AN INVESTIGATION INTO ASPECTS OF MEDICINAL PLANT USE BY TRADITIONAL HEALERS FROM BLOUBERG MOUNTAIN, LIMPOPO PROVINCE, SOUTH AFRICA

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DECLARATION

I declare that this dissertation hereby submitted to the University of Limpopo for the degree of Master of Science is my own work except where acknowledged in the text, and has not been previously submitted either as a whole or in part for a degree at any other university.

Khomotso Malehu Mathibela

DEDICATION

I dedicate this dissertation to my late grandmother Mrs A.R. Mphahlele, “ngwana Papo, tlou letebele” and to my beloved mother Mrs M.M. Mphahlele-Mathibela “Mokgaga wa mmakubela” for her love, support, guidance and sacrifices she made to ensure I make the best of my life and future. I love you mum and God bless you.

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ABSTRACT

Traditional medicine plays a major role in the primary health care of many people residing in rural areas. People in these areas still consult traditional healers who utilise plants as medicine. Medicinal plants have come under increasing pressure due to a number of factors, which have resulted in the decline of certain species, extinction in others, and a general decrease in biodiversity of high use areas of South Africa, Blouberg Mountain included.

To date there has been a lack of information on how traditional healers utilise the Blouberg Mountain with respect to amounts and species removed, or where the most important collecting sites are located. Thus, no conservation strategy exists for the Blouberg Mountain to ensure sustainable management of its natural resources. Furthermore, there is a perception amongst elders of this area that, as with indigenous knowledge around the world, the knowledge centered around Blouberg's medicinal plants is declining, and little formal documentation of that knowledge has taken place.

Consequently, this study investigated aspects related to medicinal plant use such as collection, patterns of collection, legislation, storage and packaging of medicinal plants by traditional healers around Blouberg Mountain. These were documented via a semi-structured questionnaire and a data collection sheet. Furthermore, traditional harvesting methods employed by traditional healers, and *in situ* conservation issues related to species removal from the mountain were investigated.

Data was collected between September 2010 and September 2011. Sixteen villages in close proximity to the mountain, and 32 healers (two per village) were selected. In addition 16 consulting rooms were sampled (one per village) in order to gather information on the number of species collected from the mountain and stored in the consulting rooms.

The 16 most used (indicated by village traditional healers) collection tracks, (one per village surrounding Blouberg Mountain), were travelled with traditional healers to record botanical and vernacular names of the medicinal plants, vegetation type, habitat, parts used, harvesting method, replacement value of plant species and

perceived rarity of collected material. A Garmin GPS was used to record waypoints for the beginning and end of each track. Co-ordinates were logged automatically every 10 m.

A map using Quantum GIS software to capture the position of the healers' collection tracks, overlaid with topographical and vegetation information, and protected area information of the Blouberg Mountain, was generated. Geographic Information System software was used to geo-process the collection tracks of the healers with respect to where medicinal plants were collected relative to the various vegetation types. This gave information on vegetation types important to healers.

The majority of traditional healers were females. Most of them had no formal education, with only a minority reaching secondary school. Due to their low level of literacy they tended to shy away from sources of written information, with the result that none of the questioned healers had any knowledge of the various national or provincial environmental legislations. The majority of them see between 15 and 20 patients per month. Most of the healers had more than 30 years of experience in traditional healing.

The study found 64 plant species commonly used for medicinal purposes. Most of them were harvested for their roots and bark. According to the healers, *Boophane disticha* and *Hypoxis hemerocallidea* are declining in Blouberg Mountain, with *Warburgia salutaris*, endangered in South Africa, not perceived as rare or declining. However, a number of plant species recorded in the Red Data List as of least concern, or not threatened, are seen as rare by the healers. These include *Clivia caulescens*, *Erythrina lysistemon, Lannea schweinfurthii* and *Maerua juncea*.

No exotic species were documented from the surveyed tracks. However, two naturalised exotics were collected from the mountain, namely *Cassytha filiformis* and *Corchorus tridens*. *Cocculus hirsutus*, a naturalised exotic and *Abrus precatorius*, an exotic species were found in one of the consulting rooms. *Dichrostachys cinerea*, *Philenoptera violacea* and *Tarchonanthus camphoratus*, which are indicators of bush encroachment, were identified on selected tracks. Tracks on which indicators of bush encroachment are present should be investigated more thoroughly to ascertain the extent and severity of such a threat.

Investigations into healers' collection tracks showed that the Soutpansberg Mountain Bushveld vegetation type is the most heavily utilised of the five vegetation types around Blouberg Mountain. This vegetation type is vulnerable to human population densities as most species were collected from it, therefore it should be conserved and managed if possible as it is targeted for plant species of medicinal value. The most travelled tracks were found in the *Catha-Faurea* Wooded Grassland community.

Solutions to the problems of over harvesting of medicinal plants require local innovations and the full participation of traditional healers in resource management initiatives. The development of medicinal plant nurseries together with propagation of key species will be a crucial management tool, as this will reduce over harvesting of natural resources from the wild.

In conclusion, it was found that although most species utilised around Blouberg Mountain are abundant and not threatened, healers are nevertheless concerned about dwindling medicinal plant supplies. They would welcome conservation initiatives and the use of GIS maps would be useful in prioritising conservation areas.

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GENERAL INTRODUCTION
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1.1 GENERAL INTRODUCTION

Traditional medicine is the total sum of all the knowledge, skills and practices based on the theories, beliefs, and experiences indigenous to particular cultures and areas (Elujoba *et al.*, 2005). A publication by the World Health Organisation (WHO) (2002) stated that traditional medicine is the oldest and most tried-and-tested form of medicine, and that it has existed in human societies since before the application of modern science to health. It is estimated that over one-third of the world's population lacks regular access to modern medicine and therefore traditional medicine is sometimes seen as the only affordable source of health care, especially for those in rural areas (Zhang, 2004).

Traditional healers are the custodians of this medicinal knowledge and are an important part of African societies (Gessler *et al.,* 1995). They are present in almost every rural community, and are therefore the first health care providers to be consulted for bodily illnesses as well as spiritual matters (Clarke, 1998). Between 70% and 80% (Shackleton *et al.*, 2001) of black people in South Africa use traditional medicines and this translates into an estimated 26 million of the black population (Mander *et al.,* 2007). Most of the medicines that healers use are derived from plants and these medicinal plants have been found to play an important role in the livelihood strategies of developing countries where rural people are economically vulnerable and depend greatly on natural resources (Shackleton *et al.,* 2009). Thus, the indigenous knowledge possessed by healers must be based on their understanding of the healing properties of local resources, as well as on an intimate knowledge of aspects of the natural history of plants such as flowering times and distribution (Toledo *et al.*, 2009). By capturing such information, particularly on the distribution of these plants, valuable indigenous knowledge can be assimilated into conservation recommendations for an area.

1.2 MOTIVATION FOR STUDY

Blouberg Mountain, forming the western-most boundary of the Soutpansberg Centre of Floristic Endemism, is seen as a high priority for conservation (Van Wyk and Smith, 2001) due to large tracts of indigenous vegetation (Fourie, 2006).

Many of the nearly 200 000 inhabitants of the Blouberg municipality are dependent on its medicinal plant species, via traditional healers, for their primary health care (Semenya and Mathibela, 2012). While gathering information in the area in 2009, anecdotal evidence revealed that healers have noticed a decline in certain species, for example, *Elaeodendron transvaalense, Osyris lanceolata, Securidaca longepedunculata* and *Zanthoxylum capense.* There is furthermore a concern by traditional healers around Blouberg Mountain that collectors and commercial harvesters from outside this area could pose a threat to largely still intact medicinal plant resources both through an increase in the number of harvestors, and by their perceived unsustainable harvesting techniques.

According to Magoro (2008), unemployment and poverty are forcing rural communities in South Africa to generate income by selling traditional medicinal material. Unfortunately, there is no data available on species targeted or quantities removed by harvesters from the Blouberg area. Furthermore, no information is available on the areas impacted on the Blouberg Mountain. Lack of information is an impediment to the development of a management plan to preserve this floristically rich area. This study aims to fill this knowledge gap and to contribute to future medicinal plant management recommendations for the Blouberg Mountain.

1.3 GENERAL LITERATURE REVIEW

1.3.1 Traditional healers and their indigenous knowledge

Traditional healers

Traditional healers are present in almost every black community in Africa, with Van Wyk *et al.* (2009) reporting that there are an estimated 200 000 traditional healers in South Africa. Traditional healers hold a repository of information that is invaluable, not only to their communities but also on a global scale (Maila and Loubser, 2003). They treat all age groups and cover problems related to physical as well as mental conditions (Nzue, 2009) by using and administering remedies derived from medicinal plants that are readily available, accessible and affordable (Rukangira, 2001). Traditional healers are generally divided into two categories: healers and diviners.

Healers are herbalists who work mainly with the application of herbal remedies. According to Truter (2007), approximately 90% of healers in Africa are male. Healers are expected to diagnose the illness of a patient and prescribe medicines for everyday ailments. They also excel in preventing and alleviating evil by providing protection against witchcraft and misfortune and are consulted for preparations for luck and fidelity (Pretorius, 1999). Thus, rituals and symbolism play an important role in their healing practices (Truter, 2007).

Diviners act as important intermediaries between humans and the supernatural. Although, like healers, they are predominantly male, diviners differ from healers in that they use spiritual means to diagnose problems (Gessler *et al.*, 1995). They are able to visualise and analyse the causes of specific events and interpret the messages of the ancestors (Pretorius, 1999). Diviners concentrate mostly on diagnosing the unexplainable and providing medication for the specific cases they diagnose. Most diviners do not utilise plant materials (Truter, 2007) and therefore are not the focus of this study.

Indigenous knowledge

According to Khasbagan and Soyolt (2008), indigenous knowledge is understood as the systematic information that resides in diverse social structures. Indigenous knowledge provides the basis of modern scientific discoveries and is continually evolving to meet present day needs (Tavana, 2002). Warren (1992) emphasised that indigenous knowledge represents an important database that provides mankind with insight into how numerous communities have interacted with the changing environment, providing local solutions for local problems, and suitable ways for coping with challenges posed by specific conditions.

Many products based on indigenous knowledge are major sources of income, food and primary health care for large parts of the rural population of numerous developing countries (Zhang, 2004). A number of modern drugs have been developed and isolated from natural resources based on their use in traditional medicine (Cragg and Newman, 2002; Verma and Singh, 2008).

Traditional knowledge of biodiversity concerns the folk names, uses, and management of plants and animals as perceived by the local and/or indigenous people of a given area (Khasbagan and Soyolt, 2008). In common with indigenous knowledge systems world wide (Tavana, 2002), African indigenous knowledge systems are predominantly oral and not written, and therefore could be lost and/or changed over time, unless they can be documented and stored for future generations (Van Wyk *et al*., 2009). According to Wild and Mutebi (1996), indigenous knowledge has been undervalued in the past, particularly by governments and scientific researchers. Due to the precarious nature of this knowledge, protection by governments and documentation by the scientific community is necessary to safe guard indigenous knowledge for the future.

1.3.2 Traditional Medicine in Africa

In many countries in Africa, including South Africa, traditional medicine still forms the backbone of rural health care (Cunningham, 1993). According to Sindiga *et al.* (1995), traditional medicine in Africa, especially in rural areas, is effective in curing certain cultural health problems, it is also socially acceptable, holistic in its approach, and has a wide spatial coverage where each community has its own healer. More specifically, traditional medicine has demonstrated its contribution to the reduction of excessive mortality, morbidity and disability in the treatment of diseases such as HIV/AIDS, malaria, tuberculosis, sickle-cell anemia, diabetes and mental disorders (Elujoba *et al.,* 2005). It has a strong cultural base and therefore it is also popular in cities such as those in Ethiopia where herbal remedies are mainly used by a large proportion of people in urban centers (Abbiw, 1996).

Plant-derived medicinal products are currently in high demand both by traditional healers and the herbal drug industries, and their popularity is growing (Verma and Singh, 2008). Agrawal (2005) noted that the use of herbal remedies is becoming increasingly popular due to the toxicity and side effects of allopathic medicines and that this has led to a sudden increase in the number of herbal drug manufacturers. Elujoba *et al.* (2005) thus stated that there is a need for industrial drug production from medicinal and aromatic plants in Africa in order to increase the economic value and health potentials as well as the social benefits of natural resources. Traditional medicine in Africa needs to be supported and promoted so that its effectiveness in combating diseases can be maximised (Qhobela, 2011).

It has been noted by the rural community around Blouberg Mountain that many diseases that could not be cured by western medicine have been cured by traditional medicine (Mr. P. Morata, pers. com.). It is for this reason that traditional medicines are still considered safe and are preferred and trusted over allopathic medicine in many instances. Thus, throughout Africa, the use of traditional medicine appears to be a firmly entrenched cultural practice.

1.3.3 Conservation of Medicinal plants

There is a world wide decline in natural vegetation, including medicinal plants, due to human activities, and more than half the habitable area of the planet has already been disturbed. Overutilisation of natural resources and pollution of the soil, water and the atmosphere have all reduced biodiversity (Hunde, 2007). Vegetation, particularly, is disturbed by human presence: directly by trampling, removing, damaging and poaching of plants, and/or indirectly by the introduction of invasive species (Nel and Nel, 2009). There is thus a pressing need for sound conservation practices as humans are now the dominant influence on biodiversity (Hunde, 2007). Knowledge of the threats to medicinal plants is essential to conserve this important natural resource.

1.3.3.1 <u>Threats</u>

Population growth

The main forces driving the global transformation of the biosphere are human population growth, together with increasing resource consumption and socio-cultural change. The human population has grown from about five billion in 1990 to more than seven billion in 2011 (U.S. Census Bureau, 2012). As the human population increases further, there will be fewer natural habitats remaining as land is developed for human habitation and activities (Hunde, 2007). This will lead to a number of significant consequences including increased pollution, habitat fragmentation and climate disruption.

Habitat loss and fragmentation

According to Harrison and Bruna (1999), habitat fragmentation is occurring in natural areas throughout the world, and is probably the greatest contributor to the current decline in species richness. This, together with the loss and degradation of habitat is a major threat to the continued survival of many species (Hastings and Huxel, 1999) and contributes to the danger of extinction (Nally and Parker, 2002).

Unsustainable harvesting

In developing countries population growth has caused increased harvesting pressure on frequently used natural resources including medicinal plants (Oladele *et al.,* 2011). Rukangira (2001) noted that the demand for medicinal plants in developing countries, such as South Africa, has resulted in unsustainable harvesting. For example, in the Eastern Cape Province (South Africa), intensive harvesting of wild plant material has caused the decline of stocks of many sought-after species which may pose a serious threat to the biodiversity of the area (Dold and Cocks, 2002). Harvesting and the provision of medicinal plants to meet rural and urban demands has thus become an environmentally destructive activity (Williams *et al.,* 1999).

Trading

Magoro (2008), as well as Coopoosamy and Naidoo (2011) found that unemployment and poverty are forcing communities to generate income by selling plant species of medicinal value. An estimated 20 000 tonnes of medicinal plant material is traded annually in South Africa, most of which comes from forest and woodland habitats (Mander, 2004); this volume will only increase in years to come. The harvesting and selling of medicinal plants is an example of how people, especially women, from mainly rural communities and households, generate income from trading in forest and woodland products (Williams, 2004). According to Hauff (2002), poverty forces many rural people to extract too many valuable resources to allow for natural regeneration to occur. Poverty also contributes to the trade in natural resources, which if not well managed can lead to species loss (Bodeker, 2005).

The exploitation of natural resources has resulted in significant decreases in the sizes of some wild plant populations, especially for species that have high commercial value and/or are important to rural communities (Williams, 2007). For example, although the *muthi* trade in the Limpopo Province plays a critical role in empowering many rural dwellers it leads to the loss of important species (Moeng, 2010).

Pharmaceutical and herbal industries

The pharmaceutical industry is both large and highly successful, and many of its products are derived or made from plants (Bisht *et al.* 2006). With the added demand for herbal drugs in both developing and developed countries, there is a corresponding increase in the number of pharmaceutical and herbal drug companies. The growing demand for drugs has added to the destruction of floral biodiversity through indiscriminate bioprospecting (Bisht *et al.,* 2006). This, in turn has aggravated the demand for raw plant material.

1.3.3.2 <u>Consequences of medicinal plant loss</u>

Rural people's concerns about loss of medicinal plants stem from worries about healthcare, livelihood security and financial income. Among those for whom these problems are most acute are the rural poor, reliant on medicinal plants for their healthcare, and the traditional healers for whom these plants are an important source of income (Hamilton, 2004). With the current high demand for medicinal plants and other increasing threats to natural resources, many communities in rural areas will be significantly affected in the near future. A loss of wild medicinal plants will drive up economic costs for local people who will have to travel to hospitals and clinics to seek help, a costly and time consuming factor, rather than consulting traditional healers whose fees are usually very affordable (Rukangira, 2001). Costs involved in state-sponsored health consultation will be much higher, and these are already prohibitively expensive for the rural poor (Rukangira, 2001). Medicinal plants also play an important economic role in providing employment to countless traditional healers (Wiersum *et al.,* 2006). A loss of medicinal plant species would mean that healers would lose work opportunities that are not available in the formal sector (Loundou, 2008).

According to Hamilton (2004), the adequate provision of healthcare is threatened by declines in traditional medicinal knowledge and related plant resources. There are many people in developing countries that lack effective access to western medicine and this will continue for the foreseeable future. With the governments of developing countries already feeling the pressure to provide universal health care to their citizens (Cunningham, 1993), the loss of medicinal plants would put an enormous burden on state sponsored health care facilities and budgets.

Diminishing biological resources result in a consequent loss of cultural practices (Wiersum *et al.*, 2006). Every year, indigenous knowledge about important aspects of medicinal plants is being lost (Hamilton, 2004). This includes knowledge about the different types of plants, their distribution and ecology, local methods of management and methods of using the plants (Hamilton, 2004). For areas largely reliant on oral rather than written tradition, loss of medicinal plants means not only an immediate loss of effective remedies, but also rapid erosion of the knowledge around their use.

Medicinal plants continue to play a vital role in the development of new drugs (Verma and Singh, 2008). With plants making such an impressive contribution to the drug supply today, it seems obvious that the search for drugs in plants not yet studied is likely to be rewarding, and it is probable that many valuable new remedies and drugs will be discovered and commercialised in the future, provided the remaining plants are conserved and sustainable harvesting methods are practiced (Zhang, 2004).

1.3.3.3 Conservation

Many types of actions can be taken in favour of the conservation and sustainable use of medicinal plants (Hamilton, 2004). In order to ensure that representative wild populations of vulnerable, endangered and threatened medicinal plant species are maintained, core conservation areas or other protected habitats that will allow natural processes to continue undisturbed by human activities should be designated (Cunningham, 1993).

According to Hunde (2007), in order to benefit continuously from the natural resource base, people must conserve the biodiversity within their surroundings and the related indigenous knowledge regarding medicinal plants. Indigenous knowledge can be a fundamental starting point in any conservation strategy (Bodeker, 2005) as there are often traditional management practices or rituals that promote sustainable resource use. Effective conservation of biodiversity can only be achieved through the sustained efforts of all, but most importantly rural communities, who rely directly on local biodiversity for their livelihoods (Hunde, 2007).

South African Legislation

The value of medicinal plants to human livelihoods could be infinite if correctly managed, providing fundamental contributions to human health indefinitely

(Hamilton, 2004). Qhobela (2011) stated that one way of securing the future of indigenous knowledge and research on traditional medicine is the advancement and refinement of regulatory procedures.

South Africa has a rich source of medicinal plants that form the basis of traditional medicine. However, careful legislation is needed to ensure that this resource is not destroyed, that the rights of holders of this knowledge are protected and that they receive a fair share of benefits (DEAT, 2004). According to Nzue (2009) there are several laws and policies that have a bearing on the over exploitation of natural resources as far as the South African biodiversity is concerned and they are outlined below.

Natural forests and woodlands form an important part of the environment and need to be conserved and developed according to the principles of sustainable management. The National Forests Act (Act No. 84 of 1998) states that everyone has the constitutional right to have the environment protected for the benefit of present and future generations (DEAT, 1998).

The objectives of the Limpopo Environmental Management Act (LEMA) (Act No. 7 of 2003) are to manage and protect the environment of the Province, to secure ecologically sustainable development and contribute to the progressive realisation of the fundamental rights contained in Section 24 of the Constitution of the Republic of South Africa, 1996, and to give effect to international agreements affecting environmental management which are binding on the Province (Act No. 108 of 1996). The Limpopo Province interprets and applies the Environmental Management Act in accordance with the National Environmental Management Act (NEMA) principles, thereby adhering to the principles of cooperative governance (DEAT, 2003).

Community-based Natural Resource Management

It is important to understand how local communities in rural areas use and manage their natural resources (Njoroge *et al*., 2010) before conservation plans can be developed and implemented. According to Roe *et al*. (2009), Community-based Natural Resource Management (CBNRM) covers a wide range of resource use practices, given the great diversity of both human communities and natural resources. A CBNRM programme focuses on the collective management of ecosystems to improve the livelihoods of the associated community. It thus aims to devolve authority for ecosystem management to the local community level by empowering communities to conserve and manage their own resources without damaging, depleting or degrading them (Fabricius and Collins, 2007). Jäeger (2001) noted that excluding locals from the utilisation of natural resources can lead some to engage in illegal activities by exploiting and trading resources within protected areas and putting pressure on non-protected land resources. The CBNRM approach recognises the threat to biodiversity, the need for human communities to thrive and their importance as stewards of the natural environment (Barkin, 2000).

1.4 AIM AND OBJECTIVES

1.4.1 Overall aim

This study aimed to investigate aspects related to the collection and utilisation of medicinal plants by traditional healers on Blouberg Mountain, with a view to contributing to a conservation strategy of medicinal plant use in the area.

1.4.2 General objectives

The objectives of this study were to:

a) Document medicinal plants collected by traditional healers and investigate traditional harvesting methods and storage and packaging techniques via a semi-structured questionnaire (Appendix A). This provided information on which species were being collected and used and their replacement value to healers. Information on whether there is a decline of certain available species and whether it has an impact on healers' practice was captured.
b) Generate maps to show the position of the healers' collection tracks with respect to topographical and vegetation type information.
c) Investigate conservation issues related to species removed from the mountain by means of a data collection sheet (Appendix B). This allowed for conservation management strategies to be recommended in accordance with the prevailing vegetation type around the collection tracks.

1.5 HYPOTHESES

a) Healers utilise a number of plant species from Blouberg Mountain.
b) Healers follow collection tracks, which indicate areas of high resource use.
c) Healers have an impact on the vegetation of the mountain by removing plant material.

1.6 SCOPE AND RESTRICTIONS OF THE RESEARCH

Given the research aim and objectives of the study delineated above, the scope of the study entailed four aspects - the identification and documentation of plants (indigenous and exotic) used by local traditional healers residing around the Blouberg Mountain; areas frequented by traditional healers for harvesting medicinal plants; the most important medicinal plants found in the consulting rooms of traditional healers, and lastly, proposed management recommendations for medicinal plant species growing on Blouberg Mountain.

The study however, had a set of limitations inherent in the topic investigated:

a) Given the nature of the survey methods used and the time frames available, not all of the traditional healers residing around Blouberg Mountain could be interviewed for the research.
b) Not all healers were able to or wanted to participate in the study and their input could therefore not be captured.
c) It was initially proposed that transparancies be overlaid onto a topographical map of the area such that the healers could draw the tracks they use in the correct position on the mountain. They would then have been able to rank the importance of each track. Despite their sound knowledge of the mountain, the healers were mostly illiterate and therefore using a topographical map was unfortunately beyond their understanding.
d) The possibility exists that some significant tracks were not captured as, due to time constraints, only the most used tracks were chosen.
e) Tracks might not be complete as healers may not have walked their entire track.
f) Scholes (1978) provides fine scale vegetation data which was digitised for the project. However, the area that the healers utilise extends beyond Scholes'

map, thus some tracks could not be analysed with respect to fine scale vegetation structure.

g) There were difficulties in acquiring accurate data on the amount of plant material stored in consulting rooms or collected on the mountain. Healers were unwilling to provide information about the exact amount of plant material they collect, and the small amount of information provided was imprecise (i.e. handful, plastic bag full). Volumes stated also sometimes contained mixed species.

1.7 RESEARCH ASSUMPTIONS

Blouberg is a rich reservoir of natural resources that can be used by the local community and it is specifically assumed that:

a) Medicinal plant species are present on Blouberg Mountain.
b) Traditional healers reside in communities around Blouberg Mountain.

1.8 OUTCOME OF THE RESEARCH

Information regarding the medicinal plants utilised and the most impacted areas of the mountain will be invaluable to provincial conservation officials who are in the process of implementing a conservation plan for the province. For the first time, healers' collection pathways have been digitised, geo-referenced and linked to other available information on the medicinal plants around Blouberg Mountain making this information easier to analyse and access. This study provides the first documented information on the utilisation of medicinal plants by traditional healers residing around Blouberg Mountain. Areas of importance where high resource use occurs or species of importance are collected can now be targeted for conservation action to ensure sustainable utilisation of the plant species.

The use of a GPS to record the co-ordinates of the tracks walked by the healers when collecting, and then processing the data using Geographic Information System (GIS) software, has allowed for digital maps to be constructed. These indicate areas of high use, which warrant immediate remedial action. No literature could be found indicating the use of GIS for mapping collecting tracks for resource utilisation and this method has therefore pioneered a technique for future analysis of other wild resources.

1.9 ORGANISATION OF THE DISSERTATION

This dissertation consists of a collection of chapters on several diverse but inter-related aspects of medicinal plant species of Blouberg Mountain. Chapters are compiled in the form of essentially self-contained units. Details of materials and methods, and references are present in the individual contributions. In most chapters a comprehensive literature review as well as a discussion of the results is presented.

The dissertation is presented in four chapters. Chapter 1 provides the research background on medicinal plants and traditional healers and the importance of the study. A brief literature contextualisation, research motivation, aim and objectives as well as limitations of the study are also provided. A description of the study area, its location and its inhabitants form the basis of Chapter 2.

Chapter 3 deals with the first set of research findings, with particular reference to the local indigenous knowledge system of traditional healers located around Blouberg Mountain. The chapter begins with a brief introductory section and review of the relevant literature pertaining to knowledge systems of traditional healers. The chapter also presents its own aim and objectives, research design as well as methods of data collection, processing and analyses. This is followed by a discussion of the different profiles of respondents interviewed for the study before proceeding with the identification of the most frequently cited species, plant parts used and harvesting periods and techniques, issues of sustainability and other constraints. The second set of findings presents the most important plant species used by the key informants, which links up with the questionnaires' plant list.

Chapter 4 encompasses the research findings related to the collection tracks used by traditional healers. The chapter begins with a brief introductory section and relevant literature review on how GIS is used to process data and create informative maps facilitating analysis. The chapter also presents its own aim and objectives, materials and methods of recording GPS co-ordinates of tracks and waypoints as well as developing and analysing this data. The results discuss where the collection tracks pass through the major vegetation types on the mountain and also investigate the conservation status of the affected vegetation types.

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CHAPTER 2

STUDY AREA

2.1 STUDY AREA

The Blouberg Municipality is situated west of the Soutpansberg, about 44 km northwest from Mogwadi, formerly known as Dendron, in the Limpopo Province of South Africa. The municipality covers an area of approximately 5 054 km² and it stretches up to the Botswana border (Blouberg Municipality, 2005/2006). The study area comprised 16 villages surrounding the Blouberg Mountain and is located in the foothills of the main massif (Fig. 2.1).

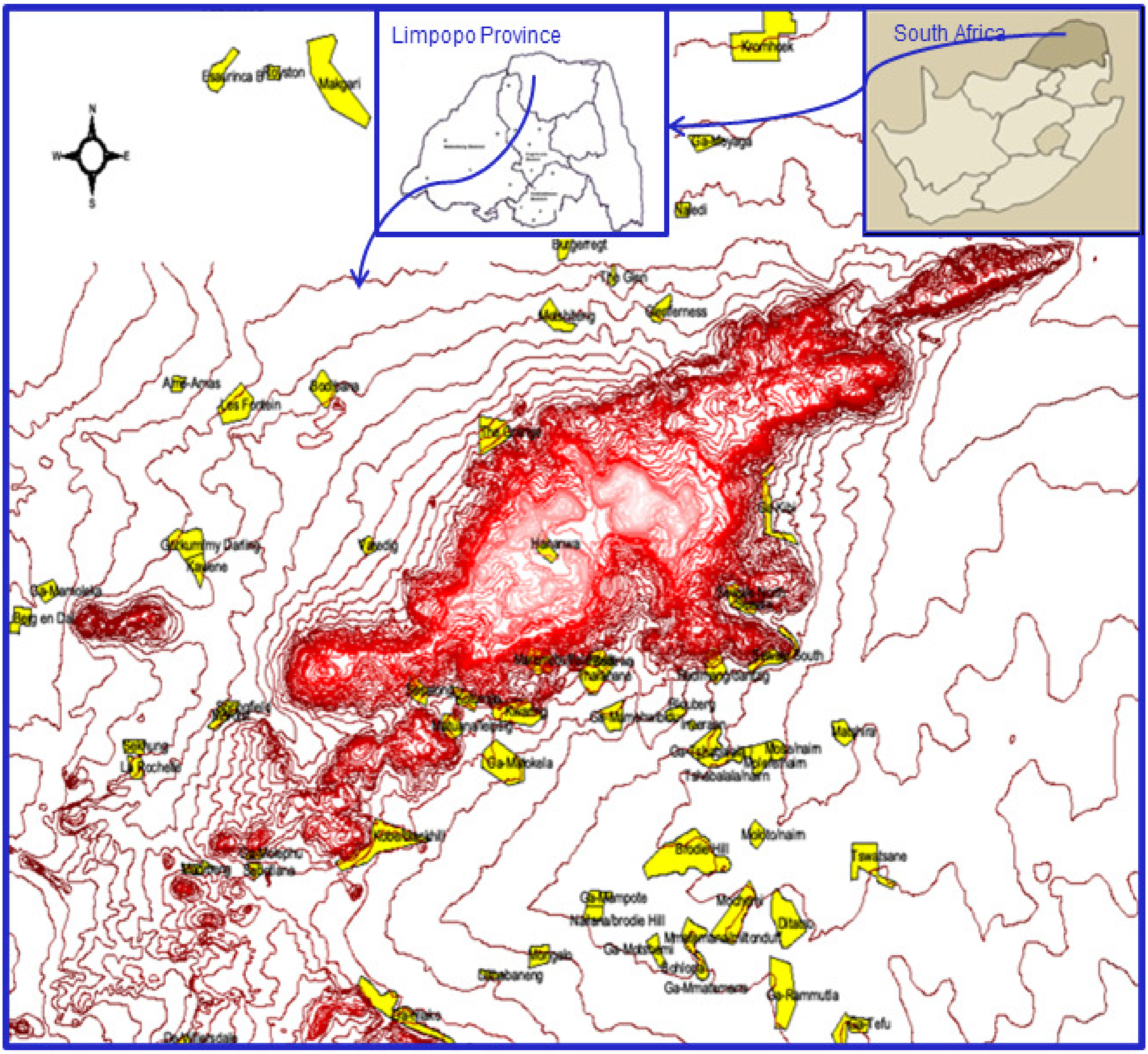

Figure 2.1. Map showing location of Blouberg Mountain situated in the Limpopo Province of South Africa, modified from unpublished data by the Limpopo Department of Economic Development, Environment and Tourism, 2011.

2.2 METEOROLOGY

The daily mean maximum temperature for the lowlands surrounding the Blouberg Mountain is 26ºC, with a mean minimum temperature of 5ºC. The daily maximum temperature is 33ºC or higher during the summer months and can be as high as 24ºC during the winter months of June and July. Summer minimum temperatures are relatively high, exceeding 13ºC, with winter minimum temperatures as cold as 0.6ºC (Scholes, 1978). Mean monthly maximum temperatures range between 11ºC and 20ºC (SA Weather, 2006). The absolute maximum temperature in the region is 38ºC. Temperatures at the mountain summit are on average at least 6ºC cooler than those of the lowlands, excluding the effects of wind-chill (Scholes, 1978).

The Blouberg region has an average annual rainfall that varies between 380 and 500 mm (Fourie, 2006). According to Van Wyk and Smith (2001), the highest rainfall is between November and February, with precipitation as high as 2 000 mm on the highest peaks. During the summer months, winds carry moisture in from the Indian Ocean, frequently covering the vegetation in mist. Frost is fairly rare (Mucina and Rutherford, 2006). During the prolonged dry season, the prevailing winds cause dehydration and desiccation of the soils and vegetation (Hahn, 2002). Rainfall in the Blouberg region originates from the east due to the rain stimulating effect which mountain masses have on approaching clouds (Scholes, 1978).

2.3 TOPOGRAPHY

Blouberg Mountain is the largest isolated mountain in South Africa (Blouberg Municipality, 2005/2006) and is located at the north end of the Pietersburg plain (23°S, 29°E). The mountain is an interesting topographical feature that forms part of the western outline of the Soutpansberg and covers an area of approximately 13 000 ha (Scholes, 1978). The highest peak is estimated at 2 051 m above sea level and is also the highest point of the entire Soutpansberg range (Fourie, 2006). The mountain lies within the sub tropics and is split by numerous fault lines trending in east-west and east-north-east directions (Scholes, 1978). The topography of the east-west-orientated ridges of the mountain changes drastically over short distances on the southern ridges, and produces a rain shadow effect on the northern ridges (Mucina and Rutherford, 2006).

2.4 GEOLOGY

According to Scholes (1978), the Blouberg region is the only place where strata of the Waterberg group and the Soutpansberg group are in contact with one another. The rocks of the Blouberg area are made up of elements of both groups and the basement group which they overlie. The geology of the Blouberg–Soutpansberg mountain range is dominated by pink, erosion resistant quartzite and sandstone (Mostert *et al.,* 2008). Brandl (1999) noted that the pink resistant quartzite was instrumental in shaping the present morphology. Soils derived from quartzite and sandstone are generally shallow, gravel, skeletal and well-drained, with low nutrient content and acidic characteristics (Mostert *et al.,* 2008). Due to the absence of water-soluble rocks, such as dolomite or limestone, the area is not prone to sinkholes or other related geological phenomena (Fourie, 2006). Other less prominent rock types include shale, conglomerate, basalt and diabase intrusions (Mostert *et al.,* 2008).

2.5 VEGETATION

Blouberg Mountain is a centre of endemism (Mostert *et al.,* 2008) and includes endangered grassland, fynbos and forest vegetation types (Blouberg Municipality, 2005/2006). It is a repository of valuable local biodiversity as the area has not yet been transformed by local infrastructure developments such as roads and housing (Boonzaaier and Philip, 2007). The Soutpansberg region (which includes the Blouberg area) is regarded as an outstanding centre of plant diversity with between 2 500 and 3 000 recorded vascular plant taxa (Hahn, 1997), and accommodates a variety of rare species such as *Podocarpus falcatus* and *Warburgia salutaris* (Blouberg Municipality, 2005/2006). According to Mostert *et al.* (2008), the Soutpansberg Centre of Endemism (SCE) is treated as an aggregated centre comprising the Blouberg and Soutpansberg. Van Wyk and Smith (2001) reported that 68% of plant families and 41% of genera occurring in southern Africa are represented within the SCE.

Scholes (1978) recognised 17 vegetation communities on the top two thirds of the Blouberg Mountain. These are amalgamated into the following broad groups:

a) Forest, which is divided into high and scrub forest. High forest is greater than 20 m in height and is found only in the wettest areas where the soil is derived from lava and intrusive rocks. Trees such as *Podocarpus falcatus* and *Ptaeroxylon obliquum* occur in the high forest. Scrub forest is approximately 10 m in height and it is found in less favourable positions on shallower soils and includes trees such as *Osyris lanceolata* and *Ziziphus mucronata.*

b) Woodland has a canopy taller than 5 m and consists of three layers (tree, shrub and herbaceous). It is located on the lower slopes of the mountain. Examples of typical species include *Blepharis subvolubilis*, *Dichrostachys cinerea*, *Pappea capensis* and *Pyrenacantha grandiflora*.

c) Scrub and thicket is made up of woody vegetation with an average height of less than 5 m and with ground cover exceeding 50%. Thicket and scrub plants differ in that thicket consists of plants that are multi-stemmed from the base whereas scrub has single-stemmed plants. Scrub and thicket dominate on steep slopes of the Blouberg Mountain. Examples of species occurring in this vegetation include *Dichrostachys cinerea*, *Elephantorrhiza burkei, Tarchonanthus camphoratus* and *Ziziphus mucronata.*

d) Wooded grassland is extremely widespread on the mountain. This vegetation together with Grassland makes up the major herbivore habitat. Wooded grassland flourishes on sandy clay loams. A large number of trees make up the woody element of the vegetation including *Burkea africana* and *Faurea saligna* but grasses such as *Brachiaria nigropedata, Digitaria eriantha* and *Melinis repens* predominate.

e) Grassland is vegetation with a woody component of less than 5% and with elements predominantly of the Poaceae family. In the Blouberg this vegetation is subjected to fires and restricted to areas of skeletal soils. It occurs at elevations above 1 200 m and *Andropogon gayanus, Aristida junciformis*, *Eragrostis nindensis* and *Trachypogon spicatus* dominate.

Mucina and Rutherford (2006) provided the following general description of the vegetation types found on and around the Blouberg Mountain:

a) Northern Escarpment Afromontane Fynbos: Shrubland comprised of sclerophyllous shrubs and herbs and occurring in fragmented patches of high-lying quartzite ridges that experience frequent mist.

b) Soutpansberg Summit Sourveld: Found on rugged summit crests and adjacent steep rocky slopes which support a mosaic of low, wiry, closed grassland and scattered closed-canopy bushy clumps.
c) Roodeberg Bushveld: Restricted to slightly undulating plains, including low hills and comprising short closed woodland to tall open woodland and poorly developed grass layers.
d) Soutpansberg Mountain Bushveld: Characteristic of low to high mountains with those in the west splitting into an increasing number of lower mountain ridges to the east. Vegetation is made up of a dense tree layer and poorly developed grassy layer. The main vegetation variations within the Soutpansberg mountain bushveld are subtropical moist thickets, relatively open savanna sand veld and arid mountain bushveld.
e) Northern Mistbelt Forest: This occurs primarily in the east-facing subridge scarps which are sheltered, moist and protected from fires. It comprises tall, evergreen afro-temperate mistbelt forest.

2.6 HUMAN SETTLEMENT AND DEMOGRAPHICS

The area is regarded as one of the least developed regions in the province with the lowest level of income and highest unemployment rate in the country (Blouberg Municipality, 2005/2006). The majority of people in Blouberg are illiterate. A large percentage of the population is younger than 21 years (Fourie, 2006). The Blouberg area has 139 settlements with an estimated population of 194 119 located in more than 100 villages, which are all in close proximity of each other (Statistics South Africa, 2007). The dominant cultural groups of the area consist of the *Ba-Pedi* and a small population of *VhaVenda* people (Blouberg Municipality, 2005/2006). The *Ba-Pedi* are made up of two groups (*Ba-Hananwa* and *Batlokwa*), with the *Ba-Hananwa* in the majority (Boonzaaier and Philip, 2007). The traditional healers who were interviewed for this study were of the *Ba-Pedi* tribe, as they are the dominant healers in the study area.

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CHAPTER 3

BLOUBERG TRADITIONAL HEALERS' PROFILE, PLANT COLLECTION AND THE CONSERVATION OF THEIR MEDICINAL PLANTS

3.1 INTRODUCTION

Medicinal plants are an important aspect of the daily lives of many people in rural areas and a central element of the South African cultural heritage (Van Wyk *et al.,* 1997). Traditional medicines are not only relevant to the South African community, but also to communities worldwide, with plants such as *Aloe ferox*, *Agathosma betulina* and *Harpagophytum procumbens* used widely as medicine (Van Wyk *et al.,* 2009). According to Elujoba *et al.* (2005), traditional medicine is a socio-economic and socio-cultural heritage, and the utilisation of traditional medicine is a thriving industry in South Africa (Magoro, 2008).

The use of plants in traditional medicinal systems of many cultures in developing countries has been extensively documented (Gurib-Fakim, 2006). In South Africa, medicinal plant use has been investigated in a number of cultures such as the Zulus (Van Staden *et al.,* 1998), Vendas (Mabogo, 1990; Tshisikhawe, 2002), Pedis (Rankoana, 2001) and Xhosas (Keirungi and Fabricius, 2005). In all of these cultures, traditional healers and their remedies play a crucial role by supporting the primary health care system in South Africa (Wiersum *et al.,* 2006).

Advantages of traditional medicine include its widespread accessibility, availability and relative cheapness for people with a low income (Patwardhan, 2005). In present-day Africa, the majority of people lack access to state-sponsored primary health care, and where it is available, the quality is poor (Abbiw, 1996). With growing recognition of the role of traditional medicine in primary health care, increasing efforts have been made regionally and internationally to include traditional healers in this health sector (Richter, 2003).

3.2 LITERATURE REVIEW

3.2.1 Demographics of healers

According to Safowora (1982) a traditional healer is defined as a person who is recognised by the community in which he or she lives as competent to provide primary health care by using medicinal plants (Fig. 3.1). Traditional healers are an important part of black African societies residing primarily in rural areas, but unfortunately the knowledge of the extent and character of traditional healing and the people involved in the practice is limited (Gessler *et al.,* 1995).

Figure 3.1. A traditional healer in his consulting room in Dantzig village.

Traditional healers operate in a unique manner depending on their culture and each of them has their own field of expertise including methods of diagnosis, application of remedies and medicines that they dispense (Truter, 2007). Despite the availability of modern medicine, traditional healers in Africa still operate successfully (Rukangira, 2001). According to Mander and Le Breton (2005), there are as many as 500 000 traditional healers in southern Africa, with an industry worth about R2.9 billion per annum (Mander *et al*., 2007).

3.2.2 Traditional healing

According to Struthers and Eschiti (2005), traditional healing is an ancient and holistic health care system practiced by indigenous people that is deeply rooted in ritual, and more complex than is commonly understood. Although traditional healing is often referred to as complementary or as an alternative medicine, Abbo (2009) noted that the use of traditional healing is growing in both low and high income countries. The art of traditional healing places an emphasis on the spirit world, super natural forces and religion (Avery, 1991). This can be acquired by inheritance from ancestors, learned from another healer, (Struthers, 2000), and/or developed through training and initiation. The specific techniques of healing and healing rituals are received directly from elder healers or from spirits encountered during visions (Cohen, 1998). Because of the spiritual nature of traditional healing, the popular media in South Africa often carry horror stories of traditional medicine and its practitioners, while sensational articles have escalated with the rise of the AIDS epidemic. Reports on the prescription of mysterious herbal treatments or *muthi*, healers who claim to have found the cure for AIDS, and unethical and unsavoury behaviour relating to treatment of patients are often covered in the media. Although a number of traditional healers have deserved the negative publicity generated by their misconduct, these stories have contributed to a largely negative sentiment towards all traditional healers and traditional healing practices. This means that the role that ethical and well-educated traditional healers can play in South Africa's response to global health issues, such as HIV/AIDS and its efforts to build up its primary health care system has largely been ignored (Richter, 2003).

Most people in rural areas consult traditional healers for a wide range of physical, psychological and social problems. According to Abbo (2009), people in Africa have a close relationship with their traditional healer who is often from the same community and culture. Robertson (2006) noted that many people in rural areas view traditional healers as providing more holistic care than western medical practitioners, and as having an approach that is more acceptable. Patients further believe that there is a lack of knowledge by western medical practitioners in the treatment of culture-bound syndromes, and that there are some ailments that can only be treated by traditional medicine (Truter, 2007). For example, mental or spiritual illnesses may be treated by a traditional healer using traditional medicine, while gastrointestinal disorders may be treated by a western physician (Adelekan *et al.,* 2001). It is estimated that up to 80% of the Zulu population seen by western medical practitioners also consult with traditional healers. In a country, such as South Africa, where access to medical doctors is limited, the value of traditional healing cannot be overestimated (Van Staden *et al.,* 1998).

Although rural people rely on traditional medicine because it is cheap, locally available and easily accessible, Kaplan (1976) noted that a shift from using traditional medicines to consulting western physicians occurs with socio-economic upliftment and consequent cultural change. Access to formal education or religious influences which forbid the use of traditional medicines by their followers, such as substituting the use of ash for holy water, re-inforces this shift (Sundkler, 1961).

3.2.3 Plant collection and harvesting

Throughout Africa the collection of medicinal plants was traditionally confined to traditional healers or their trainees, as knowledge of these species was limited to this group through spiritual calling, ritual, religious controls and the use of alternative names unknown to outsiders (Cunningham, 1993). In Africa, especially in rural areas, the use of medicinal plants has become a form of rural self-employment, as rural communities generate income by collecting plants and then selling to traders (Afolayan and Adebola, 2004). Mahindapala (2004) noted that collectors of medicinal plants are now resorting to unsustainable harvesting and exploitation causing serious harm to the survival of some species used in traditional medicine (Keirungi and Fabricius, 2005).

Not only the plant part, but also the way it is harvested will have an effect on sustainability, as different plant parts are obtained in different ways (Havinga, 2006). Cunningham (1993) stated that ring-barking of trees and uprooting of bulbs, shrubs or herbs is the most common method of collection used by commercial gatherers. Removal of rhizomes and roots automatically results in the removal of the whole plant, thereby killing the plant. This type of unsustainable harvesting of plants has resulted in the depletion of many medicinal species which are mostly collected from the wild (Bodeker, 2005). In contrast, removing leaves is less damaging as even the cutting of complete twigs does not cause a lot of harm to a plant because regrowth occurs with time.

3.2.4 Species utilisation

According to Leaman (2006) 50 000 to 70 000 of all known species of plants are used medicinally world wide. In South Africa alone it is estimated that about 3 000 plant species are used as medicine (Van Wyk *et al*. 2009). Oladele *et al.* (2011) in Nigeria and Adhikari *et al.* (2010) in India showed that herbs are the most used growth form and climbers the least. Birhane *et al*. (2010), indicated that the most frequently used plant parts in northern Ethiopia are roots, followed by leaves and then bark. Ndou (2006) noted that *Securidaca longepedunculata* is the most popular plant of all traditional medicinal plants in South Africa, especially in the Limpopo Province, where the roots are extensively used. The species is also highly prized for its roots in many other parts of Africa.

According to Mander *et al*. (2006), the average frequency of consulting with a traditional healer in South Africa is 4.8 times per year. The typical South African consumer of traditional medicines uses 750 g of medicinal plants a year, with more or less a mass of 157 g of plant material per treatment. It is estimated that in South Africa some 128 million courses of traditional medicine treatments are prescribed per year, resulting in the consumption of approximately 20 000 tonnes of plant material (Mander *et al.,* 2006).

3.2.5 Storage and packaging

Traditional healers use plants in the fresh or dried state, although some remedies require only fresh material (Van Wyk *et al*., 2009). Both fresh and dried plant material is processed by chopping, squeezing or powdering (Yineger *et al*., 2008). Fresh material does not have a long shelf life and can be contaminated by fungi which may produce mycotoxins therefore much plant material is dried (Shastry, 2002). This can be done directly in the sun or in shade. Bulbous and rhizomatous parts are cut into slices to facilitate quicker drying (Van Wyk *et al*., 2009). Once dried, material is then stored in newspaper, paper bags, glass jars and tin cans as well as plastic containers, as is, or in powdered form, in the traditional healers' consulting rooms (Birdi *et al*., 2006) (Fig. 3.2).

Post-harvest storage of medicinal plants has been poorly researched in southern Africa. This is an important aspect as without correct storage procedures plant material can decompose and is subject to microbial and insect attack (Fennell *et al.,* 2004). Van Staden *et al.* (2004) stated that most pre-storage processing of plant material, such as drying, heating, cooling and packaging can prevent the degradation of plant material during storage. Care should be taken with drying as heat can, in some cases, aid chemical degradation.

Figure 3.2. A consulting room with displayed jars of processed plant material in Inveraan village, Blouberg, Limpopo Province.

The shelf life of plant material is usually ignored by traditional healers as they believe that the plant material keeps its healing powers indefinitely. In contrast, it was shown that dried plant materials usually retain their activity for only about six months (Birdi *et al.*, 2006).

3.2.6 Legislation

Although South Africa did lag behind other African countries in recognising traditional medicine and establishing structures for traditional medicine and traditional healers according to Richter (2003), steps have since been taken to rectify this. The Traditional Health Practitioners Bill (Bill No. 24704 of 2003) provides for the establishment of an Interim Traditional Health Practitioners Council of the Republic of South Africa; this ensures a regulatory framework to ensure compliance on the efficacy, safety and quality of traditional health care services, for control over the registration, training and practice of Traditional Health Practitioners and to provide for matters related to these points.

The Traditional Health Practitioners Act (Act No. 35 of 2004) provides for the registration, training and practice of traditional health. It also serves and protects the interest of members of the public who use the services of traditional health practitioners and students engaged in or learning traditional health practice in the Republic of South Africa.

Then in 2006 the South African government took steps towards the official recognition and institutionalisation of African Traditional Medicine. These included the establishment of a Directorate of Traditional Medicine in 2008 to co-ordinate and manage initiatives regarding African Traditional Medicine within the Department of Health. In addition, the Traditional Health Practitioners Act (No. 22 of 2007) came into effect, which established the Traditional Health Practitioners Council.

For traditional healers or communities, the costs of compiling a patent registration in South Africa, is expensive as are the costs of enforcement and infringement proceedings. The Patents Amendments Act was amended to incorporate the provisions of the Biodiversity Act. The Patents Amendment Act (Act No. 20 of 2005) provides for some protection for indigenous genetic material, indigenous biological resources, traditional knowledge and the way in which an indigenous community uses an indigenous biological resource or a genetic resource (DEAT, 2005).

According to Lange (1998), while legislation and regulations exist at provincial, national and international levels to protect taxa and restrict activities and trade involving threatened or protected species, in many cases conservation measures only begin once a species has already become threatened.

Medicinal plants can be viewed not only as problems from the conservation perspective but also more positively as conservation opportunities (SANBI, 2006). This is because the actual value of these plants for health care, income and/or cultural identity carries the potential for them to act as motivating forces for conservation for the species themselves and their habitats since other non medicinal species will be growing in the conserved habitats. However, a special section in the legislation needs to be developed to deal with medicinal plants alone, as their status as a community resource is unique and has not been recognised in current environmental acts (Moeng, 2010).

South Africa is a signatory to Trade Related Intellectual Property (TRIPS), and the protection of aspects of Indigenous Knowledge Systems (IKS) within the context of trademarks is possible within this framework. Protection of IKS is also possible within its own kind of legislation in respect of the rights of Indigenous Knowledge (IK) holders. Protection of IKS is therefore feasible under TRIPS agreements (DST, 2011).

3.2.7 Conservation

In order to ensure the long-term maintenance of biodiversity within conservation areas, these areas must conserve not only the biodiversity pattern, but also the natural processes that control and maintain them (Balmford *et al.,* 1998). The ultimate goal of any medicinal plant conservation process should be to preserve the natural habitats of these species and to achieve sustainable exploitation in less vulnerable areas (Cunningham, 1993). If this cannot be achieved, then according to Rukangira (2001), African medicinal plant resources may be doomed to extinction due to the threats on natural resources. Thus, the sustainable management of traditional medicinal plant resources is important, not only because of their value as a potential source of new drugs, but due to rural people's reliance on traditional medicinal plants for their primary health care (Cunningham, 1993). Various management strategies focusing on medicinal species are in play today. The most prominent of these are cultivation and community empowerment through Community-based Natural Resource Management (CBNRM) (Barber *et al*., 2004).

Cultivation of alternative sources of popular and high conservation priority species outside of core conservation areas is essential. According to Struhsaker (1998), one of the most misunderstood and misused concepts in today's conservation area is that of sustainable harvesting. The concept refers to activities that involve the extraction of natural resources in such a way that they are not decreased and can continue to be harvested indefinitely (Struhsaker, 1998). This can be done through CBNRM which can be used to facilitate the establishment of medicinal plant gardens, nurseries and farms (Rukangira, 2001). In addition seed and gene banks of vulnerable medicinal plant species can be maintained as a precaution and backup against extinction (Cunningham, 1993).

3.3 AIM AND OBJECTIVES

3.3.1 Aim

This study aimed to understand the context in which traditional healers operate around Blouberg Mountain with respect to social demographics and plant collection.

3.3.2 Objectives

The objectives of this study were to:

a) Investigate the demographics of traditional healers.

b) Document aspects related to traditional healers' collection of plants such as methods used to collect, plant species involved, plant parts used and the perceived conservation status of the plants.

c) Document storage and packaging of plant material in consulting rooms.

c) Research the legislative environment in which traditional healers operate, and their perceived attitude towards it.

3.4 MATERIALS AND METHODS

3.4.1 Sampling of villages and healers

A total of 16 villages were selected for the study. Two traditional healers from each village volunteered to take part in the study. Table 3.1 and Figure 3.3 indicate the names of these villages and their locations around Blouberg Mountain.

Table 3.1. Villages from which traditional healers were selected.

A	Blackhill	E	Bull Bull	I	Springfield	M	Kwarung
B	Inveraan	F	Varedig	J	Sweethome	N	Bosehla
C	Bobeng	G	Stockings	K	Liepsig	O	Dantzig
D	Normandy	H	Glenfernest	L	Mafateng	P	The Glade

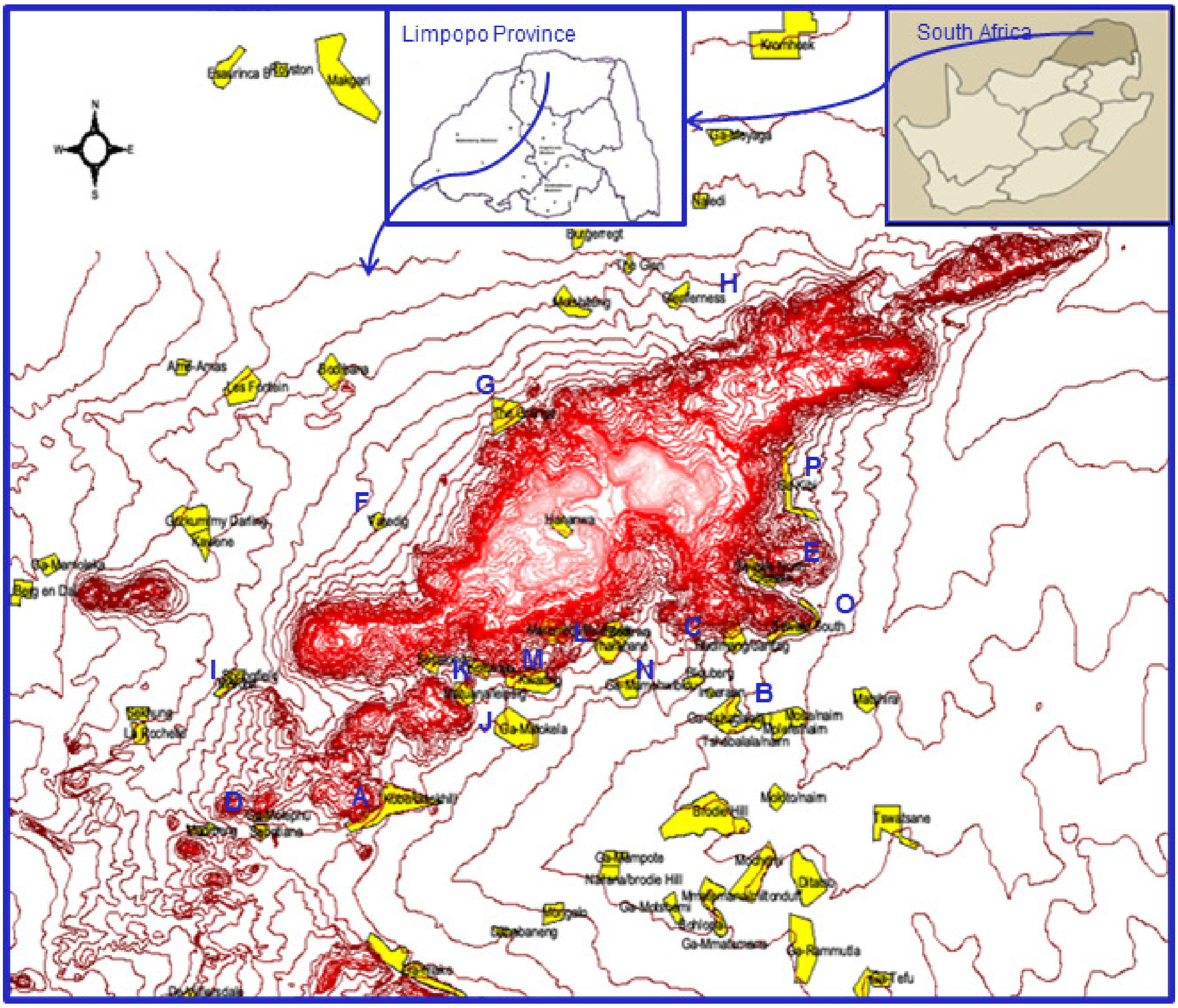

Figure 3.3. Map of Blouberg Mountain, in the Limpopo Province, South Africa, indicating the 16 villages from which each track originated. The map is modified from unpublished data provided by the Limpopo Department of Economic Affairs, Environment and Tourism, 2011.

3.4.1.1 Villages

All sixteen villages surrounding the Blouberg Mountain were chosen for the study. These villages are adjacent to each other and are also the closest villages to the mountain, being within walking distance of the foothills. Villages further away were not used as there would then be the possibility that people residing in these villages do not use the mountain as the closest source of medicinal plants. Therefore, the data obtained from this study is an under representation, as the possibility exists that traditional healers from villages located further from the mountain might also utilise this resource.

3.4.1.2 Healers

All healers in each of the 16 selected villages were invited to participate in this study. Thirty two healers (two per village) volunteered to supply information on methods of collection and use of medicinal plants, although more healers were present in the villages.

3.4.1.3 Consulting rooms

Sixteen consulting rooms (Fig. 3.4) were chosen from the 16 sampled villages. Permission was obtained from the healers to enter the consulting room and take pictures. Certain cultural procedures, such as removing shoes, the healer sniffing snuff and talking to the ancestors were followed before entering the consulting room.

Figure 3.4. A typical consulting room in Blackhill village.

3.4.2 Initial interviews and semi-structured questionnaire

3.4.2.1 Initial interviews

Face-to-face meetings were held with the traditional healers. The purpose of the meetings was to introduce the project, to determine how active traditional healers were in the area and to enlist them for the study. Their tasks were to accompany the researcher to the mountain to indicate the route of their most utilised collection track and to specify and collect the medicinal plants usually gathered from the track (see section 3.5).

3.4.2.2 Semi-structured questionnaire

The semi-structured questionnaire (Appendix A) was designed in English, and translated into and asked in Sepedi in order to overcome the language barrier. By default, the study focused on the Ba-Pedi tribe, as only Pedi traditional healers volunteered for the study, even though there are also Venda traditional healers in the area. The questionnaire was divided into sections related to various aspects of traditional healers and medicinal plants. The following aspects were investigated: General and personal information, collection of medicinal plants, patient consultation, legislation and conservation. This was done to fully comprehend the environment in which traditional healers operate. Although an attempt was made to quantify plant material removed from the mountain (see Appendices B & C), the healers were reluctant to reveal these details and this information could not be adequately captured.

3.4.3 Data collection sheet

The following information was recorded on a data collection sheet (Appendix B): Botanical and vernacular names of the medicinal plants, vegetation type, habitat, parts used, harvesting method and replacement value of plant species as well as perceived rarity of collected material. Observations of the method of collection were made. Photographs were taken during the course of walking the collection tracks.

Consulting rooms were visited to obtain information via the data sheet (Appendix C) on the amount of plant material collected from the mountain. However, information was not provided in a quantifiable manner (i.e. handful, bag full, plastic) as healers were unwilling to disclose this information. Healers were also asked to list all plant material available in the consulting rooms that were collected from the mountain, as well as information on packet sizes, harvesting methods, replacement value of plant and perceived rarity.

3.4.4 Plant collection and identification

Photographs were taken of the plants before (Fig. 3.5a) and after (Fig. 3.5b) harvesting. This was done in order to document whether sustainable harvesting was taking place or not.

Figure 3.5. Harvesting of bark from *Pleurostylia capensis* on Blouberg Mountain: (a) Before harvesting and (b) After harvesting.

Dried specimens of the plants collected from the Blouberg Mountain during the survey were taken to the Larry Leach Herbarium at the University of Limpopo for final identification. Consulting room specimens were difficult to identify as plants were already processed (ground or chopped) by traditional healers, resulting in an incomplete scientific name list for Table 3.2. Published literature was used to confirm some of the common and scientific names.

3.4.5 Data processing and analysis

Data obtained from the questionnaire (Appendix A), datasheet (Appendix B) and consulting rooms (Appendix C) were analysed by means of descriptive statistics.

3.5 RESULTS

3.5.1 Demographics of healers

Eighty percent of the healers in the villages were females (Fig. 3.6). Sixty four percent have no formal education, 32% went to primary school and only 4% managed to reach secondary school. Twenty nine percent have less than 10 years of experience in traditional healing, 21% have between 11 and 20 years, 7% between 21 and 30 years, and 43% have more than 30 years of experience. The years of experience correspond to their years of residence in the community they currently serve.

Figure 3.6. Female traditional healers from the Glade village.

3.5.2 Traditional healing

Seventy nine percent of the respondents see between 15 and 20 patients per month, 7% see between 21 and 30, 7% see more than 30, with another 7% that do not see a single patient a month. Reasons put forth by traditional healers as to why they see so few patients have to do with the large number of traditional healers in the area, the uneven use of healers due to favoritism, and that community members visit hospitals and clinics, and use allopathic medicine through western doctors.

3.5.3 Plant collection and harvesting

Eighty two percent of informants collect plants as part of a general collection trip, thus targeting a number of species. Eighteen percent collect for a specific purpose; that is collecting targeted species to match a specific remedy. Eighty two percent of healers collect medicinal plants themselves, with 18% sending people to collect for them or buying from collectors within the area. The researcher had difficulties in obtaining the exact amount of plant material collected from the mountain, as healers were estimating the amounts collected, rather than being exact. Most healers were also reluctant to supply this information, indicating only that they collect on the mountain and from nearby fields.

Although there are many collection sites that healers use, some are not regularly visited as they are difficult to reach during the rainy season and because of prevailing traditions and taboos. The vast majority (96%) of interviewees indicated that it is difficult to collect in winter as most plant parts such as leaves and fruits are not visible, which makes certain species difficult to identify. During autumn and summer, healers collect more plants, because plants are more visible and easier to identify. It is also more convenient to dig up bulbs or geophytes when the surface is moist after summer rains (Fig. 3.7). When collecting plants, healers often collect different types of species and group them together.

Figure 3.7. *Ammocharis coranica* that was dug up from Bobeng village during the summer season.

Medicinal plants were harvested from a variety of habitats (Table 3.2). Twenty eight medicinal plants were harvested from the mountain peak, 16 from the mountain slope, and one each from a swamp and a river. One species was harvested from the mountain peak as well as the slope while another species was collected from a donga and the mountain slope.

Various tools are used when harvesting, although some healers do not use tools at all. For harvesting of bark, a rock (Fig. 3.8) or an axe (Fig. 3.9) is traditionally used. A stick is commonly used to dig up roots (Fig. 3.10), but this also depends on the type of plant and soil. The roots of herbs or small shrubs are generally uprooted (Fig. 3.11). The leaves, which are seldom used, are none the less harvested by picking the upper leaves by hand or by cutting down a whole branch to obtain the leaves (Fig. 3.12).

When harvesting bulbs, only a few are collected (Fig. 3.13), not the entire community, thus, even though the entire plant is removed through uprooting, the population is not destroyed. Bark harvesting was observed to be sustainable on the whole as strip barking was undertaken. Ring barking was not observed and neither was the felling of trees for removal of the entire bark. However, excessive harvesting and chopped trunks of some species was observed, for example *Cassia abbreviata* (Fig. 3.14) and (Fig. 3.15).

Figure 3.8. A healer harvesting the bark of *Pleurostylia capensis* using a rock.

Figure 3.9. A female healer from Bull Bull village harvesting bark using an axe.

Figure 3.10. A healer from Springfield village digging up roots by using a stick.

Figure 3.11. Plants being uprooted.

Figure 3.12. A whole branch is broken to obtain leaves.

Figure 3.13. *Boophane disticha* being uprooted.

The researcher observed that some traditional healers perform rituals before harvesting plants in order to secure good quality medicinal plants and to please the ancestors. For example, snuff is sprinkled around the base of the trunk of *Securidaca longepedunculata* before harvesting the roots. Another belief is that if the roots of a plant are not covered after a portion of the root stock has been removed, the patient treated with that plant will not get better, and if the plant dies, the patient treated with that plant will also die.

3.5.4 Species utilisation

Sixty four medicinal plant species were documented as being used by the Blouberg traditional healers (Table 3.2). Of these plants, 25 species were collected only on the Blouberg Mountain tracks, and 16 documented only from the consulting rooms. Twenty three species were recorded from both tracks and consulting rooms. Twenty seven families and 43 genera were represented by those species identified.

Figure 3.14. Severely stripped bark of *Cassia abbreviata.*

Figure 3.15. Chopped down trunks of *Cassia abbreviata.*

Table 3.2. List of species collected from the Blouberg Mountain (A) and species found in consulting rooms (B), their habitat, conservation status and harvesting methods.

Scientific name	Vernacular name (Sepedi)	Family	Vegetation	Habitat	Growth form	Parts used	Where the plant was found A, B or A&B	Harvesting methods
Abrus precatorius	Mphithi	Fabaceae	*	*	Climber	Seeds	B	Collect seed
Ammocharis coranica	Mpitika	Amaryllidaceae	Forest	Mountain peak	Geophytes	Bulb	A	Uproot
Asparagus exuvialis	Mphatlalatsamaru	Asparagaceae	Forest	Mountain peak	Perennial herb	Roots	A & B	Uproot
Berchemia zeyheri	Mokee	Rhamnaceae	Forest	Mountain peak	Tree	Bark	A	Strip bark
Blepharis diversispina	Mookapitsi	Acanthaceae	Woodland	Mountain slope	Herb	Roots	A & B	Uproot
Bolusanthus speciosus	Morara	Fabaceae	Grassland	Mountain peak	Tree	Bark	A & B	Strip bark
Cadaba aphylla	Monnamoso	Capparaceae	Forest	Mountain slope	Shrub	Roots	A & B	Uproot
Callilepis laureola	Phela	Asteraceae	*	*	Shrub	Roots	B	Uproot
Callilepis salicifolia	Phelana	Asteraceae	*	*	Shrub	Roots	B	Uproot
Capparis sepiaria	Moopatladi	Capparaceae	Forest	Mountain peak	Shrub	Roots	A & B	Uproot
Carissa edulis	Mothokolo	Apocynaceae	Grassland	Mountain peak	Tree	Roots	A	Uproot
Cassia abbreviata	Monepenepe	Fabaceae	Forest	Mountain slope	Tree	Bark	A & B	Strip bark
Cassytha filiformis	Leakalala	Lauraceae	Grassland	Mountain peak	Climber	Bulb	A	Uproot
Catha edulis	Letlhatsi	Celastraceae	Forest	Mountain peak	Tree	Roots	A & B	Uproot

Scientific name	Vernacular name (Sepedi)	Family	Vegetation	Habitat	Growth form	Parts used	Where the plant was found A, B or A&B	Harvesting methods
Clivia caulescens	Maime	Amaryllidaceae	Forest	Mountain peak	Perennial	Roots	A & B	Uproot
Corchorus tridens	Thelele	Tiliaceae	Wooded grassland	Mountain slope	Herb	Whole plant	A	Uproot
Dichrostachys cinerea	Moselesele	Fabaceae	Forest	Mountain peak	Deciduous shrub	Roots	A	Uproot
Elaeodendron transvaalense	Monamane	Celastraceae	*	*	Tree	Bark	B	Strip bark
Elephantorrhiza burkei	Mosijana	Fabaceae	Forest	Mountain peak	Tree	Roots	A & B	Uproot
Erythrina lysistemon	Mmale	Fabaceae	Forest	Mountain slope	Tree	Bark	A	Strip bark
Eucomis pallidiflora	Mathubadifala	Asparagaceae	*	*	Dwarf shrub	Bulb	B	Uproot
Garcinia gerrardii	Tsebedintlha	Clusiaceae	Forest	Mountain peak	Tree	Leaves	A & B	Cut leaves
Hypoxis hemerocallidea	Thithikwane	Hypoxidaceae	*	*	Perennial	Rhizome	B	Uproot
Jatropha spicata	Modumelana	Euphorbiaceae	Forest	Mountain peak	Tree	Bark & roots	A	Strip bark & uproot
Lannea schweinfurthii	Bolebatsa	Anacardiaceae	Forest	Mountain slope	Tree	Roots	A & B	Uproot
Maerua juncea	Diraga di bonwe	Capparaceae	Forest	Mountain peak	Shrub	Roots	A	Uproot
Myrothamnus flabellifolius	Morotelatshweni	Myrothamnaceae	Forest	Mountain peak	Dwarf shrub	Whole plant	A & B	Uproot

Scientific name	Vernacular name (Sepedi)	Family	Vegetation	Habitat	Growth form	Parts Used	Where the plant was found A, B or A&B	Harvesting methods
Osyris lanceolata	Mphera	Santalaceae	Woodland	Mountain slope	Shrub	Roots	A & B	Uproot
Ozoroa sphaerocarpa	Monoko	Anacardiaceae	*	*	Tree	Roots	B	Uproot
Pappea capensis	Morobadiepe	Sapindaceae	Woodland	Mountain peak	Tree	Bark & leaves	A & B	Strip bark & cut Leaves
Philenoptera violaceae	Mphata	Fabaceae	Forest	Mountain peak	Tree	Bark	A & B	Strip bark
Pleurostylia capensis	Moromelela	Celastraceae	Forest	Mountain peak	Tree	Bark & Roots	A & B	Strip bark & uproot
Plumbago auriculata	Mashegomabe	Plumbaginaceae	*	*	Shrub	Roots	B	Uproot
Pyrenacantha grandiflora	Bjere	Icacinaceae	Woodland	Mountain slope & donga	Shrub	Whole plant	A & B	Uproot
Pyrostria hystrix	Molebatsa	Rubiaceae	Forest	Mountain slope	Tree	Roots	A	Uproot
Securidaca longepedunculata	Mpesu	Polygalaceae	Forest	Mountain peak	Tree	Roots	A & B	Strip bark & uproot
Spirostachys africana	Morekhure	Euphorbiaceae	Woodland	Mountain peak	Tree	Bark	A	Strip bark
Syzygium guineense	Monthlo	Myrtaceae	Woodland	River or stream	Tree	Bark	A	Strip bark
Talinum caffrum	Phonyoga bamphethe	Portulacaceae	Grassland	Mountain slope	Dwarf shrub	Bulb	A & B	Uproot
Tarchonanthus camphoratus	Moologa	Asteraceae	Woodland	Mountain slope	Tree	Roots	A	Uproot

Scientific name	Vernacular name (Sepedi)	Family	Vegetation	Habitat	Growth form	Parts Used	Where the plant was found A, B or A&B	Harvesting Methods
Warburgia salutaris	Molaka	Canellaceae	Woodland	Mountain slope	Tree	Bark & Leaves	A & B	Strip bark & cut leaves
Ximenia africana	Motshidi	Olacaceae	Woodland	Mountain slope	Tree	Seed	A	Collect seed
Ximenia caffra	Motshidi mpitswana	Olacaceae	Woodland	Mountain slope	Tree	Seed	A & B	Collect seed
Zanthoxylum capense	Monokwane	Rutaceae	Forest & woodland	Mountain peak & slope	Tree	Roots	A & B	Uproot
Ziziphus mucronata	Mokgalo	Rhamnaceae	*	*	Tree	Roots	B	Uproot
Unidentified 1	Letlhole	Unidentified	Forest	Mountain peak	Tree	Bark	A & B	Strip bark
Unidentified 2	Mokunye	Unidentified	*	*	*	Bulb	B	Uproot
Unidentified 3	Mokhutatsela	Unidentified	*	*	*	Roots	B	Uproot
Unidentified 4	Momoko	Unidentified	*	*	*	Roots	B	Uproot
Unidentified 5	Moogelwa	Unidentified	*	*	*	Roots	B	Uproot
Unidentified 6	Moohlo	Unidentified	*	*	*	Bark	B	Strip bark
Unidentified 7	Motlhatlhane	Unidentified	*	*	*	Roots	B	Uproot
Unidentified 8	Motlogapele	Unidentified	*	*	*	Roots	B	Uproot

Scientific name	Vernacular name (Sepedi)	Family	Vegetation	Habitat	Growth form	Parts Used	Where the plant was found A, B or A&B	Harvesting methods
Unidentified 9	Majana	Unidentified	Grassland	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 10	Mphaba	Unidentified	Forest	Mountain peak	Tree	Bark	A	Strip bark
Unidentified 11	Phayabashimane	Unidentified	Woodland	Swamp	Shrub	Rhizomes	A	Uproot
Unidentified 12	Mokgodiane	Unidentified	Grassland	Mountain slope	Tree	Leaves & roots	A	Cut leaves & uproot
Unidentified 13	Koba	Unidentified	Forest	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 14	Moopyane	Unidentified	Forest	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 15	Mokhubjane	Unidentified	Forest	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 16	Mamarela	Unidentified	Forest	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 17	Bopa	Unidentified	Grassland	Mountain slope	Shrub	Whole plant	A	Uproot
Unidentified 18	Moselekgwale	Unidentified	Forest	Mountain peak	Shrub	Roots	A	Uproot
Unidentified 19	Meswarokgane	Unidentified	Forest	Mountain slope	Shrub	Flowers	A	Flower picking

A= Collected on the mountain, B= Found in consulting room, A & B= Collected from the mountain and found in consulting room.
* Indicates that the species were not collected from the mountain, but recorded from the consulting room, hence there is no data for the vegetation type and habitat of that species

Of the species found in consulting rooms (Table 3.3), *Capparis sepiaria, Osyris lanceolata*, *Pleurostylia capensis*, *Pyrenacantha grandiflora*, *Warburgia salutaris* and *Zanthoxylum capense* were the most preferred and highly used medicinal plants recorded. Preference was based on plants used most often on patients.

Table 3.3. Plants found in consulting rooms in order of frequency.

Frequency of use	**Scientific name**	**Vernacular Name**
10	*Warburgia salutaris*	Molaka
10	*Zanthoxylum capense*	Monokwane
8	*Osyris lanceolata*	Mphera
6	*Pleurostylia capensis*	Moromelela
5	*Capparis sepiaria*	Moopatladi
4	*Bolusanthus speciosus*	Morara
4	*Elaeodendron transvaalense*	Monamane
4	*Pyrenacantha grandiflora*	Bjere
3	*Asparagus exuvialis*	Mphatlalatsamaru
3	*Blepharis subvolubilis*	Mookapitsi
3	*Elephantorrhiza burkei*	Mosijana
3	*Eucomis pallidiflora*	Mathubadifala
3	*Garcinia gerrardii*	Tsebedintlha
3	*Pappea capensis*	Morobadiepe
3	*Securidaca longepedunculata*	Mpesu
3	Unidentified 3	Mokhutatsela
3	Unidentified 8	Motlogapele
2	*Cadaba aphylla*	Monnamoso
2	*Talinum caffrum*	Phonyogabamphethe
1	*Abrus precatorius*	Mphithi
1	*Callilepis laureola*	Phela
1	*Callilepis salicifolia*	Phelana
1	*Cassia abbreviata*	Monepenepe
1	*Catha edulis*	Letlhatsi
1	*Clivia caulescens*	Maime
1	*Hypoxis hemerocallidea*	Thithikwane
1	*Lannea schweinfurthii*	Bolebatsa
1	*Myrothamnus flabellifolius*	Morotelatshweni
1	*Ozoroa sphaerocarpa*	Monoko
1	*Philenoptera violacea*	Mphata
1	*Plumbago auriculata*	Mashegomabe
1	*Ximenia caffra*	Motshidimpitswana
1	*Ziziphus mucronata*	Mokgalo
1	Unidentified 1	Letlhole
1	Unidentified 2	Mokunye
1	Unidentified 4	Momoko
1	Unidentified 5	Moogelwa
1	Unidentified 6	Moohlo
1	Unidentified 7	Motlhathlane

Trees are mostly harvested for their bark rather than for their roots. Shrubs and herbs are preferred for their roots, with a few species such as *Garcinia gerrardii* being targeted for their leaves. On Blouberg Mountain, roots are the plant parts that are predominantly used (50.8%), followed by bark (17.5%), especially that of *Cassia abbreviata* which is severely harvested (Fig. 3.14). *Cassia abbreviata* is, according to the healers, one of the species in decline due to over harvesting of its bark by both healers and local people around Blouberg Mountain (Fig. 3.15). Other underground parts like bulbs and rhizomes are also popular (11.1%). In certain cases the whole plant is harvested (6.3%) while a combination of plant parts is also used for e.g. bark with roots and or leaves, and roots and leaves (7.9%). Above ground plant parts such as leaves, flowers and seeds, are harvested to a lesser degree (6.4%).

According to 59% of traditional healers 24 plant species are in decline (Table 3.4). These plant species include those mentioned by the healers in the questionnaire (Appendix A) but not all of them were collected on the tracks or found in consulting rooms. Of these species, 18 were identified, with 6 known only by their vernacular names as they were not collected on the tracks or noted in the consulting rooms. Healers ranked the following plants as declining and scarce on Blouberg Mountain: *Capparis sepiaria*, *Hypoxis hemerocallidea*, *Osyris lanceolata*, *Siphonochilus aethiopicus* and Tlhokwa la tsela.

Table 3.4. Plant species in decline around Blouberg Mountain as perceived by healers compared with information from the South African National Biodiversity Institute's Red Data List (SANBI, 2011).

Scientific name	**Vernacular name**	**Red Data List 2011**
Artemisia afra	Lengana	LC
Boophane disticha	Mokgekolo	DECLINING
Cadaba aphylla	Monnamoso	LC
Capparis sepiaria	Moopatladi	LC
Cassia abbreviata	Monepenepe	LC
Clivia caulescens	Maime	LC
Cocculus hirsutis	Mokgwoe	*NE
Corchorus tridens	Thelele	*NE
Elephantorrhiza burkei	Mosijana	LC
Eucomis pallidiflora	Mathubadifala	LC
Garcinia gerrardii	Tsebedintlha	LC
Hypoxis hemerocallidea	Thithikwane	DECLINING
Osyris lanceolata	Mphera	LC

Scientific name	Vernacular name	Red Data List 2011
Peltophorum africanum	Mosetlha	LC
Pleurostylia capensis	Moromelela	LC
Pyrenacantha grandiflora	Bjere	LC
Siphonochilus aethiopicus	Serokolo	CR
Zanthoxylum capense	Monokwane	LC
Unidentified 20	Gashi	Unknown
Unidentified 21	Lehwama	Unknown
Unidentified 22	Mokhufi	Unknown
Unidentified 3	Mokhutatsela	Unknown
Unidentified 23	Phindamshaye	Unknown
Unidentified 24	Tlhokwa la tsela	Unknown

LC (Least Concern), CR (Critically Endangered) and NE (Not Endangered).

* Indicates that the species are naturalised exotics.

3.5.5 Storage and packaging

Medicinal plants are stored unprocessed or processed depending on the healers' preference (Fig. 3.16 and Fig. 3.17). Plants are processed either by grinding or by chopping. Processed plant material is then left in the sun to dry, before being stored in consulting rooms.

Figure 3.16. Unprocessed plant material collected from the mountain stored in one of the consulting rooms in Kwarung village.

Figure 3.17. Processed plant material in a consulting room at Blackhill village.

Some traditional healers store processed material in glass and/or plastic containers, tins (Fig. 3.18) and buckets (Fig. 3.19a). Plastic containers and cardboard boxes are preferred over glass containers because they result in less moisture build-up (Fig. 3.19b). Dry plants, uncontaminated by fungi, are viewed as more potent than fresh plants, which tend to rot.

Figure 3.18. Medicinal plants processed and stored in different plastic containers and tins in a consulting room at Kwarung village.

Figure 3.19. Processed plant material stored in (a) Different plastic buckets, containers and (b) Boxes.

Packaging of plant material for sale differs from healer to healer with some preferring to use newspapers and others plastic (Fig. 3.20). Healers who use newspapers for their packaging mentioned that newspapers keep the plant material dry, unlike plastic containers which can sometimes result in rotting of the plant material. Healers prescribe medicine either as a single species or a mixture of different plant species that can be either unprocessed or partially processed. The traditional healer's instructions on the packaging should be followed to avoid rapid decomposition and rotting of the material.

Figure 3.20. Plastic bags and newspapers used for packaging of plant material.

3.5.6 Legislation

The low level of literacy of the Blouberg community results in a tendency of the people to shy away from sources of written information. The result is that none of the questioned healers had any knowledge of the various national or provincial environmental laws relating to medicinal plants or about Red Data species. The traditional healers were also unaware of any medicinal plants that need protection.

Ninety percent of the healers interviewed were registered with the Traditional Healers Association. These healers had membership cards so that they could enter the Blouberg Mountain reserves for collecting medicinal material. Ten percent felt that they did not need membership cards as they were not collecting from the restricted areas.

Eighty two percent of the interviewees had never been visited by the officials of the Traditional Healers Association (THA). For those that had been visited the following reasons were given for calling:

a) to check on the storage conditions,

b) to determine whether traditional association rules were followed (e.g. whether patients were given the correct dosage of the medicine and whether patients were told of their illness before being treated), and

c) to ascertain whether patients were generally well taken care of.

3.5.7 Conservation

Seventy one percent of the traditional healers would be satisfied if conservation authorities or the THA enforced restrictions on plant collecting to reduce over harvesting. The twenty two percent who were not in favour of harvest restrictions were of the opinion that it would then be a waste of time to go up the mountain to collect the small amount of plant material allowed. Seven percent felt indifferent.

Eighty six percent of the interviewees have noticed a change for the worst in the vegetation on the mountain over time. Attitudes to this change are captured in Figure 3.21.

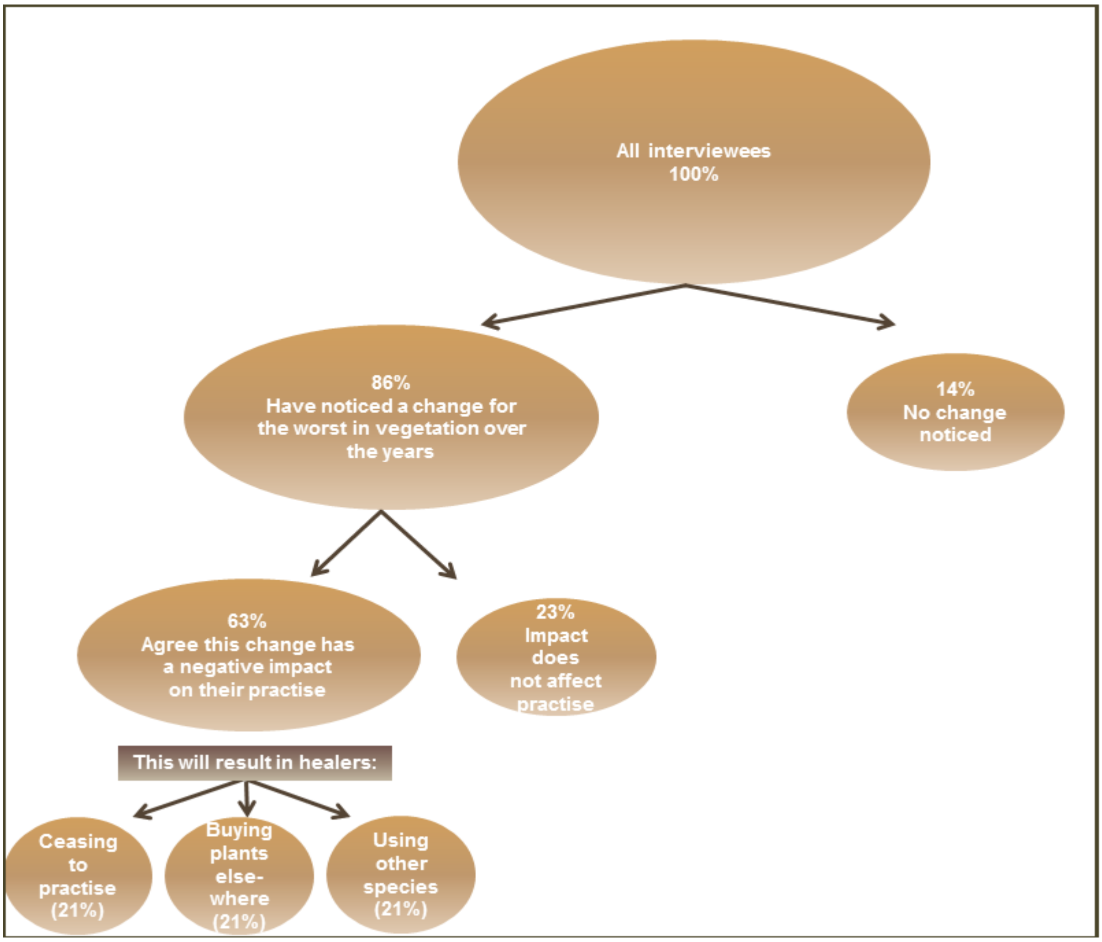

Figure 3.21. Perceptions that Blouberg Mountain traditional healers have regarding changes in vegetation on the mountain over time and their attitudes thereto.

The majority of the species collected by Blouberg healers are regarded as least concern according to the Red Data List (SANBI, 2011). However, 24 plant species (Table 3.4) are perceived to be declining by traditional healers from and around the mountain. Of these species *Clivia caulescens* and Tlhokwa la tsela were listed as rare on the western and south western side of Blouberg Mountain. However, Tlhokwa la tsela is perceived as abundant on the eastern side (Bull Bull, Dantzig and The Glade) of the mountain. *Boophane disticha* and *Hypoxis hemerocallidea* are both listed as declining by the Red Data List (SANBI, 2011) while *Siphonochilus aethiopicus* is listed as criticially endangered. These three species are also listed as declining by the Blouberg traditional healers (Table 3.4). *Warburgia salutaris* a critically endangered species (SANBI, 2011) is however not under threat according to the healers. *Catha edulis*, *Elaeodendron transvaalense*, *Philenoptera violacea*, *Securidaca longepedunculata* and *Warburgia salutaris* used by Blouberg Mountain traditional healers are protected under the National Forestry Act (Act No. 84 of

1998). *Capparis sepiaria* is protected under Limpopo Environmental Management Act (LEMA) (2004) however it is listed as least concern in the Red Data List (SANBI, 2011). *Siphonochilus aethiopicus* is protected under LEMA (2004) and listed as critically endangered in the Red Data List (SANBI, 2011).

Ninety three percent of the interviewed traditional healers would use cultivated plants if available and would even appreciate a nursery in their area. The minority who would not use cultivated plants believe that these plants are less powerful than wild grown ones. Eighty nine percent of the informants believe that they use correct harvesting methods and 11% have home gardens where a number of species are grown.

3.6 DISCUSSION

3.6.1 Demographics of healers

According to Truter (2007), approximately 90% of healers in Africa are male, this is corroborated by the findings of Moeng (2010), which revealed that 81% of traditional healers in the Limpopo Province are males. However, gender dominance depends on the area, as the majority of interviewed healers from Blouberg were females. Moeng (2010) stated that a possible reason for the provincial gender dominance could be that the collection of medicinal plants may be risky for women as most plants are found in mountainous areas which necessitate physical efforts during plant collection. Blouberg is also a mountainous area and yet female traditional healers dominate. In this sense, Blouberg is more similar to other areas in Africa such as the Cameroon where women know medicinal plants better than men and younger people (Betti, 2004), and in Kenya where the use of plant medicine is also mainly a female domain (Geissler *et al*., 2002). The Blouberg female healers thus contribute to conservation and sustainable use of medicinal plants and biodiversity as a whole as described by Resurreccion and Elmhirst (2008) for Asia, and their experiences and practices form an important part of the local indigenous knowledge.

The traditional healers from the study area are largely senior citizens, with the majority having more than 30 years of experience in traditional healing. Most of them have no formal education, and only the minority have secondary school education.

The majority of the practicing traditional healers grew up in this area, and as such they would have been subjected to the poor socio-economic conditions prevalent at the time of their schooling. Because of this low level of literacy they tend to shy away from sources of written information, with the result that none of the questioned healers had any knowledge of the various national or provincial environmental laws. The lack of formal education amongst healers is an impediment to their understanding of environmental issues and the ability to tackle such problems. The fact that the majority of healers in the sampled villages around Blouberg Mountain are illiterate makes it even more difficult for the community to implement conservation initiatives. According to Statistics SA (2007), Limpopo Province is regarded as one of the poorest provinces in the country, where poverty is common and high unemployment rates prevail. This may be the result of the very high illiteracy rate, which is the highest in Limpopo Province (Blouberg Municipality, 2005/2006).

The future of traditional healing in the area is dependent on younger people filling the ranks, however, majority of the healers in Blouberg are old, over 65 years of age and it seems that younger people are not being trained, thus healing around Blouberg Mountain area, contrary to what is happening in the rest of the country, may be on the decline. Most young people move away to get work elsewhere (Fourie, 2006), and even if they become healers, may not service this area.

3.6.2 Traditional healing

Traditional healers noted their concern about the low number (average 15 per month) of patients that consult them. The reason for this low number could be the fairly large number of traditional healers in the area as well as the presence of a hospital and a number of clinics. In the Blouberg Mountain area, western medicine has begun to replace traditional medicine, due to a number of factors, resulting in a gradual decline in the services provided by traditional healers. One reason for the decline in the number of people consulting healers could be the increased access to allopathic medicine. This means that indigenous knowledge around the way in which plants are used to treat disease could be lost if not documented. There is an opportunity to use traditional healers in the formal health sector as recommended by Thompson (1999) who noted that the integration of traditional healers into the formal health care system is a cost-effective way of providing primary health care to poor communities.

Cost could also be a contributing factor to the low consultation of traditional healers. Muela *et al.* (2000) stated that in Tanzania, people were willing to pay extra money for hospital care, as healers were charging them too much for their services, and that people resorted to traditional healers only when they felt that the treatments they received at local hospitals were not effective or could not treat their illnesses.

This decline of traditional healing has some long term positive and negative implications. On the positive side the decline in practicing traditional healers will probably lead to a drop in the volume of medicinal plant material being removed, although this study was not in a position to verify this statement. On the negative side, the decline in traditional healers' services could conceivably lead to a loss of valuable cultural knowledge. It is therefore of vital importance to document this knowledge before it is irretrievably lost. It is also possible that as the services of healers are utilised less, so the perceived value of medicinal plants drops, removing one incentive to protect them and leaving them vulnerable to local changes in land use.

3.6.3 Plant collection and harvesting

According to Williams (2007), bark is the most popular plant part harvested for traditional medicine in South Africa. However, this is not the case around Blouberg Mountain, where roots are the most harvested plant part. This preference for roots by the majority of traditional healers in the Blouberg Mountain area can be ascribed to the belief that the roots are the parts that contain the most healing power. Findings from this study are similar to those from Zimbabwe where selective harvesting of roots for medicinal use is practiced (Mavi and Shava, 1997).

In the Blouberg Mountain area uprooting of herbs and small shrubs is a standard practice. Yineger and Yewhalaw (2007) noted that shrubs and trees are the most used and represented growth forms for remedy preparations. This could be due to the fact that these growth forms are available throughout all seasons as they are relatively drought resistant and are not affected by seasonal variations (Albuquerque, 2006). Cunningham (2001) concluded that it could be difficult to assess the extent to which harvesting affects underground plant parts. The impact on root damage depends on the type of root harvested, the physical state of the plant, the rooting depth and distance, and the intensity and frequency of damage affecting the plant. In Blouberg the roots are usually ritually covered by soil after harvesting. This protects the roots against drying and further damage by herbivores thus preventing the plant from dying and allowing for future harvesting. The uprooting of herbaceous and bulbous species such as *Asparagus exuvialis* has enormous consequences for population integrity and diversity. Bulbs and rhizomes used around Blouberg Mountain area include *Boophane disticha* and *Hypoxis hemerocallidea*, which are listed as declining in the wild (SANBI, 2011) and are slow-growing and therefore vulnerable to excessive harvesting.

Some of the species that are extensively harvested from the mountain are *Cassia abbreviata, Osyris lanceolata, Warburgia salutaris* and *Zanthoxylum capense. Warburgia salutaris* is used for coughs, colds and as a snuff for headaches (Van Wyk *et al.,* 2009). The species was recorded as vulnerable by Cunningham (1993) and 14 years later, was listed as endangered in KwaZulu-Natal in 2006 by the IUCN, and by the Red Data List (SANBI, 2011), which means that harvesting and utilisation of the species has increased. The situation for this species appears to be similar in Kenya, where Kokwaro (1991) recorded that some of the largest *W. salutaris* trees in the forests have died due to ring-barking. The bark of *W. salutaris* is so much in demand that trees in protected areas are often stripped and destroyed by collectors (Maroyi, 2012). Cunningham (1989) stated that debarking of species such as *W. salutaris* causes more damage to the plant than harvesting its leaves and fruits. Moeng (2010) therefore recommended that plant part substitution should form the basis of any public awareness programme on medicinal species.

Cassia abbreviata is extensively harvested for its bark, which is used by healers and local people around Blouberg area to treat blood disorders and for blood purification. This is in line with findings by Cunningham (1993) that *C. abbreviata* is over harvested in southern Africa because of its use in the treatment of a large number of complaints such as stomach ailments and to treat venereal diseases. As such this species is vulnerable and declining in a number of southern African countries.

Mavi and Shava (1997) indicated that seeds were rarely used for medicinal purposes. When they are used as lucky charms, they are hung around the neck. This limited use of seeds allows for the perpetuation of plant species through seeding and should not have a major impact on plant population regeneration. In the Blouberg, seeds of an exotic species *Abrus precatorius* and those of *Erythrina lysistemon* are used as lucky charms and are often placed in pockets.

According to Van Wyk *et al.* (2009), taboos and social restrictions on gathering medicinal plants, and the nature of plant gathering equipment all serve to limit over harvesting of plant material (Cunningham, 1993). Although some healers are guided by their ancestors on where to collect plants, there are also practical factors that play a role in the collection, such as the locality on the mountain, and the most suitable time of the day (Gurib-Fakim, 2006). Around Blouberg Mountain, plants were mainly collected from the foot and peak of the mountain and alongside the chosen tracks. Rituals, taboos and beliefs form an integral part of traditional healers' harvest of medicinal species around Blouberg Mountain. This study found that *Capparis sepiaria* is only collected in winter because of a belief that summer harvesting causes storms and lightning. According to Moeng (2010), during winter months fewer roots are harvested when the aerial plant parts die back and the plant becomes less visible. Bulbs are harvested in the summer season as it is a time when there are flowers and the plants are easily identifiable.

Njoroge *et al.* (2010) noted that harvesting of natural resources is an economic activity recognised both locally and internationally. As such sustainable harvesting is increasingly seen to be the most important conservation strategy for wild-harvested species and their habitats, given their current and potential future contributions to local economies and their great value to harvesters over the long term (Schippmann *et al.,* 2002). Species that are most harvested, are also those that are most vulnerable, most popular, slow growing or slow to reproduce (Cunningham, 1993), or species with specific habitat requirements and a limited distribution. Sustainability of harvesting of medicinal plants is challenged by many factors, both from a social and ecological perspective (Ghimire *et al.,* 2004).

The vegetation in the Blouberg area is not only targeted for its medicinal plants, but also for firewood. The Capricorn District Municipality (2009) noted that local people around the Blouberg area still rely heavily on firewood as a fuel source due to a lack of alternative fuel sources and the limited supply of electricity in some of the villages. Plants are therefore targeted for fuel, food, livestock grazing and medicine. There is also anecdotal evidence that medicinal plants are targeted by collectors from outside Blouberg area (Shwatsa, P. & Morata, P. traditional healers from Inveraan and Blackhill, pers. com.). Harvesting of medicinal plants without permission is also of major concern. It is vital to verify the state of populations such as *Warburgia salutaris* where healers' perceptions in the area differ from documented information about their conservation status. The degree of over exploitation of species such as *W. salutaris* and *Cassia abbreviata* should be monitored so that effective conservation measures for these medicinal plants can be implemented (Cunningham, 1993).

3.6.4 Species utilisation

Healers around Blouberg Mountain use different parts of a plant for medicinal purposes with roots of species such as *Osyris lanceolata*, *Pyrenacantha grandiflora* and *Zanthoxylum capense* being mostly used. *Cassia abbreviata* and *Pleurostylia capensis* are harvested for their bark. Although the study found that the plant parts mostly used were roots, there was also a high percentage of bark used. As stated by Havinga (2006) more than half of the bark used in traditional medicine is derived from the Fabaceae. In this study most of the species collected around the mountain were also from the Fabaceae family.

From estimates by Mander *et al*. (2006), the average patient in South Africa consults a healer 4.8 times a year using approximately 157 g per treatment giving a total of more or less 750 g of plant material consumed per year. Considering that most healers in the Blouberg area see between 15 and 20 patients a month and that according to the local Traditional Healers Association, there are 90 healers operating in the Blouberg area, one can conservatively estimate the amount of material taken off the Blouberg Mountain per year using the following equation: 90 healers x 15 patients x 12 months = 16 200 patients using plant material via traditional healers per year. The estimated amount of plant material used per year on and around Blouberg Mountain is then: 16 200 x 750 g / 1 000 = 12 tonnes. Considering that 20 000 tonnes of medicinal plant material is harvested annually country wide in South Africa (Mander *et al.* 2006), 12 tonnes would seem a negligible amount. On the surface, traditional healers around Blouberg Mountain are not the main cause of plant destruction and for most species, harvesting of medicinal plant species can continue. Traditional healers around the Blouberg Mountain are nonetheless concerned that medicinal plants are being over utilised and this should be investigated further.

The following species were perceived as rare and some are recorded as mostly used and preferred in Blouberg: *Capparis sepiaria, Catha edulis*, *Eucomis pallidiflora, Securidaca longepedunculata, Siphonochilus aethiopicus* and *Tallinum caffrum*. *Securidaca longepedunculata* and *Siphonochilus aethiopicus* were recorded by Moeng (2010) as the most expensive, highly utilised and preferred species in other parts of Limpopo Province as well as being the most expensive plants traded in the *muthi* market and scarce in the informal market. The remaining species listed above are also highly sought after and becoming scarce in the Limpopo market (Moeng, 2010).

With respect to individual species, Williams *et al*., (2001) reported that *Siphonochilus aethiopicus* is already extinct from natural areas of Kwa-Zulu Natal, and possibly with time this will also happen in the Limpopo Province as the species has been recorded as the most used, most traded and the most scarce medicinal plant in the *muthi* market and communal lands around the province. It is also decreasing at an alarming rate at local level (Moeng, 2010). Although the species is not highly sought after in Blouberg Mountain, it is however listed by healers as one of the species in decline on the mountain. Thus, it is important to conserve this plant in the Blouberg area and ensure that sustainable management is correctly practiced.

Tshisikhawe (2002) reported that *Securidaca longepedunculata* has a high occurrence in *muthi* shops in Venda, as the species is believed to have the same effect as Viagra™. Moeng (2010) stated that this belief will increase the current utilisation. This may pose a serious threat to the survival of the species, as the roots are the plant parts harvested, which will cause immense damage to this slow growing plant.

Clivia caulescens is one of the medicinal plant species listed by traditional healers as declining but is recorded as least concern in the Red Data List (SANBI, 2011). Some species are perceived by traditional healers to be declining or rare from the mountain but in fact, country wide they are common species that are listed as least concern and/or not threatened in the Red Data List (SANBI, 2011). According to Moeng (2010), *Clivia caulescens* is not a frequently used or preferred medicinal plant in other parts of the Limpopo Province. The species is probably not in danger of over harvesting, however, it might still be worth growing it in a nursery as it is in local demand.

Although in Limpopo Province *Warburgia salutaris* is also one of the most expensive and most used medicinal plant traded in the market (Moeng, 2010), around the Blouberg Mountain it is not perceived by the healers to be under threat. This perception should be verified and monitored as these Blouberg trees may be targeted in the future due to their high value and scarcity elsewhere.

Although not many red data listed species are targeted by the healers, the potential amount of material taken off the mountain is cause for concern and should be validated. In addition, as stated under the conservation section, traditional healers around Blouberg Mountain are concerned that medicinal plants are being over utilised. More intensive research at village level on the species of medicinal plants used by people further away from the mountain should be further investigated. This data will give an important overall impression of healers around Blouberg Mountain, the medicinal plants of the area, and would assist in managing the resource as it would give a better indication of the number of resource users.

3.6.5 Storage and packaging

The storage and packaging of the plant material is very important, especially to consumers who should be assured of a safe product. According to Van Staden *et al.* (2008), a survey of rural clinic patients in South Africa revealed that 84% would prefer more hygienically and safely packaged indigenous medicine. A first step in the storage process should be adequate identification and labelling of various plants to avoid confusion and the incorrect dispensing of medicinal material.

Some of the healers leave their plant material in the sun to dry. However according to Van Wyk *et al.* (2009) it is unacceptable for the plant material to be left exposed to the sun, wind, dust and potential contact with strangers. In the Blouberg Mountain area, sun-dried material is also the norm and this material is therefore also exposed to undesireable elements.

During storage, plant material can be contaminated by microorganisms and pesticides, which can be poisonous to humans. Plant material must be stored in a safe and healthy environment, as the lack of correct storage facilities can result in the spoiling of plant material (Van Staden *et al.,* 2008). Storage can also influence the physical appearance and chemical quality of plant materials and hence it is necessary to maintain appropriate storage conditions so as to increase the product's shelf life (Birdi *et al.,* 2006).

Storage of plant material in consulting rooms around Blouberg area depends on the healers' preference. Plant material is either stored unprocessed or as processed material ready to be given to patients. Depending on the healer and on the plant material, processed material is stored in different containers, such as jars, tins, buckets, boxes, bottles and plastic containers. Packaging of plant material differs between healers. Some healers prefer using newspapers when packaging material because the newspaper keeps the plant material dry, instead of using plastic which results in the mixture been moist.

3.6.6 Legislation

The fact that none of the healers interviewed had any knowledge of environmental legislation means that the entire Blouberg traditional medicine community is probably operating outside the framework of national and environmental legislation regarding the collection of medicinal species. Moeng (2010) noted that there is a wide range of legal control measures applicable to medicinal plants, including a total ban on the harvesting of certain species without possession of a permit and proclaiming areas with important plants as protected areas. However, Cunningham (1993) stated that governmental legislation is largely ineffective in controlling the collection and utilisation of medicinal plants in Africa.

The following are a number of reasons put forth by Moeng (2010) for the ineffectiveness of environmental legislation regarding the protection of medicinal plants in Limpopo Province: Firstly, a lack of enough and adequately trained environmental officers. Some environmental officials were found to be confused about the application of the various laws that deal with the plants. Secondly, overlapping responsibilities for the environment by different government departments (e.g. Environmental Affairs, and Water Affairs and Forestry) has meant that responsibilities for certain duties do not get taken up by relevant departments. Thirdly, communities themselves are not familiar with relevant legislation and fourthly the high level of poverty in especially rural areas increases the temptation to engage in illegal activities. These reasons are relevant to the Blouberg context. For example on the two nature reserves, people observe the permit system by using access cards to collect plant material. However, on the rest of the Blouberg Mountain there is limited enforcement of this legislation. Blouberg healers are unaware of relevant environmental legislation, thus do not apply for permits to collect protected species.

Visits from the Traditional Healers Association to healers do not have an impact on the sustainable utilisation of medicinal plants in the Blouberg Mountain area. This is due to the fact that they do not regulate conservation issues or legislation but only the medical aspects of the healers' practises. In Blouberg, the complete lack of knowledge over such legal control measures means that education should take place simultaneously with the implementation of plant conservation laws. Conducting workshops on conservation issues and legislation would assist in educating the Traditional Healers Association and the tribal authority on the legislation regarding the conservation of natural resources. Appointing them as honorary rangers or officials responsible for the implementation of some of these laws could assist in reducing over harvesting of these natural resources.

The participation of traditional healers and local people in programmes such as Adult Basic Education and Training (ABET) will improve the standard of education at village level. This in turn will facilitate their understanding of sustainable resource management and their awareness of the existence of environmental legislation. It will also ensure that environmentally sustainable activities can take place from the grassroots level upwards to prevent biodiversity loss. These programmes could build in modules covering natural resource use and the legislation thereof. Such programmes should include specific modules that would be useful to the healers in particular and should bear in mind that more than 80% of the healers around Blouberg Mountain are female. Programmes to educate the youth during formal schooling could also build on the successful eco-schools programme in the area.

3.6.7 Conservation

The demand for medicinal plants has led to increased pressure on wild populations especially in rural areas (Dold and Cocks, 2002). Shackleton (2005) stated that the root of the problem is socio-economic, and this is substantiated by Semenya and Mathibela (2012) who noted that poverty is forcing people around the Blouberg area to resort to harvesting of resources to make a living. People around Blouberg still live with a high level of poverty, which has resulted in community members harvesting and selling medicinal plants to generate income (Blouberg Municipality, 2005/2006). Most informants mentioned that they have noticed a decline in certain species around Blouberg Mountain and that this decline is starting to have a negative impact on their profession. Traditional healers around Blouberg mentioned that the decline of medicinal plants in their area is not only due to excessive harvesting by Blouberg healers, but also by healers and traders from outside their area. Species such as *Siphonochilus aethiopicus* which is viewed by traditional healers as on the decline and listed in the Red Data List (SANBI, 2011) as critically endangered, is already extinct in KwaZulu-Natal (Williams *et al.,* 2001) and possibly with time this will also happen in the Limpopo Province (Moeng, 2010).

Warburgia salutaris deserves special attention, as the species is listed as endangered in the Red Data List (SANBI, 2011). At the international level it is categorised as extinct in the wild in Zimbabwe (Maroyi, 2008), critically endangered in Swaziland (Dlamini and Dlamini, 2002), endangered in Malawi (Msekandiana and Mlangeni, 2002) and vulnerable in Mozambique (Izidine and Bandeira, 2002). According to Mander (1997) *Warburgia salutaris* is becoming increasingly difficult to obtain in South Africa and as a result is imported from neighboring countries such as Lesotho, Mozambique, Swaziland and Zimbabwe. However, this species is not listed or viewed by traditional healers around Blouberg Mountain as declining even though the species is mostly used and preferred. A positive development for this species is the promulgation of legislation to protect the mistbelt forest of Blouberg in which *W. salutaris* which is mentioned in the Government Gazette No. 34089 of 2011.

In contrast some species that are mentioned by healers as rare or declining are not on the Red Data List (SANBI, 2011). According to Williams (2007), species that are flagged as highly threatened by the trade and that are not red listed are candidates for re-evaluation of their conservation status.

Cultivation is usually recommended as a conservation measure for medicinal plants in order to provide alternative supplies for medicinal species in high demand and for those that are declining (Dold and Cocks, 2002). Cultivation may often be the best, if not the only option to replace the declining species. According to Cunningham (1993), if cultivation is to be a success as an alternative supply to improve the self-sufficiency of traditional healers and take harvesting pressure off wild stocks, then plants have to be produced cheaply and in large quantities.

Cunningham (1993) noted that the success of cultivation depends on the positive attitude of traditional healers to cultivated material, and that this varies from place to place. The majority of Blouberg healers interviewed, would use plants from the nursery, and would even appreciate a nursery in their area. This is in contrast to findings by Mavi and Shava (1997) who recorded that Zimbabweans rejected the planting of medicinal species because they believe that indigenous plants lose their curative properties when cultivated. Similarly, in Botswana, traditional healers were not in favour of using cultivated plants, as they believe that they do not have the original healing powers of material collected from the wild, therefore, the use of cultivated plant materials was unacceptable (Cunningham, 1993). However, the same study showed that in South Africa there is a general acceptance of cultivated material by healers as an alternative for declining species. Specifically, research by Dold and Cocks (2002) in the Eastern Cape Province, showed that up to 82% of urban-based healers were willing to make use of cultivated plant material for medicinal purposes. Similarly, in the Malolotja area of Swaziland, traditional healers accepted cultivation as a viable alternative to wild harvesting (Cunningham, 1993).

Community-based Natural Resource Management (CBNRM) projects can be initiated to decrease pressure on natural resources such as medicinal plants (Moeng, 2010). These projects are by their nature, inclusive of all in the community and strive to utilise local resources sustainably. Nursery projects for the cultivation of medicinal and other useful, rare and local plants are particularly conducive to such a programme. Trees used medicinally would be good candidates for CBNRM projects as they can fulfill a number of uses and would also be beneficial to reforestration programmes. Medicinal plants need to be grown by the people who rely on them (Mander, 1997), which is an important consideration in initiating CBNRM projects. The success of this strategy would be dependent on the joint work of the government (tribal, local and provincial), individual community members, healers, funders and educators.

The majority of healers in Blouberg were willing to use cultivated plants, stating that a medicinal plant will have healing powers whether cultivated or collected from the wild. This study recommends that species such as *Capparis sepiaria*, *Cassia abbreviata*, *Clivia caulescens, Hypoxis hemerocallidea*, *Osyris lanceolata*, *Siphonochilus aethiopicus*, *Warburgia salutaris* and Tlhokwa la tsela should be candidates for inclusion in a nursery scheme, as some of these species were ranked by healers as declining or becoming rare from the mountain and some were over harvested and over utilised.

The majority of Blouberg's medicinal plants are not highly endangered but they perform important ecosystem functions in Blouberg which will be lost if they disappear. The maintenance of this vegetation is therefore vitally important. However, most of the healers in the Blouberg Mountain area have noticed a change for the worst in vegetation due to excessive harvesting of medicinal plants by other healers and traders from outside the area.

Increasing public appreciation and awareness of the value and importance of biodiversity (CBD, 2001), and teaching the community about sustainable use of medicinal plants, instituting campaigns that promote the importance of habitat and medicinal plant conservation and encouraging the cultivation of medicinal plants can prevent loss of biodiversity (Cunningham, 1993). Therefore, conservation education programs, such as conducting workshops, are necessary to educate local people (young and old) about the need for conservation and its subsequent benefits and also to improve their understanding of biodiversity (CBD, 2001). Implementation of a media campaign through national radio networks to publicise information on the scarcity of popular medicinal plants would assist in such education programmes (Cunningham, 1993). These programmes need to target females and the youth as they constitute the majority of the illiterate people in the sampled villages. The implementation of programmes such as Adult Basic Education and Training (ABET) are essential to improve the standard of education at village level (Cromhout, 2002).

3.7 CONCLUSIONS

From this study it was found that most healers are over 65 years of age and the majority are female. The main harvesting methods were bark stripping and digging up of roots and bulbs. Roots are the preferred plant parts collected and used. There is a wide range of packaging and storage methods depending on healers' preferences. Of the 64 species used, *Warburgia salutaris*, *Siphonochilus aethiopicus* and *Securidaca longipedunculata* are listed as threatened. It can be seen that healers are concerned about dwindling plant supplies. In addition they do value the supplies and feel a sense of ownership of them. This is verified by the fact that 71% of them are willing to have conservation measures put in place.

By improving harvesting and monitoring techniques so that they become sustainable, the over harvesting of medicinal plants can be minimised and the decline of certain medicinal plants from the wild, halted. Harvesting of roots and bark is particularly destructive and it should be seen as a priority to develop alternative methods in order to ensure recovery and growth of targeted individuals.

3.8 FUTURE RESEARCH STEMMING FROM THIS PROJECT

a) A future study could look at female traditional healers around Blouberg Mountain area as they form the majority of the healers. The study could determine whether more women are treated as well as whether more female afflictions are considered compared to their male counterparts.

b) In addition, future research could focus on aspects of the healers' indigenous knowledge around medicinal plants. This can then be stored in electronic format and made available to National Government agencies such as the South African National Biodiversity Institute (SANBI) and the South African Department of Science and Technology (DST) for inclusion into the national indigenous knowledge database that is being constructed.

c) Storage and packaging of plant material should be further investigated. This would give an indication of how plants are stored and the length of time they are stored in consulting rooms, as there is limited detailed information on this aspect of traditional healing. Poor storage and packaging can have serious health implications for consumers.

d) Species abundance on the mountain should be investigated for the following groups: Red data listed species, those plants perceived by healers to be declining and the healers' ten most-frequently used species.

e) By empowering communities with information on legislation, education around sustainable management and training and recruitment in law enforcement programmes, it is possible that indiscriminate harvesting of the most threatened Blouberg medicinal plants can be brought under control.

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CHAPTER 4

THE USE OF A GEOGRAPHIC INFORMATION SYSTEM IN ANALYSING PATTERNS OF PLANT COLLECTION

4.1 INTRODUCTION

The majority of medicinal plant studies have focused primarily on three areas, i.e., the systematic documentation of useful plants, particularly within protected areas (Acharya *et al*., 2009), the traditional uses of such plants (Moeng, 2010) and the isolation of active phytochemicals (Mokwala, 2007). Recently, the distribution patterns of medicinal plant species, including their conservation status has been included as an additional focal area.

Various graphing techniques have been used to investigate such patterns. These include using elevational gradients to determine the effectiveness of existing protected areas for their conservation (Acharya *et al*., 2009), inventory plots to make quantitative assessments of medicinal plant populations, habitat features and abundance of target species (Russell-Smith *et al.,* 2006), and using quadrats to determine the local distribution of medicinal plant species (Kala, 2000).

Geographic Information Systems (GIS) have been found to be useful in developing maps of the distribution of medicinal plants. For example, Gorman *et al*. (2008) used GIS technology to define the distribution and relative abundance of plant species having potential for use in the Maningrida region, Australia. In another example, Aspinall *et al*. (1998) utilised GIS technology to make predictions of the probability of species richness by using an inductive modelling technique based on Bayesia's theorem, involving presence absence data.

Despite the increased use of GIS technology in medicinal plant investigations, no published literature could be found which examines the use of GIS to specifically map the tracks (paths) which healers walk when collecting medicinal plants, in order to analyse patterns of harvest.

4.2 LITERATURE REVIEW

4.2.1 Patterns of collection

An understanding of the occurrence, distribution and conservation status of medicinal plants is essential if this valuable resource is to be managed sustainably (Lyke, 2001). The patterns that medicinal plant collectors follow when gathering such material can add vital information to its sustainable management (Estomba *et al*., 2006).

Caballero and Mapes (1985), examining collection patterns amongst the P'urhepecha Indians of Mexico, found that approximately 25% of the useful flora was commonly collected as part of a complex subsistence pattern. This study further noted that different medicinal plants were preferentially collected at different times of the year.

Ladio and Lozada (2003) looked at the influence of different environments (e.g. steppe and forest) on collection patterns in northwestern Patagonia, Argentina. They found that the shortest distances travelled to plants and areas from which plants were gathered was influenced by the nutritional value of those plants, but that exclusion from areas through reserve management was the greatest influence. These results were obtained using semi-structured questionnaires and although voucher specimens of the plants were taken, no GPS points were recorded and thus GIS technology was not utilised for the analysis.

Collection patterns by medicinal plant collectors in Argentina were investigated by Estomba *et al.* (2006) using interview and questionnaire techniques rather than GIS technology. Findings of this study revealed that distance influenced collection patterns from dwellings with only native and frequently used species collected at further distances.

4.2.2 Plant communities

The GIS database makes it possible to model, combine and analyse spatial relations between data sets for characterisation and mapping of plant communities and their habitats (Nilsen, 1999).

For example, GIS and statistical modeling were used to map plant communities and their environmental features in Denmark, where information layers such as aerial photograph vegetation maps were incorporated into a GIS database (Nilsen *et al*., 1996). Out of this, conclusions could be drawn on plant communities that would otherwise not have been possible.

Johnston (1993) noted that models for the spatial distribution of plant communities can be developed using GIS, if statistically valid relationships exist between communities and mapped environmental variables. There has thus been an increased use of predictive vegetation mapping and assessment of the impact of environmental change on vegetation distributions using GIS (Palmer and Van Staden, 1992).

4.2.3 Exotic plants

Exotic plants are often an important component of traditional healers' medicinal stock. They should therefore be considered in any management plans for medicinal plants. According to D'Antonio and Meyerson (2002), exotic species have increasingly become a management problem, and decision-makers need to invest more in assessing their potential impacts to biodiversity (McNeely, 2001). In South Africa, exotic species have been a problem in the environment for many years (Richardson and Van Wilgen, 2004). The invasion of natural habitats by exotic species is an ongoing threat to biodiversity because they can outcompete native species (Mooney, 1999), and they have the ability to infect them with diseases to which they have no resistance to (Vitousek *et al.*, 1997). If they are found to be valuable to the local healers this should be incorporated into conservation plans for the area.

4.2.4 Bush encroachment

Certain species implicated in bush encroachment can also be valuable healing plants. Bush encroachment is a form of land degradation (Archer, 1995), which occurs in many arid regions where fuel loads are insufficient for fires (Ward, 2005). Ten to twenty million hectares of South Africa's land is affected by bush encroachment (Ward, 2005). Archer *et al.* (2000) noted that although bush encroachment has long been of concern in grasslands and savannas, most research has focused on the effects of woody plants on grass production instead of the underlying ecological mechanisms driving encroachment (Coetzee *et al.*, 2007). Factors that cause bush encroachment include: overgrazing, suppression of bushfires and changing climate conditions (Von Maltitz *et al.*, 2003), all leading to a reduction of grazing capacity (Smit *et al.*, 1996). The impact of traditional healers' collection of plants implicated in bush encroachment should thus be investigated.

4.2.5 The use of GIS as a decision-making tool

A Geographic Information System is recognised as an important decision-making tool that creates meaningful, clear and attractive maps that can be applied to development for natural resource management, including conservation (Tripathi and Bhattarya, 2004). According to Zenilman *et al.* (2002), GIS makes it easier to visualise the spatial diversity of resources, to analyse and integrate data sets, and to assess the impact of interventions, thereby enhancing the transparency of decisions regarding natural resource use.

Geographic Information System techniques are used to address the problems associated with the storage, analysis and processing of indigenous knowledge (Brodnig and Mayor-Schöberger, 2000). Programmes involving the integration of GIS and indigenous knowledge have for the most part been used within natural resource management projects (Tripathi and Bhattarya, 2004). Harmsworth (1998) acknowledged that GIS tools can be used to store and transfer the information captured within an oral-based indigenous knowledge system for more widespread use. It thus provides a framework to document and store indigenous knowledge (Tripathi and Bhattarya, 2004). The documentation and mapping of indigenous knowledge and medicinal plants is intended to preserve knowledge held by traditional healers and local indigenous people. The use of GIS techniques to document the indigenous knowledge of an area has become more prevalent lately.

Despite the advent of such techniques and the availability of associated information such as local vegetation types, topography and demographics, this study could not find any publication documenting the use of GIS techniques to analyse the collection tracks of healers. Furthermore, after a thorough search, no ethnobotanical literature on the use of collection tracks by traditional healers could be found. Thus, the analysis of medicinal plant collection pathways using this method is ground breaking. The closest example of such work is that by Ghimire *et al*. (2004) who combined ethnobotanical interview surveys with vegetation mapping using GPS devices and GIS techniques to gain an understanding of the interaction between knowledge of medicinal plants and their occurrence and conservation status. Their research also did not follow specific collection tracks although healers were asked to locate medicinal plants in the field and geographic data around each specimen was obtained.

4.3 AIM AND OBJECTIVES

4.3.1 Aim

This study aimed to examine the use of GIS for mapping the collection tracks of traditional healers and generating digital maps relating these tracks to other physical features around Blouberg Mountain.

4.3.2 Objectives

The objectives of this study were to:

a) Map collection tracks (pathways) used by healers around Blouberg Mountain in order to draw conclusions on the location of the most impacted vegetation types and communities, and therefore those most in need of attention from conservation authorities.
b) Generate digital maps using Geographic Information System technology to capture the position of the healers' collection tracks with respect to vegetation types and plant communities. This will allow for conservation management strategies to be developed in accordance with the prevailing vegetation types and their associated plant communities around the collection tracks.

4.4 MATERIALS AND METHODS

4.4.1 Selection of tracks

All healers willing to participate in the study, from each of the 16 closest villages surrounding Blouberg Mountain, were asked to select their most used tracks. They then ranked them by frequency and intensity of use during group participatory sessions. The track with the highest ranking per village was chosen for geo-referencing, resulting in a total of sixteen collection tracks, one per village.

4.4.2 Data sheet

Each of the tracks was walked in the presence of a volunteer traditional healer from the village from which the track originated. While walking each track, the most important and used medicinal species were identified. The following information on these species was recorded on a data collection sheet (Appendix B): Botanical and vernacular names, vegetation type in which they grow, their habitat and parts used. Information related to their collection such as harvesting method was also noted. In addition, replacement value and perceived rarity of the species was also investigated. A replacement value of high indicates that the plant is difficult to replace, a value of medium, indicates that the plant is common in the area, and a value of low indicates the plant is easy to locate. Global Positioning System (GPS) co-ordinates of plants from which material was harvested were logged although not further analysed in the results.

4.4.3 Recording GPS co-ordinates of tracks

For each village, a collection track was walked together with one volunteer healer in order to log the co-ordinates of the track. A Global Positioning System (Garmin GPS) eTrex Vista HCx model was used to capture the beginning and end of each track. Co-ordinates along the tracks were logged automatically on the GPS every 10 m. This is the distance that gives the most detail and best precision by using the least amount of GPS memory and therefore storage capacity.

4.4.4 Plant identification

Voucher specimens of most of the species noted when walking the collection tracks were identified by and lodged with the Larry Leach Herbarium, University of Limpopo. For those medicinal plants referred to during the walks but difficult to identify due to insufficient material, vernacular names were used in the analysis.

4.4.5 Analysis

Geographic Information System technology was used to generate maps of the paths that healers use during plant collection. An Open Source Linux system using Quantum GIS Mimas software Version 1.3.0 was used to develop the various topographical, vegetation type and collection track layers to build into geographically accurate maps. All geoprocessing, including the building of layers and their incorporation into the various maps was conducted using a projection of WGS 84 (EPSG 4326). An ‘on the fly’ setting was used to ensure that the co-ordinate reference system correctly geopositioned each layer as it was brought in to construct the maps.

The healers' collection tracks were geo-processed and converted to a layer which could be manipulated to contribute to building the map of medicinal plant use on Blouberg Mountain.

Scholes' 1978 map of the vegetation communities on a part of Blouberg Mountain was scanned and digitised and used as a layer to place the species collected in a wider ecological system. A scale of 1:10 000 was used during the digitisation process to ensure this layer would correspond correctly to the topography of the area.

The vegetation layer from Mucina and Rutherford (2006) on vegetation types which was already digitised and available from the Limpopo Department of Economic Development Environment and Tourism (LEDET) was incorporated. A topographical layer of the mountain, obtained from LEDET was used.

The various layers were combined to form the following four composite maps:

a) Topography + tracks: this map allows for the visualisation of tracks with respect to the topography of the mountain. Medicinal plants collected from the different surveyed collection tracks belong to various vegetation communities and a number of vegetation types. Information on the healers' collection tracks on Blouberg Mountain was generated and all tracks mapped were overlaid onto the Blouberg Mountain topography (Fig. 4.1).
b) Topography + tracks + Mucina and Rutherford + reserves: this facilitates the visualisation of collection tracks with respect to different vegetation types occurring around the mountain. Information from Mucina and Rutherford (2006) on vegetation types, topographical information and nature reserve boundaries were overlaid on the position of the collection tracks (Fig. 4.2).
c) Topography + tracks + Scholes + reserves: which allows for the visualisation of tracks surveyed on the mountain with respect to vegetation communities described by Scholes (1978) on the eastern side of the mountain. It should be noted that Scholes (1978) surveyed only two thirds of the mountain, and therefore half the tracks cannot be compared with the vegetation communities of Scholes (Fig. 4.3).

d) Topography + tracks + Mucina and Rutherford + Scholes + reserves: this map gives an overall view of the mountain and tracks with respect to vegetation types, vegetation communities, and the nature reserves (Blouberg and Malebogo) (Fig. 4.4).

4.5 RESULTS AND DISCUSSION

Forty eight plant species of medicinal value were collected from the 16 surveyed tracks (Fig. 4.1). Of these 48 species, 36 were identified and 12 are known only by their vernacular names due to insufficient material for identification (Table 4.1). Sixty nine percent of the species were recorded only once, with 31% commonly distributed over more than one track and therefore recorded more often. *Pyrenacantha grandiflora* and *Zanthoxylum capense* are the most prevalent species with *Zanthoxylum capense* occurring in 44% of the tracks and *Pyrenacantha grandiflora* occurring in 38% of the tracks. *Catha edulis* occurred in 25% of the tracks. These two species *Pyrenacantha grandiflora* which was found in three consulting rooms and *Zanthoxylum capense* found in 10 consulting rooms are amongst the most used and preferred plants species around Blouberg.

Thirty one species are listed as Least Concern (LC), one as Not Threatened (NT), one as Endangered (EN), two as Not Endangered (NE), one as Data Deficient-Taxonomically Problematic (DDT) and 12 as unknown because they were unidentified (Table 4.2). Of the 48 species documented, traditional healers perceived 36 to be common and 12 to be rare. These values are also in line with their replacement value. A number of species such as *Cassia abbreviata*, *Corchorus tridens*, *Clivia caulescens*, *Erythrina lysistemon*, *Lannea schweinfurthii*, *Maerua juncea*, Majana and Moselekgwale are perceived by healers to be either rare or becoming rare. However, none of them are documented in the Red Data List (SANBI, 2011) as declining or threatened. Possibilities are that these plants may be perceived as rare or declining by the healers around Blouberg Mountain as they are mostly used and preferred. Rarity of these species might be based on the fact that these species are mostly collected from one side of the mountain, hence their decline. Plants listed above are examples of species which need to be further investigated to verify whether healers' perception regarding the perceived rarity of these plants is correct.

4.5.1 Collection sites

Plants were collected mainly from the foot and peak of the mountain and along-side the chosen tracks. Species which were perceived by the healers as declining and/or rare were predominantly from the western (north western, western and south western sides), rather than the eastern side of the mountain. For example, species such as *Clivia caulescens* were collected on the north western side of the mountain and *Corchorus tridens* on the south western side. Of the 48 species collected from the mountain, 70% were collected from the western side and 30% from the eastern side, making the western side more impacted in terms of plant collection. It is therefore recommended that healers start shifting their plant collection to the less impacted sides of the mountain.

Lannea schweinfurthii was collected on the western side of the mountain and also on the south eastern sides of the mountain. *Erythrina lysistemon* and *Cassia abbreviata* were collected on the north eastern side of the mountain. *Maerua juncea* was collected on the eastern side of the mountain, and this species would be a good candidate for cultivation, as, according to the healers it is found only on the eastern side of the mountain.

4.5.2 Vegetation

The Blouberg area is characterised by Mucina and Rutherford (2006) as part of the Savanna Biome, one of the most extensive biomes in Africa. In addition, however, grassland and forest patches also occur on the Blouberg Mountain (Capricorn District Municipality, 2009). There are five vegetation types on and around Blouberg Mountain as described by Mucina and Rutherford (2006). These include the Northern Escarpment Afromontane Fynbos, Northern Mistbelt Forest, Roodeberg Bushveld, Soutpansberg Summit Sourveld and Soutpansberg Mountain Bushveld. All except the Northern Escarpment Afromontane Fynbos vegetation types were found amongst the tracks surveyed on the Blouberg Mountain.

The Northern Escarpment Afromontane Fynbos vegetation type is protected formally and privately elsewhere in South Africa, such as in the Blyde River Canyon National Park and Mac Mac Conservation area in Mpumalanga (Mucina and Rutherford, 2006). According to Mucina and Rutherford (2006), very little transformation of this vegetation type has occurred. In Blouberg, none of the plants were collected from this vegetation type and it is not extensively targeted by the healers. This is fortunate because the rehabilitation of fynbos in degraded areas is only possible if the impact of desiccation can be avoided and soils are deep enough. Neither of these conditions are met in the Blouberg area, which is drought prone with a rugged landscape and shallow soils.

The Northern Mistbelt Forest vegetation type is viewed as least threatened (Mucina and Rutherford, 2006), but the endangered *Warburgia salutaris,* was collected in this vegetation type on the north eastern side of the mountain. Von Maltitz *et al.* (2003) noted that increasing firewood collection in communal lands and selective harvesting of bark are the most pressing threats affecting this vegetation type, both of which occur around Blouberg Mountain. Thus, although *W. salutaris* is at present perceived as common in this area, this could change and its status should be monitored. A new development is the gazetting of the Northern Mistbelt Forest as a threatened ecosystem type (National Environmental Management: Biodiversity Act No.10 of 2004, Government Gazette No. 34089 of 2011). This prohibits any disturbance of the vegetation without an Environmental Impact Assessment and will have implications for the collection of medicinal plants in this vegetation type. The fact that *Warburgia salutaris* is highly sought after but found in this recently protected area should be advertised to the local government officials and traditional authorities so that appropriate permits can be organised for the healers.

Roodeberg Bushveld vegetation type is classified by Mucina and Rutherford (2006) as least threatened in the country and the area it covers is mostly used for game ranching. This vegetation type covers nearly the entire Blouberg Mountain area. Species viewed by traditional healers as declining from the mountain were found in this vegetation type and for this reason they should be further investigated to determine their true status on the mountain.

Soutpansberg Summit Sourveld vegetation type is also least threatened, but the inappropriate introduction of game from savanna plains to this vegetation type should be avoided as it could be a further threat (Mucina and Rutherford, 2006). Overgrazing by cattle and donkeys also pose a threat to this vegetation type.

Soutpansberg Mountain Bushveld is part of the Soutpansberg Centre of Endemism (Van Wyk and Smith, 2001). This vegetation type is the second largest after the Roodeberg Bushveld as it also covers nearly the entire Blouberg Mountain area. Although few species perceived as declining were found in this vegetation type, it is the most heavily utilised of the five vegetation types around the Blouberg Mountain, and is vulnerable to increased human population densities as most tracks (n=14) traverse it. Thus, as the population in the area expands and the pressure on medicinal plants also intensifies, this vegetation type will be increasingly impacted. In addition, the results show that healers collect the majority of species from this vegetation type. Species such as *Blepharis diversispina*, *Carissa edulis*, *Catha edulis*, *Elephantorrhiza burkei*, *Myrothamnus flabellifolius* and *Zanthoxylum capense* were collected from this vegetation type and according to Mucina and Rutherford (2006), are also some of the important taxa around Blouberg Mountain. It is thus clear that this vegetation type should be the focus of conservation measures.

In general, *Catha edulis*, *Jatropha spicata*, *Osyris lanceolata*, *Pyrenacantha grandiflora*, and *Zanthoxylum capense* are the five medicinal plant species most used by traditional healers around Blouberg Mountain. This preference was based on the number of times each species was recorded per track.

4.5.3 Plant Communities

Twelve out of the 17 vegetation communities recognised by Scholes (1978) were mapped, with *Mimusops* Woodland and *Catha-Faurea* Wooded Grassland as the dominant communities on the mountain covering three tracks each. Not all tracks could be analysed at a fine vegetation scale as there are some tracks which did not traverse any of Scholes' communities because the area the healers utilised and the tracks walked extended beyond Scholes's map. Scholes surveyed only the eastern part of the mountain and therefore half the tracks cannot be compared with these vegetation communities. The composite map shows that none of the travelled tracks pass through the nature reserves, nor do they intercept one another (Fig. 4.4).

Table 4.1. Plant species collected from 16 surveyed tracks in order of number of times of occurrence on a track.

Track No.	Species collected		No. of times species occurs on that track	Co-ordinates of each track	
	Vernacular name	Scientific name		Start	End
1	Monokwane	*Zanthoxylum capense*	4	S 23.1576 E 28.8895	S 23.1614 E 28.8794
	Molebatsa	*Pyrostria hystrix*	3		
	Mokee	*Berchemia zeyheri*	3		
	Morobadiepe	*Pappea capensis*	2		
	Tsebedintlha	*Garcinia gerrardii*	2		
	Mphata	*Philenoptera violaceae*	2		
	Mamarela	Unidentified 16	2		
	Maime	*Clivia caulescens*	1		
	Moromelela	*Pleurostylia capensis*	1		
	Modumelana	*Jatropha spicata*	1		
	Mphaba	Unidentified 10	1		
	Moopyane	Unidentified 14	1		
	Mokhubjane	Unidentified 15	1		
2	Mphera	*Osyris lanceolata*	3	S 23.1125 E 28.9846	S 23.1102 E 28.9854
	Molaka	*Warburgia salutaris*	3		
	Letlhatsi	*Catha edulis*	3		
	Phayabashimane	Unidentified 11	3		
	Morobadiepe	*Pappea capensis*	2		
	Monthlo	*Syzygium guineense*	2		
	Bjere	*Pyrenacantha grandiflora*	2		
	Motshidi mpitswane	*Ximenia caffra*	1		
3	Bjere	*Pyrenacantha grandiflora*	4	S 23.1219 E 28.9903	S 23.1223 E 28.9950
	Mothokolo	*Carissa edulis*	3		
	Phayabashimane	Unidentified 11	3		
	Morara	*Bolusanthus speciosus*	1		
	Leakalala	*Cassytha filiformis*	1		
	Mpitika	*Ammocharis coranica*	1		
	Majana	Unidentified 9	1		

Track No.	Species collected		No. of times species occurs on that track	Co-ordinates of each track	
	Vernacular name	Scientific name		Start	End
4	Phonyoga bamphethe	*Talinum caffrum*	4	S 23.1817 E 28.8085	S 23.1800 E 28.8073
	Mookapitsi	*Blepharis diversispina*	4		
	Mokgodiane	Unidentified 12	3		
	Monokwane	*Zanthoxylum capense*	2		
5	Mosijana	*Elephantorrhiza burkei*	1	S 23.1090 E 29.0470	S 23.1071 E 29.0478
	Modumelana	*Jatropha spicata*	1		
	Koba	Unidentified 13	1		
6	Meswarokgane	Unidentified 19	2	S 23.0931 E 28.8872	S 23.0931 E 28.8872
	Letlhatsi	*Catha edulis*	2		
	Letlhole	Unidentified 1	1		
	Thelele	*Corchorus tridens*	1		
7	Mphatlalatsa maru	*Asparagus exuvialis*	2	S 23.0368 E 28.9555	S 23.0410 E 28.9325
	Moselelsele	*Dichrostachys cinerea*	2		
	Morekhure	*Spirostachys africana*	1		
	Morobadiepe	*Pappea capensis*	1		
	Modumelana	*Jatropha spicata*	1		
	Letlhole	Unidentified 1	1		
	Moselekgwale	Unidentified 18	1		
8	Monepenepe	*Cassia abbreviata*	3	S 23.0284 E 28.9994	S 23.0187 E 29.0028
	Morotelatshweni	*Myrothamnus flabellifolius*	2		
	Mphatlalatsa maru	*Asparagus exuvialis*	2		
	Moopatladi	*Capparis sepiaria*	1		
	Monnamoso	*Cadaba aphylla*	1		
	Bolebatsa	*Lannea schweinfurthii*	1		
	Mpesu	*Securidaca longepedunculata*	1		
	Mphaba	Unidentified 10	1		

Track No.	Species collected		No. of times species occurs on that track	Co-ordinates of each track	
	Vernacular name	Scientific name		Start	End
9	Bolebatsa	*Lannea schweinfurthii*	1	S 23.1285 E 28.8238	S 23.1340 E 28.8295
	Bjere	*Pyrenacantha grandiflora*	1		
	Phonyoga bamphethe	*Talinum caffrum*	1		
10	Monokwane	*Zanthoxylum capense*	2	S 23.1583 E 28.9045	S 23.1518 E 28.9135
	Phonyoga bamphethe	*Talinum caffrum*	2		
	Mokgodiane	Unidentified 12	1		
	Bopa	Unidentified 17	1		
11	Mphera	*Osyris lanceolata*	3	S 23.1366 E 28.8879	S 23.1303 E 28.8967
	Motshidi	*Ximenia africana*	2		
	Monokwane	*Zanthoxylum capense*	2		
12	Bjere	*Pyrenacantha grandiflora*	2	S 23.1382 E 28.9437	S 23.1377 E 28.9458
	Monepenepe	*Cassia abbreviata*	1		
12	Mmale	*Erythrina lysistemon*	1		
	Monokwane	*Zanthoxylum capense*	1		
13	Monokwane	*Zanthoxylum capense*	2	S 23.1365 E 28.9360	S 23.1362 E 28.9339
	Bjere	*Pyrenacantha grandiflora*	2		
	Monepenepe	*Cassia abbreviata*	1		
14	Mphera	*Osyris lanceolata*	2	S 23.1220 E 28.9725	S 23.1223 E 28.9765
	Letlhatsi	*Catha edulis*	2		
	Moologa	*Tarchonanthus camphoratus*	1		
15	Monokwane	*Zanthoxylum capense*	1	S 23.1214 E 29.0218	S 23.1214 E 29.0220
	Bjere	*Pyrenacantha grandiflora*	1		
	Letlhatsi	*Catha edulis*	1		
16	Moopatladi	*Capparis sepiaria*	2	S 23.0883 E 29.0508	S 23.0912 E 29.0528
	Diraga di bonwe	*Maerua juncea*	1		

Table 4.2. Plant species collected from 16 surveyed tracks. Their conservation status, and perceived rarity and replacement value to the healers.

Track No.	Species collected		Red Data List (2011)	Perceived rarity	Replacement value
	Vernacular name	Scientific name			
1	Mokee	*Berchemia zeyheri*	LC	Common	Medium
	Maime	*Clivia caulescens*	NT	Rare	High
	Tsebedintlha	*Garcinia gerrardii*	LC	Common	Medium
	Modumelana	*Jatropha spicata*	LC	Common	Medium
	Morobadiepe	*Pappea capensis*	LC	Common	Medium
	Mphata	*Philenoptera violacea*	LC	Common	Medium
	Moromelela	*Pleurostylia capensis*	LC	Common	Medium
	Molebatsa	*Pyrostria hystrix*	LC	Common	Medium
	Mamarela	Unidentified 16	Unknown	Common	Medium
	Mphaba	Unidentified 10	Unknown	Common	Medium
	Moopyane	Unidentified 14	Unknown	Common	Medium
	Mokhubjane	Unidentified 15	Unknown	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
2	Letlhatsi	*Catha edulis*	LC	Common	Medium
	Mphera	*Osyris lanceolata*	LC	Common	Medium
	Morobadiepe	*Pappea capensis*	LC	Common	Medium
	Bjere	*Pyrenacantha grandiflora*	LC	Common	Medium
	Monthlo	*Syzygium guineense*	LC	Common	Medium
	Phayabashimane	Unidentified 11	Unknown	Common	Medium
	Molaka	*Warburgia salutaris*	EN	Common	Medium
	Motshidimpitswane	*Ximenia caffra*	LC	Common	Medium
3	Mpitika	*Ammocharis coranica*	LC	Common	Medium
	Morara	*Bolusanthus speciosus*	LC	Common	Medium
	Mothokolo	*Carissa edulis*	LC	Common	Medium
	Leakalala	*Cassytha filiformis*	* NE	Rare	High
	Majana	Unidentified 9	Unknown	Rare	High
	Phayabashimane	Unidentified 11	Unknown	Common	Medium

Track No.	Species collected		Red Data List (2011)	Perceived rarity	Replacement value
	Vernacular name	**Scientific name**			
4	Mookapitsi	*Blepharis diversispina*	LC	Common	Medium
	Phonyogabamphethe	*Talinum caffrum*	LC	Common	Medium
	Mokgodiane	Unidentified 12	Unknown	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
5	Mosijana	*Elephantorrhiza burkei*	LC	Common	Medium
	Modumelana	*Jatropha spicata*	LC	Common	Medium
	Koba	Unidentified 13	Unknown	Rare	High
6	Letlhatsi	*Catha edulis*	LC	Common	Medium
	Thelele	*Corchorus tridens*	* NE	Rare	High
	Letlhole	Unidentified 1	Unknown	Common	Medium
	Meswarokgane	Unidentified 19	Unknown	Rare	High
7	Mphatlalatsamaru	*Asparagus exuvialis*	LC	Common	Medium
	Moselekgwale	*Dichrostachys cinerea*	LC	Common	Medium
	Modumelana	*Jatropha spicata*	LC	Common	Medium
	Morobadiepe	*Pappea capensis*	LC	Common	Medium
	Morekhure	*Spirostachys africana*	LC	Common	Medium
	Moselekgwale	Unidentified 18	Unknown	Rare	High
	Letlhole	Unidentified 1	Unknown	Common	Medium
8	Mphatlalatsamaru	*Asparagus exuvialis*	LC	Common	Medium
	Monnamoso	*Cadaba aphylla*	LC	Common	Medium
	Moopatladi	*Capparis sepiaria*	LC	Common	Medium
	Monepenepe	*Cassia abbreviata*	LC	Rare	High
	Bolebatsa	*Lannea schweinfurtii*	LC	Rare	High
	Morotelatshweni	*Myrothamnus flabellifolius*	DDT	Common	Medium
	Mpesu	*Securidaca longepedunculata*	LC	Common	Medium
	Mphaba	Unidentified 10	Unknown	Common	Medium
9	Bolebatsa	*Lannea schweinfurthii*	LC	Rare	High
	Bjere	*Pyrenacantha grandiflora*	LC	Rare	High

Track No.	Species collected		Red Data List (2011)	Perceived rarity	Replacement value
	Vernacular name	Scientific name			
	Phonyogabamphethe	*Talinum caffrum*	LC	Common	Medium
10	Phonyogabamphethe	*Talinum caffrum*	LC	Common	Medium
	Bopa	Unidentified 14	Unknown	Common	Medium
	Mokgodiane	Unidentified 12	Unknown	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
11	Mphera	*Osyris lanceolata*	LC	Common	Medium
	Motshidi	*Ximenia africana*	LC	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
12	Monepenepe	*Cassia abbreviata*	LC	Rare	High
	Mmale	*Erythrina lysistemon*	LC	Rare	High
	Bjere	*Pyrenacantha grandiflora*	LC	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
13	Monepenepe	*Cassia abbreviata*	LC	Rare	High
	Bjere	*Pyrenacantha grandiflora*	LC	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
14	Letlhatsi	*Catha edulis*	LC	Common	Medium
	Mphera	*Osyris lanceolata*	LC	Common	Medium
	Moologa	*Tarchonanthus camphoratus*	LC	Common	Medium
15	Letlhatsi	*Catha edulis*	LC	Common	Medium
	Bjere	*Pyrenacantha grandiflora*	LC	Common	Medium
	Monokwane	*Zanthoxylum capense*	LC	Common	Medium
16	Moopatladi	*Capparis sepiaria*	LC	Common	Medium
	Diraga di bonwe	*Maerua juncea*	LC	Rare	High

LC (Least Concern), NT (Not Threatened), EN (Endangered), NE (Not Engangered) and DDT (Data Deficient-Taxonomically Problematic).

* Indicates that the species are naturalised exotics.

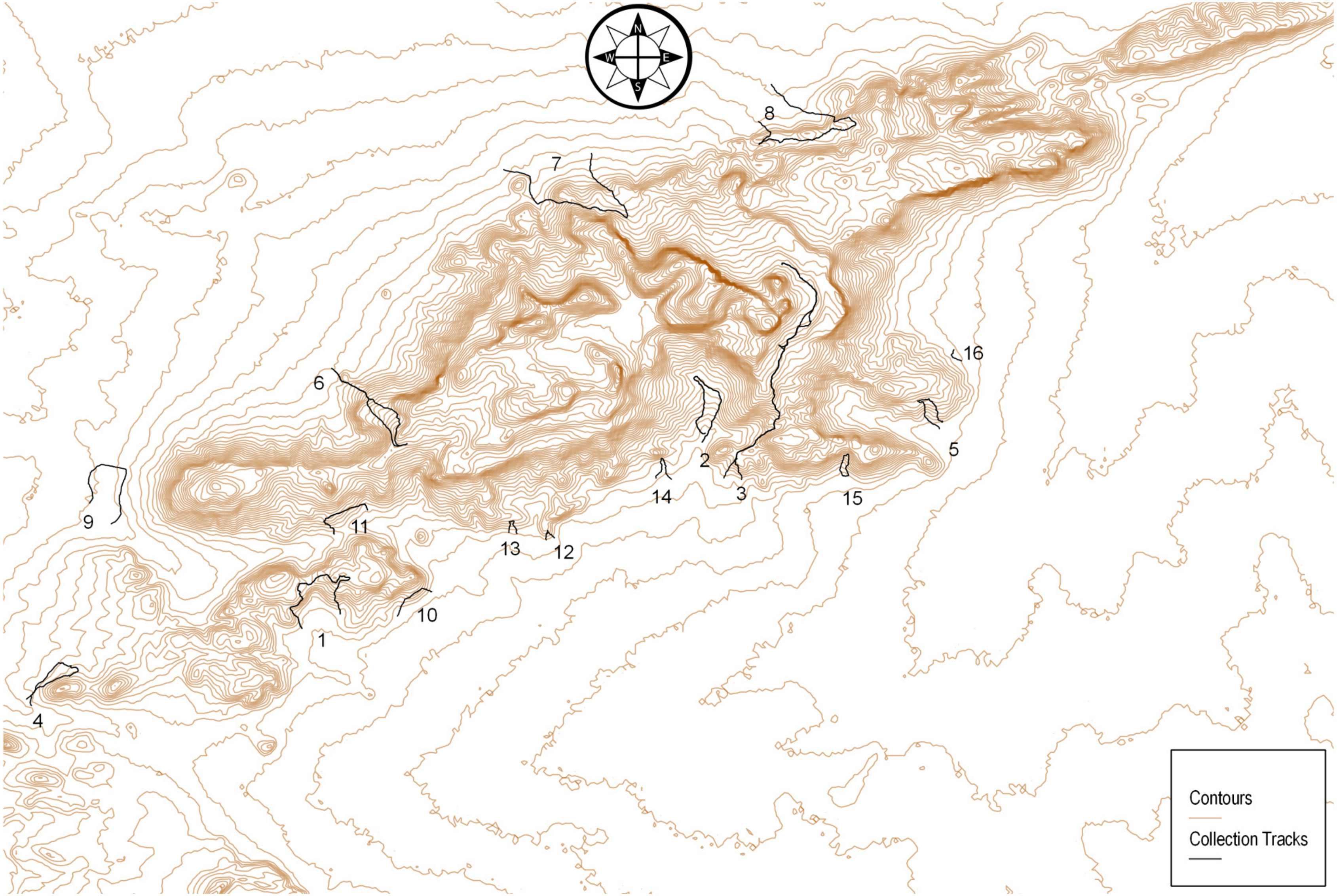

Figure 4.1. Blouberg Mountain showing 16 collection tracks surveyed.

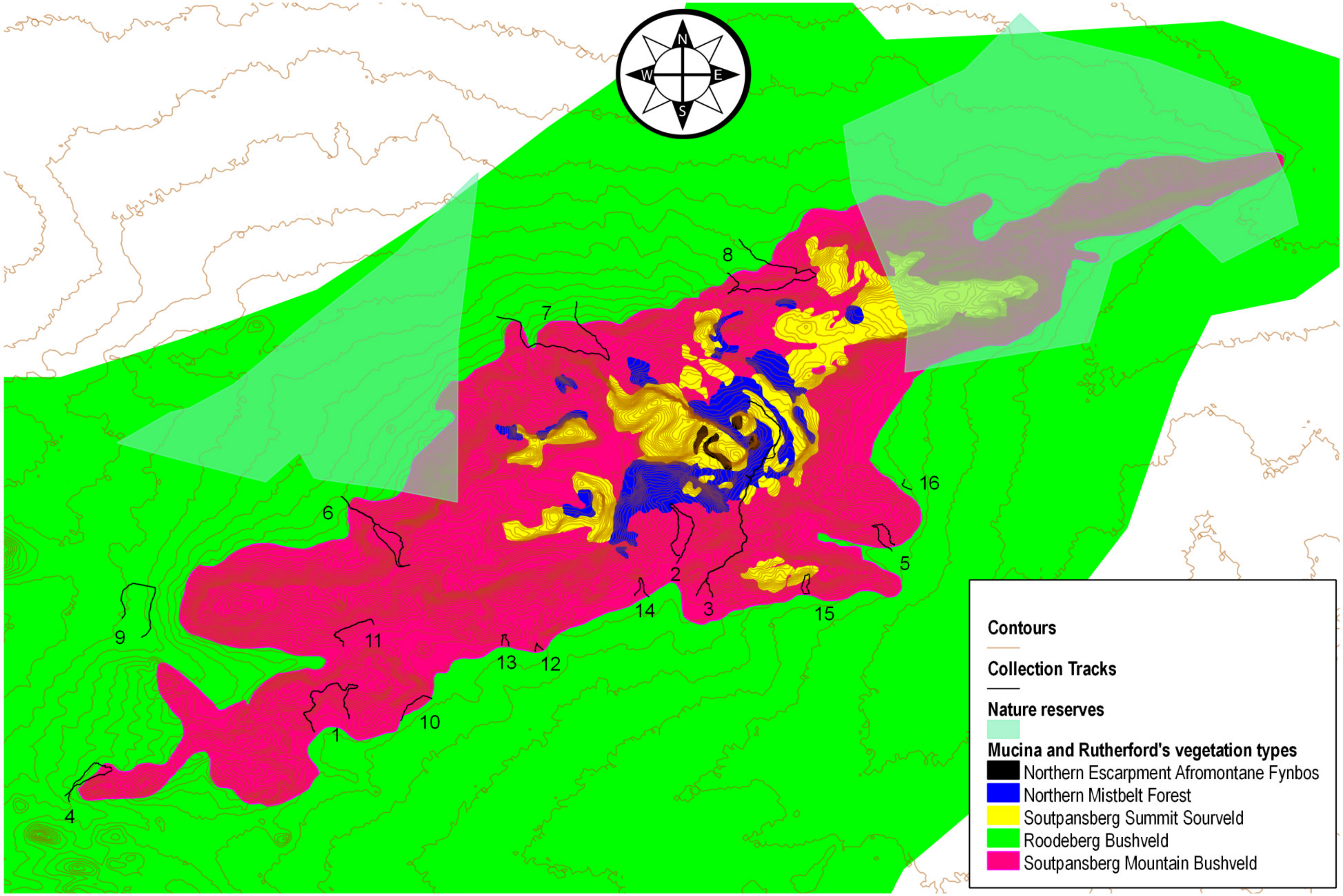

Figure 4.2. Vegetation types occuring on Blouberg Mountain, as described by Mucina and Rutherford (2006).

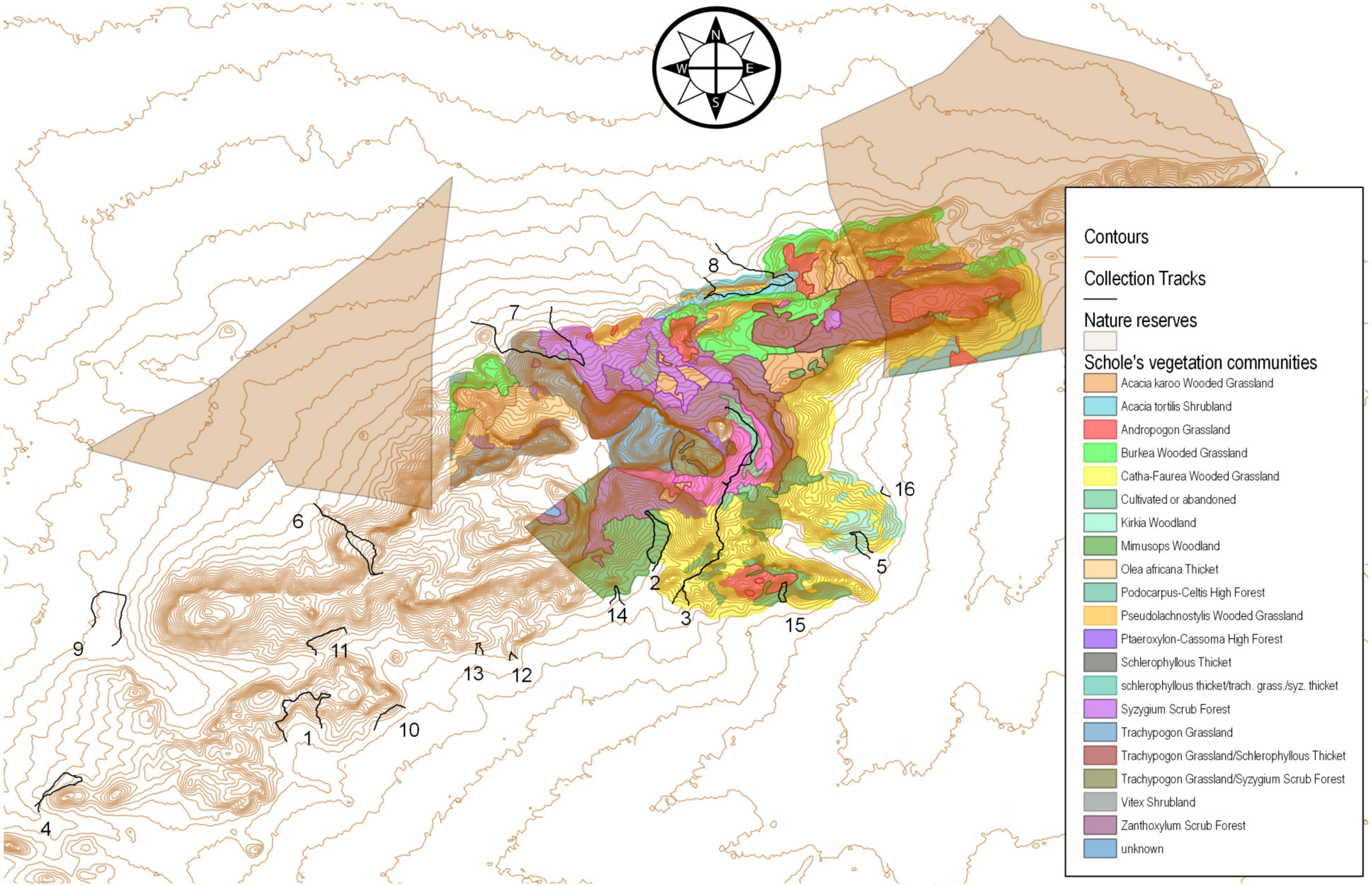

Figure 4.3. Vegetation communities on Blouberg Mountain, as described by Scholes (1978).

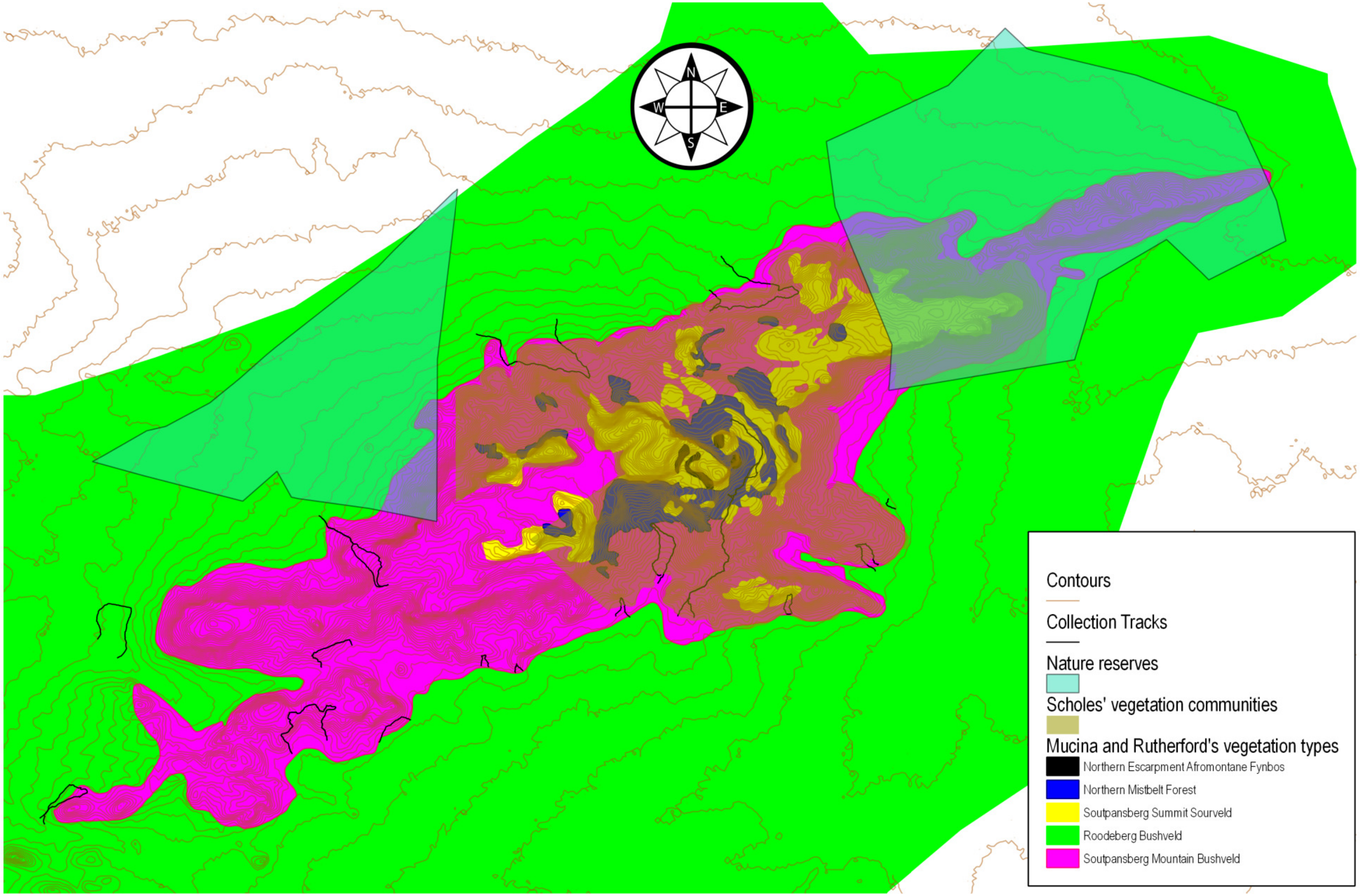

Figure 4.4. Tracks surveyed, vegetation types (Mucina and Rutherford) and communities (Scholes) on Blouberg Mountain.

4.5.4 Tracks per village

Track 1 (Blackhill village)

Thirteen species were collected, of which nine were identified and four known only by their vernacular names. *Clivia caulescens* is listed as not threatened in the Red Data List (SANBI, 2011), however this species is viewed by traditional healers as in decline. As such *Clivia caulescens* is perceived by traditional healers to be rare and its replacement value is high. This species is a good candidate for cultivation. It is already available commercially and would be in demand by traditional healers around Blouberg Mountain, as healers mentioned that due to its scarcity they buy this plant from other healers outside their area. *Philenoptera violaceae,* which is an indicator of bush encroachment (Bromilow, 2010), was collected on this track. A more in depth investigation should take place to ascertain the severity of bush encroachment on this track. If shown to be problematic then harvesting this species or introducing grazing by goats would play an important role in limiting their spread to vegetation on the mountain.

The track intercepted the Soutpansberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006). According to Mucina and Rutherford (2006), this vegetation type is vulnerable to human population (see section 4.5.3). None of the species collected from this track were listed under Scholes' (1978) vegetation communities because the area the healers utilised extended beyond Scholes's map. Track 1 is in need of conservation measures, as it is the most impacted in terms of the number of species collected. It is suggested that this track be further investigated to determine the quantities of each species removed in order to decide whether harvesting should be limited here.

Track 2 (Inveraan village)

A total of eight species were collected from this track, of which seven were identified and one known only by its vernacular name. One species, *Warburgia salutaris* has a replacement value of medium and it is perceived as common, however the species is recorded as endangered in the Red Data List (SANBI, 2011). This discrepancy might be due to the fact that it is still abundant on Blouberg Mountain, but rare, declining or even near extinction in other areas. This species has been used for centuries and is popular amongst other medicinal trees in Africa (Venter and Venter, 2002). Venter and Venter (2002) suggested that bark be selectively harvested from the stems and branches and possibly sold to the *muthi* trade to help reduce over harvesting and preserve natural populations.

Track 2 covered two of Mucina and Rutherford's (2006) vegetation types: the Soutpansberg Mountain Bushveld and Northern Mistbelt Forest. The track overlaid two of Scholes' vegetation communities: *Mimusops* Woodland and *Zanthoxylum* Scrub Forest.

Track 3 (Bobeng village)

Seven medicinal species were collected, of which five were identified and two known only by their vernacular names. *Cassytha filiformis* is a naturalised exotic of unknown origin (Germishuizen and Meyer, 2003) and is perceived by the healers to be rare and its replacement value high. This may be due either to the fact that it is exotic and occurs in vegetation that is in good condition with little disturbance and therefore rare, or that it is highly targeted. Majana is also perceived by the traditional healers to be rare and has a high replacement value, therefore it is important to identify this species to determine its conservation status.

This track intercepts three of the vegetation types listed by Mucina and Rutherford (2006): Soutpansberg Mountain Bushveld, Northern Mistbelt Forest and Soutpansberg Summit Sourveld. Northern Mistbelt Forest and Soutpansberg Summit Sourveld are least threatened vegetation types (Mucina and Rutherford, 2006). The track intercepts five of Scholes' communities: *Catha-Faurea* Wooded Grassland, Cultivated or abandoned, *Mimusops* Woodland, *Podocarpus-Celtis* High Forest and *Zanthoxylum* Scrub. It is the longest track and the only one that covers three of Mucina and Rutherford's (2006) vegetation types.

Track 4 (Normandy village)

Four medicinal species were collected of which three were identified, with one known only by its vernacular name. Plant species collected in track four fall under the Roodeberg Bushveld, which is least threatened and Soutpansberg Mountain Bushveld vegetation types (Mucina and Rutherford, 2006). Track four does not intercept any vegetation communities of Scholes' (1978), as this map only covers half of the mountain.

Track 5 (Bull Bull village)

Two of three medicinal species collected were identified, with one known only by its vernacular name. The unidentified species, Koba, is perceived by healers to be rare on the mountain and has a high replacement value. Identification of this species is therefore paramount in order that its conservation status can be investigated. The healers from the eastern side of the mountain were hesitant in taking part in the study, which may be one reason for the low number of species collected from this track and track 16.

Two of the identified medicinal plants collected from this track were found in the Soutpansberg Mountain Bushveld vegetation type. The unidentified plant, Koba, is found within the Roodeberg Bushveld vegetation types (Mucina and Rutherford, 2006). It is also found within *Catha-Faurea* Wooded Grassland and *Kirkia* Woodland vegetation communities (Scholes, 1978).

Track 6 (Varedig village)

A total of four medicinal species were collected, of which two were identified and two known only by their vernacular names. *Corchorus tridens* and Meswarokgane are species perceived by the healers to be rare and their replacement value is high. As in the case of *Cassytha filiformis*, *C. tridens* is a naturalised exotic. This plant is frequently collected as wild spinach in disturbed areas of South Africa (High and Shackleton, 2000). *Corchorus tridens* is listed as one of the most widely used leafy vegetables (*morogo*) in Limpopo Province (Jansen van Rensburg *et al.*, 2009), and it also plays a significant role in the socio-economic and health well-being of many Zimbabweans (Maroyi, 2011). The fresh leaves of *C. tridens* are used as pot herbs by the Vhavenda people in the Venda region of Limpopo Province (Maanda and Bhat, 2010). Harvesting these exotic species may play an important role in limiting their spread to untransformed vegetation on the mountain. Meswarokgane should be further investigated and identified in order to determine the reasons for its rarity on Blouberg Mountain.

Medicinal plants collected from this track were from the Soutpansberg Mountain Bushveld and Roodeberg Bushveld vegetation types (Mucina and Rutherford, 2006). This track does not intercept Scholes' (1978) vegetation communities.

Track 7 (Stockings village)

Seven medicinal species were collected, five were identified, with two known only by their vernacular names. Moselekgwale is perceived by the traditional healers to be rare and has a high replacement value which would make it suitable for cultivation. This species should be identified for conservation purposes. *Dichrostachys cinerea*, an indicator of bush encroachment (Bromilow, 2010), was found and collected on the track. Species which are indicators of bush encroachment should be managed and monitored, as bush encroachment might be a major threat to biodiversity in the long term around the Blouberg Mountain.

Medicinal plants were collected from Soutpansberg Mountain Bushveld and Roodeberg Bushveld vegetation types (Mucina and Rutherford, 2006). Two species were collected from Scholes' (1978) vegetation communities: *Vitex* Shrubland and *Syzygium* Scrub Forest.

Track 8 (Glenfernest village)

Seven out of eight medicinal species collected could be identified. *Lannea schweinfurthii* and *Cassia abbreviata* are perceived by the traditional healers to be rare and have a high replacement value, whereas these species are listed as least concern in the Red Data List (SANBI, 2011). In contrast to the healers' perception of *C. abbreviata,* it was observed by the researcher that this species is still abundant on the area where the track began. This might be the result of reluctance by healers to go further up the mountain to collect this species, and thus they perceive it to be rare because of over harvesting at the start of the track.

Plant species collected from this track were collected from two of Mucina and Rutherford's (2006) vegetation types mainly Soutpansberg Mountain Bushveld and Roodeberg Bushveld. The plants were also collected from three of Scholes' (1978) vegetation communities, namely: *Burkea* Wooded-Grassland, *Acacia tortilis* Shrubland and *Pseudolachnostylis* Wooded-Grassland.

Track 9 (Springfield village)

All three medicinal species collected from track nine were identified. *Lannea schweinfurthii* and *Pyrenacantha grandiflora* are perceived by traditional healers to be rare and their replacement value is high. However, these species are of least concern in the Red Data List (SANBI, 2011). These species would thus be good candidates for cultivation in the Blouberg area. It would also be in the interest of conservation if traditional healers from the side of the mountain where species are declining shift the focus from that side and target the other side of the mountain where these species are still abundant.

All species on this track were collected from the Roodeberg Bushveld vegetation type (Mucina and Rutherford, 2006). The track does not intercept any of Scholes' vegetation communities.

Track 10 (Sweethome village)

Two of four species collected were identified and two known only by their vernacular names. The four species collected from this track fall under the Soutpansberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006). The track does not intercept Scholes' (1978) vegetation communities.

Track 11 (Liepsig village)

All three plant species collected from this track were identified. Species from this track fall under the Soutpansberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006), and the track does not intercept Scholes' (1978) vegetation communities because the area the healers utilised to collect plants extended beyond Scholes's map.

Track 12 (Mafateng village)

Four medicinal species were collected and identified. *Erythrina lysistemon* and *Cassia abbreviata* are perceived by the healers to be rare on the mountain, and these species have a high replacement value, but they are documented in the Red Data List (SANBI, 2011) as least concern. Species collected from track 12 were from Soutpansberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006). This track did not intercept any of Scholes' vegetation communities.

Track 13 (Kwarung village)

A total of three medicinal species were collected and identified. *Cassia abbreviata* is recorded as least concern in the Red Data List (SANBI, 2011); however, it is perceived by traditional healers to be rare and its replacement value to be high. All species on this track were collected from the Soutpansberg Mountain Bushveld (Mucina and Rutherford, 2006), and none of the species collected were covered by Scholes' vegetation communities.

Track 14 (Bosehla village)

All three medicinal species collected from track 14 were identified. *Tarchonanthus camphoratus,* an indicator of bush encroachment (Bromilow, 2010), was found and collected from this track. According to Venter and Venter (2002), tree cuttings from *Tarchonanthus camphoratus* make a good fuel, thus the spread of this encroacher can be minimized by fuel wood harvesting.

Medicinal plants from this track were collected from the Soutpansberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006). All three species collected on this track traversed only one of Scholes' (1978) vegetation communities, *Mimusops* Woodland.

Track 15 (Dantzig village)

Three medicinal species were collected and identified. Soutpansberg Mountain Bushveld and Soutpansberg Summit Sourveld (Mucina and Rutherford, 2006) are the vegetation types which this track passes through. Plant species collected from this track were found in the following vegetation communities listed by Scholes (1978): *Mimusops* Woodland, *Catha-Faurea* Wooded-Grassland and *Andropogon* Grassland.

Track 16 (The-Glade village)

A total of two medicinal species were collected and identified. *Maerua juncea,* which is listed as of least concern by the Red Data List (SANBI, 2011), is perceived by the healers to be rare and the replacement value of the species is high. All species on this track were collected from the Roodeberg Bushveld vegetation type (Mucina and

Rutherford, 2006), and the track did not intercept any of Scholes' (1978) vegetation communities.

Tracks 4–6 and 9–16 are not highly impacted with respect to plant species collection, due to the low numbers (3–4) of species taken from them. The most probable reason for this low number of species is the difficult topography, with a number of streams. Thus, healers cannot cover great distances in the search for plants or they might not have walked the entire track with the researcher (see chapter 1, section 1.6).

The Roodeberg Bushveld vegetation type occurred in parts of six tracks although none of the tracks encompassed only this vegetation type. This vegetation type was not heavily utilised but a number of species perceived by the healers as declining were located in this vegetation type. It should therefore be further investigated to understand the reason for this perceived decline. Soutpansberg Summit Sourveld and Northern Mistbelt Forest occurred in two tracks each. These vegetation types are therefore not commonly utilised or heavily impacted in terms of plant collection. (see section 4.5.2). Soutpansberg Mountain Bushveld covered 14 tracks, in which seven tracks were fully covered by the vegetation type and seven tracks had Soutpansberg Mountain Bushveld as well as two or more other vegetation types combined. None of the tracks surveyed pass through the Northern Escarpment Afromontane Fynbos vegetation type (Fig. 4.2) which is therefore not impacted by plant collection.

4.5.5 Traditional healers' perception of natural resource availability compared with Red Data listings

The study revealed discrepancies between what the healers perceived as rare and what is documented in the Red Data List (SANBI, 2011) and protected plants legislation for the province. The healers are not aware of how to conserve these species or even that there is legislation protecting such species. A number of species are perceived by the healers to be rare on the mountain, however, none of those species appear in the Red Data List (SANBI, 2011) as threatened or endangered.

The traditional healers from the western and southern sides of the mountain listed *Clivia caulescens* and Tlhokwa la tsela as rare species on the mountain. However, other respondents from the far eastern side of the mountain mentioned that Tlhokwa la tsela is abundant. Reasons for this anomaly could be that healers have very specific areas in which they collect and therefore, those who collect on one side of the mountain seldom collect on the other. Thus, although it is important to take into account the healers perceptions on species decline, validation should always follow. The fact that healers in general have a positive attitude to management of these plants bodes well for the instigation of conservation measures for such plants. *Cassia abbreviata* is documented as of least concern in the Red Data List (SANBI, 2011), although perceived as rare by the healers around Blouberg Mountain, making this species a good candidate for cultivation as it is amongst the most collected species in the area.

Although healers perceived *Warburgia salutaris* as common and abundant on the Blouberg Mountain, they may understand the conservation need once they realise its Red Data List (SANBI, 2011) status. A study in Zimbabwe revealed that once certain traditional healers were made aware of the threatened status of *W. salutaris* they were then willing to conserve it (Maroyi, 2008). The replacement value of the majority of species which are perceived by healers to be common, was medium, with a few of the species perceived to be rare which were of high replacement value (Table 4.2). This is an indication that the species may be in need of conservation measures and that the species would be a good candidate for cultivation. When a species is perceived as common, and the replacement value is medium, then that species is probably still abundant on the mountain.

In situ conservation plays a major role in the conservation of plant species, as it is the most effective way in which biodiversity can be maintained (Müller, 1994). These species which are viewed by healers as rare could none the less be taken up for either *in situ* or *ex situ* conservation strategies.

4.5.6 Exotic plants

The spread of exotic species poses a threat to global biodiversity, which is becoming an important issue in conservation biology (Arim *et al.* 2006).

Cassytha filiformis (track 3) and *Corchorus tridens* (track 6) are two exotic species identified on the mountain. These species are naturalised exotics of unknown origin (Germishuizen and Meyer, 2003). A naturalised species is an introduced species, which is either a non-native, exotic or alien, spreads faster and competes with the native flora to form dense populations, and which always consistently reproduces and sustains populations over many generations without direct intervention by humans (Pyšek *et al*., 2002). Although exotic, neither of these species are of concern as invasives, and are rather indicative of disturbed land.

The fact that only two exotics were found on the tracks and utilised by the traditional healers indicates that the vegetation is still in good condition. If more were present it is probable that Blouberg healers would have indicated them on the tracks.

4.5.7 Bush encroachment

Bush encroachment poses a threat to the biodiversity of certain tracks (1, 7 and 14) on the Blouberg Mountain. Indicators of bush encroachment, such as *Dichrostachys cinerea*, *Philenoptera violacea* and *Tarchonanthus camphoratus* were found on these tracks.

According to Moleele *et al*. (2002), bush encroachment by species such as *Dichrostachys cinerea* increases around kraals at the expense of the grass cover. *Dichrostachys cinerea* is considered to be a prolific invader species, and it encroaches rapidly on overgrazed and old lands where the grass cover has been removed (Venter and Venter, 2002). According to Venter and Venter (2002) *D. cinerea* is difficult to eradicate and the only way to control its spread is by chemical and mechanical control measures. However, in contrast to Venter and Venter (2002), Yayneshet *et al*. (2008) stated that the spread of the shrub can be controlled by goat grazing as the species regenerates from seeds and root buds. The effect of medicinal plant harvesting on this species could therefore be important particularly as it is uprooted.

Tarchonanthus camphoratus has the potential to be a significant encroacher mostly in disturbed semi-arid savanna habitats (Coetzee *et al*., 2007). *Tarchonanthus camphoratus* reproduces vegetatively and has small wind dispersed seeds (Noad and Bernie, 1989), exhibiting two of the major life history characteristics which have been shown to contribute to invasive success (Coates-Palgrave, 2002), and making it a potential bush encroacher in disturbed habitats (Kiruki and Njung'e, 2007).

Around the Blouberg Mountain, *Dichrostachys cinerea* is a significant problem in over-grazed areas, but *Philenoptera violacea* and *Tarchonanthus camphoratus* are not yet a cause for concern.

4.5.8 The use of GIS as a decision-making tool

The area where GIS is proving most valuable to conservation efforts is in the exploration of impacts of future environmental change such as climate and land use on Africa's biodiversity (Swetman and Reyers, 2011). The utilisation of medicinal plants is an important land use option in many rural areas and therefore warrants further investigations using GIS as an analytical tool.

The benefit of using GIS technique is that it provides for the rapid integration of data from a variety of sources, with the added benefit of a computer graphics display. It is ideal for combining sets of information which when analysed together give a broader understanding of a situation than would be possible by examining each set individually. According to Swetman and Reyers (2011), GIS technology is currently in a position to meet the needs of scientists, policy-makers and citizens in managing their biodiversity in more sustainable ways.

4.5.8.1 A reflection on this study's use of GIS as a decision-making tool

Selection of tracks

Only sixteen tracks were selected from the 16 villages surveyed, however, more tracks could have been sampled if more healers had been willing to take part in the study. Involving more healers in the selection of the tracks would have given a better indication of numbers of healers using each track. In the future, more tracks should be surveyed to give a more comprehensive picture of the medicinal plants collected and used from the mountain.

Data sheet

The information on the amounts collected per month was inadequate because the healers gave poor estimates on the quantity of the plant material removed from the mountain, rather than the exact amount collected. More accurate and detailed information is required which can only be obtained from extended and direct observations of material collected rather than relying only on questionnaires. This is vital to any conservation plan for these plants.

Mapping and investigation of tracks

More tracks should be mapped and accurate information on the actual availability of medicinal plants per track should be determined through species abundance plots. The tracks should also be investigated with respect to other impacts on the vegetation. This will facilitate research into finding means of ameliorating poor land management on the tracks mapped.

Analysis

Techniques that capture and manage spatially linked data provide for a common structure for different types of information, making analysis more systematic and strategic (Mbile *et al*., 2003). In this study a Geographic Information System was used as the tool for mapping features and tracks accurately using precise co-ordinates, and it provided a significant saving in time and money. Unlike with a paper map, GIS techniques allow for the combination of many digital layers of information into a composite map which can then be modified and manipulated. Tracks that have never before been geo-referenced were geo-processed and converted into a digital layer. The Geographic Information System thus presented the opportunity to archive, retrieve and transform such research data and this will now be made available to various stakeholders at regional, national or international level.

The digital maps now indicate areas of high use, such as impacted vegetation types, and these can be targeted for immediate remedial action. These maps are a tool where information on the position of medicinal plant species relative to healers' collection tracks, vegetation types and topographical features can easily be viewed and analysed. This information is now available to government agencies for conservation planning as well as to the Blouberg Municipality and Tribal Authority to assist in management decisions that may impact on medicinal plants and/or traditional healers.

It would also be worth re-visiting the tracks to physically plot the occurrence of those plants that the healers believe are rare to determine whether this is indeed the case. The combination of information into a series of maps indicating the position of the tracks and vegetation types in which bush encroachment, exotic species and species of medicinal importance that are in decline gives an overall indication of the extent of medicinal plant use in the Blouberg area. The tracks on which indicators of bush encroachment are present should be investigated more thoroughly to ascertain the extent and severity of such a threat.

Mapping of vegetation structures allows for more in depth analysis of threats to the indigenous flora of an area. In Blouberg, threats such as bush encroachment, invasion of vegetation by exotic components, and destruction by focused plant removal, wood harvesting and overgrazing are potential problems. Mapping of these threats can reveal the extent and position of problem areas and give insight into possible solutions.

Visiting the mountain in different seasons to capture information on plants not available when this study was done would help to identify those that could not be identified and capture species not available during the seasons surveyed. Unidentified plants perceived to be rare and with high replacement value must be identified as a top priority. These can then be analysed with respect to their vulnerability on the mountain. Validation should include the species which are perceived as rare but not documented in the Red Data List (SANBI, 2011). The possibility exists that one species may be known by two vernacular names or *vice versa* and thus it is also important that all plant species known only by Sepedi names are identified.

4.6 CONCLUSIONS

It is clear that healers follow collection tracks which can be mapped and linked to additional information such as species names and numbers. This first testing of a GIS technique for mapping and analysing collection tracks can now be modified to investigate other patterns of natural resource use on Blouberg Mountain. Fuel wood collection, cattle grazing and edible plant collection patterns are all examples of resource uses that could be elucidated through the techniques pioneered in this study. Furthermore, this method can be adapted to capture and disseminate the associated local indigenous knowledge around all natural resources in the Blouberg area.

Soutpansberg Mountain Bushveld is the most heavily utilised vegetation type when compared with other vegetation types. This vegetation type should be conserved and managed if possible as it is targeted for plant species of medicinal value. Most of the highly used species were collected from this vegetation type. Information from this study, particularly that regarding quantities of medicinal plants utilised and most impacted areas of the mountain in terms of collection, will be invaluable to Limpopo Province conservation officials who are in the process of implementing a conservation plan for the province.

Solutions to the problems of over harvesting of medicinal plants require local innovations and the full participation of local communities and traditional healers in resource management initiatives. Unless medicinal plant cultivation is rapidly instituted amongst the Blouberg community, medicinal plants are likely to become rare or difficult to locate in the wild. The development of medicinal plant nurseries together with propagation of key species will be a crucial management tool.

The identification of new, alternative plants of medicinal value that can be used in conjunction with the current ones will take some pressure off the over-harvested species. In addition the indigenous knowledge regarding the use of medicinal plants around the Blouberg Mountain should be examined for indigenous methods of sustainable harvesting and recorded for posterity.

4.7 FUTURE RESEARCH STEMMING FROM THIS PROJECT

a) The method (GIS technique) is applicable to investigating the use of any resource around Blouberg Mountain where tracks are followed for collecting purposes for example, fire-wood and edible plants.

b) Patterns of collection by people further away from the mountain than those investigated in this study should be explored. This would assist in managing the resource as it would give a better indication of the actual number of resource users.
c) Scholes' vegetation communities should be revised and digitised and more vegetation communities must be investigated for the entire mountain as Scholes surveyed only half of the mountain.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

Appendix A

QUESTIONNAIRE NUMBER [ ]

1. Geographical information							
Villages							
1	Blackhill	5	Dantzig	9	Liepsig	13	Sweet home
2	Bosehla	6	Glenfernest	10	Normandy	14	The Glade
3	Bobeng	7	Inveraan	11	Springfield	15	The Glen
4	Bull Bull	8	Kwarung	12	Stocking	16	Varedig

2. Personal information								
2.1	Level of education							
	1	No formal education	2	Primary schooling	3	Secondary schooling		
2.2	How many years experience in traditional healing?							
	1	<10	2	11-20	3	21-30	4	>30
2.3	How many years in this community?							
	1	<10	2	11-20	3	21-30	4	>30

3. Consultation								
3.1	How many patients do you see per month?							
	1	<20	2	21-30	3	>30	4	Other (specify)

4. Collection								
4.1	Are you aware of any traditional way of collecting plants to ensure sustainability?							
	1	Yes	2	No				
4.2	If yes, explain?							
4.3	How are plants collected?							
	1	It is a general collection per trip	2	For a specific species	3	For a specific purpose	4	Other (specify)

4.4	Is there a seasonal difference in the amount of plant materials that you collect?							
	1	Yes			2	No		
4.5	If yes, explain							

5.	**Legislation**							
5.1	Do you have any knowledge of the Limpopo Environment Management Act (LEMA)?							
	1	Yes			2	No		
5.2	Have you ever been visited by officials of the Department of Environmental Affairs?							
	1	Yes			2	No		
5.3	If yes, how often?							
	1	Monthly	2	Half yearly	3	Annually	4	Other (specify)
5.4	For what reason?							
	1	To verify where plant material is stored	2	General research	3	To verify permits	4	Other (specify)
5.5	Do you have permits to collect protected plants?							
	1	Yes			2	No		
5.6	If no, why not?							
	1	No collection in restricted areas	2	No knowledge on how to apply	3	Expensive to apply	4	Did not know we need one
5.7	Are you registered with the traditional association for healers?							
	1	Yes			2	No		
5.8	If not, why not?							

	1	Gift from the ancestors	2	Very strict requirements	3	Long and expensive registration	4	Other (specify)
5.9	Have you ever been visited by the officials of the traditional healers association?							
	1	Yes	2	No				
5.10	If yes, how often?							
	1	Monthly	2	Half yearly	3	Annually	4	Other (specify)
5.11	To verify that:							
	1	Plant materials used are fit for human consumption	2	Storage condition for plants are correct	3	Traditional association rules are followed	4	Other (specify)

6.	**Conservation**							
6.1	Is there a decline of certain available species?							
	1	Yes	2	No				
6.2	If yes, please name them?							
	1		5		9			
	2		6		10			
	3		7		11			
	4		8		12			
6.3	Does it have an impact on your practice?							
	1	Yes	2	No				
6.4	If yes, explain the impact							
	1	No plant material means no patients	2	Expensive to buy plant materials from other places	3	Decline will result in loss of knowledge	4	Other (specify)

6.5	Have you noticed a change in vegetation on the mountain over time due to erosion, excessive harvesting of fuelwood, overgrazing or other reasons?							
	1	Yes			2	No		
6.6	If so, does this impact on your collection							
	1	No	2	Negatively	3	Positively	4	Other (specify)
6.7	Would you use plants from a nursery?							
	1	Yes			2	No		
6.8	If no, explain why							
6.9	As a traditional healer, how do you ensure that there are plants to harvest in the future?							
	1	Have plants in my garden	2	Use correct harvesting techniques	3	Never take too many plants/the last plant	4	Other (specify)
6.10	Do you have any ideas how to ensure that there are plants in the future?							
	1	Yes			2	No		
6.11	If yes, what are those ideas?							
6.12	Do you buy stock (plants) that are not available in the area?							
	1	Yes			2	No		
6.13	If yes, where do you buy them?							
	1	From other healers in the area	2	From the street vendors	3	From the markets	4	Other (specify)
6.14	How would you feel if conservation authorities, or the traditional healers							

	associations or the local tribal authority placed restrictions on the number of plants you could collect to ensure that they were not over harvested?					
	1	Unhappy	2	Happy	3	Indifferent
6.15	Why?					

APPENDIX B

DATA COLLECTION SHEET

Appendix B **Data Collection Sheet**

Village name:

Healer: (name and contact details)

Plant name	**Vegetation type**	**Habitat**	**Parts used**	**Packets collected per month**	**Harvesting Method**	**Replacement value of plant**	**Perceived rarity**	**GPS Co-ordinates**
Scientific and Vernacular names	1=forest 2=woodland 3= grassland 4=wooded grassland 5= scrub and thicket	1=mountain peak 2=mountain slope 3=waterfall 4=river/stream 5=donga 6=other (specify)	1=bark 2=stem 3=leaves 4=roots 5=fruits 6=flowers 7=other (specify)		1=uproot 2=cut leaves 3=strip bark 4=ring bark 5=other (specify)	1=low 2=medium 3=high	1=abundant 2=common 3=rare	S 23º 15` E 29º 17`

APPENDIX C

DATA SHEET FOR CONSULTING ROOMS

Appendix C **Data Sheet for consulting rooms**

Village name:

Healer:

Plant name	**Parts used**	**Packets (and size of packet) collected**	**No. of buckets in the room**	**Litre bucket**	**Harvesting method**	**Replacement value of plant**	**Perceived rarity**
Vernacular name	1= bark 2= stem 3= leaves 4= roots 5= fruits 6= bulb 7=other (specify)				1= uproot 2=cut leaves 3=strip bark 4=ring bark 5=other (shift)	1=low 2=medium 3=high	1=abundant 2=common 3=rare

APPENDIX D

LIST OF PLANT SPECIES

Species names

Abrus precatorius L. subsp. *africanus* Verdc.

Ammocharis coranica Herb.

Artemisia afra Jacq. ex Willd.

Asparagus exuvialis Burch.

Berchemia zeyheri (Sond.) Grubov

Blepharis diversispina C.B.Clarke

Bolusanthus speciosus (Bolus) Harms

Boophane disticha (L.f.) Herb.

Cadaba aphylla (Thunb.) Wild

Callilepis laureola DC.

Callilepis salicifolia Oliver

Capparis sepiaria L.

Carissa edulis Vahl

Cassia abbreviata Oliv. subsp. beareana (Holmes) Brenan

Cassytha filiformis L.

Catha edulis (Vahl.) Endl. (Vahl) Forssk. ex Endl.

Clivia caulescens R.A.Dyer

Cocculus hirsutis (L.) Diels

Corchorus tridens L.

Dichrostachys cinerea (L.) Wight & Arn.

Elaeodendron transvaalense (Burtt Davy) R.H.Archer

Elephantorrhiza burkei Benth.

Erythrina lysistemon Hutch.

Eucomis pallidiflora Baker

Garcinia gerrardii Harv. ex Sim

Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.

Jatropha spicata Pax

Lannea schweinfurthii Engl.

Maerua juncea Pax subsp. *crustata* (Wild) Wild

Myrothamnus flabellifolius Welw.

Osyris lanceolata Hochst. & Steud.

Ozoroa sphaerocarpa R.Fern. & A.Fern.

Pappea capensis Eckl. & Zeyh.

Peltophorum africanum Sond.

Philenoptera violaceae (Klotzsch) Schrire

Pleurostylia capensis Oliv.

Plumbago auriculata Lam.

Pyrenacantha grandiflora Baill.

Pyrostria hystrix (Bremek.) Bridson

Securidaca longepedunculata Fresen.

Siphonochilus aethiopicus (Schweinf.) B.L.Burtt

Spirostachys africana Sond.

Syzygium guineense (Willd.) DC.

Talinum caffrum (Thunb.) Eckl. & Zeyh.

Tarchonanthus camphoratus L.

Warburgia salutaris (Bertol.f.) Chiov.

Ximenia africana L.

Ximenia caffra Sond.

Zanthoxylum capense (Thunb.) Harv.

Ziziphus mucronata Willd. subsp. mucronata