

**Ethnomedicinal survey of invasive alien plant species used in the Capricorn  
District, Limpopo Province, South Africa**

By

Mosibudi Wendy Cherane

(11570040)



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(11570040)

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School of Mathematical and Natural Sciences

University of Venda

Thohoyandou, Limpopo

South Africa

Supervisor: Prof. M.P. Tshisikhawe

Co-supervisor: Dr K. Magwede

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## DECLARATION

I, Mosibudi Wendy Cherane, declare that this dissertation is my original work and has not been submitted for any degree at any other university or institution. The dissertation does not contain other persons' writing unless specifically acknowledged and referenced accordingly.

Signed (Student): ..... Date: .....

## DEDICATION

This dissertation is dedicated to my son Rendani Sengani, my fiancé David Sengani, my mother Modjadji Sara Matlala, my father Matome Sias Cherane, my sister Tshepo Selina Cherane, as well as my brother Tobias Karabo Cherane.

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## ABSTRACT

Invasive alien plants (IAPs) are non-native species that have spread beyond the introduction site; become abundant to an extent that they serve as agents of change that also threaten native biological diversity (Garcia-Berthou, 2007). IAPs have medicinal applications for the treatment of various ailments in humans (Jäger *et al.*, 1996).

In this study, an ethnomedicinal survey was conducted on medicinal uses of invasive alien plant species in order to identify and investigate the various disease treatment methods employed by Bapedi traditional health practitioners within Capricorn District. Six traditional health practitioners were randomly selected, via the snowball method from each of the five local municipalities namely: Aganang, Blouberg, Lepelle-Nkupi, Molomole and Polokwane. The whole survey included 30 traditional health practitioners. A semi structured questionnaire was administered to document information about the medicinal uses of IAPs from participants. The collected data from the questionnaire was captured in Microsoft Excel 2010 and analyzed using descriptive statistics.

The study recorded 22 IAPs belonging to 14 plant families. Records or data collected show invasive alien plants species to have been used for treatment of different ailments amongst Bapedi traditional health practitioners. Plant families with the most recorded species include: Solanaceae and Myrtaceae with 18.2% for both of them. The plant parts most frequently used in descending order were as follows: roots

(40%), followed by the leaves (39%), fruits (7%), thorns (6%), bark (4%), seeds (2%) and lastly stems (2%). Decoction was recorded as the most dominant method used during medicinal preparations (n = 176) and flu was recorded as the most treated ailment amongst traditional health practitioners (n = 29).

Apart from clearing IAPs as part of management strategy by South African government, there are other alternative innovative ways that can be employed to ensure that the number of IAPs introduced does not exceed beyond measure. This could be achieved by encouraging local people to use them as either medicinal sources or by incorporating them into any other local ethnobotanical use. The new innovative ways (such as traditional health practitioners utilizing the IAPs instead of endangered plants or indigenous plants species) can bring in some form of relief to the already declining indigenous species populations. Research scholars from different research institutes and higher education research centres can regard IAPs used medicinally as source of new pharmaceutical leads to create new medications. With such attention turned to alien invasive species, their survival as well as their spread will be kept on check at the same time creating a control measure to their spread with little effort. Further laboratory-based studies are needed to determine efficiency and safety of the IAPs used by traditional health practitioners in this study.

**Key words:** Ethnomedicinal, Survey, Invasive alien plants, Traditional health practitioners.

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## LIST OF ABBREVIATIONS

<b>%:</b>	Percentage
<b>=:</b>	Equal to
<b>≤:</b>	Less- than or Equal to
<b>CARA:</b>	Conservation of Agricultural Resources Act No. 43 of 1983
<b>GDP:</b>	Gross Domestic Product
<b>HIV:</b>	Human Immunodeficiency Virus
<b>IAPs:</b>	Invasive Alien Plant Species
<b>KM:</b>	Kilometres
<b>LM:</b>	Local Municipality
<b>Ms Excel:</b>	Microsoft Excel
<b>n:</b>	Number
<b>NEMBA:</b>	National Environmental Management Biodiversity Act No. 10 of 2004
<b>NRF:</b>	National Research Foundation
<b>STI's:</b>	Sexually Transmitted Infections
<b>USD:</b>	United States Dollar

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Invasive alien plants species are non-native species that have spread beyond the introduction site; become abundant and serve as agents of change threatening native biological diversity (Garcia-Berthou, 2007). The process of species invasion consists of three stages namely: introduction, establishment and finally dispersal. Both abiotic and biotic factors from the environment are major contributors to the success of the stages involved in the process of species invasion (Moyle and Light 1996; Rosecchi *et al.*, 2001). Successful invasion results when the species adapt to new environmental conditions (Winemiller and Rose, 1992). To classify an introduced species as established, there must be evidence of reproduction and the existence of a self-sustaining population (Gozlan *et al.*, 2010).

Due to IAPs lack of natural enemies in their introduced environment, their population most likely outcompete indigenous species, with many ending up being adopted into the local livelihood of communities and even given local names. Communities often switch and use other species instead of indigenous ones due to the scarcity of the indigenous species and the abundance of IAPs as invasion progresses (McGarry *et al.*, 2005). In Thulamela Local Municipality in the Vhembe District of South Africa, a study was conducted in 2010 where local people and traditional health practitioners

were interviewed. Twenty-one IAPs, belonging to fifteen families were found to be used by local people. The IAPs were found to be used for aesthetic purposes, as food, medicine, and firewood. As a result of over exploitation of the indigenous counterparts, it led to IAPs being alternative sources of utilization for different types of uses (Semenya *et al.*, 2012).

Mbambala *et al.* (2017) found 38 IAPs belonging to 23 families to have been used in the Vhembe District Municipality for the treatment of different ailments by traditional health practitioners. Traditional health practitioners are practitioners of traditional African medicine and are generally divided into two categories; those that serve the role of diviner diagnostician (or diviner-mediums) and those who are healers (or herbalists). The diviner provides a diagnosis usually through spiritual means, while the herbalist chooses and applies relevant remedies (World Health Organization, 2003). Traditional medicines are diverse health practices and beliefs incorporating plant, animal, mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being as well as treatment or diagnoses or prevention of illness (World Health Organization, 2007). Approximately 3 000 plant species are used for herbal medicines by 27 million people in South Africa (McConnachie *et al.*, 2012). Traditional medicines are preferred over western medication because they are generally more accessible and affordable (Mander, 1998). Furthermore, traditional health practitioners are present in almost every community (Van Wyk *et al.*, 2009).

## 1.2 Problem Statement

Exotic plants invasion is one of the largest threats to indigenous flora in South Africa (Kaiser, 1999), and consequently to the ecosystem services provided to humanity and other organisms. The impact associated with IAPs include reduced surface water runoff and reduced ground water reserves, increased biomass and high fire intensity, markedly reduced biodiversity, and several economic consequences (Working for Water, 2004).

Different parts of plants such as bark, leaves and roots are used by traditional health practitioners to prepare both single and multiple plant species extracts (Tabuti *et al.*, 2010). The efficacy of some of these extracts by traditional health practitioners are validated by scientific studies such as York *et al.* (2012). In most parts of the provinces of South Africa, invasive plants are extensively exploited with some becoming embedded in the people's daily lives, used as traditional medicines. Most of the ethnobotanical studies conducted in the Limpopo Province are based on the utilization of indigenous plants. However, there is limited research conducted on the utilization of IAPs by traditional health practitioners in the Limpopo Province. Reliance on IAPs for medicinal purposes may promulgate the continuous use of such plants at the cost of biodiversity loss. Understanding the extent of the utilization of IAPs in traditional medicine may assist in monitoring and managing their proliferation rate.

### **1.3 Aim and objectives of the study**

The aim of this study was to conduct an ethno-medicinal survey on invasive alien plant species of the Capricorn District Municipality. The following objectives were investigated by the study:

- i. Documentation and identification of invasive alien plant species used by Bapedi traditional health practitioners in the Capricorn District.
- ii. Analysis of ethno-medicinal trends on invasive alien plant species used by traditional health practitioners within Capricorn District.
- iii. Categorization of invasive alien plant species on the CARA and NEMBA listing.

### **1.4 Hypotheses**

The hypothesis set up as a way of guiding the study was that traditional health practitioners in the Capricorn District Municipality use invasive alien plants to treat different ailments despite them being a major threat to biodiversity.

### **1.5 Structure of the dissertation**

This dissertation has been structured in a format that allows coherent reading. The chapters follow one another in compilation of a single scientific document. There

should therefore be no repetition of aspects discussed in other chapters. The chapters are therefore structured as follows:

Chapter one deals with the introduction of the topic, hypothesis, and structure of the dissertation as well as aim and objectives of the study. Chapter two gives a thorough literature review about invasive medicinal plants species. Chapter three describes the study area and outlined the materials used as well as the methodology followed when conducting the research. Chapter four gives the results and the interpretation thereof and discusses the results obtained in the study in line with findings by other researchers. Chapter five gives general conclusions and recommendations emanating from the study.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Traditional medicine practice

The World Health Organization define traditional medicine as health practices, knowledge, beliefs and approaches that incorporate plant, animal and mineral based medicines, spiritual therapies and manual techniques, applied singly or in combination to treat, diagnose and prevent illnesses or maintain wellbeing (Pieroni *et al.*, 2008). Medicinal plants are used for medicine, spiritual or cultural rituals (Dold and Cocks, 2005). Plants are usually burned, crushed, infused, macerated or boiled in dried form or fresh form before they are used (Van Wyk *et al.*, 1997). There is inter trading of medicine nationally and internationally, Zulu to Pedi and many African traders had incorporated Indian herbs into their medicines. African-owned shops display are similar to those of Indian shops showing how Indian and African interactions had advanced (Flint, 2006).

#### 2.2 Invasive alien plant species

These Invasive plants are a subset of naturalized plants that produce reproductive offspring. Offspring are usually produced in very large numbers and at considerable distances from the parent plants, and therefore have the potential to spread over a

large area before the species populations are changed from alien plants to invasive alien plants (Convention of Agricultural Resources Act 43 of 1983 ).

One reason why invasive plant species spread rapidly and uncontrollably is because of lack of natural enemies (this are organisms that feed on the IAPs in their native homes but absent in the environment that they have been introduced to). As a result, the IAPs spread uncontrollably and outcompete the indigenous plant. The proliferation of IAPs is mainly controlled chemically, mechanically and biologically in South Africa (Working for Water, 2004).

### **2.3 Control of invasive alien plant species**

The first record in the world of a successful biological control in plants was in 1836, after a cochineal bug (*Dactylopius ceylonicus*) was introduced to combat the smooth prickly pear (*Opuntia vulgaris*), as the bug is a native enemy to the smooth prickly pear and it was absent in the country the plant was introduced to (Bromilow, 2010). Although there are methods used to control these invasive alien species which threaten biodiversity as well as the natural ecology of the country, their success is not guaranteed. Chemical control may be harmful to other living organisms; mechanical method may result in plant re sprouting and biological controls may result in introducing natural enemies attacking other indigenous organisms and can lead to destabilizing the local ecological system completely (Bromilow, 2010).

The fight against the spread of IAPs in this South Africa has been going on for centuries and seems not to be slowing down (Hulme, 2006). Invasive alien plant species are the biggest threat to biodiversity as they impact landmarks such as nature reserves and vulnerable agricultural land. An estimated 7% of water that would flow into rivers is used by IAPs. These plants also cover over 10 million hectares of the already water scarce South Africa (equivalent to the size of KwaZulu-Natal Province). If sufficient action is not taken, hectares presently occupied by IAPs are expected to double in the coming 15 years. It is estimated that it will cost South Africa R600 million a year to control these IAPs in the coming 20 years (Water wise, 2014).

Invasive alien plant species may have been introduced by mistake or intentionally for the purpose of enhancing trade (e.g. *Eucalyptus camaldulensis*), ornamental purposes (e.g. *Catharanthus roseus*), food (e.g. *Opuntia ficus-indica*), medicine (e.g. *Ricinus communis*), wood (e.g. *Pinus patula*), forestry and agroforestry as barrier or hedge plants, stabilizers of sand dunes, crop production, timber and fodder (*Prosopis* species). Forestry plantations play an important role in the South African economy; in the late 1990s the value was estimated at US\$ 300 million annually or 2% of the GDP and employing over 100 000 people (Moran *et al.*, 2000; Van Wilgen *et al.*, 2001).

The effect of invasive alien plant species is not only seen within the plant community but also within a broad range of introduced species of fauna, flora and micro-organisms. Other forms of invasive alien species can be predators in the case of fauna (Weyl *et al.*, 2010). The budget for the eradication of alien invasive plants only for a period of three years ranges at R7.8 billion estimated through Working for Water

projects which strived to control invasive alien species. The control of IAPs protects to a certain degree ecosystem services through the management of the environment, but ways for the scientific community to assist in the identification and implementation of improvement is yet to reach a target in ecosystem restoration (Van Wilgen *et al.*, 2001).

Studies on antimicrobial activities of plant derived extracts has shown that large percent of plant species to have positive antimicrobial activity (Eloff, 1998). To develop commercial products, a large quantity of the species must be cultivated, which may result in a high level of complication, in addition there will be a need for the government to implement control measures which can assists in the commercialization processes of the products (Vila and Weiner, 2004). Most IAPs and alien plants pose extreme danger to the environment more especially to fauna including humans especially when the detection is not noted early before spreading beyond control (Evans, 1997). Most invasive species introduced into an environment reproduce more spontaneously rigorous due to lack of natural enemies that may limit their development and spread beyond carrying capacity. They compete with native plants for water, light and nutrients; causing enormous losses in native biodiversity (Mdee *et al.*, 2009). Invasive alien weedy species of plants that may contain good microbial activity can be useful source of anti-microbial compounds or extracts since large quantities of material are available (Mdee *et al.*, 2009).

In South Africa, more than 120 species have been declared unwanted invasive plants since 2010 (Bromilow, 2010). An estimated 8%, or 10 million hectares of South Africa has been invaded by different alien species (Versveld *et al.*, 1998). By using unwanted weeds and IAPs as raw material for extraction of medicinal products may protect

indigenous plants, and at the same time may create or boost local economic wealth (Mdee *et al.*, 2009).

Biological invasion is a global problem, an estimated 480 000 alien species has transverse worldwide due to anthropogenic activity as they infiltrate new environments around the world with an estimation of more than 90% of most regions newly occupied by humans introduced during the 20<sup>th</sup> century. *Opuntia ficus-indica* has been introduced worldwide by mistake from the tropical Americas with many other plant species from the same genus (Boy and Witt, 2013) in the 17<sup>th</sup> century. This caused devastating loss of biodiversity after its introduction in Europe and in 1788 it reached Australia invading 25 million hectares of land due to lack of natural enemies causing a devastating loss in biodiversity and in 1920 it led to the implementation of biological control agents (Matthews and Brand, 2004). A global population budget for Invasive alien control in 2001 was marked at an estimated 7 billion USD (Boy and Witt, 2013).

In Africa there are devastating results of the introduction of Water Hyacinth (*Eichhornia crassipes*) which is thought to have entered Lake Victoria in the 1980's possibly from Rwanda via the Kagera River as a result of debris escape in ponds from gardens of long departed Belgian settlers who introduced the plant as an ornamental. It covered 20 000 hectares of Lake Victoria's surface around 1998, paralyzing activities in ports, bays and villages. Biological control has since reduced the infestation, which now covers barely 3000 hectares. In West Africa the Water Hyacinth remains a serious problem, despite continuing efforts in countries such as Niger, Mali, Côte d'Ivoire, Nigeria, Ghana and Senegal to control its spread (Boy and Witt, 2013).

More than 550 km of the River Niger's course has been invaded. The economic loss due to impacts of Water Hyacinth infestations in seven African countries have been estimated to be between USD 20 million and USD 50 million annually. Impact costs across Africa may exceed USD 100 million annually (Boy and Witt, 2013).

South Africa is severely affected by alien invasion and has one of the biggest infestation problems in the world (Macdonald *et al.*, 2003). At least 161 species cause serious problems (Henderson *et al.*, 1995). Alien invasive species are widespread in the rural areas of South Africa. It has been noted that 117 alien plants are well-established, and are major invaders that are more widespread in South Africa (Nel *et al.*, 2004). According to Zhang and Hiziroglu (2010), invasive alien vegetation would spread at an average rate of 1% per annum in South Africa.

In Limpopo Province, Semanya *et al.* (2012) confirms the use of IAPs by most of the Pedi people. These species have become imbedded in their daily lives to an extent that they are overly used and exploited mainly for personal use and trade. Sixty eight percent of the species on the study are listed in the Convention of Agricultural Resources Act 43 of 1983. The extent of invasion in the Capricorn District by IAPs is not easily accessible due to lack or little profiling and documentation. Semanya and Potgieter (2014b), sampled and documented a total of 43 plant species of which 32.5% are exotics planted in Bapedi Traditional health practitioner's gardens.

### 2.3.1 Ecological impact

Invasion is one of the largest threats to indigenous biodiversity in South Africa (Kaiser, 1999) impacting on the ecosystem services provided to humanity and other organisms. Impacts of invasion looks at three facets which biodiversity is made up of namely: functional, compositional and structural (Noss, 1990). Compositional diversity (number of different species in a system) is most frequently accepted as a measure of biodiversity, however, functional (system functions such as water provision, water filtering and cleaning, water retention and flood prevention) and structural diversity (structural component of a system may be composition of grass and woody layers; old growth forest and under story components) are an integral part of the systems dynamics, and are frequently severely altered by biological invasions (Van Wilgen and Van Wyk, 1999).

Invasive alien plant species are known to affect more than one facet, and when one facet has been impacted, the other facets tend to fall off too. Impacts of IAPs are replacement of diverse systems with a single or mixed species stand of aliens, soil chemistry alteration, alteration of geomorphological processes, alteration of fire regimes, alteration of hydrology, invasions leading to extinction of compositional diversity and the direct threat to indigenous fauna (Cronk and Fuller, 1995). Furthermore, the destruction of riparian habitats in Southern Africa is a key impact of IAPs (Richardson *et al.*, 1997)

## **2.4 The ethnobotanical value of invasive alien plant species**

Zhang and Hiziroglu (2010) and Semenya *et al.* (2012) are amongst the several studies that have shown IAPs to have a positive impact on economic wealth, social aspects and ecological contributions. The economic value brought by IAPs needs to be considered when assessing the costs resulting from invasion. Invasive alien plant species can be used in agroforestry for function and services that cannot be provided by native species. These services include rapid biomass accumulation, nitrogen fixation and reforestation of degraded land, as well as to improve farrows and contour (Crooks, 2002).

## **2.5 Utilization of invasive alien plants in traditional medicine**

Plants have been one of the major developmental sources of medicines ever since the dawn of human civilization (World Health Organization, 2003). Over 60% of all pharmaceuticals are based on plant products (Pallant and Steenkamp, 2008). The practice of African traditional medicine is arguably the oldest and most diverse of all the medicinal systems (Gurib-Fakim, 2006). South Africa has a rich floral biodiversity including approximately 4 000 plant species with medicinal properties (Van Wyk and Gericke, 2000). Therefore, it is not surprising that an estimated 80% of the South African population rely on plant-based medicines for their primary healthcare requirements (Jäger *et al.*, 1996).

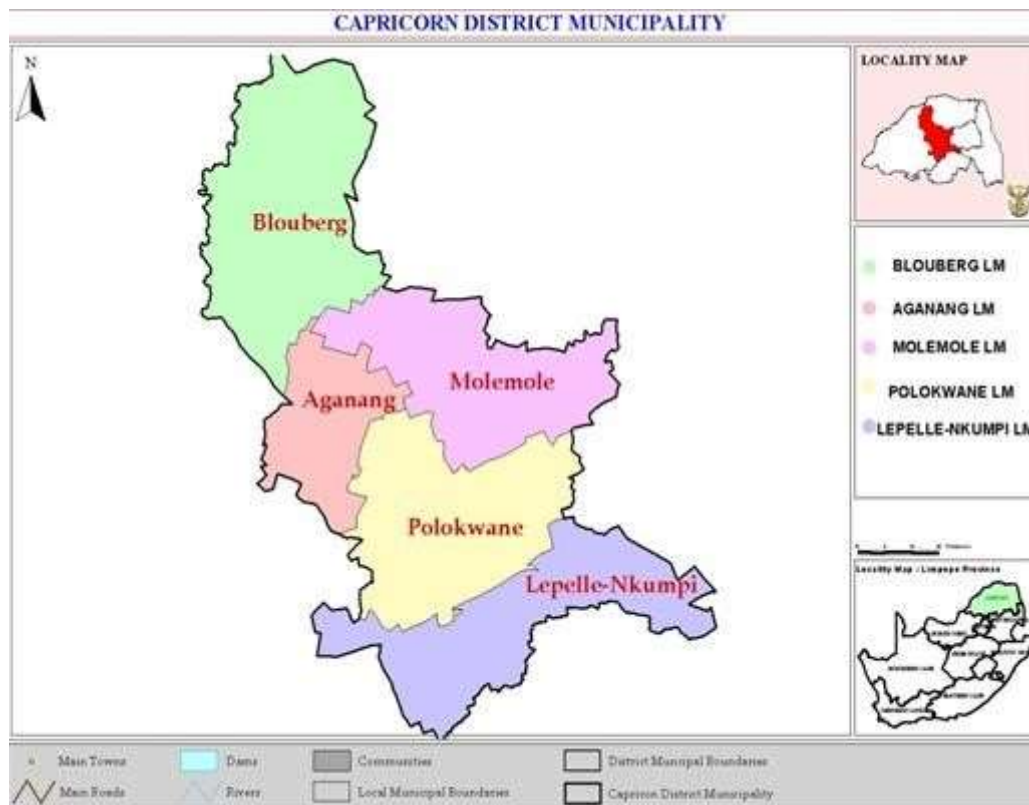
Although a significant number of herbal plants traditionally have certified medicinal benefits, the vast majority of plants still need to be scientifically validated and much work is still needed to investigate the bioactivity and phytochemicals of plants product (Apaya and Chichioco-Hernandez, 2011).

## CHAPTER THREE

### STUDY AREA, MATERIALS AND METHODS

#### 3.1 Study area

This study was conducted in the Capricorn district of the Limpopo Province, South Africa. The study covered five local municipalities; Aganang, Blouberg, LepelleNkumpi, Molemole and Polokwane (Figure 1). The Capricorn District has a population of 1261463, with the most spoken language being Sepedi. Majority of the population speaks Sepedi (84.90%), followed by the minority Afrikaans, Xitsonga, English, Isindebele, Tshivenda and others respectively (Statistics South Africa, 2011). Bapedi traditional health practitioners play a vital role in the primary health care of rural people living in the Limpopo Province (Semenya and Potgieter, 2014a), however, there is a lack of literature profiling social and demographic variables, as well the traditional healing profile of traditional health practitioners (Semenya and Potgieter, 2014a).



**Figure 1:** Map showing local municipalities within the Capricorn District Municipality.

### 3.2 Sampling and data collection

Six traditional health practitioners were randomly selected, via the snowball method from each of the five local municipalities, resulting in 30 traditional health practitioners being interviewed. Snowball sampling method is a non-probability sampling method based on random selection (Heckathorn, 2011). Information about the medicinal use of invasive plants was collected using a semi structured questionnaire. (Appendix A). Semi-structured interviews are used by researchers mostly because questions can be prepared ahead of time. This allows the interviewer to be prepared and appear competent during the interview and can provide reliable, comparable qualitative data (Heckathorn, 2011).

### **3.3 Plant collection**

Different plant parts based on the information provided by traditional health practitioners was collected from their natural habitat in the five local municipalities. Collected plants were identified using literature at the herbarium housed in the University of Venda.

### **3.4 Data analysis**

The collected data from the questionnaire was captured in MS Excel 2010 and analysed using descriptive statistics. Tables and graphs were used to portray the findings of the study.

## CHAPTER FOUR

### RESULTS AND DISCUSSIONS

#### 4.1 Informants profile

A total of 30 traditional health practitioners were interviewed, 26 females and 4 males (Table 1). Interviews results show more female traditional health practitioners having more knowledge of ethnomedicine of invasive alien species as compared to their male counterparts.

**Table 1:** Age and gender of traditional health practitioners interviewed.

Gender	Age (years)			Total
	21-40	41-60	61-80	
Female	2	11	13	26
Male	0	2	2	4

The results of this study agrees with those of York *et al.* (2011) conducted on an antimicrobial evaluation of plants used for the treatment of respiratory infections in rural Maputaland, KwaZulu-Natal, South Africa and that conducted by Mahwasane *et al.* (2013) on an ethnomedicinal survey of indigenous knowledge on medicinal plants

used by the traditional healers of the Lwamondo area, Limpopo Province, South Africa. In both studies, ethnobotanical surveys resulted in more female traditional health practitioners being interviewed compared to their male counterparts. This may be due to reluctance of male traditional healers in sharing their ethnobotanical knowledge on medicinal plants when compared to female traditional health practitioners.

#### **4.2 Invasive alien medicinal plants profile**

The study recorded 22 IAPs belonging to 14 families (Table 2). The recorded IAPs were used for the treatment of different ailments by traditional health practitioners in the Capricorn District. A list of plant species with family names, botanical names, vernacular names, and ailment treated, plant part(s) used, and methods of preparation is presented in Table 2. The dominant family was found to be Solanaceae and Myrtaceae (18.2%) were both recorded respectively as the most dominant families.

The invasive alien plant species (used medicinally and for other purposes) from Solanaceae and Myrtaceae were also reported by Semanya *et al.* (2012) as dominant families in the Thulamela Local Municipality, Limpopo Province. Bhat (2014) also reported Solanaceae family as the most important medicinal family that is frequently used medicinally by traditional health practitioners of *Xhosa* people in the Transkei region of Eastern Cape, South Africa.

**Table 2:** Invasive alien medicinal plant species used in Capricorn district for treatment of various diseases.

<b>Families and Botanical names</b>	<b>Common English (E) and Sesotho (S) vernacular names</b>	<b>Plant parts used</b>	<b>Ailments treated</b>	<b>Preparation</b>
<b>Asparagaceae</b> <i>Agave americana</i> L.	Spreading centuryplant (E)	Roots and leaves	Internal sores, swollen legs, HIV and high blood pressure	Decoction and infusion
<b>Asparagaceae</b> <i>Agave sisalana</i> Perrine	Sisal (E), Mokgotla (S)	Leaves and roots	HIV, body pains, internal sores, impotent, swollen legs, and high blood pressure	Decoction and infusion
<b>Papayeraceae</b> <i>Argemone mexicana</i> L.	Yellow-flowered Mexican poppy (E), Sehlaba mesisi (S)	Roots, leaves and thorns	Gonorrhoea, swollen legs, internal sores, impotent, body pains and STI's	Decoction, burn and grind into powder
<b>Papayeraceae</b> <i>Argemone ochroleuca</i> Sweet	White-flowered Mexican poppy (E), Sehlaba mesisi (S)	Roots, leaves and thorns	Gonorrhoea, wound, swollen legs, internal sores, impotent, body pains, epilepsy and STI's	Decoction, grind into powder and burn
<b>Apocynaceae</b> <i>Catharanthus roseus</i> (L.) G.Don	Madagascar periwinkle (E)	Roots	STI's, Gonorrhoea, tooth ache, internal sores and abortion	Decoction

<b>Solanaceae</b> <i>Datura ferox</i> L.	Large thorn apple (E), Mphufi (S)	Seeds, roots, fruits, leaves, stem and thorns	Mental disorder, STI's sores, internal sores, body pains and stroke	Infusion, decoction, grind into powder and maceration
<b>Solanaceae</b> <i>Datura stramonium</i> L.	Common thorn apple (E), Leswe (S)	Seeds and fruits	Sores and tooth ache	Burn and decoction
<b>Myrtaceae</b> <i>Eucalyptus camaldulensis</i> Dehnh.	River red gum (E), Mopilikomu (S)	Leaves	Cough and flu	Decoction, mastication and infusion
<b>Myrtaceae</b> <i>Eucalyptus sideroxylon</i> A.Cunn. ex Woolls	Red ironbark (E), Mopilikomu (S)	Leaves	Cough and flu	Decoction and mastication
<b>Myrtaceae</b> <i>Eucalyptus tereticornis</i> Sm.	Forest red gum (E), Mopilikomu (S)	Leaves	Cough and flu	Decoction
<b>Bignoniaceae</b> <i>Jacaranda mimosifolia</i> D.Don	Jacaranda (E), Mojakaranda (S)	Leaves and roots	Flu, cough, weak body, and stomach ache	Decoction and infusion
<b>Meliaceae</b> <i>Melia azedarach</i> L.	Seringa (E), Moseringa (S)	Roots, leaves and barks	Infertility, body pains, Gonorrhea, over weight baby, flu and asthma	Decoction
<b>Moraceae</b> <i>Morus alba</i> L.	Common mulberry (E), Morupeila (S)	Roots, barks and leaves	High blood and stomach ache	Decoction and grind into powder

<b>Cactaceae</b> <i>Opuntia ficus-indica</i> (L.) Mill.	Sweet prickly pear (E), Motloro (S)	Roots and leaves	Pain, HIV, infertility, impotent, Gonorrhoea, tooth ache, vomiting, diabetes, cough, STI's and swollen legs	Decoction and maceration
<b>Pinaceae</b> <i>Pinus patula</i> Schiede ex Schltdl. & Cham.	Patula pine (E), Mopine (S)	Barks and roots	Drop and HIV	Decoction
<b>Myrtaceae</b> <i>Psidium guajava</i> L.	Guava (E)	Stem, leaves, barks	High blood, body pain, flu, STI's, diabetes and ulcer	Decoction and infusion
<b>Euphorbiaceae</b> <i>Ricinus communis</i> L.	Castor-oil plant (E), Mohkure (S)	Leaves, stem and seeds	Body pains, head ache, ear ache, nausea, sores, skin ulcer, swollen and swollen legs	Ash, decoction, grind into powder, grind wet, roast and infusion
<b>Anacardiaceae</b> <i>Schinus molle</i> L.	Pepper tree (E), Mokwepere (S)	Leaves	Flu	Decoction
<b>Fabaceae</b> <i>Senna didymobotrya</i> (Fresen.) Irwin & Barnaby	Peanut butter cassia (E), Morotela-tšhoši (S)	Roots	High blood, infertility, Gonorrhoea, impotent, flu, cough, mouth sores, internal sores, body pain, abnormal periods and STI's	Decoction and infusion
<b>Solanaceae</b> <i>Solanum elaeagnifolium</i> Cav.	Silver-leaf bitter apple (E), Tholla (S)	Fruit and roots	Accelerate growth, body pains, impotent, internal sores, stomach ache and tooth ache	Burn, decoction and infusion
<b>Solanaceae</b> <i>Solanum mauritianum</i> Scop.	Bugweed (E)	Roots	Stroke	Decoction

<b>Asteraceae</b> <i>Xanthium strumarium</i> L.	Large cocklebur (E), Mopokolo (S)	Leaves	Stomach ache	Decoction
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\*E- English, S- Sepedi

Eighty-two percent (n = 18) of the species recorded in this study are listed under Regulation 15 of the Convention of Agricultural Resources Act 43 of 1983 (Table 3). Out of 82%, 44% (n = 8) are listed in category 1: *Argemone mexicana* L, *Argemone ochroleuca* Sweet, *Datura ferox* L, *Datura stramonium* L, *Opuntia ficus-indica* (L.) Mill, *Solanum elaeagnifolium* Cav, *Solanum mauritianum* Scop and *Xanthium strumarium* L. 33% (n=6) are listed in category 2: *Agave sisalana* Perrine, *Eucalyptus camaldulensis* Dehnh, *Eucalyptus sideroxylon* A.Cunn. ex Woolls, *Pinus patula* Schiede ex Schltdl. & Cham, *Psidium guajava* L and *Ricinus communis* L. 22% (n = 4) are listed in category 3: *Agave americana* L., *Jacaranda mimosifolia* D.Don, *Melia azedarach* L., *Morus alba* L.

#### NEMBA listed species

99% (n = 21) of the species recorded in this study are listed under National Environmental Management: Biodiversity Act 2004 (Act No, 10 of 2004) (Table 3). Out of this 99%, 67% (n = 14) are listed in category 1b: *Argemone mexicana* L., *Argemone ochroleuca* Sweet, *Catharanthus roseus* (L.), *Datura ferox* L., *Datura stramonium* L., *Eucalyptus camaldulensis* Dehnh., *Eucalyptus tereticornis* Sm., *Jacaranda mimosifolia* D.Don, *Melia azedarach* L., *Opuntia ficus-indica* (L.) Mill, *Senna didymobotrya* (Fresen.) Irwin & Barneby, *Solanum elaeagnifolium* Cav., *Solanum mauritianum* Scop. and *Xanthium strumarium* L. 19% (n = 4) are listed in category 2: *Agave sisalana* Perrine, *Pinus patula* Schiede ex Schltdl. & Cham., *Psidium guajava* L. and *Ricinus communis* L. 14% (n = 3) are listed in category 3: *Agave americana* L., *Morus alba* L. and *Schinus molle* L.

**Table 3:** The scientific names, CARA and NEMBA listing of the recorded invasive alien medicinal plants species.

<b>Scientific name</b>	<b>Category</b>	<b>Appearance</b>
<i>Agave americana</i> L.	3	NEMBA
<i>Agave sisalana</i> Perrine	2	NEMBA & CARA
<i>Argemone mexicana</i> L.	1b, 1	NEMBA & CARA
<i>Argemone ochroleuca</i> Sweet	1b, 1	NEMBA & CARA
<i>Catharanthus roseus</i> (L.)	1b	NEMBA
<i>Datura ferox</i> L.	1b, 1	NEMBA & CARA
<i>Datura stramonium</i> L.	1b, 1	NEMBA & CARA
<i>Eucalyptus camaldulensis</i> Dehnh.	1b, 2	NEMBA & CARA
<i>Eucalyptus sideroxylon</i> A.Cunn. ex Woolls	2	CARA
<i>Eucalyptus tereticornis</i> Sm.	1b	NEMBA
<i>Jacaranda mimosifolia</i> D.Don	1b, 3	NEMBA & CARA
<i>Melia azedarach</i> L.	1b and 3 in urban areas, 3	NEMBA & CARA
<i>Morus alba</i> L.	3	NEMBA & CARA
<i>Opuntia ficus-indica</i> (L.) Mill.	1b, 1	NEMBA & CARA
<i>Pinus patula</i> Schiede ex Schtdl. & Cham.	2	NEMBA & CARA

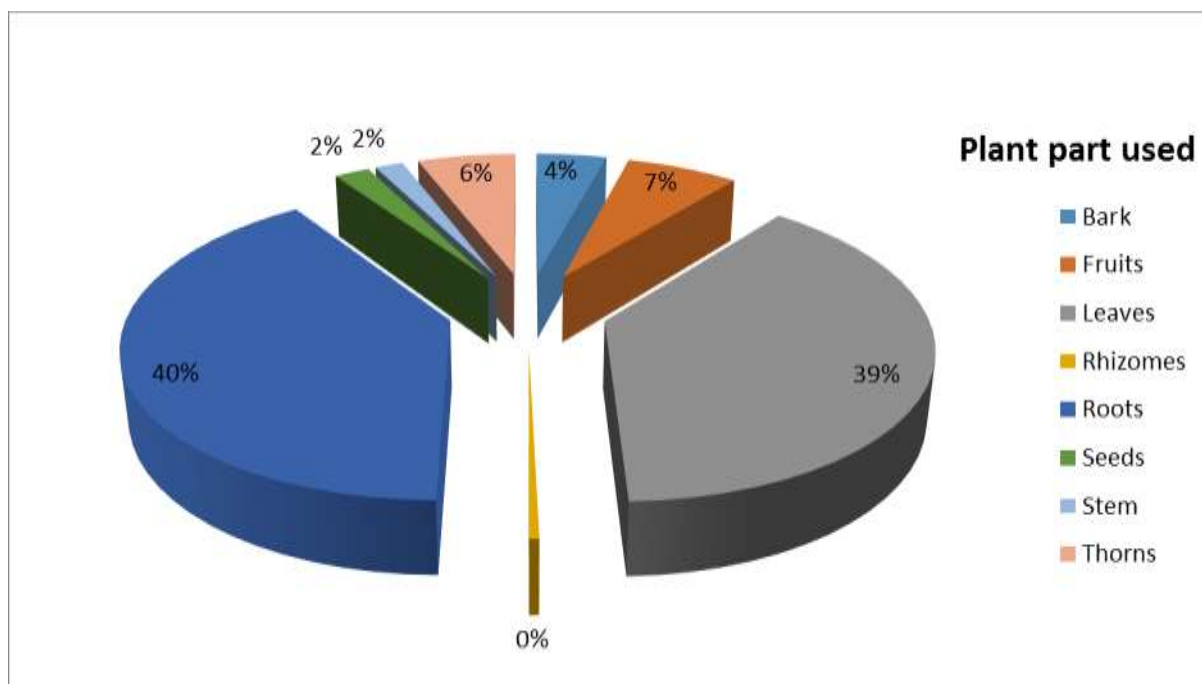
<i>Psidium guajava</i> L.	2	<b>NEMBA &amp; CARA</b>
<i>Ricinus communis</i> L.	2	<b>NEMBA &amp; CARA</b>
<i>Schinus molle</i> L.	3	<b>NEMBA</b>
<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	1b, 3	<b>NEMBA &amp; CARA</b>
<i>Solanum elaeagnifolium</i> Cav.	1b, 1	<b>NEMBA &amp; CARA</b>
<i>Solanum mauritianum</i> Scop.	1b, 1	<b>NEMBA &amp; CARA</b>
<i>Xanthium strumarium</i> L.	1b, 1	<b>NEMBA &amp; CARA</b>

#### CARA listed species

Invasive plant species in Category 1 are not allowed to spread inland, water surfaces and are also prohibited from propagation. IAPs in this category must be removed and destroyed immediately, and their trade is also prohibited. Category 2 IAPs can be grown in demarcated area or under controlled conditions and permit is required for propagation. IAPs that belong to category 2 are declared category 1b if they spread outside demarcated area and they must be eradicated. Category 3 IAPs are not allowed to be propagated or sold and existing species do not need to be removed (CARA, 1983 and NEMBA, 2004)

### 4.3 Plant parts utilized

Figure 2 shows roots (40%) to be the highest percentage of the plant parts used in this study followed by leaves (39%), fruits (7%), thorns (6%), bark (4%), seeds (2%) and stem (2%).

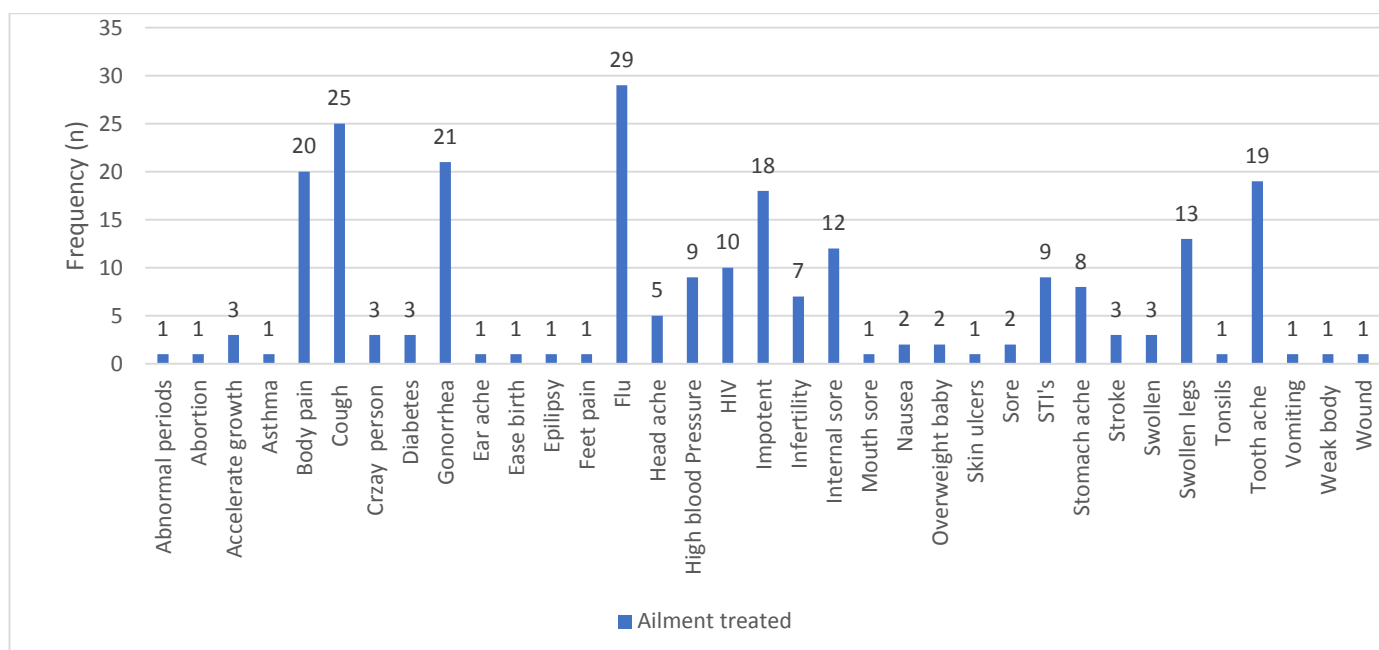


**Figure 2:** Plant parts percentage used for the treatment of different diseases.

A study done by Mahwasane *et al.*, (2013) reported roots as the dominant plant part used on ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa. Mbambala *et al.*, (2017) also reported roots as the most frequently used plant part in invasive alien plants used in the treatment of HIV/AIDS-related symptoms by traditional healers of Vhembe Municipality, Limpopo Province, South Africa. In their study, the roots contributed 35%.

#### 4.4 Categories of ailments treated

Figure 3 shows flu ailment (n = 29) to be the most treated disease followed by cough (n = 25), gonorrhoea (n = 21), body pain (n = 20), tooth ache (n = 19), impotent (n = 18), swollen legs (n = 13), internal sores (n = 12), HIV (n = 10), high blood pressure (n = 9), STI's (n = 9), Stomach ache (n = 8), Infertility (n = 7), head ache (n = 5) and other ailments contributing  $n \leq 3$  each.

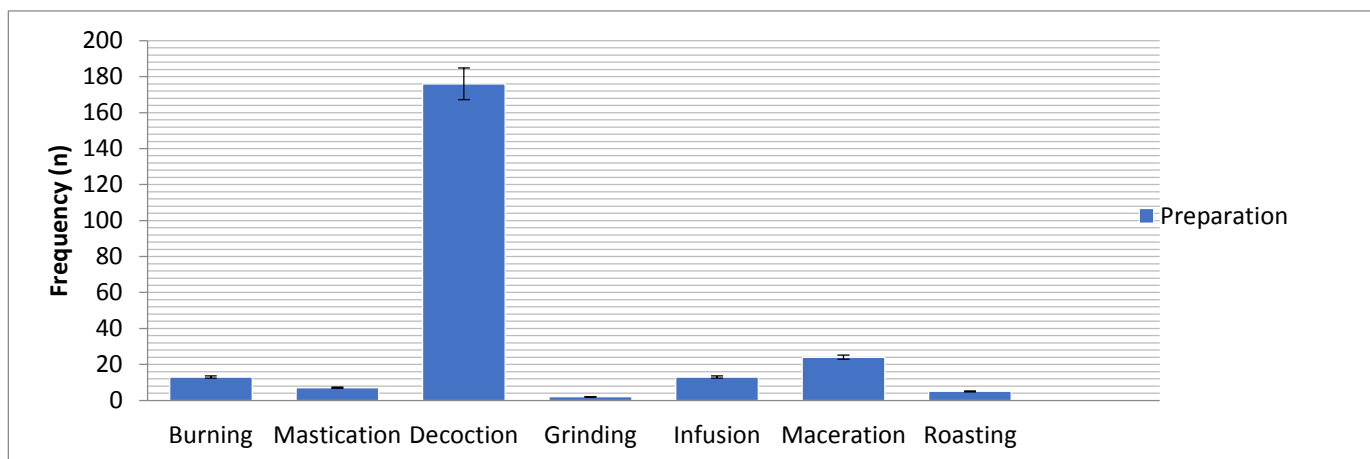


**Figure 3:** Most treated ailments by traditional health practitioners in the Capricorn District.

A similar trend was recorded by Maema *et al.* (2016) on a study conducted on invasive alien plant species used for the treatment of various diseases in Limpopo Province, South Africa.

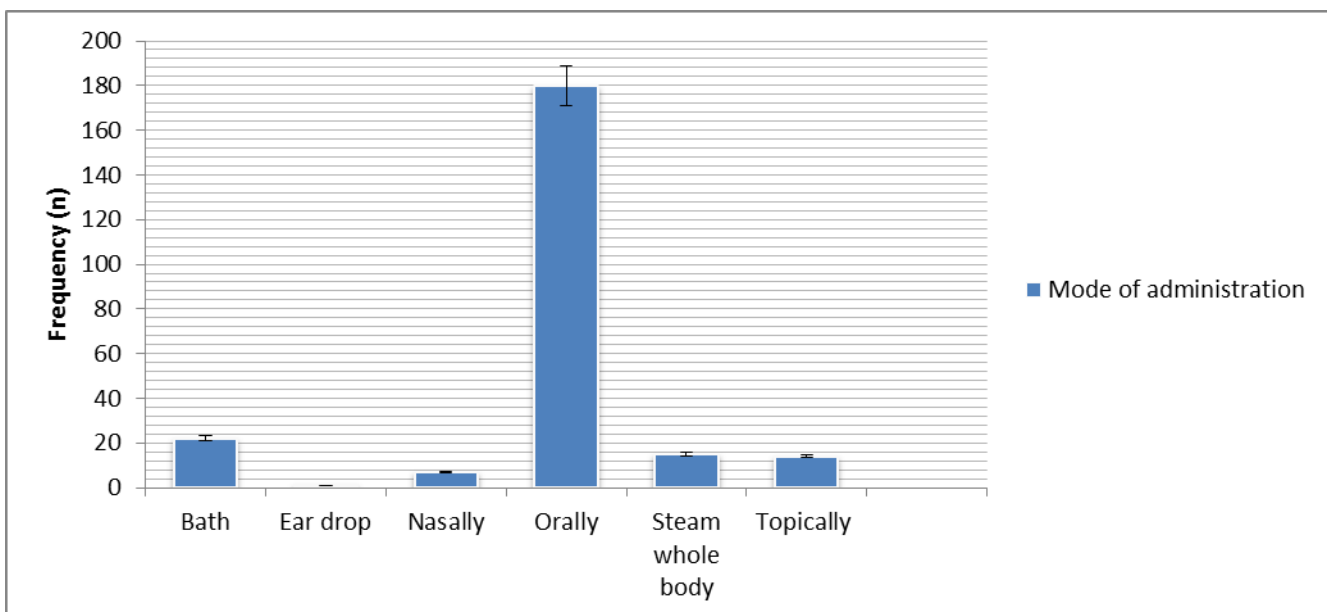
#### 4.5 Preparation and administration of medicinal materials

Figure 4 indicates the most frequent method used by traditional health practitioners in obtaining their extracts. The most used method was decoction (n = 176) followed by maceration (n = 24), infusion (n = 13), burning (n = 13), mastication (n = 7), roasting (n = 5) and grinding (n = 2).



**Figure 4:** Number of records per method used for preparation of the medicine.

Chauke *et al.* (2015) also reported decoction as the most frequently used method to obtain extracts. Decoction was the most common route followed by traditional health practitioners while preparing their medicinal extracts. This involves boiling plant materials for a certain amount of time to soften them before extraction of active compounds.



**Figure 5:** Records per mode of medicinal administration by traditional health practitioners.

Figure 5. Indicates most of the medicinal extracts in this study to have been administered orally ( $n = 180$ ) followed by bath ( $n = 22$ ), stream whole body ( $n = 15$ ), topically ( $n = 14$ ), nasally ( $n = 7$ ) and eardrop ( $n = 1$ ) (Figure 5). The oral mode of medicinal administration includes drinking, eating and mastication of fresh plants material. In a study compiled by Ourlad *et al.* (2018) on ethnobotanical survey of medicinal plants (used by Ayta communities in Dinalupihan, Bataan, Philippines) reported similar observation showing majority of medicinal preparations to have been taken or administered orally.

## CHAPTER FIVE

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

This study indicates that traditional health practitioners in the Capricorn District Municipality use IAPs to treat different types of ailment and therefore IAPs play a major role in primary health care within Capricorn District Municipality. Records of this study shows that male traditional health practitioners are more reluctant in sharing their ethnomedicinal knowledge as compared to their female counterparts resulting in more female traditional health practitioners being interviewed although similar number of male traditional health practitioners were approached.

Capricorn District Municipality has shown to have a wealth of knowledge on IAPs used medicinally. This study is the first to reflect on treatment of major ailments using IAPs. The results of this study will also serve in conserving methods of preparation as well as mode of administration implemented by traditional health practitioners of Capricorn District Municipality in treatment of ailments using IAPs extracted compounds. The fact that most of this IAPs had been within CARA listed species and NEMBA listed species can brought in future much needed cost effective measures in dealing with proliferation rate of IAPs . With this information now made available, traditional health practitioners may be encouraged to use IAPs as an alternative to indigenous species while reserving their cultural heritage as indigenous species will be available for future

generation. Roots are the most used plants parts on this study, this indicates that the harvesting of roots in itself is a control measure and the more usage of IAPs will relieve pressure on the indigenous species and the endangered species. The data collected in this study will serve in future comparative studies within the district over time or used in future comparative studies with other districts in Limpopo Province or whole of South Africa as well as other international studies conducted elsewhere.

## **5.2 Recommendations**

There is a need for careful consideration of IAPs that are used medicinally. Apart from clearing invasive alien plant species as part of management strategy by South African government, there are other alternative innovative ways that can be employed to ensure that the number of invasive alien plant species introduction does not exceed beyond measure through encouragement of their use as either medicinal sources incorporating them into local ethnobotanical use. The new innovative ways (such as traditional health practitioners utilizing the IAPs instead of endangered plants or indigenous plants species) can bring in some form of relief to the already declining indigenous species populations.

Research scholars from different research institutes and higher educational research centres can regard invasive alien plants used medicinally as source of new pharmaceutical leads to create new medications. With such attention turned to alien invasive species, their survival as well as their spread will be kept on check at the same time creating a control measure to their spread with little effort. Further

laboratory-based studies are needed to determine efficiency and safety of the IAPs used by traditional health practitioners in this study.

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## APPENDIX A

### Questionnaire

#### Ethnomedicinal survey of invasive alien plant species used in the Capricorn District, Limpopo Province, South Africa

*NB: Informants were interviewed with their consent.*

1. Geographical information									
Aganang municipality		Blouberg municipality		Lepelle-Nkupi municipality		Molemole municipality		Polokwane municipality	
Villages		Villages		Villages		Villages		Villages	
1	Kgoroshi	1	Mosehleng	1	Mafefe	1	Nthabiseng	1	Mentz
2	Ramalapa	2	Inveraan	2	Ga-mathabatha	2	Morebeng	2	Badimong
3	Sechaba	3	Cracouw	3	Thabampoopo	3	Matoks	3	Makanye

2. Personal information									
2.1	Gender								
2.2	Age								
2.3	Level of education								
	1	No formal education	2	Primary schooling	3	Secondary schooling			
2.4	How many years' experience in traditional healing?								

	1	<10	2	11-20	3	21-30	4	>30
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<b>3. Collection</b>								
3.1	Do you collect plants?							
	1	Yes			2	No		
3.2	If no how do you get plant materials?							
	1	Get from other traditional health practitioners.	2	Buy from the chemist/market.	3	Send someone to collect for me.	4	Other (Specify).
3.3	How are plants collected?							
	1	For a specific purpose.	2	General collection.	3	For a specific plant species.	4	Other (Specify).
3.4	Is there a seasonal difference in the amount of plants material that you collect?							
	1	Yes			2	No		
3.5	If yes explain.							
3.6	Do you know what invasive alien plants are?							
	1	Yes			2	No		
3.7	Do you collect invasive plant species?							
	1	Yes			2	No		
3.8	If yes, how do you differentiate alien invasive from indigenous plants?							

<b>4. Legislation</b>								
4.1	Do you have knowledge of LEMA (Limpopo Environmental Management act)?							
	1	Yes	2	No				
4.2	Have you ever been visited by the officials of Department of Environmental affairs?							
	1	Yes	2	No				
4.3	If yes, how often do they visit?							
	1	Monthly	2	Half yearly	3	Annually	4	Others (Specify)
4.4	For what reasons?							
	1	General research	2	To verify permits	3	To verify where plant materials are stored.	4	Others (specify)
4.5	Do you know of any protected plants?							
	1	Yes	2	No				
<b>5. Medicinal use</b>								
5.1	Vernacular name of plant							
5.2	Scientific name of plant							
5.3	Which diseases does the invasive alien plants treat/ prevent?							
5.4	How is a patient diagnosed?							
5.5	Plant parts used							
	1	Barks	2	bulbs	3	fruits	4	leaves
	5	Roots	6	seeds	7	stems	8	tubers
5.6	How do you dispose the parts which are not used for medicine?							

5.7	Do you use the plant parts fresh or dried?							
5.8	Mode of preparation							
	1	Decoction	2	Infusion	3	Orally	4	Maceration
	5	Others (specify).						
5.9	Do you add other ingredients when preparing the medicine?							
5.10	How the medicines are stores							
5.11	Mode of administration							
5.12	Dosage							

<b>6. Conservation</b>								
6.1	Do you use cultivated plants?							
	1	Yes	2	No				
6.2	If no, explain why?							
6.3	Do you have any ideas on how to ensure that there are plants in the future?							
	1	Yes	2	No				
6.4	If yes, what are those ideas?							
	1	Use correct harvesting techniques	2	Grow plants in my garden	3	I make sure i collect only what I need in a smaller scale	4	Others (Specify)
6.5	Are there stock (plants) that are not available in your area?							
	1	Yes		2	No			

6.6	If yes, how do you get them?						
	1	Get them from other healers	2	Buy them from the market	3	Buy them from street vendors	4 Others (Specify)