CHAPTER 1

INTRODUCTION

The biodiversity and conservation debate in Maputaland

The Maputaland region represents *ca*. 17 000 km^2 shared by South Africa (*ca*. 9 500 km^2), Swaziland and Mozambique and has been described as a Centre of Plant Endemism (Van Wyk 1996; Van Wyk and Smith 2001), and is currently included in the Maputaland – Pondoland – Albany hotspot of biodiversity (Matthews 2006; Smith *et al.* 2006). Maputaland harbours a wide range of endemic or near endemic plant, mammal, insect, reptile, and bird species (Matthews 2006). The diversity of Maputaland is thought to stem from a great variety of habitats, but also from its geographical position at the extreme of the tropical zone and with a considerable influence from the temperate zone (Matthews 2006). It is hypothesized that biological evolution, including speciation, is particularly active among the plant and animals of the Maputaland Centre, especially due to its recent geological formation, which favour the appearance of neo-endemic (recently formed) species (Van Wyk and Smith 2001; Matthews 2006). Approximately 28% of the South African part of Maputaland is under formal conservation and the remainder of the land is under tribal landownership (Smith *et al.* 2006).

The region is dominated by a finely interwoven mesh of forest-like woodlands (Van Rensburg *et al.* 1999) of varying densities and the intriguing Sand Forest, interspersed with swamps and grasslands including wooded grasslands (Matthews 2006). The Sand Forest and wooded grasslands are considered the two most unique vegetation types of this region and in the case of the Sand Forest it also hosts a great portion of Maputaland's biodiversity (Matthews 2006). Wooded grasslands are characterised by an extreme abundance of dwarf shrubs growing from perennial underground stems of exceptional proportions. This vegetation type has also been called an underground forest because of its underground biomass (Matthews 2006). The Sand Forest is considered an anomalous vegetation type for such a nutrient poor, acidic soil and a mean rainfall well below that observed for forests of similar richness and growth form (Kirkwood and Midgley 1999; Lewis and Mander 2000; Matthews 2006; Mucina and Rutherford 2006). A wealth of herbivore mammals, with important tourism appeal, roams these landscapes within the parks and reserves but they have been nearly completely extirpated from non-conserved areas (Matthews *et al.* 2001; Gaugris *et al.* 2004; Morley 2005; van Eeden 2005; Guldemond and Van Aarde In Press).

Three debates currently dominate biodiversity conservation in Maputaland. The first debate is within conserved areas, where the size of animal populations have increased as a consequence of successful conservation efforts (Guldemond and Van Aarde In Press). These populations are believed to have reached densities that are incompatible with biodiversity conservation, especially in the case of African elephant *Loxodonta africana* (Blumenbach 1797) impact on the Sand Forest vegetation (Matthews 2006; Botes *et al.* 2006; Guldemond and Van Aarde In Press). Ideally, the management of reserves should ensure that their natural resources and dynamics are retained (Margules and Pressey 2000) and there is now a concern that natural dynamics could be perturbed within formally conserved areas. Only two studies (Guldemond 2006; Matthews and Page In Prep) have quantified the potential impact of mammals on vegetation in conserved areas of the region. Both concentrated on the African elephant and did not evaluate the contribution of other mammals that have also increased in density (Matthews 2000; Matthews 2006). Moreover, the results are either already outdated (Matthews and Page In Prep) or are too superficial to describe plant species responses to increased animal densities and only provide trends at community level (Guldemond 2006).

The second debate is that Sand Forest represents a forest in stasis, which maintains itself under current climatic conditions that are not optimal. The proponents of this hypothesis argue that Sand Forest is not resilient and is most likely to disappear and become dense woodland if it is cleared (Van Rensburg *et al.* 1999; Matthews 2006). This argument is challenged by the fact that surveys of the Sand Forest at present are preliminary (see Everard *et al.* 1995; Matthews *et al.* 1999; Matthews *et al.* 2001) and that studies conducted outside conserved area where human utilisation was low showed a dynamic system with potential transitions between the two described Sand Forest units (Gaugris *et al.* 2004; Gaugris and van Rooyen In Press).

The third debate developed further in the next section is about the use of vegetation by people outside protected areas. The level of utilisation is variable. On the one hand, cases have been documented where utilisation is so low that these areas were possibly in a better state than formally protected ones (Brookes 2004; Botes *et al.* 2006; Gaugris *et al.* 2007). However, this is in stark contrast to other studies that document intensive use and loss of natural landscapes to an ever increasing human population and a modernising society (Lewis and Mander 2000; Peteers 2005). The problem to solve for Maputaland is therefore defining what is happening in terms of vegetation utilisation in order to understand why such contradictory results are documented.

The rural people of Maputaland and the biodiversity conservation question

African rural people rely heavily on "free" resources found in woodlands and forests to live (Shackleton *et al.* 2007). Two particularly important aspects are the gathering of firewood to cook food and heat the house during cold seasons (Shackleton 1993), and the harvesting of poles and laths for the construction of houses (Gaugris *et al.* 2007). In terms of energy, this reliance on natural resources continues even when a modern source of energy has been provided. Interestingly, the energy provided through an electrification of rural households programme in South Africa did not lead to a reduction of firewood utilisation, but the energy was used for new purposes (Madubansi and Shackleton 2006; Madubansi and Shackleton 2007). In the Lowveld region of South Africa it was established that unless the South African government were to change their policy and provide more free electricity, firewood utilisation was likely to remain as widely utilised as before (Madubansi and Shackleton 2007). The likelihood of a similar situation occurring in Maputaland where the electrification programme has yet to reach the most remote parts of the subregion appears high, and it must be expected that firewood utilisation in rural households will remain at current level.

In terms of household construction in rural Maputaland, two building types seem to have become popular choices. When money is limited, rectangular buildings with locally sourced (from the surrounding vegetation) wooden frames and reed walls are favoured, but when money is available, people build houses with brick walls and purchase wood for the roof frame (Peteers 2005; Gaugris *et al.* 2007). This construction pattern is encouraging as it reduces the wood volume used considerably (Gaugris and Van Rooyen 2006; Gaugris *et al.* 2007). However, two factors are undermining these potential savings in Maputaland. These factors are population growth and society modernisation (Peteers 2005). Population growth is self explanatory, but the more delicate case of society modernisation needs explaining.

Modernisation is observed in two ways. The first way represents the increased access to, and use of modern technology such as cell phones, televisions, radios, fridges, cars, tractors and implements, powered tools and many more items that make life easier and more comfortable (Kloppers 2001; Muchagata and Brown 2003; Peteers 2005; Madubansi and Shackleton 2006). While desirable and beneficial, this aspect of modernisation, especially cars and tools, improves access to resources, both natural and from a market economy. By using vehicles, the distance from a resource no longer limits people to harvest preferred materials (Brookes 2004). On the other hand, it may equally favour the use of bought materials, which is considered superior to using materials sourced from the surrounding environment, as ownership of a vehicle often correlates with sufficient wealth to purchase construction material (Peteers 2005). Of even more concern could be the improved access to modern agricultural machines and powered tools. The Maputaland region is considered of low agricultural potential for subsistence farming (Matthews 2006). However, if mechanised means of production combined with irrigation are utilised, the agricultural potential of the region becomes viable (Eeley *et al.* 2001; Reyers *et al.* 2001). The prospect of forest clearing for agricultural development is raised and might indeed be worth considering, because it may be that local people will benefit more from agriculture than conservation (Perrings and Lovett 1999).

The second way represents a change in household social structure and is probably more significant. More households are built but fewer people live in them than before (Peteers 2005). This trend is the result of new immigrants that have arrived recently, or mostly local young people that have left the family homestead to settle themselves either someplace of their own or in a different community where work is more likely (Peteers 2005). The net result is the clearing of more land for new households, an increased number of buildings being constructed and more firewood used for a greater number of cooking and heating fires. These changes alone are sufficient to offset the potential gains from a modernised building method that utilises less wood sourced from the surrounding vegetation (Gaugris *et al.* 2007).

The resulting question is therefore how much has the utilisation of natural resources from the surrounding vegetation changed the vegetation patterns and structure and potentially its dynamics, and how much has it affected the local biodiversity? It is crucial that these details be known as it appears most unlikely that wood utilisation will decrease, and highly possible that further forest and woodlands will be cleared for agriculture by mechanised means.

Key questions

As presented above, several pertinent questions are raised about the ecology of Maputaland and its conservation value, and have made clear the need to have abundant baseline information on the natural resources of the region. Resolving all of them would be well beyond the scope of a single study, and it will therefore not be attempted here. However, it has become obvious that the baseline information on vegetation is needed in several ways and needs to be interpreted within the context of several debates that currently separate other studies. The goals of the present study were to present and / or debate the following aspects:

- A refinement of current perceptions and debating the hypotheses presented by several authors regarding the nature of the Sand Forest based on a representative study of this vegetation type in the Maputaland region.
- An analysis of the vegetation structure at the community and species levels, within protected areas, outside protected areas under the influence of people, and within a control zone where neither animals nor people have influenced vegetation in order to gain an understanding of the underlying dynamics.
- A quantitative assessment of the influence of animals and people on the vegetation structure and discussing their possible future effects on vegetation dynamics
- After obtaining, analysing and defining the above an informed discussion on the intrinsic value of flora and fauna in Maputaland and their possible management along well known or less explored conservation strategies is presented, within the current Maputaland demographic context.

To evaluate the above aspects botanical surveys were conducted in Tembe Elephant Park and the Manqakulane community. These sites offer the advantage of studying two well-separated treatments (animals / people) on similar and comparable vegetation (Matthews *et al.* 2001; Gaugris *et al.* 2004), and the comparisons of effects with a control zone (Tshanini Community Conservation Area on the land of the Community of Manqakulane, previously studied by Gaugris in 2004) where neither treatment was applied. Coincidentally, the treatments and control areas have been subjected to their various regimes over a similar period of time, since 1989 for Tembe Elephant Park, and 1992 for the other 2 sites. The added advantage of such a design is to provide a time scale over which changes become evident.

The present study will also serve as a baseline to evaluate the ecological integrity of northern Maputaland and can form part of the baseline building blocks needed for discussing the future of conservation in this valuable region.

Note on the layout of the thesis

The thesis is presented as a collection of manuscripts, of which some have been submitted for publication or will soon be submitted for publication in scientific journals. In that respect, study area, methodology and reference lists are presented in each chapter / manuscript, and a certain amount of duplication of information for these sections was unavoidable.

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