problem is by erecting an elevated walkway or observation tower just below the tree canopy level. This enables visitors to view the forest canopy without damaging the habitat.

According to Canopy Construction Associates (Van Eeden 2001), under appropriate conditions, the bridge component of a walkway can typically be up to 100 m or longer. The height above ground is a function of the selected trees, or in some cases, manmade towers that are constructed on site. Walkways can also criss-cross each other at different heights. Observation platforms likewise can be built to any dimension allowed by the architecture of the trees, but are typically 2 x 2 m with safety railings.

Canopy Construction Associates (Van Eeden 2001) use both galvanized and stainless steel cable and associated hardware throughout, sized to meet a safety design factor of 5:1, thus the stress on any given component may not exceed one-fifth of its minimum breaking strength when full weight is loaded on it. Polyester rope and cordage are also used in various applications under the same restrictions. According to the above reference, walkways that are made from galvanized steel cables and other hardware components may last 20 to 30 years while stainless steel will last longer. All the walkway systems should be regularly inspected and be maintained properly and constantly.

7.14 ROADS

A road is a disturbance to the natural environment and should be designed and built with care. According to Du Toit and Van Rooyen (1996) tourist, firebreak and hunting roads are the three types of roads that are usually used on a wildlife reserve. The proposed road network in the Tshanini Community Conservation Area has been set out in Figure 7.1.

The aim of a tourist road is to provide the tourist with the opportunity of viewing and experiencing the scenery and other natural resources on the reserve. Tourist roads should ideally twist through the bush and should not include long straight stretches. In the case of the Tshanini Community Conservation Area, situated in the dense Sand Forest, this will not be feasible. Tourist roads should also link waterholes and traverse through as many vegetation types in the reserve as possible (Du Toit & Van Rooyen 1996).

Firebreak roads should be at least 8 m wide to prevent accidental fires from crossing them. They should be planned and built in such a way that they separate the different major vegetation types on the reserve. This will enable the reserve management to use the road for different functions. A tourist road can also serve as a firebreak road as long as the road

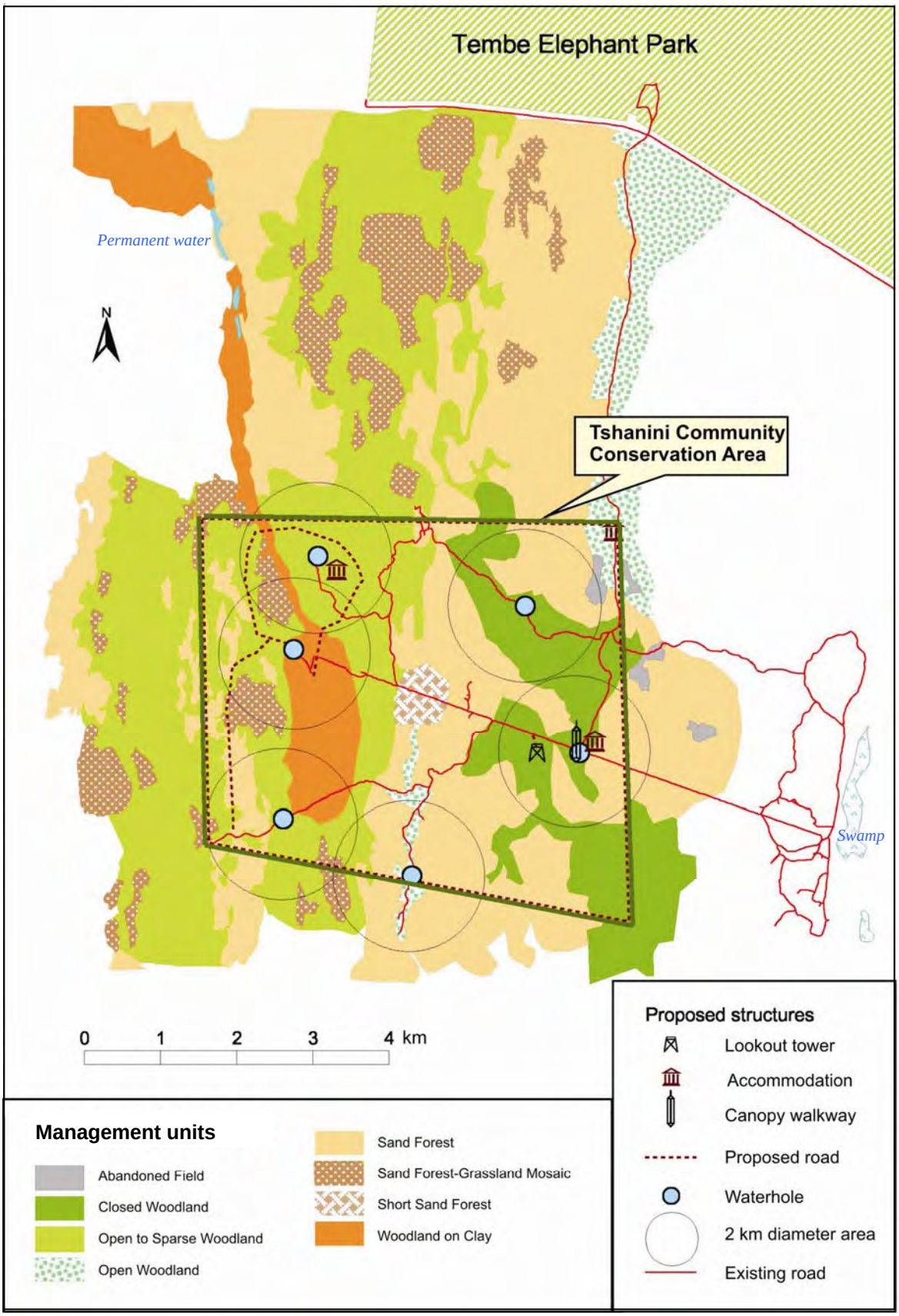


Figure 7.1 The management units (adapted from Gaugris *et al*. 2004) and proposed structures in the Tshanini Community Conservation Area, KwaZulu-Natal.

complies with the necessary specifications for both types of roads (Du Toit & Van Rooyen 1996).

Hunting roads on the other hand are two-track roads that cause as little ecological disturbance as possible. Hunting roads should enable the hunter or cropping team to deliver any hunted or captured animal to the skinning and/or holding facilities with the minimum of delay (Du Toit & Van Rooyen 1996).

7.15 FENCES

The erection of an effective wildlife fence is determined by the type of wildlife kept, the nature of the terrain, the type of material used and the finances available. There is no 'ideal' fence that can be prescribed for all types of game reserves. Every reserve should evaluate its own situation and wildlife complement and consult its local conservation authority with regard to specific prescriptions or requirements before a wildlife-proof fence is erected (Van Rooyen *et al.* 1996).

According to Van Rooyen *et al.* (1996) a good wildlife-proof fence should be straight, with firmly anchored straining posts, all of them reaching the same height above ground level. To make the fence firm, the straining points should not be too far apart (8 to 15 m apart to ensure fence elasticity). Furthermore, the wire strands should all be parallel to each other and to the ground level, and this spacing should remain regular throughout the complete fence. Droppers should be neatly and evenly spaced between the line posts and wire strands in order to maintain the space between the strands. For a long-lasting investment and low maintenance cost, the fence should be erected with the best quality material possible.

The height of the fence will depend on the type of wildlife kept. On the basis of their movement over, under, or through fences, wildlife can be classified into the following classes (Van Rooyen *et al.* 1996):

1. Animals that jump over fences: eland, greater kudu, impala and waterbuck.
2. Animals that crawl under fences: gemsbok, sable antelope, roan antelope, red hartebeest and tsessebe.
3. Animals that move freely through fences: warthog, bushpig, nyala, duiker, steenbok, klipspringer and predators.

4. Animals that break fences: buffalo, rhinoceroses, giraffe, waterbuck bulls, eland bulls and blue wildebeest bulls.

The posts that are used for the fence can either be made of wood or iron. According to Van Rooyen *et al.* (1996) the main advantages of a wooden post for a fence is that in sand or loose soil it is more secure than an iron post fence. A wooden post fence will thus be better suited for the habitat of the Tshanini Community Conservation Area than a metal one. Furthermore, the main disadvantage of an iron post fence is that it rusts quickly in humid conditions such as experienced in the Tshanini Community Conservation Area. Under these conditions one should also use fully galvanized wire (yellow label). Fences on a wildlife ranch are a major capital investment. Poor workmanship will result in high maintenance cost, while wildlife can be lost through a poorly constructed fence. However, no fence is completely wildlife-proof, although thorough maintenance can limit unnecessary animal lossese.

In an exceptional case an electrified fence may have to be erected. This can be done alone, or in combination with a normal wire fence. The design of an electrical wildlife-proof fence is determined mainly by these two factors: the size of the reserve and the type of animals that must be controlled by it (Du Toit 1996). When electrical fences are erected, they may cut off natural migration routes or traverse the territory of certain individual animals. Territorial and migrating animals tend to test certain parts of the fence regularly, and therefore it is desirable to have a minimum of 4 000 volts of power available for effective control. The more powerful the shock, the quicker the animal will learn to respect the fence.

7.16 WATER PROVISION

Restriction on the movement of wildlife in the Tshanini Community Conservation Area by artificial obstructions like fences will generate more stress on the areas surrounding the artificial waterholes than in natural or larger systems. Thorough consideration and planning is needed before artificial waterholes are introduced into any reserve. These waterholes should be well positioned to sustain water dependent wild animals in such a way that the utilization of the available grazing is promoted (Van Rooyen 2002b). Consideration should be given to reduce factors that lead to an increase in grazing pressure and trampling around these introduced watering points. Factors that have to be considered in this regard are: topography, geology, vegetation, soil type and the habitat preferences and drinking habits of

the different types of wildlife. A more even distribution of herbivores will be possible, and even utilization of the available grazing will occur when waterholes are placed according to factors mentioned above. Attention should be given to the results from the studies in the Kruger National Park where it was shown that watering points were not always effective as a tool for promoting rotational grazing or animal migration (Thrash 1993).

Du Toit and Van Rooyen (1996) list the following requirements for an ideal waterhole:

- Sufficient water must be economically exploitable.
- The design of the waterhole must satisfy the drinking preferences of different wildlife species.
- The waterhole must be controllable so that it can be opened or closed to encourage wildlife movements.
- The design must limit wildlife losses where competition for water between different types of wildlife may occur.
- The location relative to that of other waterholes must be considered to limit over- or underutilization of the rangeland.
- The waterhole must be permanent and reliable during times of drought.
- Sufficient shade where wildlife can rest after drinking must be available at the waterhole.
- The waterhole must be constructed in such a manner that it allows maximum wildlife viewing, coupled with the minimum of disturbance to wildlife movements.
- Waterholes should not be placed on watersheds (high-lying areas between two drainages) or on highly erodible soils because it would encourage soil erosion.
- Waterholes must be designed to provide the minimum cover for predators.
- Physically, the waterhole must appear as natural as possible.

All waterholes must be constructed on level terrain. The maximum slope allowed on a site is 5° to prevent erosion and trampling. Waterholes that are too far apart may result in gaps of unutilised veld, while waterholes that are too close may cause severe overutilisation and trampling of the veld. Busy roads and rest camps can also be a disturbance for game, and waterholes should preferably be constructed at least 100 m away from them. When constructing a hide or observation tower at a waterhole, a screened walkway of at least 100 m from a parking area to the hide or tower is required to ensure that the wildlife are not disturbed by the visitors. The nature of the veld and the wildlife species involved must guide

the correct placement of waterholes (Du Toit & Van Rooyen 1996). Figure 7.1 illustrates the proposed layout of waterholes in the Tshanini Community Conservation Area. Areas were selected that are not sensitive to overexploitation by wildlife. The Sand Forests were avoided as far as possible.

7.17 ALIEN INVASIVE PLANT SPECIES

Invading exotic or alien plant species can be terrestrial or aquatic and are characterized by their ability to adapt aggressively to local conditions thereby being able to displace indigenous plant species (Van Rooyen 2002b). These alien invading species establish homogeneous stands and thereby alter the species diversity and structure of the vegetation. Such invasions have significant negative consequences for biodiversity. Exotic plant species are also able to invade or multiply in certain areas because of poor veld management practices. The control of invading exotic plant species has become a major component of the management of protected areas. The control of such plant species is not only time- and labour-intensive, but the costs are often prohibitively high.

According to the Conservation of Agricultural Resources Act No. 43 of 1983 (Regulation 15), the following categories of declared weeds and invader plants are recognised on a national level:

- *Category 1 plants:* These species are prohibited and must be controlled by the landuser. Example: the sweet prickly pear *Opuntia ficus-indica*.
- *Category 2 plants:* These are plant species that serve a commercial purpose, and which may be grown and maintained in demarcated areas provided that one has a permit to do so, and that steps are taken to prevent their spread. Example: the guava *Psidium guajava* and the black wattle *Acacia meansii*.
- *Category 3 plants:* These are ornamental plants. Plants represented by this category may no longer be planted, maintained or multiplied. Existing plants may remain, as long as all reasonable steps are taken to prevent their spreading. Example: the syringa tree *Melia azedarach*.

Should any listed alien invader plant species be encountered in the Tshanini Community Conservation Area or the surrounding areas, immediate steps should be taken to control them by removing them either by mechanical and/or chemical means.

A document was prepared by Hanekom (2001b) on the control of alien plant species within the Tembe Elephant Park. Because of the proximity of the Tshanini Community Conservation Area the same measures can be applied. Cooperation with the management of the Tembe Elephant Park in controlling invasive plants in the whole region should be encouraged.

Preventative measures and early response programmes to control alien plant species and to curb their spread are invaluable. The key to successful control is the early recognition of potential problem areas and plant species. This will enable a rapid response to be made to any potential threats.

7.17.1 Control of alien invasive plant species

According to Hanekom (2001b) the first step in controlling alien invasive plant species is to draw up an inventory of all such plant species occurring in the area. This list however, requires continual updating as new species may be identified. A priority species list was compiled for the Tembe Elephant Park (Appendix 7) and the management of the Tshanini Community Conservation Area can use this list to identify potential invaders. When compiling the list the following aspect of each species was assessed:

- **Dispersion**: The ability of the plant to invade, as well as the method of dispersion. The weighting ranged from 1 to 10, with 1 being a poor disperser and invader and 10 being an aggressive invader with extremely efficient dispersal methods.
- **Control:** The complexity, difficulty and cost of the applicable methods of control as well as the necessity for follow-up procedures, were evaluated. The weighting ranged from 1 to 10 with 1 being plants that are relatively easy to control and 10 being extremely difficult ones.

- **Re-infestation:** The ability of the plant to re-infest the controlled area, following the initial control programme. The weighting ranged from 1 to 10, with 1 being a low probability of re-infestation and 10 being a high probability of re-infestation.
- **Habitat threat:** The ability of the alien plant species to alter the habitat in which it becomes established, and how it affects the natural biodiversity. The weighting ranged from 1 to 10, with 1 being of little threat and 10 being a large threat to the floristic composition and structure of the vegetation, thus having a significant impact on the biodiversity of the area.
- **External seed source:** This would include the current density and distribution of alien plant species that occurred within 6 km from the Tembe Elephant Park. The weighting ranged from 0 to 10, within 0 being no infestation and 10 being a high density and a wide distribution pattern. With the above two criteria factors such as the estimated plant density, plant nature (single, scattered, clumped or continuous) and the distribution of the infestations were considered. The priority species to be controlled will be determined by the sum of the weightings as allocated to each plant species in the various categories.

Chapter 8
CONCLUSIONS

8.1 GENERAL CONCLUSION

It was apparent that cattle still played an important role in the study area. The older people still adhered to traditional values whereas the younger generation attached a more utilitarian value to cattle.

The management of communal rangelands are a challenging and dynamic process. What makes management in communal rangeland difficult is the diversity of stakeholders or individual cattle owners and the current socio-economic conditions. The focus should be directed towards a multidisciplinary understanding and a holistic view of these complex farming systems, if new policies are to make any appreciable difference to rural livelihoods. Should intervention be inevitable, the focus then must be on sustainable use of natural resources for the people to become self-subsistent, and eventually independent. The people or community themselves should buy into these new concepts and policies and claim ownership. Only by doing this can success follow.

The results of the vegetation studies provided a baseline of the species composition, dynamics and productivity of the herbaceous stratum of the Tshanini Community Conservation Area and the unconserved Tembe Traditional Area. Over time, long-term data will become available through the process of scheduled monitoring. This data should then be used to make calculated recommendations for management practices.

Because of the availability of long-term monitoring data in the Tembe Elephant Park and Sileza Nature Reserve these could be used to compare the rangeland condition and herbaceous biomass in the Tshanini Community Conservation Area to other conservation areas. These comparisons allowed trends to be established and measurable data to make management recommendations more concrete and scientifically justifiable. Not only did it gave a platform to work from but it also helped to gain information that would otherwise not have been reliable enough to make any conclusions in the shorter term.

8.2 FUTURE RESEARCH PROSPECTS

While conducting the present study many unanswered questions arose which were beyond the scope of the study. The following section briefly outlines possible future work associated with the present study that could be done in and around the Tembe Elephant Park (including the Tembe Traditional Area and Tshanini Community Conservation Area). These include:

- A well-organised cattle census should be conducted. Such a census could be combined with an aerial count. This can be done in combination with the yearly aerial counts that are undertaken by staff of the Tembe Elephant Park.
- Veterinarian autopsies of cattle carcasses are needed to evaluate the most common reasons for cattle mortalities.
- Questionnaires are to be conducted in the wards that were not incorporated in the present study.
- A grazing gradient for the whole of Maputaland should be established which can be used to verify the ecological classes of the grass species.
- The browsing capacity of the study area should be evaluated.
- An integrated management plan should be compiled for the whole study area which takes the people, their culture, their land, their cattle and most important the environment as a whole into consideration.

REFERENCES

ABSA. 2002. *Game Ranch Profitability in southern Africa.* Second edition. Absa Group Economic Research, Johannesburg. South African Financial Sector Forum.

BARNES, D.L., J.J. ODENDAL & B.H. BEUKES. 1982. Use of the dry-weight rank method of botanical analysis in the Eastern Transvaal. *Proceedings of the Grassland Society of South Africa* 17: 79-82.

BEMBRIDGE, T.J. & D.R. TAPSON. 1993. Communal livestock systems. Pp. 361-373. *In:* MAREE, C. & N.H. CASEY (eds). *Livestock production systems.* Agri Development Foundation, Brooklyn, Pretoria.

BINNS, C.T. 1975. *The Warrior People: Zulu Origins, Customs and Whitchcraft.* Robert Hale and Co., London.

BOOMKER, J. & I.G. HORAK. 2000. Die parasiete van wilde diere: Ekto- en endoparasiete. Pp. 498-510. *In*: BOTHMA, J. DU P. (ed.). *Wildplaasbestuur*. Derde uitgawe. Van Schaik, Pretoria.

BOTHMA, J. DU P. (Ed). 1996. *Game Ranch Management.* Third edition. Van Schaik, Pretoria.

BOTHMA, J. DU P. (Ed). 2002a. *Game Ranch Management.* Fourth edition. Van Schaik, Pretoria.

BOTHMA, J. DU P. 2002b. Counting wild animals. Pp. 335-357. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

BOTHMA, J. DU P. 2002c. Harvesting wild animals. Pp. 358-381. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

BOTHMA, J. DU P. 2002d. Bow hunting. Pp. 495-500. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

BOTHMA, J. DU P. & N. VAN ROOYEN. 2002. Ecological monitoring. Pp. 30-33. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Managemen.* Van Schaik, Pretoria.

BOTHMA, J. DU P. & N. VAN ROOYEN. 2005 (eds). *Intensive wildlife production in Southern Africa*. Van Schaik, Pretoria.

BOTHMA, J. DU P., N. VAN ROOYEN & J.G. DU TOIT. 2002. Antelope and other smaller herbivores. Pp. 49-175. *In:* J. du P. Bothma (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria, South Africa.

BOTHMA, J. DU P., N. VAN ROOYEN & M.W. VAN ROOYEN. 2004. Using diet and plant resources to set wildlife stocking densities in African savannas. *Wildlife Society Bulletin* 32(3): 840-851.

BOYD, C., R.M. BLENCH, D. BOURN, L. DRAKE, & P. STEVENSON. 1999. Reconciling interest among wildlife, livestock and people in eastern Africa: a sustainable livelihoods approach. *National Resource Perspective* 45: 1-8.

BRANSBY, D.I. & N.M. TAINTON. 1977. The Disc Pasture Meter: possible applications in grazing management. *Proceedings of the Grassland Society of Sout Africa* 12: 115-118.

BROCKETT, B.H. 1996. Calibrating a disc pasture meter to estimate grass fuel loads on the Zululand Coastal Plain. *South African Journal of Range and Forage Science* 13: 39-41.

BROOKES, P.A. 2004. *Modeling tree resources harvesting on communal land in the Maputala Centre of Endemism*. M.Sc. dissertation. University of Kent, Canterbury.

BRUTON, M.N. & K.H. COOPER (Eds). 1980. Studies on the ecology of Maputaland. Rhodes University & Wildlife Society of South Africa, Grahamstown & Durban.

BRUTON, M.N., M. SMITH, & R.H. TAYLOR. 1980. A brief history of human involvement in Maputaland. P 437. *In:* BRUTON, M.N. & K.H. COOPER (eds). *Studies on the Ecology of Maputaland.* Rhodes University & Wildlife Society of South Africa, South Africa.

BRYANT, A.T. 1929. *Olden Times in Zululand and Natal*. Longmans, Green and Co. London.

BRYANT, A.T. 1967. *The Zulu people as they were before the white man came*. First edit 1949. Shuter & Shooter, Pietermaritzburg.

CAMP, K.G.T & J.M.B. SMITH. 1997. Veld management planning in KwaZulu-Natal. Cedara Report No. N/A/97/5, Cedara.

CAMP, K.G.T. 1997. Veld burning in Kwazulu-Natal. Pp130-135. *In:* CAMP, K.G.T. & J.M.B. SMITH (eds). *Veld management planning in KwaZulu-Natal*. Cedara Report No. N/A/97/5, Cedara.

CAMPFIRE. 1990. *People, Wildlife and Natural Resources*. The CAMPFIRE Approach to Rural Development in Zimbabawe. The Zimbabwe Trust, Harare.

CASTLE, M.E. 1976. A simple disc instrument for estimating herbage yield. *Journal of the British Grassland Society* 31: 37-40.

CHENEY, C. 2005. *Managing game farms for bowhunting*. Eagle's Wing, South Africa. (PC CD-ROM).

CHILD, B. 1991. "The Beitbridge CAMPFIRE programme: a model for decentralized rural development". *In:* CHILD, B. & J.H. PETERSON (jr.) (eds). *CAMPFIRE in Rural Development: The Beitbridge Experience.* Branch of Terrestrial Ecology, Department of National Parks and Wildlife Management of Zimbabwe, Harare.

COERTZE, R.D. 1978. Teorie en navorsing. *South African Journal of Ethnology* 1(2): 9-20.

COERTZE, R.D. 1986. Livestock in the Social and Cultural Life of African Communities. *South African Journal of Ethnology* 9(3): 129-135

CONLONG, D.E. 1986. *An ecological study of the grasslands of the Eastern Shores of Lake St Lucia, Zululand*. MSc. Dissertation, University of Natal, Pietermaritzburg.

CONROY, A.M. 2005. The springbok: Legislation. Pp 214-225. *In:* BOTHMA, J. DU P. & N. VAN ROOYEN. (eds). *Intensive wildlife production in Southern Africa.* Van Schaik, Pretoria.

COX, C.B. & P.D. MOORE. 1994. *Biogeography: an ecological and evolutionary approach.* 5th edition. Oxford: Blackwell Scientific Publishing.

DANCKWERTS, J.E. 1989. Management of veld types: Sweet grassveld. Pp. 140–149. *In:* DANCKWERTS, J.E & W.R.E. TEAGUE. *Veld management in the Eastern Cape.* Pasture Research Section, Departtment of Agriculture & Water Supply, Eastern Cape Region, Stutterheim.

DANCKWERTS, J.E. & W.R.E TEAGUE. 1989. *Veld management in the Eastern Cape.* Pasture Research Section, Departtment of Agriculture & Water Supply, Eastern Cape Region, Stutterheim.

DANCKWERTS, J.E. & W.S.W. TROLLOPE. 1980. Assessment of the Disc Pasture Meter on natural veld in the False Thornveld of the Eastern Province. *Proceedings of the Grassland Society of South Africa* 15: 47-52.

DE BRUYN, T. D. & P.F. SCOGINGS. 1998. Communal rangelands in Southern Africa: a synthesis of knowledge. Proceedings of a symposium on policy-making for the sustainable use of Southern African communal rangelands. Pp 280-291. *In.* DE BRUYN, T.D. & P.F. SCOGINGS (eds). Department of Livestock & Pasture Science, University of Fort Hare, Alice.

DEKKER, B. 1997. Calculating stocking rates for game ranches: substitution ratios for use in the Mopani Veld. *African Journal of Range & Forage Science* 14(2): 62-67

DEKKER, B., N. VAN ROOYEN & J. DU P. BOTHMA. 1996. Habitat partitioning by ungulates on a game ranch in the Mopani Veld. *South African Journal of Wildlife Research* 26: 117-122.

DHONDT, A.A. 1988. Carrying capacity: a confusing concept. *Acta Oecologica-Oecologia generalis* 9: 337-346.

DU PLESSIS, W.P. 1992. *The development of techniques for the assessment of range condition in the Etosha National Park.* M.Sc. dissertation. University of Pretoria, Pretoria.

DU PLESSIS, W.P. 1997. Refinement to the burning strategy in the Etosha National Park, Namibia. *Koedoe* 40(1): 63-76.

DU TOIT, J.G. 1996. Game fences-electric fences. Pp. 91-94. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management.* Third edition. Van Schaik, Pretoria.

DU TOIT, J.G. 2002. Preventative disease management. Pp. 313-317. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management.* Fourth edition. Van Schaik, Pretoria.

DU TOIT, J.G. & J. VAN ROOYEN. 1996. The design and location of waterholes. Pp. 99-108. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management.* Third edition. Van Schaik, Pretoria.

EAST OF SCOTLAND COLLEGE OF AGRICULTURE (ESCA). 1973. Animal husbanding, advisory and development Department. *The East of Scotland College of Agriculture bulletin* (ESCA) Number 6.

EASTON, J. 2004. *Hunting for conservation targets: designing a community conservation area network for Maputaland, South Africa.* M.Sc. Dissertation. University of Kent, Canterbury.

EBEDES, H. 2000. Wildhokke en wildkampe. Pp. 121-132. *In:* BOTHMA, J. DU P. (ed.). *Wildplaasbestuur.* Derde uitgawe. Van Schaik, Pretoria.

EDMONSON, A.J., I.J. LEAN, L.D. WEAVER, T. FARVER, & G. WEBSTER. 1989. A body condition scoring chart for Holstein dairy cows. *Journal of Dairy Science* 72: 68-78.

EDWARDS, P.J. 1981. Principles of grassland management: grazing management. Pp. 323-354. *In*: TAINTON, N.M (ed.). *Veld and pasture management in South Africa*. Shuter & Shooter, Pietermaritzburg.

EDWARDS, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14: 705-712.

ELS, H. 1996. *Die benutting van hernubare natuurlike hulpbronne by die Vanhlanganu-Mnisi van die Mhala-distrik.* D.Phil. Thesis. University of Pretoria, Pretoria.

ELS, H. & J. VAN DER WALT. 1996. Final Report: Anthropological component of the project on sustainable, and acceptable control of ticks and tick-born diseases of livestock in Zululand. University of Pretoria, Pretoria.

ELS, H. 2000. Maputaland Conservation-Based Community Development and Research Programme, praxis orientated programme in multi-institutional and multi-dicsiplinary research co-operation. Programme presentation and planning report. University of Pretoria, Pretoria.

ELS, H. 2002. The Tshanini Game Reserve: Manqakulani Ward of the Tembe Tribal Area, Ingwavuma District, Maputaland, Northern KwaZulu-Natal. Unpublished report. University of Pretoria, Pretoria.

ELS, H. & J. DU P. BOTHMA. 2000. Developing partnerships in a paradigm shift to achieve conservation reality in South Africa. *Koedoe* 43(1): 19-26.

ENPAT (ENVIRONMENTAL POTENTIAL ATLAS). 2001. National Geospatial (GIS) Dataset. Department of Environmental Affairs and Tourism and University of Pretoria, Pretoria.

ESTES, R.D. 1997. *The Behaviour Guide to African Mammals.* Russel Friedman Books, Halfway House.

EVERSON, C.S. & G.P.Y. CLARKE. 1987. A comparison of six methods of botanical analysis in the montane grasslands of Natal. *Vegetatio* 73: 47-51.

EVERSON, T.M., G.P.Y. CLARKE & C.S. EVERSON. 1990. Precision in monitoring plant species composition in montane grasslands. *Vegetatio* 88:135-141.

EVERSON, T.M. & G.P. HATCH. 1999. Managing veld (rangeland) in the communal areas of southern Africa. Pp. 381-388. In: N.M. Tainton (ed.). *Veld Management in South Africa.* University of Natal Press, Pietermaritzburg.

FABRICIUS, C., E. KOCH & H. MAGOME. 2001. *Community wildlife management in southern Africa: Challenging the assumptions of Eden.* Evaluating Eden Series No. 6: 1-51. Earthscan, London.

FRIEDEL, M.H. & K. SHAW. 1987. Evaluation of methods for monitoring sparse patterned vegetation in arid rangelands. I. Herbage. *Journal of Environment Management* 25: 297-308.

FRIEDMANN, Y. & B. DALY. (Eds). 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/ IUCN), Endangered Wildlife Trust. South Africa.

FURSTENBURG, D. 2002. Game production optimization within a new era: the essence, the principles and the pendulum to financial success. Pp. 146-154. *In:* PENZHORN, B. L. (ed). *Proceedings of a Symposium on Game Ranch Planning and Management.* The Wildlife Group, South African Veterinary Association, Onderstepoort.

FURSTENBURG, D. 2005a. The greater kudu. Pp.147-168. *In*: BOTHMA, J. DU P. & N. VAN ROOYEN (eds). *Intensive wildlife production in southern Africa.* Van Schaik Publishers, Pretoria.

FURSTENBURG, D. 2005b. The impala. Pp.187-202. *In:* BOTHMA, J. DU P. & N. VAN ROOYEN (eds). *Intensive wildlife* production *in southern Africa.* Van Schaik Publishers, Pretoria.

FURSTENBURG, D. 2005c. The steenbok. Pp.248-257. *In:* BOTHMA, J. DU P. & N. VAN ROOYEN (eds). *Intensive wildlife production in southern Africa.* Van Schaik Publishers, Pretoria.

FURSTENBURG, D. 2006. The Wildlife CD. Uitgawe 1.1. Wild & Jag/Game & Hunt, JLO Publishers, Lynnwood, Pretoria.

GAUGRIS, J.Y. 2004. *Sustainable utilization of plants in the Manqakulane Conservation Area, Maputaland, KwaZulu-Natal*. M.Sc. Dissertation. University of Pretoria, Pretoria.

GAUGRIS, J.Y., W.S. MATTHEWS, M.W. VAN ROOYEN & J. DU P. BOTHMA. 2004. The vegetation of the Tshanini Game Reserve and a comparison with equivalent units in the Tembe Elephant Park in Maputaland, South Africa. *Koedoe* 47(1): 9-29.

GIBBS-RUSSEL, G.E., L. WATSON, M. KOEKEMOER, L. SMOOK, N.P. BARKER, H.M. ANDERSON, M.J. DALWITZ. 1991. *Grasses of Southern Africa.* Memoirs of the Botanical Survey of Southern Africa No. 58. National Botanic Gardens/ Botanical Research Institute. South Africa.

GIBSON, C.C. & S.A. MARKS. 1995. Transforming rural hunters into conservationists: an assessment of community-based wildlife management programs in Africa. *World Development* 23(6): 941-957.

GILLEN, R.L. & E.L. SMITH. 1986. Evaluation of the dry-weight-rank method for determining species composition in tall grass prairie. *Journal of Environment Management* 39(3): 283-285.

GOODMAN, P.S., B. JAMES & L. CARLSILE. 2002. Wildlife utilization: its role in fostering biodiversity in KwaZulu-Natal. Pp. 21-32. *In:* PIERCE, S.M., R.M. COWLING, T. SANDWITH & N. MacKINNON (eds). *Mainstreaming Biodiversity in Development: Case Studies from South Africa.* The Worl Bank, Washington D.C.

GRANGER, J.E. 1998. Subhumid Lowveld Bushveld. Pp. 29-30. *In:* LOW, A.B. & A.G. REBELO (eds). *Vegetation of South Africa, Lesotho and Swaziland.* Department of. Environmental Affairs and Tourism, Pretoria.

GRANGER, J.E, G. BREDENKAMP & N. VAN ROOYEN. 1998. Coastal Bushveld-Grassland. P 30. *In:* LOW, A.B. & A.G. REBELO (eds). *Vegetation of South Africa, Lesotho and Swaziland* Department of Environmental Affairs and Tourism, Pretoria.

GROSSMAN, D., P.I. HOLDEN & R.F.H COLLINSON. 1999. Veld management on the game ranch. Pp. 261-279. *In:* TAINTON, N.M. (ed.). *Veld Management in South Africa.* University of Natal Press, Pietermaritzburg.

HALE, W.G., J.P. MORGHAN & V.A. SAUNDERS. 1995. *Collins Dictionary of Biology*. Second Edition. Harper Collins, London.

HANEKOM, C.C. 1998a. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 1999b. *Sileza Nature Reserve veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 1999a. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2000. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2001a. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2001b. *The Prioritised Control of Alien Invader Plant Species in the Ndumo Game Reserve, Maputaland*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2002a. *Sileza Nature Reserve veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2002b. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2003a. *Sileza Nature Reserve veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2003b. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2004a. *Sileza Nature Reserve veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HANEKOM, C.C. 2004b. *Tembe Elephant Park veld evaluation*. Unpublished Internal Report, Ezemvelo KwaZulu-Natal, Pietermaritzburg.

HARDY, M.B. & M.T. MENTIS. 1985. The relative efficiency of three methods of estimating herbage mass in veld. *Journal of the Grassland Society of South Africa.* 2: 35-38.

HARDY, M.B., C.R. HURT & O.J.H. BOSCH. 1999. Veld Condition assessments: Grassveld. Pp. 195-207. *In:* TIANTON, N.M. (ed.). *Veld Management in South African*. University of Natal Press, Pietermaritzburg.

HELM, C.V. 2006. *Ecological separation of the black and blue wildebeest on Ezemvelo Nature Reserve in the highveld grasslands of South Africa*. M.Sc. Dissertation. University of Pretoria, Pretoria.

HERSKOVITS, M.J. 1926. The Cattle Complex in East Africa. Pp230-272. *In:* LOWIE, R.H. (ed). *American Anthropologist*. Volume 28. Kraus Reprint Corporation, New York 17, N.Y.

HIN, C.J. 2000. *A natural resource inventory of Sango Ranch, Save Valley Conservancy, Zimbabwe*. M.Sc. Dissertation. University of Pretoria, Pretoria.

HUGO, M.L. & P.K. BEWSHER. 1995. Trails. Pp. 35-40. *In:* HATTING, P.S. & S. SCHINDLER (eds). *Conference on Eco- and Farm Tourism*. Centre of Ecotourism, Pretoria.

HULME, D. & M. MURPHREE. 2001. Community conservation in Africa: An introduction. Pp 1-8. *In:* HULME, D. & M. MURPHREE (eds). *African wildlife and livelihoods: The promise and performance of community conservation.* Woolnough, Irthlingborough.

HURT, C.R. & M.B. BOSCH. 1991. A comparison of some range condition assessments techniques used in southern African grasslands. *Journal of the Grassland Society of South Africa* 8: 131-137.

KINGDON, J. 1997. *The Kingdon Field Guide to African Mammals.* Academic Press, San Diego.

KISS, A. (ed.). 1990. *Living with Wildlife: Wildlife Resource Management with Local Participation in Africa*. World Bank Technical Paper Number 130. The Wildlife Society, Washington.

KLOPPERS, R. (ed.). 2005. *Conservation without boundaries: case studies from the Lubombo TFCA. A collection of papers by various authors researching the need for, and posing solutions on how to form partnerships between formal conservation and local communities within South Africa and across our borders.* Department of Environmental Affairs and Tourism Republic of South Africa and Ezemvelo KwaZulu-Natal Wildlife, Conservation, Partnerships & Ecotourism.

KRIGE, E.J. 1981. *The Social System of the Zulus*. Eighth print; first print 1950. KwaZulu. Doctoral dissertation. Vista University, Pretoria.

LOW, A.B. & A.G. REBELO. 1998. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

LUBBE, R.A. 1996. *Vegetation and flora of the Kosi Bay Coastal Forest Reserve in Maputaland, northern KwaZulu-Natal, South Africa*. M.Sc. Dissertation. University of Pretoria, Pretoria.

LUGG, H.C. 1964. "Agricultural Ceremonies in Natal and Zululand". *Bantu Studies*. Shuter & Shooter, Pietermaritzburg.

MATTHEWS, W.S. 1990. *Grazing Capacity Determining Routine, based on Quattro Pro*. Unpublished manuscript, Ezemvelo KwaZulu-Natal Wildlife, Tembe Elephant Park.

MATTHEWS, W.S. 1995. *The vegetation of the Sileza Nature Reserve and surrounding community areas, in Maputaland, Northern KwaZulu-Natal*. Unpublished internal report.

MATTHEWS, W.S., A.E. VAN WYK, & N. VAN ROOYEN. 1999. Vegetation of the Sileza Nature Reserve and neighbouring areas, South Africa. And its importance in the conserving the woody grasslands of the Maputalnd Centre of Endemism. *Bothalia* 29: 151-167.

MATTHEWS, W.S., A.E. VAN WYK, N. VAN ROOYEN & G.A. BOTHA. 2001. Vegetation of the Tembe Elephant Park, Maputaland, South Africa. *South African Journal of Botany* 67: 573-594.

MAUD, R.R. 1980. The climate and geology of Maputaland. Pp1-7. *In:* BRUTON, M.N. & K.H. COOPER (eds). *Study on the Ecology of Maputaland*. Rhodes University and Wildlife Society of South Africa, Grahamstown and Durban.

McKENZIE, B. 1998. Sand Forest. Pp 13. *In:* LOW, A.B. & A.G. REBELO (eds). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

MEISSNER, H.H. 1982. *Vervangingswaardes van verskillende klasse van plaasdiere en wild in terme van 'n biologies-gedefinieerde grootvee-eenheid*. Boerdery in Suid-Afrika; Vleisbeeste C.3. Department of Agriculture, Pretoria.

MEISSNER, H.H. 1999. Nutrient supplementation of the grazing animal. Pp. 323-354. *In:* TAINTON, N.M. (ed.). *Veld management in South Africa*. University of Natal Press, Pietermaritzburg.

MELTZER, D.G.A. 1993. Diseases common to wildlife and domestic animal populations. Pp. 300-305. *In:* MAREE, C. & N.H. CASEY (eds). *Livestock production systems*. Agri-Development Foundation, Brooklyn, Pretoria.

MENTIS, M.T. 1981. Evaluation of the wheel-point and step-point methods of range condition assessment. *Proceedings of the Grassland Society of South Africa* 16: 89-94.

MILLS, G. & L. HES. 1997. *The Complete book of Southern African Mammals.* Struik Winchester, Cape Town.

MILTON, S.J. 2000. Community-based conservation: exploring positive feedback between economic development and conservation. *South African Journal of Science* 96(3).

MÖNNIG, H.O. & F.J. VELDMAN. 1989. *Handboek oor veesiektes.* Tafelberg, Kaapstad

MOLL, E.J. 1977. The vegetation of Maputaland: a preliminary report of the plant communities and their future conservation status. *Trees in South Africa* 29(4): 31-59.

MOLL, E.J. 1980. Terrestrial plant ecology. Pp 52-68. *In:* BRUTON, M.N & K.H. COOPER (eds). *Studies on the Ecology of Maputaland*. Rhodes University & Wildlife Society of South Africa, Grahamstown & Durban.

MOLL, E.J. & F. WHITE. 1978. The Indian Coastal Belt. Pp. 575-598. *In:* WERGER, M.J.A. (ed.). *Biogeoraphy and Ecology of South Africa*. The Hague, Junk.

MOUTON, J. & H.C. MARAIS. 1989. *Metodologie van die geesteswetenskappe: Basiese begrippe*. Pp303. Human Sciences Research Council. Pretoria.

MUCINA, L. & M.C. RUTHERFORD (eds). 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

NOVELLIE, P. & G. STRYDOM. 1987. Monitoring the response of vegetation to use by large herbivores: an assessment of some techniques. *South African Journal of Wildlife Research* 17(4): 109-117.

NYEMBEZI, S. & O.E.H. NXUMALO. 1966. *Inqolobane Yesizwe.* Shuter & Shooter, *Oecologica-Oecologia Generalis* 9: 337-346.

OBEREM, P.T. & J. SCHRÖDER. 1993. Ecto- and endoparasites. Pp. 334-360. *In:* MAREE, C. & N.H. CASEY (eds). *Livestock production systems.* Agri-Development Foundation, Brooklyn, Pretoria.

O'CONNOR, T.G. 1994. Influence of rainfall and grazing on the compositional change of the herbaceous layer of a sandveld savanna. *Journal of the Grassland Society of South Africa* 8: 103-109.

PEEL, M.S.J., D. GROSSMAN & N. VAN ROOYEN. 1991. Determinants of herbaceous plant species composition on a number of ranches in the north-western Transvaal. *Journal of the Grassland Society of southern Africa* 8(3): 99-102.

PEEL, M., J.C. PAUW & D.D. SNYMAN. 1994. The concept of grazer and browser animal units for African savanna areas. *Bulletin of the Grassland Society of southern African* 5: 61.

PFITZER, S. & I. COLENBRANDER. 2005. The duikers. Pp. 227-247. *In:* BOTHMA, J. DU P. & N. VAN ROOYEN (Eds). *Intensive wildlife production in southern Africa.* Van Schaik Publishers, Pretoria.

PFITZER, S. & H. KOHRS. 2005. The nyala. Pp.169-186. *In:* BOTHMA, J. du P. & N. VAN ROOYEN (Eds). *Intensive wildlife production in southern Africa.* Van Schaik Publishers, Hatfield, Pretoria.

PIMBERT, M.P. & J.N. PRETTY. 1997. Diversity and sustainability in community conservation. Pp. 9-12. Paper for the UNESCO-IIPA regional workshop on Community-based Conservation. India.

RAUTENBACH, I.L., J.D. SKINNER & J.A.J. NEL. 1980. The Past and present Status of the mammals of Maputaland. Pp. 322-345. *In:* BRUTON, M.N. & K.H. COOPER (Eds). *Studies on the Ecology of Maputaland* Rhodes University, Grahamstown and Natal Branch of the Wildlife Society of Southern Africa, Durban.

ROTHAUG COLLABORATIVE & MASEKO HLONGWA ASSOCIATES. 2002. Umkhayakude District Municipality Integrated Development Plan. The Independent Development Trust. Glenwood Office Park, Pretoria.

SCHMIDT, A.G., G.K. THERON & W. VAN HOVEN. 1995. A comparison of some methods used to estimate the grazing capacity of a game ranch in the Northern Province, South Africa. *Koedoe* 38 (2): 123-128.

SCHMIDT, A.G. & D.D. SNYMAN. 2002. Nutritional and mineral deficiencies, and supplementary feeding. Pp. 267-279. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

SCHULTZE, R.E. 1982. Agrohydrology and agroclimatology of Natal. Agricultural catchments Research Unit. Report 14**.** University of Natal, Pietermaritzburg, South Africa.

SKINNER, J.D. & C.T. CHIMIMBA. 2005. *The Mammals of the Southern African Subregion.* 3rd edition. University of Cambridge, Cambridge.

SMEDLEY, L.N. & J.L. RIBEIRO-TôRRES. 1979. *Man and the Pongola floodplain: a preliminary study.* Report Number S-62. South African Human Science Council, Pretoria.

SMIT, G.N. 1996. BECVOL: *Biomass Estimates from Canopy Volume (Version 2)-user's guide*. Unpublished manual. University of the Free State, Bloemfontein.

SNYMAN, D.D. 1991. *Drakragnorme vir wildsplase in die mopaniveld, noord van die Soutpansberg*. Research Centre for Plant Production, Department of Agriculture Development, Government Printer, Pretoria.

SNYMAN, D.D., D. GROSSMAN & N.F.G. RETHMAN. 1990. Tekortkominge van die naaste plantmetode en Dyksterhuis-verwante klassifikasie om range toestand te bepaal. *Journal of the Grassland Society of South Africa* 7(4): 273-276.

SOIL CLASSIFICATION WORKING GROUP. 1991. Soil Classification. A Taxonomic system for South Africa. Memoirs on the Agricultural Natural Resources of South Africa 15. South Africa. Pp 217-242. University of Natal Press, Pietermaritzburg.

SOUTH AFRICA. 2006. *Agricultural Natural Resources Atlas* – geospatial (GIS) dataset. Agricultural Research Council (ARC) – Institute for Soil, Climate and Water, Pretoria.

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY (SACS), 1980. Stratigraphy of South Africa. Part 1 (Comp. L.E. Kent). Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia, and the Republics of Bophuthatswana, Transkei and Venda. *Handbook of the Geological Survey of South Africa* 8:569-573. Southern Africa: a review with emphasis on succulents. UMDA.

SRTYDOM, S. 2005. Bosluisbeheer in wild 'n noodsaaklikheid. *Game and Hunt* 11(5): 54-55.

STUART-HILL, G.C. 1989. Some problems with using proportional species composition. Pp. 92-95. *In*: DANCKWERTS, J.E. & W.R.TEAGUE (eds). *Range management in the eastern Cape.* Pasture Research Section, Department of Agriculture & Water Supply, Eastern Cape Region.

SWANEPOEL, F., A. STROEBEL, A. OTTERMAN, D.R. WEEKS & C. TURNER. 2000. *Limpopo Basin Study-Learning To Live With Drought.* Participatory Rural Appraisal in Nebo and Makuya, Northern Province, South Africa. Report for the FAO-SAFR, Harare, Zimbabwe.

SWAN, G.P., D.J. BOTES & P.L. SMIT. 2000. *Hunting Africa: a practical guide.* J.L van Schaik Publishers, Pretoria.

TAINTON, N.M. 1999. Veld condition assessment. Pp. 194-195. *In:* TIANTON, N.M. (ed.). *Veld management in South Africa.* University of Natal Press, Pietermaritzburg.

TARR, J.A., M.W. VAN ROOYEN, & J. DU P. BOTHMA. 2004. The response of *Phragmites australis* to harvesting pressure in the Muzi Swamp of the Tempe Elephant Park, South Africa. *Land Degradation and Development* 15: 487 – 497.

TAPSON, D.R. 1990. *A Socio-economic Analysis of Small-Holder Cattle Producers in KwaZulu.* Doctoral thesis. Vista University, Pretoria.

TAPSON, D.R. & C.J. ROSE. 1984. *An investigation into the KwaZulu cattle industry.* Agricultural and Rural Development Research Institute. University of Fort Hare. Number 2(84).

THOMSON, R. 1992. *The Wildlife Game.* The Nyala Wildlife Publication Trust, Westville.

THRASH, I. 1993. *Implications of providing water for indigenous large herbivores in the Transvaal Lowveld*. M.Sc. Dissertation, University of Pretoria, Pretoria.

TROLLOPE, W.S.W., B.K. CLARK & L.A. TROLLOPE. Undated. *The Disc Pasture Meter*. The University of Fort Hare, Alice.

TROLLOPPE, W.S.W. 1980. Controlling bush encroachment with fire in the savanna areas of South Africa. *Proceedings of the Grassland Society of South Africa* 15: 173-177.

TROLLOPE, W.S.W. 1989. Veld burning as a management practice in livestock production. Pp. 67-73. *In:* DANCKWERTS, J.E. & W.R. TEAGUE (eds). *Veld management in the Eastern Cape*. Eastern Cape: Pasture Research Section. Government Printer, Pretoria.

TROLLOPE, W.S.W. 1990. Development of a technique for assessing range condition in the Kruger National Park using key grass species. *Journal of the Grassland Society of South Africa* 7*:* 46-51.

TROLLOPE, W.S.W. 1999. Fire behaviour. Pp. 218-242. *In:* TAINTON, N.M. (ed.). *Veld management in South Africa.* University of Natal Press, Pietermaritzburg.

TROLLOPE, W.S.W. & A.L.F. POTGIETER. 1985. Fire behaviour in the Kruger National Park. *Proceedings of the Grassland Society of South Africa* 2: 17-22.

TROLLOPE, W.S.W. & A.L.F. POTGIETER. 1986. Estimating grass fuel loads with a disc pasture meter in the Kruger National Park. *Proceedings of the Grassland Society of South Africa* 3: 148-152.

TROLLOPE, W.S.W., A.L.F. POTGIETER & N. ZIMBATIS. 1989. Assessing range condition in the Kruger National Park using key grass species. *Koedoe* 32 (1): 67-75.

TROLLOPE, W.S.W., L.A. TROLLOPE & O.J.H. BOSCH. 1990. Veld and pasture management terminology in southern Africa. *Journal of the Grassland Society of South Africa* 7*:* 52–61.

TURNER, J.R. 1990. *The development of stocking rate models for three veld types in Natal*. PhD. thesis, University of Natal, Pietermaritzburg, South Africa.

VAN DER MERWE, B.J. & P.G. STEWART. 1995. Condition scoring of dairy cows. Pp 37-40. *In: Dairying in KwaZulu-Natal.* Kwazulu-Natal Department of Agriculture on behalf of the Co-ordinated Extensive Committee of Natal-Natal, Pietermaritzburg.

VAN EEDEN, D.G. 2001. *Planning of the Tshanini Game Reserve*. Pp 7-17. Unpublished Report.

VAN EEDEN, D.G. 2005. *Aspects of the ecology and conservation status of selected wildlife in and around Tembe elephant Park, KwaZulu-Natal, South Africa*. M.Sc. Dissertation. University of Pretoria, Pretoria.

VAN HOVEN, W. 1996. The natural diet of game. Pp. 176-191. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Van Schaik, Pretoria.

VAN HOVEN, W. 2002. Nutrition. Pp 255-261. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management.* Van Schaik, Pretoria.

VAN OUDTSHOORN, F.P. 1994. *Gids tot grasse van Suid Afrika.* Briza Publikasies Bk., Pretoria.

VAN OUDTSHOORN, F.P. 1999. *A guide to grasses of southern Africa*. Briza Publikasies Bk., Pretoria.

VAN ROOYEN, N. 20002a. Veld management in the savannas. Pp. 571-617. *In:* BOTHMA, J DU P. (ed.). *Game Ranch Management.* Fourth edition. Van Schaik, Pretoria.

VAN ROOYEN, N. 2002b. Veld condition assessment and stocking a game ranch. Pp. 41-51. *In.* PENZHORN, B. L. (ed.). *Proceedings of a Symposium on Game Ranch Planning and Management*. The Wildlife Group, South African Veterinary Association, Onderstepoort.

VAN ROOYEN, N. 2003. Vegetation types and wildlife re-establishment in the Greater St Lucia Wetland Park. Draft. Ecotrust CC, Lynwood, Pretoria.

VAN ROOYEN, N., G. J BREDENKAMP & G. K. THERON. 1996. Veld management. Pp 539–572. *In:* BOTHMA, J DU P. (ed.). *Game Ranch Management.* J.L. van Schaik, Pretoria.

VAN ROOYEN, N., G.J. BREDENKAMP, G.K. THERON, J. DU P. BOTHMA, & E.A.N. LE RICHE. 1994. Vegetation gradients around artificial watering points in the Kalahari Gemsbok National Park. *Journal of Arid Environments* 26: 349-361.

VAN ROOYEN N., J.G. DU TOIT & J. VAN ROOYEN. 2000. Wildwerende omheinings-draadheinings. Pp. 74-85. *In:* BOTHMA, J DU P. (ed.). *Game Ranch Managemen.* Third edition. Van Schaik, Pretoria.

VAN WILGEN B.W. & R.J. SCHOLES. 1997. The vegetation and fire regimes of southern hemisphere Africa. Pp. 27-46. *In:* VAN WILGEN, B.W., M.O. ANDREAE, G.J. GOLDAMMER, & J.A. LINDSAY (eds). *Fire in southern African savannas: ecological and atmospheric perspectives.* Witwatersrand University Press, Johannesburg.

VAN WYK, A.E. 1994. Maputaland-Pondoland region. Pp. 227-235. *In:* DAVIS, S.D., V.H. HEYWOOD & A.C. HAMILTON (eds). *Centres of plant diversity: a guide and strategy for their conservation.* Oxford University Press, Oxford.

VAN WYK, A.E. 1996. Biodiversity of the Maputaland Centre. Pp. 198-207. In: VAN DER MAESEN, L.J.G., X.M. VAN DER BURGT & J.M. VAN MEDENBACH DE ROOY (eds). *The biodiversity of African Plants.* Kluwer Academic Publishers.

VAN WYK, A.E. & G.F. SMITH. 2001. Regions of floristic endemism in Southern Africa: a review with emphasis on succulents. Umdaus Press, Pretoria, South Africa.

VAN ZYL, J. & H.J. SATORIUS VON BACH. 2002. Basic principles of financial Management. Pp. 50-67. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

VAN ZYL, J. H.J. SATORIUS VON BACH & J. DU P. BOTHMA. 2002. Economic benefits of wildlife production. Pp. 67-74. *In:* BOTHMA, J. DU P. (ed.). *Game Ranch Management*. Fourth edition. Van Schaik, Pretoria.

VORSTER, M. 1982. Development of the ecological index method for assessing range condition in the Karoo. *Proceedings of the Grassland Society of Southern Africa* 17: 84-89.

WALKER, B.H. 1970. An evaluation of eight methods of botanical analysis on grasslands in Rhodesia. *Journal of Applied Ecology* 7: 403-416.

WATKEYS, M.K., T.R. MASON & P.S. GOODMAN. 1993. The role of geology in the development of Maputaland, South Africa. *Journal of African Earth Science* 16(2): 205-221.

YOUNG, E. 1992. *Game farming and wildlife management.* Eddie Young Publishers, Nylstroom.

ZIEGER, U. 1998. *Wildlife recommendations based on studies of population dynamics, parasites and diseases of game on the Mtendere Game Ranch, Zambia*. M.Sc. Dissertation, University of Pretoria, Pretoria.

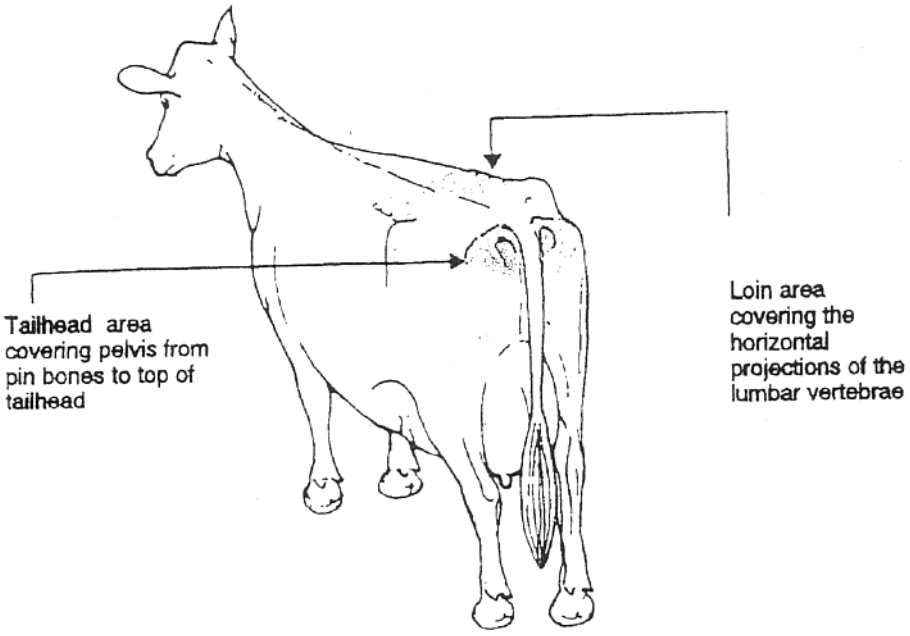
APPENDICES

Appendix 1: An ungulate checklist and animals that are categorized as grazing species for the Tshanini Community Conservation Area, in which the families and subfamilies are arranged alphabetically. Sources: Rautenbach *et al*. (1980), Estes (1997) and (Skinner & Chimimba 2005)

Animal	Family	Subfamily/Tribe	Genus	Species	Subspecies
Order Perissodactyla					
Burchell's zebra	Equidae	-	*Equus*	*burchellii*	
Order Artiodactyla					
Impala	Bovidae	Aepycerotini	*Aepyceros*	*melampus*	
Blue wildebeest	Bovidae	Alcelaphini	*Connochaetes*	*taurinus*	*taurinus*
Suni	Bovidae	Neotragini	*Neotragus*	*moschatus*	
Steenbok	Bovidae	Neotragini	*Raphicerus*	*campestris*	
Nyala	Bovidae	Tragelaphini	*Tragelaphus*	*angasii*	
Greater kudu	Bovidae	Tragelaphini	*Tragelaphus*	strepsiceros	
Grey duiker	Bovidae	Cephalophini	*Sylvicapra*	*grimmia*	
Red duiker	Bovidae	Cephalophini	*Cephalophus*	*natalensis*	
Reedbuck	Bovidae	Reduncini	*Redunca*	*arundinum*	
Giraffe	Giraffidae	Giraffe	*Giraffa*	*camelopardalis*	
Warthog	Suidae	Phacochoeinae	*Phacochoerus*	*africanus*	
Bushpig	Suidae	Suinae	*Potamochoerus*	*larvatus*	*nyasae*

Note: No classification at that particular level is indicated by a hyphen (-)

Appendix 2: The physical condition scoring region for cattle; focussing around the tailhead and lion area.



Appendix 3: The physical condition scoring chart for cattle as used to assist in data capturing of the physical condition of the cattle present at the different dipping tanks

***Isigotdi*/Ward:**	_____	**Date:**	_____
Diptank number:	_____	**Evaluators:**	_____
Locality:	_____	**Landtype:**	_____
Longitude:	_____		_____
Latitude:	_____		_____

Cows & Heifers

O	B	CF	H	C		0	1	2	3	4
					TOTAL					

O = Ox
B = Bull
CF = Calf
H = Heifer
C = Cow

Appendix 4: An open ended questionnaire which the author compiled to assist with the research theme of Phase 1, Chapter 3

Interviewers:_____

Time:_____

Homestead reference:_____

Date:_____

Number	**CATTLE:**
1	Does your family own cattle?
2	How many cattle do your family own?
3	To whom do the cattle belong?
4	Why do you keep cattle?
•	Bank "financial backdoor"?
•	Draught power?
•	Llobola?
•	Utilization (milk, meat)?
•	Other?
5	Do you eat the meat of cattle?
•	Yes?
•	No?
	How often do you eat meat of cattle?
•	Every day?
•	Once a week?
•	Once a month?
•	Once every six months?
•	Once a year?
6	Where do you get the meat of cattle?
•	I buy it at the tree butchery?

• I buy it at the Spar/Boxer/Butchery?
• I slaughter my own cattle?
• I get it from friends/family/for free?

7 What do you pay for a piece of meat as big as a man's hand?

8 What features are important for good cattle?

• Horns:
• Colour patterns (what are the colours and patterns, is any pattern more desirable?)
• Physical condition:

9 Do you select for these traits when breeding with cattle?

10 What strains or breeds of cattle do you own?

11 Are bulls selected for breeding?

12 How many bulls to a herd?

13 Are superfluous bulls castrated or killed?

14 Are cows sent to other people's bulls for service?

15 Is a fee asked?

16 Does it affect the ownership of the calf?

17 How is pregnancy detected in cows?

18 How are pregnant cows managed?

- Doctored?
- Treated with care?
- Isolated?
- Other?

19 Is the time of calving known or calculated?

20 Is assistance given during birth?

- How?

21 What is done in difficult cases/problems when calving?

22 Is assistance given by experts on such occasions?

- How?

23 Are cows doctored to make them conceptive/fertile?

- How?

24 What is done with barren cows?

- Sold?
- Doctored?
- Slaughtered?

25 What names are given for cows that have calved once, twice or three times?

- Once?
- Twice?
- Three times?

26 How are calves herded and are they kept separated from the rest of the herd?

27 How is a newborn calf cared for?

• Doctored?
• For what?
• With what?

GRAZING:

28 Where do your cattle graze in the:

• Summer?
• Winter?

29 Who looks after the cattle?

• Head?
• Spouse?
• Children?
• Other?

30 At what time in the day do you let your cattle out to graze?

31 At what time do they return from the grazing area?

32 Are you allowed to take your cattle to graze in other *izigodi*?

33 Do you have a specific place that you take your cattle to graze?

• Where?

34 How did you obtain access to the grazing area?

• Induna?
• Village committee?
• The traditional local council?

35 Who decides on the place for your cattle to graze?

• Head?
• Spouse?
• Children?
• Other?

36 What are the signs of good grazing?

37 Which grasses are good grazing?

38 Which plants make animals sick or thin?

DIPPING DATA:

39 Do your cattle get dipped?

• Once a weak?
• Twice a month?
• Once a month?
• Less often?

40 Where is this dipping site?

DISEASES:

41 What causes diseases?

42 Which types of diseases do you get here?

• Redwater (*umbendeni*)?
• Heartwater?
• Blackquarter (*unkonyana*)?
• Gall sickness (*inyongo*)?
• Liver fluke?
• Mastitis?
• Nagana (*unagane*)?
• Rabies?
• Stiff-sickness?
• Tapeworm?

43 What medicines do you use on sick animals and for what sickness?

• Hi-Tet?
• Teramycin?
• Pro-inject yellow?
• Volpazine?
• Debomex?
• Valbazin?
• Aloe leave extract?
• Other?

44 Do you think that the chemicals which they use in the dipping tank are good medicine?

45 Are the following good?

• Triatix?
• Grenade?
• EcoTraz 250?

GENERAL QUESTIONS:

45 Do you keep your cattle in a kraal at night?

46 Do your cattle get supplementary food?
Salt licks?
Crop residues?
Hay that has been cut for them in the dry season?
Other?

47 Do you think that your cattle are in a good physical condition?

48 Do you think that ticks and parasites kill the animals?

49 How many cattle did you lose last year?

50 What do you think caused the loss?

51 What do you prefer to eat, the meat of cattle or the meat of wild animals?

52 Do you burn the fields where your cattle graze?

53 Do you see yourself as a cattle farmer or just as a cattle owner?

54 Are you a member of the dipping committee?

55 Do you think the dipping committee is necessary?

56 Do you think that they are doing their job?

57 Do you get any help from the animal health technicians?

58 Who is your section head?

59 Who is your state veterinarian?

60 Who is your dip tank chairperson?

61 Who is your animal health technician?

62 Are your cattle marked by any means for identification purposes?

- Branding?
- Notches and slits?
- Other?

63 What names and praises are given to cattle? (Dirêtô, izibongo)

64 Are fees or costs involved to dip your cattle or to let them graze in your *isigodi?*

65 How many cattle did you own before they started dying?

66 What year did your cattle start dying?

67 How many calves were born last year?

68 Do you think that the foot-and-mouth disease fence is functional and necessary, does it serve its purpose and does it work by keeping the cattle from the northern and southern sections separated?

Appendix 5: List of grass species recorded for the Tembe Traditional Area. Sources: Gibbs Russel *et al.* (1991), Van Oudtshoorn (1994, 1999), Lubbe (1996), Camp & Smith (1997), Hardy *et al.* (1999) and Van Rooyen (2002a), Hanekom (2004a,b).

Grass taxa and ecological classes	Authors	English name	Afrikaans name
Ecological class 1 species:			
Cenchrus ciliaris	L.	Blue buffalo grass	Bloubuffelsgras
**Chloris gayana*	Kunth	Rhodes grass	Rhodesgras
Dactyloctenium australe	Steud.	L.M. grass/Natal crowfoot	L.M.-gras
Dactyloctenium giganteum	Fisher & Schweick.	Giant crowfoot	Reuse-hoenderspoor
Digitaria eriantha	Steud.	Common finger grass	Vingergras
Diheteropogon amplectens	(Nees) Clayton	Broad-leaf bluestem	Breeblaarblougras
Ischaemum fasciculatum	Brongn	Hippo grass	Rooivleigras
Eragrostis heteromera	Stapf	Bronze love grass	Rooikopergras
Eragrostis lappula	Nees		
Eragrostis superba	Peyr.	Sawtooth love grass	Weeluiseragrostis
Eustachys paspaloides	(Vahl) Lanza & Mattei	Red Rhodes grass/Fan grass	Bruin-hoenderspoor
Monocymbium ceresiiforme	(Nees) Stapf	Boat grass	Bootjiesgras
Leptochloa uniflora	A. Rich.		
Panicum coloratum var. *coloratum*	L.	White buffalo grass	Witbuffelsgras
Panicum deustum	Thunb.	Reed/Broad-leaved panicum	Breeblaarbuffelsgras
Panicum kalaharense	Mez.		
Panicum maximum	Jacq.	Guinea grass	

Grass taxa and ecological classes	Authors	English name	Afrikaans name
Panicum natalense	Hochst.	Natal panicum/buffalo grass	Suurbuffelsgras
Pennisetum sphacelatum	(Nees) Dur. & Schinz	False bristle grass	Bulgras
Schmidtia pappophoroides	Steud.	Sand quick	Kalahari sandkweek
Setaria sphacelata var. sphacelata	(Schumch.) Moss	Common bristle grass	Gewone mannagras
Sporobolus fimbriatus	(Trin.) Nees	Bushveld dropseed	Bosveldfynsaadgras
Sporobolus ioclados	(Trin.) Nees	Pan dropseed	Pan fynsaadgras
Sporobolus congoensis	Franch.		
Themeda triandra	Forssk.	Rooigras	Rooigras
Ecological class 2 species:			
Alloteropsis semialata subsp. eckloniana	(R.Br.) Hitchc.	Black-seed grass	Donkersaadgras
Andropogon chinensis	(Nees) Merr.	Hairy blue grass	Harige-blougras
Andropogon gayanus	Kunth	Rhodesian bluegrass	Blougras
Andropogon schirensis	A. Rich.	Stab grass	Tweevingergras/Gesteektegras
Cymbopogon excavatus	(Hochst.) Stapf ex Burtt Davy	Broad-leaved turpentine grass	Breeblaarterpentyngras
Cymbopogon plurinodis	(Stapf) Stapf ex Burtt Davy	Bitter turpentine grass	Smalblaarterpentyngras
Diheteropogon filifolius	(Nees) Clayton	Threaded-leaved andropogon	Smalblaarblougras
Hyparrhenia hirta	(L.) Stapf	Common thatching grass	Dektamboekiegras
Hyperthelia dissoluta	(Nees ex Steud.) Clayton	Yellow thatching grass	Geeltamboekiegras
Schizachyrium sanguineum	(Retz.) Alst.	Red autumn grass	Rooiherfsgras
Trachypogon spicatus	(L. f.) Kuntze	Giant spear grass	Reuse pylgras

Grass taxa and ecological classes	Author	English name	Afrikaans name
Triraphis schinzii	Hack.		
Tristachya leucothrix	Nees	Trident grass	Rooisaadgras
Urelytrum agropyroides	(Hack.) Hack.	Quinine grass	Varkstertgras
Ecological class 3 and 4 species:			
Bewsia biflora	(Hack.) Goossens	False love grass	Vals-eragrostis
Bothriochloa insculpta	(A. Rich.) A. Camus	Pinhole grass	Klosgras
Bothriochloa radicans	(Lehm.) A. Camus	Stinking grass	Stinkgras
Chloris virgata	Swartz	Feathered chloris	Klossiegras
Dactyloctenium geminatum	Hack.	Sign grass	Wysergras
Dacthyloctenium aegyptium	(L.) Willd.	Common crowfoot	Hoenderspoor
Elionurus muticus	(Spreng.) Kunth	Wire grass	Koperdraadgras
Eragrostis chloromelas	Steud.	Curly leaf	Krulblaar
Eragrostis ciliaris	(L.) R. Br.	Woolly love gras	Wollerige-eragrostis
Eragrostis curvula	(Schrad.) Nees	Weeping love gras	Oulandsgras
Eragrostis lehmanniana	Nees	Lehmann’s love grass	Knietjiesgras
**Eragrostis superba*	Peyr.	Sawtooth love gras	Weeluiseragrostis
Heteropogon contortus	(L.) Roem. & Schult.	Tanglehead	Assegaaigras
Loudetia simplex	(Nees) C.E. Hubb.	Common russet grass	Besemgras
Sporobolus africanus	(Poir.) Robyns & Tournay	Dropseed	Taaipol
Stipagrostis uniplumis var. *uniplumis*	(Licht.) De Winter	Silky bushman grass	Blinkaarboesmangras

Grass taxa and ecological classes	Author	English name	Afrikaans name
Tricholaena monachne	(Trin.) Stapf & C.E. Hubb.	Blue-seed grass	Blousaadgras
Urochloa mosambicensis	(Hack.) Dandy	Bushveld signal grass	Bosveldbeesgras
Ecological class 5 species:			
Andropogon eucomus	Nees	Snowflake grass	Kleinwitbaardgras
Aristida adscensionis	L.	Annual three-awn	Eenjarige steekgras
Aristida bipartite	(Nees) Trin. & Rupr.	Rolling grass	Grootrolgras
Aristida congesta subsp. barbicollis	Roem. & Schult. subsp. (Trin & Rupr.) De Winter	Spreading three-awn/prickle grass	Lossteekgras/Witsteekgras
Aristida congesta subsp. congesta	Roem. & Schult	Tassel three-awn	Katstertsteekgras
Aristida stipitata subsp. *graciliflora*	Hack. subsp. (Pilg.) Meld.	Long-awned three-awn	Langnaaldsteekgras
Aristida stipitata subsp. *stipitata*	Hack.	Long-awned three-awn	Langnaaldsteekgras
Cynodon dactylon	(L.) Pers.	Couch grass	Kweek
Eragrostis gummiflua	Nees	Gum grass	Gomgras
Melinis repens	(Willd.) Zizka	Natal red top	Natal-rooipluim
Sporobolus pyramidalis	Beauv.	Catstail dropseed	Katstert-fynsaadgras
Perotis patens	Gand.	Cat’s tail/Bottlebrush grass	Katstertgras
Pogonarthria squarrosa	(Roem. & Schult.) Pilg.	Herringbone grass	Sekelgras
Tragus berteronianus	Schult.	Common carrot-seed grass	Gewone wortelgras
Trichoneura grandiglumis	(Nees) Ekman	Small rolling grass	Klein rolgras

Appendix 6: Classification of recorded grass species into ecological status categories, and an indication of their grazing values on a scale of 0 (poor) to 10 (excellent) to determine a veld condition score or ecological index. Sources: (Camp 1997, Van Oudtshoorn 1999, Van Rooyen 2002a).

Grass taxa	Ecological Class	Old Categories	Grazing Value
Andropogon chinensis	Class 2	Increaser 1	7
Andropogon gayanus	Class 2	Increaser 1	7
Andropogon schirensis	Class 2	Decreaser, Increaser 1	7
Antephora pubescens	Class 1	Decreaser	10
Aristida adscensionis	Class 5	Increaser 2c	1
Aristida bipartita	Class 5	Increaser 2c	1
Aristida canescens	Class 5	Increaser 2c	1
Aristida congesta subsp. *barbicollis*	Class 5	Increaser 2c	1
Aristida congesta subsp. *congesta*	Class 5	Increaser 2c	1
Aristida diffusa	Class 5	Increaser 2c	1
Aristida stipitata subsp. *stipitata*	Class 5	Increaser 2c	1
Bewsia biflora	Class 3	Increaser 2a	4
Bothriochloa insculpta	Class 4	Increaser 2b	4
Bothriochloa radicans	Class 4	Increaser 2b	4
Brachiaria eruciformis	Class 5	Increaser 2c	1

Grass taxa	Ecological Class	Old Categories	Grazing Value
Brachiara serrata	Class 1	Decreaser	10
Brachiaria brizantha	Class 2	Increaser 1	7
Cenchrus ciliaris	Class 1	Decreaser	10
Chloris pycnothrix	Class 5	Increaser 2c	1
Chloris virgata	Class 4	Increaser 2b	4
Cymbopogon excavatus	Class 2	Increaser 1	7
Cymbopogon plurinodis	Class 2	Increaser 1	7
Cymbopogon validus	Class 2	Increaser 1	7
Cynodon dactylon	Class 5	Increaser 2c	1
Digitaria eriantha	Class 1	Decreaser	10
Digitaria longiflora	-		-
Digitaria monodactyla	Class 4	Increaser 2b	4
Digitaria sanguinalis	Class 5	Increaser 2c	1
*Diheteropogon amplectens**	Class 1	Decreaser	10
Diheteropogon filifolius	Class 4	Increaser 2b	4
Eleusine coracana	Class 5	Increaser 2c	1
Elionurus muticus	Class 4	Increaser 2b	4
Enneapogon scoparius	Class 4	Increaser 2b	4
Eragrostis aspera	Class 5	Increaser 2	1
Eragrostis chloromelas	Class 4	Increaser 2b	4
Eragrostis curvula	Class 4	Increaser 2b	4
Eragrostis gummiflua	Class 5	Increaser 2c	1

Grass taxa	Ecological Class	Old Categories	Grazing Value
Eragrostis inamoena	Class 3	Increaser 2a	4
Eragrostis lehmanniana	Class 3	Increaser 2a	4
Eragrostis nindensis	Class 4	Increaser 2b	4
Eragrostis plana	Class 4	Increaser 2b	4
Eragrostis pseudosclerantha	Class 3	Increaser 2a	4
Eragrostis racemosa	Class 4	Increaser 2b	4
Eragrostis rigidior	Class 5	Increaser 2c	1
Eragrostis superba	Class 4	Increaser 2b	4
Eustachys paspaloides	Class 1	Decreaser	10
Heteropogon contortus	Class 3	Increaser 2a	4
Hyparrhenia hirta	Class 2	Increaser 1	7
Hyparrhenia tamba	Class 2	Increaser 1	7
Hyperthelia dissoluta	Class 2	Increaser 1	7
Ischaemum fasciculatum	Class 2	Increaser 1	7
Loudetia simplex	Class 2	Increaser 1	7
Melinis nerviglume	Class 1	Decreaser	10
Melinis repens	Class 5	Increaser 2c	1
Panicum ecklonii	Class 1	Decreaser	10
Panicum kalaharense	Class 1	Decreaser	10
Panicum maximum	Class 1	Decreaser	10
Panicum natalense	Class 1	Decreaser	10
Pennisetum clandestinum		Invader-Exotic	

Grass taxa	Ecological Class	Old Categories	Grazing Value
Pennisetum sphacelatum	Class 1	Decreaser	10
Perotis patens	Class 5	Increaser 2c	1
Pogonarthria squarrosa	Class 5	Increaser 2c	1
Rendlia altera	Class 5	Increaser 2c	1
Schizachyrium sanguineum	Class 2	Increaser 1	7
Schmidtia pappophoroides	Class 1	Decreaser	10
Setaria sphacelata var. *sericea*	Class 1	Decreaser	10
Setaria sphacelata var. *sphacelata*	Class 1	Decreaser	10
Setaria sphacelata var. *torta*	Class 4	Increaser 2b	4
Sporobolus africanus	Class 4	Increaser 2b	4
Sporobolus fimbriatus	Class 1	Decreaser	10
Sporobolus nitens	Class 5	Increaser 2c	1
Stipagrostis uniplumis var. uniplumis	Class 3	Increaser 2a	4
Themeda triandra	Class 1	Decreaser	10
Trachypogon spicatus	Class 2	Increaser 1	7
Tragus berteronianus	Class 5	Increaser 2c	1
Tragus racemosus	Class 5	Increaser 2c	1
Tricholaena monachne	Class 4	Increaser 2b	4
Trichoneura grandiglumis	Class 5	Increaser 2c	1
Tristachya leucothrix	Class 2	Increaser 1	7
Tristachya rehmannii	Class 4	Increaser 2b	4
Urelytrum agropyroides	Class 2	Increaser 1	7
Urochloa mosambicensis	Class 4	Increaser 2b	4

Appendix 7: Alien Plant Species – Tembe Elephant Park, Maputaland

Plant Species	**Common Name**
Azolla filiculoides	red water fern
Bidens pilosa	blackjack
Bougainvillea sp.	bougainvillea
Caesalpinia decapetala	Mauritius thorn
Carica papaja	paw-paw
Catharanthus roseus	periwinkle / graveyard flower
Chromolaena odorata	triffid weed
Cirsium vulgare	Scotch thistle
Commelina benghalensis	Bengal wandering Jew
Flaveria bidentis	smelter's bush
Ipomoea congesta	morning glory
Melia azederach	syringe
Opuntia ficus-indica	sweet prickly pear
Parthenium hysterophorus	parthenium, congress grass
Passiflora sp.	granadilla sp.
Pereskia aculeata	Barbados gooseberry
Physalis angulata	wild gooseberry
Portulacaria afra	spekboom
Ricinus communis	castor oil plant
Rubus cuneifolius	american bramble
Senna didymobotrya	peanut-butter cassia