THE POTENTIAL SIGNIFICANCE OF REFUGIA IN SAFEGUARDING NON-TIMBER FOREST PRODUCTS UNDER HARVESTING

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Abstract

Many rural households living in and adjacent to forests in South Africa harvest a variety of Non-Timber Forest Products (NTFPs) such as wild fruits, fibre, fuelwood, seeds, medicine and bush meat for domestic use, sale and maintaining cultural values. To promote the continued availability of these NTFPs it is important that NTFPs are well maintained and that harvest off-take is sustainable, because if it is not, then the important livelihood function that they fulfil will be jeopardized over time. The role of refugia in conserving pockets of threatened species from overharvesting has rarely been considered. Building on Shackleton *et al.* (2015), six applications of the concept are considered: size refugia, spatial refugia, cultural/spiritual refugia and physical/habitat refugia. I examined the prevalence and type of refugia for NTFPs at three coastal sites in the Eastern Cape province of South Africa. This was done via several community focus group discussions at each site. Here I report on the role of refugia in offering some safeguard to NTFPs by assessing harvested and non-harvested sites of refugia as well as individual plant species by measuring population density, harvest damage and size class profile. Respondents from the focus group discussions perceived a general decline in the abundance of common, widely used species over the past five decades. Decreasing rainfall and distant farming activities was reported consistently by the majority of the respondents. The most common form of refugia was spatial refugia, followed by cultural/spiritual refugia and physical/habitat refugia. Only six species were identified to be in refugia, namely *Cyperus congestus, Cyperus textillis, Millettia grandis*, *Olea europaea* subsp. *africana, Phoenix reclinata,* and *Ptaeroxylon obliquum.* Population inventories revealed that regeneration and population densities of some NTFP species in the non-refuge site were adversely affected by harvesting. Populations in refuge sites generally had the largest size classes indicating a regeneration potential but likely to impact regeneration over time if pressures are maintained. Therefore, if refuge sites keep larger individuals, NTFP populations can be maintained. Few studies have critically analyzed the concept of refugia in relation to how NTFPs can be safeguarded and the practical implication of the refuge concept needs to be considered in conservation and strategies and population models.

Declaration

I, Nwabisa Mjoli, hereby declare that the work described in this thesis was carried out in the Department of Environmental Science, Rhodes University, under the supervision of Professor Charlie Shackleton. The various components of the thesis comprise original work by the author and have not been submitted to any other university.

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Dedication

I dedicate this piece of work to my guardian angels, my mother Siyasanga Ngxesha and my grandmother Nomfanelo Ivy Ngxesha.

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 Background and definitions

Around the world, non-timber forest products (NTFPs) provide rural households with a variety of important natural products such as wild fruits, honey, fibre, resin, fuelwood, seeds, construction material, medicine, wildlife meat as well as raw materials to produce handiwork for domestic use and sale (de Beer and McDermott, 1989; Makhado and Kepe, 2006; Pereira *et al.*, 2006; Schreckenberg, 2004; Shackleton and Shackleton, 2004; Shackleton *et al.*, 2011; Syampugani *et al.*, 2009). Products are often gathered from areas surrounding areas and landscapes such as woodlands, forests and other lands or fields (Shackleton *et al.*, 2011). It has been recognized that poor, rural households tend to be more reliant on NTFPs than richer or more affluent households (Angelsen *et al.*, 2014; Heubach *et al.*, 2011; Hogarth *et al.*, 2013; Paumgarten and Shackleton, 2009; Shackleton and Shackleton, 2004). Most studies on NTFP use have been undertaken in poor, rural communities of Asia, Africa and other less economically advanced countries (Angelsen *et al.*, 2014; Cavendish, 2000; Heubach *et al.*, 2011; Timko *et al.*, 2010) including urban areas to a lesser extent (Davenport *et al.*, 2012; Kaoma and Shackleton, 2014; Kilchling *et al.*, 2009).

Non-timber forest products fulfill several livelihood requirements for many urban and rural communities around the world. According to Shackleton and Pandey (2014), these livelihood requirements take five forms: (1) the fulfilling of household consumption and daily use needs (Saha and Sundriyal, 2012; Shackleton and Shackleton, 2004); (2) tangible economic benefits through sale (Angelsen *et al.*, 2014; Babulo *et al.*, 2008; Dovie *et al.*, 2002; Heubach *et al.*, 2011; Paumgarten and Shackleton, 2009; Shackleton and Shackleton, 2004); (3) help through difficult times (McSweeny, 2004; Paumgarten and Shackleton, 2011; (4) maintaining cultural values (Cocks and Dold, 2004; Cocks and Wiersum 2003; Cocks *et al.*, 2011; Posey, 1999); and 5) helping households save money (Shackleton *et al.*, 2007). The contributions of NTFPs to rural livelihoods have long been recognized both internationally and within southern Africa, yet there is still no universally agreed definition of a NTFP. However, for the purposes of this study the term “NTFP” refers to “any biological resource collected from the wild by rural people for direct consumption or income generation on a small scale”, in which the majority of the benefit is for the local people (Shackleton and Shackleton, 2004:658).

1.1.1 NTFPs for daily household consumption

Research in Zimbabwe over two years showed that more than one-third of all household income was derived from NTFPs (Cavendish, 2000). In Burkina Faso, shea (kernel oil and karate butter) was found to be the third most important national export (Schreckenberg, 2004). As a result of the comprehensiveness of these two case studies, they have since become widely cited studies on NTFP use. Their publication prompted a number of extensive studies on environmental income to be carried out, especially from the CIFOR’s Poverty and Environment Network (PEN).

A number of studies have documented the role of NTFPs in many rural communities of developing countries. For example, Angelsen *et al*. (2014) provided results from a household survey in 24 developing countries and found that environmental income contributes 28% of total household income and that 77% is derived from natural forests. India is well known for being one of the many developing countries that have populations relying extensively on forest based products. According to Saigal *et al*. (2005) the country has more than 500 million people depending on NTFPs to fulfil their daily subsistence needs. In Africa, major NTFPs were found to contribute 47% of annual household income in the Bonga forest area of southwestern Ethiopia (Melaku *et al*., 2014). Heubach *et al*. (2011) investigated the economic importance of NTFPs to different socio-economic groups in rural, northern Benin, and found that they contribute 39% to the total household income. In northeast Peru, NTFPs were found to contribute 64% to household income (L’Roe and Naughton-Treves, 2014). Similarly, in Nepal, NTFPs were found to contribute up to 50% to household income (Pyakurel and Baniya, 2016). Research in two villages of South Africa, Ntubeni and Cwebe showed that the gross, annual, direct-use values of NTFPs were over R12 000 in Ntubeni and R4 000 in Cwebe (Shackleton *et al*., 2007). Such information is important to relevant government policies, programmes and incentives that aim to promote and support NTFP use, rural livelihoods and forest conservation.

Shackleton and Shackleton (2004) describe NTFPs that are used on a daily basis as the 'daily net'. For example, they report that over 85% of rural households in South Africa make use of fuelwood, wild herbs, wild fruits, and grass brushes. Over 50% make use of medicinal plants, construction timber, plants fibres for weaving, thatch grass and bushmeat. However, the proportion of households using daily net resources varies between villages and is also likely to change through time (Mtati, 2014) as resource supply changes and demand is shaped by other income sources and availability of alternatives. For example, access to electricity can change the demand for fuelwood (Madubansi and Shackleton, 2006).

1.1.2 NTFPs for cash income

NTFPs play an important role in enhancing the local livelihoods of many rural and urban communities around the world and when these products are turned into income generating activities, a number of traders are able to earn significant incomes (Angelsen *et al.*, 2014; Kamanga *et al.*, 2009; Shackleton and Campbell, 2007; Vedeld *et al.*, 2007). The amounts, type and number of NTFPs sold vary extensively between households. It could be a small medicinal plant, a few kilograms of firewood to tens of thousands of different NTFPs for national and international export. Some traders prefer to participate full time while others choose to participate part time. At a global scale NTFP trade has been estimated to be over US$ 400 billion p.a. (UNEP, 2013). Trade in NTFPs in sub-Saharan Africa alone provides millions of rural households with income generating opportunities (Kaimowitz, 2003; Petheram *et al.*, 2006; Vedeld, 2004). According to Hogarth *et al.*, (2013), numerous studies have shown that earnings from the trade of natural products range from 6% to 45% of total household income with some contributions found to be even higher than agricultural contributions. In South Africa, over the last two decades the contribution of plant based non-timber craft making as a source of cash income has been documented in several rural communities (Cawe and Ntloko, 1997; Cunningham, 1987; Cunningham and Terry, 2006; Gyan and Shackleton, 2005; Mjoli and Shackleton, 2015; Pereira *et al.*, 2006). For example, the local sale of reed products in Mpozolo and Ntubeni villages of the Eastern Cape was found to provide an average net annual income of R1 246 $\pm$ 144 (Pereira *et al.*, 2006). Similarly, studies on the trade of four NTFPs in

Bushbuckridge, South Africa (traditional brooms, reed mats, woodcraft, and "marula" beer) revealed that nearly over 40% of all manufacturers earned an annual net income of more than R1 000 per annum (Shackleton *et al.*, 2008). These products are often traded within the communities in which they are made or to local tourist markets (Pereira *et al*., 2006).

Despite the rich literature available on the trade in NTFPs, few studies have managed to assess the proportion of households trading in one or more NTFPs. Shackleton (2015) puts forward that there is no data on the proportion of households trading in NTFPs but makes three observations that are found to be true in most studies on NTFPs: (1) More affluent households tend to control and participate in the trade of high value NTFPs, whereas low income households dominate high volume, low vale NTFPs with low capital asset needs or requirements (Shackleton, 2015), (2) local trade between households and communities is often significant and "provides an income equalizing role" because poor or low income earning households often sell NTFPs to wealthier households which frequently buy instead of gathering NTFPs themselves (Shackleton and Shackleton 2006), and (3) every year, global trade in NTFPs is valued at billions of dollars and has the potential to be even higher if the necessary backing is available and active.

1.1.3 NTFPs for cash saving

Apart from the labour and time invested in the harvesting of NTFPs, most are harvested at no monetary cost. Many NTFPs are recognized as "free" natural resources that require little capital investment (Delang, 2006). This allows poor households to spend their already stressed cash resources to fulfill other livelihood needs such as the payment of school fees, medical costs, local transportation or the purchase of agricultural inputs. The government is also able to save money (Shackleton *et al.*, 2007) and use its existing resources to support and fulfill other important obligations that are not provided through NTFP use (e.g. water and sanitation).

1.1.4 NTFPs as safety nets

Currently no universal definition of a rural safety net exits. McSweeny (2003) and Shackleton and Shackleton (2004) describe a rural safety net as a function that comes into play in response to unpredictable misfortunes or emergencies. Many poor, rural households are often exposed to a range of unprecedented challenges and shocks such as crop failure, drought, death or job loss (McSweeny, 2003; Paumgarten, 2005; Shackleton and Shackleton, 2004). During such times, households or individuals tend to use natural resources in greater amounts as a form of "natural insurance" (McSweeny, 2003; Paumgarten, 2005; Shackleton and Gumbo, 2010; Shackleton and Shackleton, 2004). Depending on the range of assets available, the degree of insurance may vary among households. For example, some households might solely depend on natural capital assets while others might solely rely on social capital, etc. According to Shackleton and Shackleton (2004), the safety net role of NTFPs for household provisioning may takes three routes: (1) the use of NTFPs that are not normally used by that household (e.g. the use of fuelwood rather than purchasing electricity when the main bread winner has lost a job); (2) the increase in consumption of the NTFPs that are already used by the household, where the procurement of a purchased good is substituted in favour of a harvested good (e.g. the use of a medical plant to treat a cough rather than purchasing medicine from the local chemist), and (3) some households might temporarily trade in NTFPs which for some, the trade develops into a permanent activity (e.g. the local trade of palm wine in the Maputoland, Kwazulu Natal) Cunningham (1990). Despite the accumulating evidence on the potential role of NTFPs as safety nets, examples of this function are largely drawn on individual case studies and are often descriptive in nature (McSweeney, 2004; Paumgarten, 2005; Wunder *et al.*, 2014). Moreover, it is important to highlight that sometimes people do not immediately turn to or solely rely on natural resources during difficult times but can rely in different amounts. For example, McSweeny (2003) found that connections and loans from relatives and friends were the main forms of insurance during difficult situations in Eastern Honduras and that only a certain number of households chose to sell forest products for the needed cash. Other forms of insurance included the selling of livestock, remittances, use of savings and the practice of different farming practices. There has been much debate regarding the factors and conditions that drive households to seek or rely extensively on forest products during times of crisis and risk (McSweeny, 2003). Paumgarten and Shackleton (2011) are one of the few who have reported and explored other potential contributing factors. Their study in two South African villages (Dyala and Dixie over two years) revealed that there are differences in how males and females respond to shocks and that wealth influences the experience of shocks and responses.

1.1.5 NTFPs for cultural purposes

Although many studies have solely focused on determining the economic returns of NTFPs, there have also been some exploration of the cultural value of NTFPs (Cocks and Dold, 2004; Cocks and Wiersum, 2003; Cocks *et al.*, 2011; Posey, 1999). For almost every NTFP that is widely used, it is not uncommon to find that there is a cultural value attached to it (Shackleton, 2015). For example, according to Cocks and Dold (2004), brooms made out of grass in the Eastern Cape Province of South Africa have three main cultural uses. Firstly, they are used as traditional wedding gifts. Secondly, traditional grass brooms are believed to protect households against lightning. In the Xhosa culture, brooms are associated with sorcery. It is believed that the presence of a broom in the house can protect the people living in it. Lastly, traditional grass brooms can be used to apply traditional, protective medicine. Medicinal plants are mixed to splash or spray on the floor, walls and roof (Dold and Cocks, 2002). It is believed that this process brings prosperity and good health for the people living in the household (Cocks and Moller, 2002). It was found that more than half (59%) of the urban broom buyers bought the brooms for cultural reasons (Cocks and Dold, 2004). This suggested that cultural practices still play an important role in urban areas (Cocks and Wiersum, 2003).

Traditional grass brooms are not the only NTFPs used in cultural ceremonies and gatherings. In the Nkakayo area of the Eastern Cape Province baskets and mats produced from *Cyperus textilis* are used in traditional gatherings called *izitya zengca* (literally - grass utensils) (Kepe, 2003). The gathering involves two components; the first is the presentation of gifts between family, neighbours and friends (could be five to ten) and the second involves the presenting of *izitya zengca* (Kepe, 2003). The main aim and special focus of this gathering is to provide a platform for those who produced the products to showcase their skills and also draw attention to the humanity and kindness of the people bringing the gifts (Kepe, 2003).

Various plant species often form part of rituals and sacrifices performed by the amaXhosa and amaMfengu ethnic groups of the Eastern Cape. For example, the *Olea eauropea* subsp. *africana*, called umnquma in the Xhosa language, is used in several important rituals and ceremonies such as *ukubuyisa* and *ukukhapha* where an ox is sacrificed (slaughtered inside the kraal) (Cocks and Dold, 2008). Not long after the death of a family member (on the patriarchal side), these ceremonies are performed and then repeated one year later. The aim is to please as well as to strengthen the connection between them and their ancestors (*izinyanya*).

In countries like India and in many African countries, some NTFPs are located in areas that are considered taboo or sacred to harvest from. For example, sacred groves in India were once common (Gadgil and Vartak, 1976) and still exist in many parts of India (Gadgil and Chandran, 1992; Ormsby, 2013; Ormsby and Bhagwat, 2010). In south-western Nigeria, there are sacred groves used for rituals and for burials (Warren and Pinkston, 1998). To these communities such sites help strengthen cultural values, preserve history and heritage. In southern Africa, the sacred forests of Zimbabwe are well known as sites with higher biodiversity and lower rates of forest cover loss (Byers *et al.,* 2001).

In South Africa, various NTFPs have been reported to form part of the daily lives of many rural Xhosa households in the Eastern Cape, but a great deal of such can be regarded as cultural use rather than directly consumptive (Cocks and Wiersum, 2003). For example, according to Kepe (2003), the rural women of the Khanyayo area in the north-eastern Pondoland create products made from *Cyperus textilis* such as traditional sitting mats (which are exclusively used by women), sleeping mats and food mats. In the Nelson Mandela Metropole (NMM) of the Eastern Cape, brooms made from *Cymbopogon validus* were found to be used for various household cleaning purposes (Cocks and Dold, 2004). Similarly, in the Bushbuckridge municipality of the Limpompo Province, brooms made from grass or palms were found to fulfill various domestic and cultural functions (Shackleton and Campbell, 2007). However, Shackleton (2015) puts forward that factors such as changing socio-economic influences, globalization and migration have had a major influence in the disappearance of knowledge on species that have been traditionally used. These factors have also been highlighted by Benz *et al.* (2000) and Cullen *et al.* (2007).

1.2 Ecological impacts of NTFP harvesting

Given these multiple uses, it is important that NTFPs are well maintained and that harvest off-take is sustainable because if it is not then the important livelihood functions fulfilled by NTFPs will be jeopardized over time (Shaanker *et al.,* 2004). Hall and Bawa (1993) define the sustainable harvesting of NTFPs as "the level of harvest that does not impair the ability of the harvested population to replace itself", while Ticktin and Shackleton (2011) describe it as management that allows for the long term persistence of harvested populations and does not damage or impair other species or the ecosystem at large. Studies over the last decade have highlighted various ecological impacts from NTFP overharvesting (Thang *et al*., 2004; Ticktin, 2004; Schmidt *et al.,* 2011). Some of the negative effects of NTFP extraction include a decline in productivity, density and/or regeneration of the plant species being gathered (Figure 1), depending on the part of the plant that is used (Cunningham, 2001). Growth, survival and reproduction are some of the vital rates that are often directly impacted from NTFP harvest (Pinard, 1993; Ticktin, 2004; Ticktin and Shackleton, 2011). For example, Kinnaird (1992) found that excessive harvesting of *Phoenix reclinata* significantly impacts the plant's growth and reproduction. According to Endress *et al.* (2006) during leaf harvest, the reproductive output of palms and ferns can significantly be affected because photosynthates and nutrients are removed. At the same time, certain cases revealed that leaf harvest is able to enhance growth due to the change in the assortment of stored photosynthates in the plant (Endress *et al.,* 2006). During NTFP harvest, some harvesters prefer to target certain parts and leave others behind. This selection process can potentially create evolutionary variations that can simultaneously lead to demographic impacts (Gaoue and Ticktin, 2007). Moreover, seeking desirable characteristics in NTFP populations can also lead to significant changes in their genetic diversity as human intervention increases. For example, intsense harvesting of the American ginseng plant led to a significant decrease in its genetic diversity (Cruse-Saunders and Hamrick, 2004). Changes can either increase or decrease the genetic diversity of that plant species and as such compromise its long-term survival (Arnold and Ruiz-Perez, 2001).

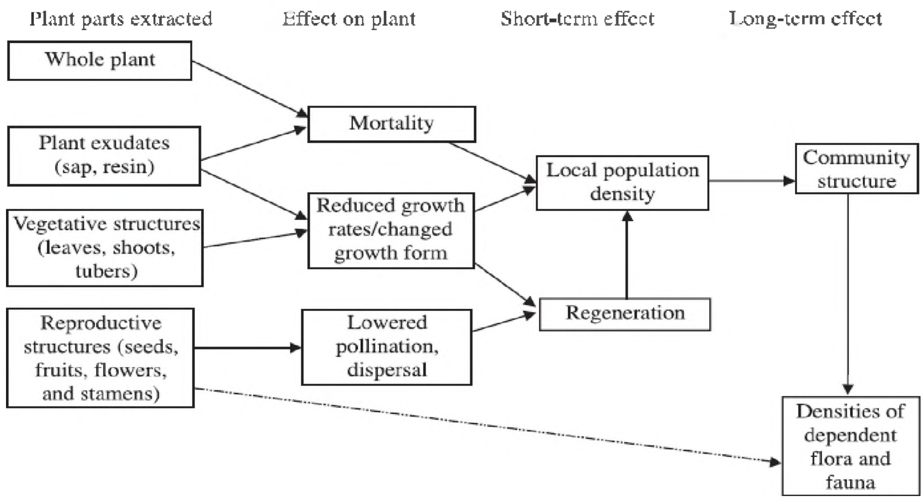

Figure 1: Possible ecological impacts of NTFP extraction (from Shahabuddin and Prasad, 2004)

There has been very little work on the impacts of NTFP harvesting at higher scales, such as on landscape and ecosystem processes. For example, Ruwanza and Shackleton (2017) claim that there are only a couple of studies that have explicitly sought to investigate the impacts of harvesting on soil nutrient stocks. Their recent work indicated that the effects on soil nutrients is likely to be a function of the amount of biomass removed in relation to the size of the plant and the dominance of that species in the biological community.

Although knowledge gaps remain, there are many NTFP populations that have been documented as being overharvested but at the same time exhibit potential for sustainability (Ticktin, 2004). Stanley *et al*. (2012) reviewed case studies in less developed countries from 2000-2010 from an ecological sustainability point of view. Of the 101 ecological studies they reviewed, the majority addressed harvest consequences at the population-individual level (62.4%), and over half (52.5%) were carried out in Latin America.The review showed that almost two-thirds (63.3%) of the studies reported that extraction of NTFPs was sustainable or can potentially be sustainable and less than one-fifth (17.8%) reported that extraction was unsustainable. Therefore, careful caution should be taken into generalizing the ecological effects of NTFP harvesting.

The above case study examples clearly validate that assessing the ecological effects of NTFP harvest is not an easy task because there are too few case studies to confidently establish broad, general patterns or summaries of the ecological impacts of NTFP harvesting. However, Ticktin and Shackleton (2011) and Ticktin (2015) offer some for further testing. The majority of literature on NTFP harvesting puts an emphasis on the following five common concerns and complexities that have made it difficult for researchers to generate a concise general understanding of NTFPs currently under threat. Firstly, most NTFP studies lack long term data (Ticktin, 2004; Vedeld *et al*., 2004). For example, Ticktin (2004) found that no more than 10% of research on NTFPs managed to monitor NTFP populations for longer than three years. Secondly, harvesting patterns and plants gathered vary extensively and are further complicated by different species responses to harvesting or even different responses within the same species located in different environments (Gaoue and Ticktin, 2007). Thirdly, findings of harvesting impacts are never consistent, some species populations can appear to be stable or tolerant under harvesting (Mandle *et al.,* 2013; Mendoza *et al.,* 1987; Shackleton *et al.,* 2007; Ticktin, 2004) while others can appear to be negatively impacted from harvest pressures and exhibit damaging impacts (Siebert, 2004**;** Soehartono and Newton, 2001). Fourthly, the majority of NTFPs that are considered to be economically important are often locally abundant or widespread (Shackleton, 2005). There is a common notion that the harvest of these species has the potential to be sustainable (Cunningham, 2001) due to their high abundance (Mandle *et al*., 2013). As a result, NTFP literature on the ecological impacts of intense harvesting of such species is often not widely available in comparison to studies on species that are considered to be rare or declining (Reid, 2005). Lastly, impacts can manifest across multiple ecological scales, from individual populations to communities and ecosystems (Hall and Bawa, 1993; Hiremath, 2004; Ticktin and Shackleton, 2011; Shaanker *et al.,* 2004) which are overall underpinned by a multitude of ecological, social and economic factors (Ticktin, 2004; Ticktin and Shackleton, 2011). In the face of environmental and climatic change, it is important that NTFPs are protected as have they have become increasingly important in conservation planning (Loarie *et al.,* 2008). It is for this reason that our study looks into the potential significance of refugia in safeguarding NTFPs under household use.

1.3 Refugia for NTFPs

What is a refugium? It is a widely used term but is rarely explicitly defined. In simple terms a refugium (plural *refugia*) describes areas that protect, shelter or act as "safety spots" from danger, disturbance or disaster. The term has been used by biologists in reference to threats that include long-term environmental changes such as global warming and glaciation as well as shorter-term phenomena such as fires, floods, livestock grazing, browsing and harvesting. In the dictionary of ecology, Allaby (2010:323) defines a refugium as "an isolated area where extensive changes, most typically due to changing climate, have not occurred. Plants and animals formerly characteristic of the region in general find a refuge from unfavourable conditions in these areas". According to Bennett and Provan (2008), the term refugia was first used by Heusser in 1955 in which he stated: "The number and kinds of pollen in the basal peat favor the interpretation that vegetation persisted in refugia through at least the last glaciation" (Heusser, 1955:429); a conclusion that he established from his findings on the late Quaternary pollen data from Queen Charlotte Islands (western Canada). Subsequently, numerous case examples of refugia have been cited over the years under different ecological and conservation contexts such as competition (e.g. Sebens, 1982), predation (e.g. Brown, 2003) disturbance (e.g. Magoulick and Kobza, 2003), as well as harvesting for NTFPs (Gyan and Shackleton, 2005; Shackleton *et al.*, 2009). However, the majority of the research on refugia has been on paleo-reconstruction of past climates, vegetation and fauna distributions to describe multi-scale situations about plant and animal species that have managed to survive the Last Maximum Glacial (LMG) period (Bennett and Provan, 2008) and most have been based in the northern hemisphere (Keppel *et al.,* 2012). For example, according to Beheregaray (2008) about 76% of the publications in 2009 about refugia were in the context of Quaternary climate change.

One of the most cited definitions of refugia is by Sedell *et al*. (1990:711), who define refugia as "habitats or environmental factors that convey spatial and temporal resistance and/or resilience to biotic communities impacted by biophysical disturbances". Another is by Lancaster and Belyea (1997:222) who describe refugia as "places (or times) where the negative effects of disturbance are lower than in the surrounding area (or time)". Several recent studies provide useful definitions and different applications of refugia (Ashcroft, 2010; Dobrowski, 2011; Keppel *et al.,* 2012; Sigh *et al.,* 2013; Tzedadis *et al.,* 2013). Some scholars provide discussions of refugia from a geographic context. For example, Ashcroft (2010), Dobrowski (2011) and Gavin *et al.* (2014) recognize refugia as geographic landscapes that shelter or protect plants and animal species as a result of their ability to maintain a climate that is being affected by the impacts of rising global temperatures. Keppel *et al*. (2012:393) define refugia as "sites to which biota retreat, persist in and potentially expand from under changing environmental conditions". Others define refugia in relation to stress and disturbance. For instance, Barthel *et al*. (2013:1142) define refugia as "places where relict (formerly more widespread or abundant) species have found shelter during periods of stress, such as from forest fires or inclement climate". Some definitions of refugia emerge from scenarios whereby species are protected from harvesting pressures by virtue of growing in formally or informally recognized protected areas. For example, Pitman *et al*. (2015) define refugia as "management units with off take levels below an established sustainable harvest rate".

Despite the wide usage of the term, there is currently no consistent globally accepted definition of refugia (Ashcroft, 2010; Bennett and Provan, 2008; Keppel *et al.,* 2012). Yet, in most definitions, refugia are seen as spatial areas where a species or populations can "hide" from adverse pressures. However, the concept can be broader than simply a spatial area. In Table 1, four applications of the concept are considered building on Shackleton *et al*. (2015). For example, Gyan and Shackleton (2005) considered *Phoenix reclinata* plants or populations that were local on steep slopes that harvesters would not climb as being located in a spatial refuge. In contrast, Shackleton *et al.* (2009) described size refugia in the instance where harvesters avoided small *Ischrolepis eleocharis* plants and only selected those with long shoots. The spatial designation overlaps with a cultural one when the basis of the protection or lack of harvest is related to cultural norms or rules prohibiting access to or use of particular areas.

Table 1. Types and examples of refugia for Non-Timber Forest Products.

Type	**Description**	**Examples**
Spatial	Individual NTFP populations that are in places that are not easily accessible or are in places harvesters keep away from (Shackleton *et al.*, 2015)	Regardless of the intense harvesting pressure on the population of *Phoenix reclinata* in King Williamstown, Gyan and Shackleton (2005) reported that individuals located on steep slopes and on rocky surfaces above pools were avoided and were not harvested at all. In another example, soapberry fruit harvesters by the Soliga community of India preferred nearby densely populated areas to distant areas that have low densities of trees (Setty, 2015).
Size	Individual NTFPs that are considered too little or too big to make use of by harvesters (Shackleton *et al.*, 2015)	All palm leaf harvesters interviewed from Willowvale mentioned that they never cut from a tree that has a stem with very few fronds and that the dry and old leaves from mature stems are never harvested because they are too hard for a needle to go through the rachis (Mjoli and Shackleton, 2015). In another example, Shackleton *et al.* (2009) found that gatherers of *Ischyrolepis eleocharis* ignored short stems and only preferred long stems.
Cultural/ Spiritual	A fraction of NTFP populations that are located in particular places that are believed to hold strong cultural or spritual significance such as sacred sites or places that are considered taboo to harvest from (Shackleton *et al.*, 2015)	Bhagwat *et al.* (2005) found that NTFP populations in sacred groves have significantly higher densities compared to nearby or neighbouring forests and sites.
Physical/ Habitat	Individual NTFPs that are located in areas or places that act or offer natural protection from environmental conditions	Examples of these types of physical/habitat refugia include slopes on mountains, and is usually invoked in relation to glaciation changes, but may well be important in future under climate change resulting from global warming.

The concept of refugia is now being increasingly used in relation to areas that should be conserved to mitigate the impacts of increasing global temperatures (Barnosky, 2008; Loarie *et al.*, 2008; Noss, 2001; Rull, 2009; Taberlat and Cheddadi, 2002). At the same time, the concept has many different interpretations and can be validly applied in diverse settings. For example, within the conservation field, some studies on variability of populations in fragmented landscapes have used concepts that are very similar to refugia but are described in different terms such as source populations (from source/sink models), core habitat and viable populations (Block and Brennan, 1993; Pulliam *et al.*,1992). On the other hand, there is far less understanding of refugia to other situations or landscapes that have not been affected by moving ice sheets. For instance, these could be refugia for animal and plant species that are sheltered from anthropogenic threats such as fires, livestock grazing, heavy harvesting or land clearing. Such types of disturbances can significantly affect NTFP populations and have been studied extensively (e.g. Ganesan and Setty, 2004; Mandle *et al.*, 2015; Sinha and Brault, 2005).

1.4 Rationale for the study

The poorest people of South Africa reside in rural areas (Kepe, 2009; Petheram *et al.*, 2006). Throughout most of the twentieth century, the state in South Africa restricted black South Africans to small regions of land referred to as Bantustans or homelands (Kepe and Tessaro, 2014). Under a series of racial laws, the apartheid government allocated and controlled land ownership, use and dwelling on the basis of racial grounds. These past injustices have left a legacy of underdevelopment and deprivation which remains visible to this day which exacerbate the condition of the dispossessed and poor. The majority of rural communities in the Eastern Cape have high levels of unemployment, lack access to resources and markets (Shackleton and Lukert, 2015). The collection of NTFPs tends to be a prominent livelihood activity that many rural people partake in to meet various livelihood outcomes (Hebinck and Lent, 2007; Shackleton *et al.*, 2007). There has been extensive research in the Eastern Cape province on the use of NTFPs and their contribution in fulfilling and meeting rural livelihood outcomes**.** The most commonly used NTFPs in South Africa (wild spinaches, edible fruit, grasses and fuelwood) are used by more than 85% of the surveyed households, whilst 50% or more use edible insects, wild honey, wood for building structures and reeds for weaving (Shackleton and Shackleton, 2004). Previous studies in the Eastern Cape province highlight the significance of plant fibre species for many rural communities such as grasses and reeds (Kepe, 2003; Makhado and Kepe, 2006; Pereira *et al*., 2006; Ruwanza and Shackleton, 2015; Shackleton *et al.*, 2009) to make various products such as mats, brushes traditional containers and baskets. Palm fronds are shredded from *Phoenix reclinata* to make hand brushes (Gyan and Shackleton, 2005; Mjoli and Shackleton, 2015). Wood is also another NTFP that is used extensively to fulfill various livelihood functions such as fuelwood, construction, fencing and carving (Cocks *et al.*, 2008; Shackleton and Shackleton, 2004). For example, in the Kat River valley respondents stated that they prefer fuelwood species of wood species *of Vachelia karroo*, *Tarchonanthus camphoratus*, *Coddia rudis* and *Maytenus heterophylla* (Shackleton *et al.*, 2002). In Peddie and King William's Town district of the Eastern Cape, 243 plant species were utilized and valued for various livelihood outcomes (14 of these were alien species) (Cocks *et al.*, 2008). With such wide usage of NTFPs, a number of scholars have raised concerns about the sustainability of NTFP harvesting (Schmidt *et al.*, 2011; Stanley *et al.*, 2012; Ticktin, 2004). Similar concerns have also been voiced in southern Africa (Syampungani *et al*., 2009; Watson and Dlamini 2012). These concerns have prompted efforts to limit or minimize the ecological disturbances of NTFPs to not only help meet conservation goals but to help sustain the local livelihoods of the many households depending on forest products. Clear property rights, secure tenure, promotion of local ecological knowledge (LEK) (McLain and Niekerk, 2015; Ros-Tonen and Koen Kusters, 2011) and prohibitions in harvesting (e.g. seasonal harvesting, permits) (Ros-Osorno-Sánchez *et al.*, 2012) are some of the key concepts and management systems that have been adopted in limiting the ecological disturbances of NTFP harvesting. However, the role of refugia in conserving pockets of threatened species from overharvesting has rarely been considered. This study aims to draw attention to this potential role and add to the ongoing and increasing discussions concerning the conservation of NTFP species.

1.5 Research objective and key questions

The objective of this research was to assess the potential significance of refugia in safeguarding NTFPs under household use.

Three key questions are posed to meet this objective:

(i) What is the prevalence of refugia in maintaining or protecting NTFP populations?

(ii) Which form of refugia is the most common?

(iii) How do NTFP populations in refugia compare to harvested populations?

2. Study Areas

Three study sites were selected to address the key research questions set out in section one (Figure 2). These were [1]Willowvale, Tsholomnqa and Port. St John's. The sites were selected because they had two similar characteristics. Firstly, all of the sites are in areas where detailed research on NTFP use at household level has been previously covered. Secondly, they are all in the coastal belt of the Eastern Cape Province.

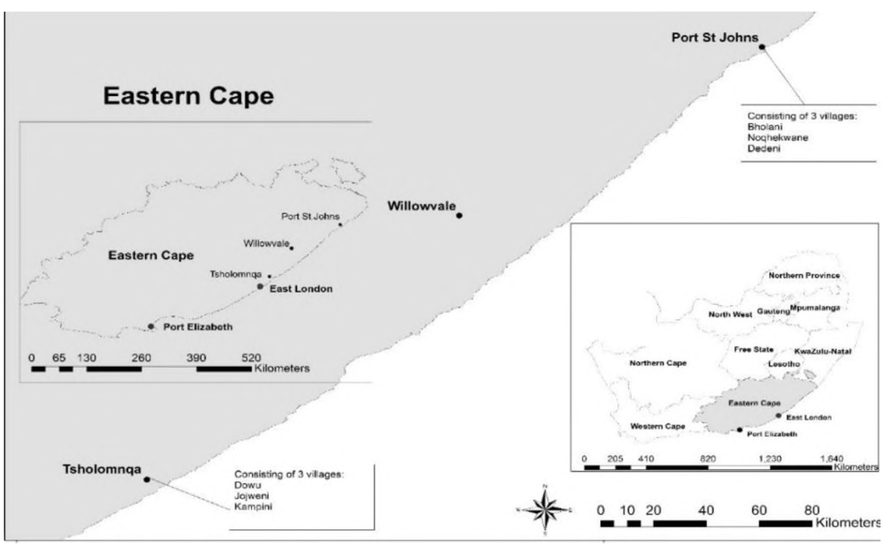

Figure 1: Map of study areas

[1] Unlike Tsholomnqa and Port. St John's, Willowvale has no distinct villages.

2.1 Tsholomnqa

2.1.1 The biophysical environment

Tsholomnqa is a rural area located in the former Ciskei homeland of the Eastern Cape of South Africa (33° 1610' "S; 27° 5282' "E) under the Buffalo Metropolitan Municipality. The area has a mean annual rainfall of 864 mm, which generally peaks in the months of October to March. Maximum temperatures range from 20.4 °C in July to 25.4 °C in February with mean minimum temperatures down to 9.5 °C. The geology comprises of mainly sedimentary rock including mudstones and sandstones which originate from the Beaufort Group of the Karoo Supergroup as well as the Jurrasic Dolerite suite intrusions. The vegetation of Tsholomnqa is dominated by *Vallechia karroo* which has taken over from what used to be a natural grassland. Mucina and Rutherford (2006) categorize the vegetation of the area as Buffels Thicket. This type of vegetation typically consists of rolling hills, steep slopes and valleys dominated by woody species such as *Aloe ferox*, *Vallechia karroo* and *Cussonia spicata*.

2.1.2 The socio-economic environment

No research has been conducted in evaluating the socio-economic environment of Tsholomnqa. However, according to a Draft Assessment report for the proposed development plan in Tsholomnqa compiled by the Indwe Environmental Consulting (2014), the population of the area is 21 062 of which 48% are male and 52% are female. The majority of the population (58%) is under the age of 35 and only 5 916 people are employed. According to Stats SA (2011), the Buffalo Metropolitan Municipality has an unemployment rate of 35.1%. Tsholomnqa is an area characterized by small and scattered villages as well as open fields that were once used as agricultural and grazing lands. Though the intensity is not as high as in the previous decades, some households use the land for subsistence farming and grazing. The tenure system in Tsholomnqa consists of a mixture of private property, common property, communal grazing and collection of natural resources where chiefs and local municipalities work together in allocating land. The majority of the population depends on the sale of natural resources, social welfare grants, livestock, farm labour and remittances. Tsholomnqa is one of the many rural areas in the Eastern Cape with high rates of unemployment and little opportunities to financial markets and quality education.

Three villages were randomly selected from the area namely: Jojweni, Kampini and Dowu which are all different in size and population (Table 2). In Jojweni village, the houses are arranged in a linear pattern, largely influenced by its mountainous location. In Dowu village the settlement is in an L-shaped pattern, whilst the houses in Kampini village are in a nucleated pattern. All three villages have similar characteristics in terms of their reliance on natural resources and livestock farming. Currently no academic research exists for these three villages.

Table 2. Village profiles of Tsholomnqa.

Key statistics		**Village**		
		Jojweni	Dowu	Kampini
Latitude		33°.1658 S	33°.1981 S	33°.2189 S
Longitude		27°.448 E	27°.4865 E	27°.4525 E
Total population		1 818	486	263
Education	No. schooling (aged 20+)	15.5%	17.9%	21.3%
	Some primary	29.2%	24.7%	31.6%
	Completed primary	6.0%	8.6%	8.8%
	Some Secondary	32.1%	40.2%	25.7%
	Matric	13.2%	6.9%	9.6%
	Higher education	4.1%	1.7%	2.9%
Female headed households		51.1 %	47.8%	50.6%
Elderly (aged 65+)		11.5%	14.6%	13.6%
Piped water inside dwelling		0.5%	1.5%	0%
Electricity for lighting		94.6%	97.7%	87.0%

2.2 Willowvale

2.2.1 The biophysical environment

Willowvale is located in the Eastern Cape province of South Africa (32° 15' 46.33"S; 28° 28' 50.15"E) under the Mbhashe local municipality along the Wild Coast (Ncube *et al.*, 2016; Shackleton *et al.*, 2013). It falls within the Maputoland-Pondoland-Albany biodiversity hotspot and its natural vegetation comprises of a mosaic of thorn savanna, dune thicket, indigenous forests and grassland patches. Moist grassland and Eastern Thorn Bushveld dominate the upland areas while coastal grassland and forest vegetation dominate the low altitude areas (Machingura, 2007). The area has an average annual rainfall that ranges from 800-1 000 mm peaking in October to April with mean maximum temperatures of 27° C in summer and a mean minima of 3° C in winter (Shackleton *et al.,* 2013). According to Mucina and Rutherford (2006) Willowvale has an altitude extending from sea level to around 450 m with rolling hills and valleys forming the characteristic topography. Sandy and clay loam soils of the Glenrosa and Mispah dominate the soil types of Willowvale (Mucina and Rutherford, 2006). Forests in the area have been recognized as being the most species rich, non-tropical forests in the world (CEPF, 2010).

2.2.2 The socio-economic environment

The tenure system in Willowvale consists of a mixture of common property, conservation, communal grazing and collection of natural resources. Chiefs and local municipalities work together in allocating land and in managing the use of natural resources. However, the lack of financial resources over the years has halted strategies and plans for managing natural resources. Like many rural areas in South Africa, Willowvale is characterized by sparsely populated rural settlements lacking markets, basic facilities and services like libraries, electricity and reliable access to water supply (Stats SA, 2011). The population density is approximately at 53 persons per km^2. Sixty-four per cent of those older than 20 years old have basic reading and writing skills, whereas 27% of the adult population has never attended school (Stats SA, 2011). The unemployment rate in Willowvale is at 79% (Local Municipality Mbhashe, 2010/2011). The majority of (50.3%) of the households have no access to electricity and only 3.5% have piped water in their houses (Stats SA, 2011). The average household size is 4.1 persons and more than half (58%) of households are female-headed. The majority of the population depends on government social welfare grants, livestock, migrant labour and remittances (ARDRI 2001; Fay, 2013; Timmermans, 2004). There is also a large dependence on the collection of non-timber forest products (NTFPs), either for sale or household use.

2.3 Port St Johns

2.3.1 The biophysical environment

Three villages were selected from the Port St John's local municipality namely; Bolani, Dedeni and Noqhekwane. According to the municipality's Integrated Development Plan (IDP) (2012/13-2016/17) Port St John's is located on the coast of the Indian Ocean in the Eastern Cape. Its coastal and inland areas all fall under the Transkei with approximately 130 rural villages. The area is characterized by a moderate, humid and subtropical coastal climate. Summer mean temperatures can vary from a maximum of 25 °C to an average minimum of 20 °C, while winter temperatures are mild, with maximum and minimum temperatures being 21 °C and 8 °C, respectively. The mean annual rainfall that varies between 1 100 and 1 400 mm, peaking in the summer (October to March). Port St John's is dominated by the following variety of vegetation types: Coastal Forest Thornveld and Scarp Forest found along the coastal area, Coastal Bush Veld Savanna mostly found in the central part of the region, Valley thicket, Eastern Valley Bush on the north-western side Afromontane Forest in small pockets that are mostly concentrated in the central eastern side of the region as well as the Ngongoni Veld in the western parts of the municipality (Mucina and Rutherford, 2006). According to the Port St John's municipality Integrated Development Plan (IDP) (2012/13-2016/17), the area comprises of both indigenous and exotic trees. Common indigenous tree species are *Ptaeroxylon obliquum*, *Millettia grandis*, *Duvernoia adhatodoides, Mimusops caffra* and *Parsonsia straminea* while exotic trees are mostly gum trees. It comprises of three biomes namely, grassland, Indian Ocean coastal belt and Savanna.

2.3.2 The socio-economic environment

According to the municipality's Integrated Development Plan (IDP) (2012/13-2016/17) the total population of Port St. John's is estimated to be 156 136 people. The area has an unemployment rate of 50.3% where 61% of the youth (15-34) is unemployed. The average household size is 4.5 and more than half (60.1 %) of households are female-headed. Twenty-four percent of those older than 20 years old have no formal education while only 4% of the adult population has higher education. Three percent of households have piped water inside the dwelling and two per cent have flush toilets connected to sewerage. The main economic activity is subsistence farming and tourism (Statistics SA, 2011).

Three villages were randomly selected from the area namely: Noqhekwane, Bholani and Dedeni (Table 3). All three villages are in dire need of municipal services such as access to reliable water sources, electricity and sanitation. There are no health clinics within the villages. Old and young people have to walk long distances to acquire these services (Mashiri *et al.,* 2009). Livestock grazing and collection of natural resources are some of important livelihood activities that make up the daily lives of people living in these villages.

Table 3.Village profiles of Port. Johns

Key statistics		**Village**		
		Noqhekwane	Bholani	Dedeni
Latitude		31°.6003 S	31°.572 S	31°.5733 S
Longitude		29°.586 E	29°.5876 E	29°.5576 E
Total population		1 234	316	996
Education	No schooling (aged 20+)	17.3%	41%	26.7%
	Some primary	38.9%	29.1%	26.2%
	Completed primary	6.8%	5.1%	7.3%
	Some Secondary	20.6%	22.2%	30.9%
	Matric	14.8%	1.7%	7.9%
	Higher education	1.6%	0.9%	1%
Female headed households		57.8%	70.8%	61.4%
Elderly (aged 65+)		4.1%	5.7%	4.9%
Piped water inside dwelling		4.6%	0%	2.2%
Electricity for lighting		1.5 %	0%	0%

3. Research methods

3.1 Ethical considerations

This study was approved by the Dept of Environmental Science Ethics committee and carried out in accordance with the Rhodes University Standard guidelines. Permission to work in the area was granted by the traditional local authority of each study site where the purpose of the research was explained. I observed and applied the principles of the Rhodes research ethical guidelines. These principles included acquiring informed verbal consent and if consent was not granted, no discussion was conducted, avoiding invasion of privacy and confidentiality and having due regard for their customs and cultural heritage. All the respondents in this study were kept anonymous for their protection.

3.1.1 Data Collection

Three components were carried out in each of the three study sites. The first component consisted of focus group discussions, the second consisted of Participatory Rural Appraisal (PRA) techniques, and the third was ecological assessments of population structure and abundance. Hennink (2013) highlights that a focus group discussion involves an interactive discussion on a specific issue with a group of pre-selected people with common experiences, concerns or interests. The aim is to generate a range of topics, perceptions and views on the research objective with a trained moderator and should normally take 60-90 minutes with not more than five to ten people (Hennink, 2013). The focus group discussions were primarily used as a tool to communicate the purpose of the research, evoke independent views and insights as well as acquire information at the community level where people consider their own viewpoints along with other peoples' viewpoints in the group. According to Theis and Grady (1991:22), PRA is a way of learning from, and with, community members to investigate, analyse and evaluate constraints and opportunities, and make informed and timely decisions regarding development projects. To achieve "participation" and "team work", PRA techniques were employed in a series of focus group discussions. Participation and team work are among the key principles that make up the methodologies of PRA (Cavestro, 2003) because not only are the community members knowledge carriers but they are also co-workers in the gathering of information.

In each study area several focus group discussions were to help me understand the various key roles that are played by NTFPs in people's livelihoods. The participants were asked to list the NTFPs that they use in their households or those that are used by other households in the village. This included fuelwood, grass, medical plants, palms and wild fruits. Each species name was written on a chart in its local isiXhosa name. The range of PRA techniques applied included: ranking exercises, time-trend exercises, transect walks and seasonal calendars. From there on for each product, six to eight harvesters were invited to a PRA workshop where the following topics were discussed:

- Land tenure systems
- Harvesting areas and those not harvested from
- Reasons for not harvesting and how strong are these reasons (e.g. would they ever harvest?)
- Specific sizes that they do not harvest? If yes? If too small is this above or less than size of reproduction
- Harvesting practises, norms and re-harvest intervals (of sites and individual plants)
- Parts used and processed
- Beliefs, taboos, stories, cultural norms
- Sustainability of NTFPs

3.1.1.1 Ranking exercises

Once the list of widely used NTFPs had been established, a ranking exercise was then conducted where each NTFP was ranked and voted according to the most important (species that the participants felt they could not live without). Ranking was used to understand the relative importance of NTFPs for households using them.

3.1.1.2 Transect walks

The aim of using transect walks was to familiarize myself with the spatial layout of the site as well as provide an opportunity for ground thruthing current NTFP use and management. For each widely used NTFP, a transect walk was arranged with five local harvesters to locate the different places where people reported to collect the NTFPs as well as those they avoided (if any). This involved direct observations, questioning, discussing, learning and listening to the harvesters. For example, for areas where there would be noticeable cultivation or cuttings compared to other sites, participants' werere asked to describe everything noticed and to explain the key characteristics of the features they see.

3.1.1.3 Time-trends

Time-trend exercises were employed to help identify changes as well as to understand the history of the community (in relation to NTFP use). Using flip charts respondents were asked to use pebbles to represent the abundance/availability of species over time and discussed whether it had decreased, increased or stayed the same within the last 50 years as well as reasons why certain trends or changes occurred. People were also asked how the changes affected their livelihood and how they responded to those changes at the time. The different species were along the y-axis and decades along the x-axis.

3.1.1.4 Seasonal calendars

Seasonal calendars were used to obtain information about the months of the year people harvest, reasons for harvesting in those months and reasons why they do not. Using a flip chart and pebbles respondents worked together to draw a 12-month table indicating the months they harvest.

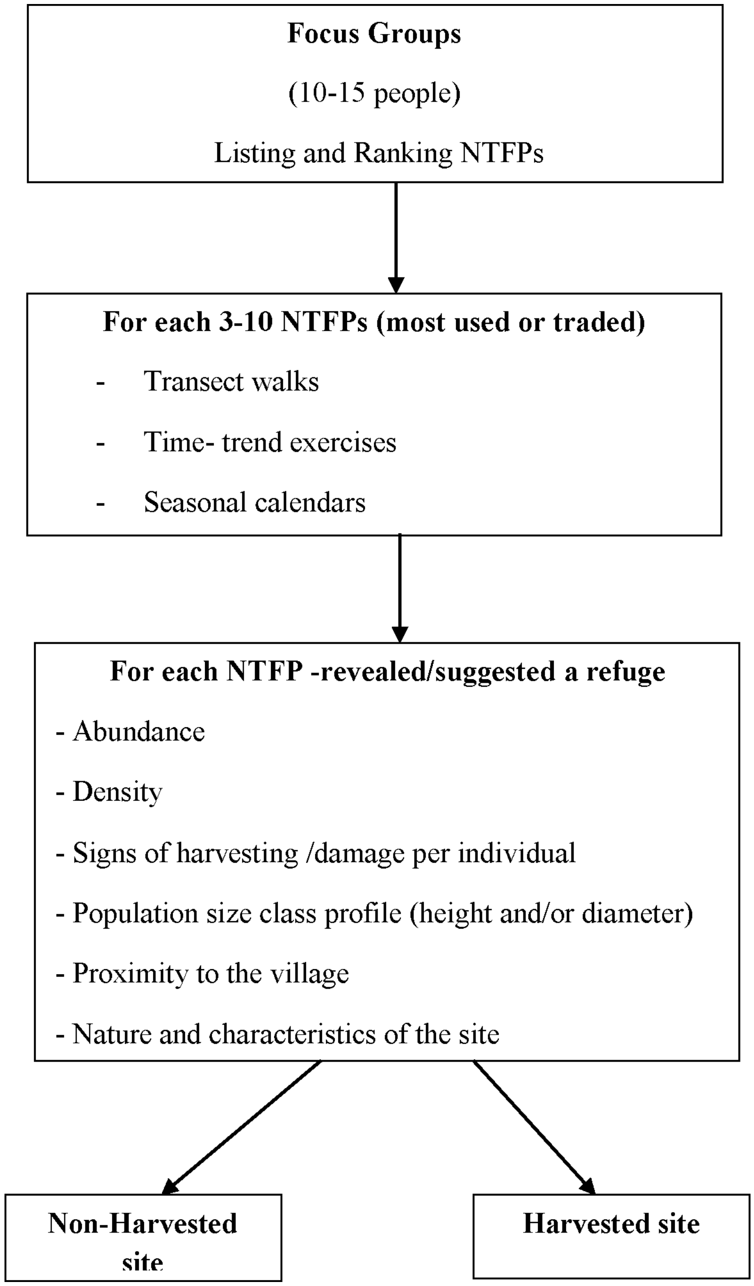

Figure 2: A summary of the research methodology at each site/village

3.2.1 Field sampling design

Once the PRA workshops were complete, the next step was to determine the prevalence of refugia in maintaining or potentially protecting NTFP populations as well as to understand how populations in refugia compare to harvested populations. For each of the most widely used NTFPs established from the ranking exercise, sites of similar conditions (e.g. vegetation) of harvested and non-harvested/sites where identified across different categories of refugia (Table 1).

3.2.1.1 Tree species

The abundance of tree species was assessed by means of fifteen 50 m x 4 m line transects in each harvested and non-harvested site (a total of 30 transects for one tree species in refuge) identified with the help of local harvesters. In each transect, every tree of the target species was counted, along with the number of stems per tree, height, diameter (at 35 cm above ground level) and the visual estimate of the extent of cutting per tree was also assessed.

3.2.1.2 Grass species and reeds

The density of grass or reeds NTFPs was counted in 188 quadrats (1 m^2) across the different sites. Within each quadrat, the number of plants and diameter of each plant (using a ruler) was recorded. To assess the density of reeds, a 25 cm x 25 cm quadrat was used in which the following was assessed or measured; number of shoots, number of shoots cut and mean height of shoots per area sampled.

3.3.1 Data Analysis

The data collected during the PRA workshops and field sampling was collated and analysed statistically where possible, and presented in diagrams and tables where relevant and then imported to Statistica for analysis. Simple descriptive statistics (means and standard deviations) was used to summarise continuous data. Graphical summaries (e.g. histograms) were used show the distribution of data and the factors that influences (e.g. size class profile of tree species). Many species with long lifespans exhibit attributes influenced by factors such as spatial patterns (Seidler and Plotkin, 2006; Werner *et al.*, 1984) and selective pressures (Werner and Gilliam, 1984) that vary across size-classes. As a result, these factors are found to contribute to the changes in mechanisms of species assembly as trees age. Independent t-tests and Pearson's Chi-Squared Test (x^2) were used to compare the differences in attributes between harvested and non-harvested sites (e.g. height, diameter, stem density). A p-value of less than 0.05 was taken to be significant. Size class influences the assembly of tree species within communities as well as their co-existence (Hu *et al.*, 2014).

4. Results

4.1 Key NTFPs and trends in abundance

4.1.1 Dowu village

4.1.1.1 Ranking of key NTFPs

Sixty-seven community members participated in the workshop, 42 females and 25 males. Twenty-six members (39%) owned livestock and the rest were involved in the collection of natural resources. None of the participants had formal employment. The focus group discussions revealed that the most widely used species in Dowu village were various tree species, herbs, medicinal plants and other plant species for rituals (Table 4) (species were listed from most important to least most important).

Table 4. The top ten most widely used species at Dowu village.

IsiXhosa name and Common name	Species	Life form	Use
iHlaba/Cow thistle	*Sonchus asper*	Herb	Food
uMsobo/Nightshade	*Solanum nigrum*	Herb	Food
uTyuthu/Cape pigweed	*Amaranthus hybridus*	Herb	Medicinal
uThuvishe/Kedrostis nana	*Kedrostis foetidissima*	Vine	Medicinal
iNqwebeba/Tall white squill	*Drimia altissima*	Bulb	Medicinal
uMnquma/Wild olive	*Olea europaea* subsp. *africana*	Tree	Rituals
uMthathi/Sneezewood	*Ptaeroxylon obliquum*	Tree	Rituals
iSilawu/African dream root	*Silene undulata*	Herb	Rituals
iSiphingo/ Droogies	*Scutia myrtina*	Tree	Stick making
uMngcunube/River willow	*Salix mucronata*	Tree	Rituals

4.1.1.2 Seasonal availability

According to the majority of the participants, all the tree species listed are collected throughout the year. This was also the case for medicinal plants, herbs and plant species for rituals.

4.1.1.3 Changes in abundance of key NTFPs over the last five decades

The majority of harvesters in Dowu village put forward that from the 1960s to the present decade, rainfall levels had gradually decreased (Table 5). They reported that prolonged periods of drought conditions began to manifest from the decade of 2000s-2010s and that this change contributed to the decline in the abundance of all species mentioned. Yet, out of all the species listed, herbs and medicinal plants were the only species that were reported to have significantly declined over the past five decades. On the other hand, all tree species highlighted in the list had not decreased significantly and can still be found in sizeable quantities. There was a general agreement that the number of harvesters for all species listed had decreased because of the disinterest and lack of knowledge from young people about the uses of these forest resources. Moreover, it was reported that the majority of old people who have the knowledge about the uses of these trees do not have the strength to walk long distances to gather these resources.

Table 5. Trend-line of Dowu village where participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Herbs *Sonchus asper, Solanum nigrum* and *Silene undulata*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
12	9	7	6	4	2
According to the respondents, from the 1960s, rains were frequent and people valued livestock farming as a result *Sonchus asper, Solanum nigrum* and *Silene undulata* thrived. Adequate rains and livestock farming continued to persist throughout the 1970s. However, a period of strong and turbulent rains in the 1980s halted many livestock and farming activities. Adequate rains picked up again from the 1990s but from the early 2000s they became lighter and less frequent. As a result, livestock farming declined significantly causing a decline in the abundance of herbs. A noticeable decline in their abundance began from the early 2010s. Respondents attributed the decline in cultivated environments (e.g. distant farming activities) caused by persistent dry climatic conditions, government social grants as well as young people migrating to big towns as key drivers. Fields have now become forests and most wild leafy vegetables are found in small home gardens or near kraals.					

Medicinal plants *Amaranthus hybridus, Kedrostis foetidissima* and *Drimia altissima*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
9	9	8	6	5	3
The decades of 1960s-1970s were characterized by frequent rains and harvest of a variety of medicinal plants. From the 1980s, weather patterns that bring rain had become less frequent and from the 1990s, hot weather patterns began to persist discouraging many people from the village from practising distant farming activities. From 2000s to the present state, harvesters stated that forests are now filled with what they refer to as "inwele" plant species as well as woody species that have made it difficult to find and collect medicinal plants. Moreover, respondents felt that the democratic transition in South Africa came with easy and reliable access to health facilities and that people no longer feel the need to walk long distances to collect medical herbs.					

Trees *Ptaeroxylon obliquum*, *Olea europaea* subsp. *africana*, *Salix mucronata* and *Scutia myritina*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	8	7	6	5	6
According to the harvesters, from the 1960s-1970s rains were adequate and there was an intense harvest of the above mentioned tree species but they all thrived and were high in abundance. Adequate rains were attributed to the high abundance. Frequent and turbulent storms from the 1980s destroyed the topsoil causing a slight decline in their abundance. From the late 1990s, harvest intensity continued though rains were lighter and less frequent. These conditions along with dry climatic conditions persisted till the late 2000s resulting in their decline particularly for *Salix mucronata* (as it a water resource depended tree). However, a steady increase in the abundance for all the trees mentioned was noted from 2010s. The increase was largely attributed to the decline in the number of harvesters in the village. The remaining knowledge carriers are old people who lack the strength to walk long distances to collect these trees.					

4.1.2 Kampini village

4.1.2.1 Ranking of key NTFPs

Twenty-one community members participated in the workshop, 16 females and five males. Ten members (67%) owned livestock and all participants were involved in the collection of natural resources. None of the members had formal employment. The focus group discussions revealed that the most widely used species in Kampini village were tree species, grass species and plant species for medicinal and ritual purposes (Table 6) (species were listed from most important to least important).

4.1.2.2 Seasonal availability

According to the majority of the participants, all the tree species listed are collected throughout. This was also the case for herbs, bulb, rush and grass species. *Cynodon dactylon* and *Gasteria croucheri* were an exception as they are only harvested in summer and spring seasons.

Table 6. The top ten most widely used species at Kampini village.

IsiXhosa name and Common name	Species	Life form	Use
uMnquma/Wild Olive	*Olea europaea* subsp. *africana*	Tree	Rituals
uMthathi/Sneezewood	*Ptaeroxylon obliquum*	Tree	Rituals
iSilawu/African dream root	*Silene undulata*	Herb	Rituals
iMpepho/Everlasting	*Helichysum odoratissimum*	Herb	Medicinal
Umathunga/White paint brush	*Haemanthus albiflos*	Bulb	Medicinal
uChithibhunga/Wild grape	*Rhoicissus tomentosa*	Climber	Medicinal
iNtelezi/Gasteria	*Gasteria croucheri*	Succulent	Medicinal
iQunde/Rooigras	*Themeda triandra*	Grass	Craft
Incaluka/Rush lily	*Bobartia orientalis*	Rush	Craft
uQaqaqa/Couch grass	*Cynodon dactylon*	Grass	Craft

4.1.2.3 Changes in abundance of key NTFPs over the last five decades

The trend-line revealed that over the past five decades, the abundance of all of the key NTFP species had gradually decreased (Table 7). More than half of the respondents attributed the decline to prolonged periods of dry climatic conditions that began from the late 2000s. According to the respondents, the decades of 1960s to late 1980s were characterized by periods of significant harvest, appreciation of forest resources, adequate rains and mild temperatures where the majority of the key species listed thrived. However, from 2000s-2010s this changed and harvest levels declined significantly because democracy came with better access to monetary resources, especially government social grants, and building materials that could easily be purchased replacing the difficulty and labour of walking long distances.

Table 7. Trend-line of Kampini village participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Trees *Ptaeroxylon obliquum* and *Olea europaea* subsp. *africana*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	8	7	5	6	7
The 1960s and 1970s were described as periods of heavy harvest and frequent rains that were accompanied by mild temperatures. The 1980s on the other hand were periodic events of turbulent rains that destroyed the topsoil and negatively affected the abundance of *Ptaeroxylon obliquum* and *Olea europaea* subsp. *africana*. In the 1990s and 2000s, rains were lighter and less frequent and even more from 2010s to the present decade. It was highlighted that the number of harvesters over the years decreased significantly because democracy came with better access to cash (social grants) as well as building materials that replaced the hassle of walking long distances to collect the above mentioned trees.					
Herbs *Silene undulata* and *Helichysum odoratissimum*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	7	7	7	6	5
The 1960s were characterized by adequate rainfall events, which prevailed until the 1970s-1980s. From the 1990s, rains were lighter and less frequent and dry weather conditions started to persist from the early 2000s. From 2010s to the present state, rains were reported to start later and then stop early.					

Medicinal plants *Rhoicissus tomentosa, Gasteria croucheri* and *Haemanthus albiflos*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	8	7	5	4	2
In the 1960s, medicinal plants were abundant around the village. In the 1970s, events of heavy rainfall persisted but heavy and turbulent rainfall events in the 1980s removed top soil contributing to the decline in abundance of many medicinal plants. From 2000s, forests were dominated by unusual plant and woody species that significantly contributed to the decline of the above mentioned medical plants.					
Rush *Bobartia orientalis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	7	8	7	5	6
In the 1960s-1970s, rains were frequent and there was a heavy harvest of *Bobartia orientalis* for craft purposes. Use continued up until the 1980s-1990s. However, the number of harvesters significantly declined because dependence on *Bobartia orientalis* declined. From 2000s, rains began to be less frequent and the elderly who have the indigenous knowledge about the rush species felt that they are too old to travel long distances to forests. From 2010s, rains further declined and drought conditions were common but since *Bobartia orientalis* is a perennial herb, it had managed or has the ability to survive harsh conditions.					
Grasses *Cynodon dactylon* and *Themeda triandra*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	13	8	6	4	3
From 1960s, rains were frequent and even more frequent from 1970s. However, good rains and strong winds characterized the decade of 1980s and resulted in the decline of *Cynodon dactylon*. From the 1990s, rains were lighter and less frequent as a result *Cynodon dactylon* significantly declined. These conditions continued up until 2000s-2010s and abundance of *Cynodon dactylon* further declined from 2010s as drought conditions began to manifest.					

4.1.3 Jojweni village

4.1.3.1 Ranking of key NTFPs

Twenty-seven community members participated in the workshop, 15 females and 12 males. Ten members (37%) owned livestock and the rest were involved in the collection of natural resources. Only one member had formal employment. The focus group discussions revealed that the most widely used species in Jojweni village were propalis, medicinal plants and tree species (Table 8) (species were listed from most important to least important).

Table 8. The top ten widely used species at Jojweni village.

IsiXhosa name and Common name	Species	Life form	Use
uMnquma/Wild Olive	*Olea europaea* subsp. *africana*	Tree	Rituals
uMnga/Sweet Thorn	*Vachellia karroo*	Tree	Fuel
uMthathi/Sneezewood	*Ptaeroxylon obliquum*	Tree	Rituals
iNtsinde/Bone apple	*Coddia rudis*	Woody shrub	Building
iMizi/ Tall star sedge	*Cyperus textilis*	Sedge	Craft
iMpepho/Everlasting	*Helichysum odoratissimum*	Herb	Medicinal
uMathunga/White paint brush	*Haemanthus albiflos*	Bulb	Medicinal
uBulawu/African dream root	*Silene undulate*	Herb	Ritual
Incaluka/Rush lily	*Bobartia orientalis*	Rush	Craft
Ubusi/Propalis			Craft

4.1.3.2 Seasonal availability

According to the harvesters, all the NTFP species listed can be harvested all year.

4.1.3.3 Changes in abundance of key NTFPs over the last five decades

According to the majority of the harvesters, drought conditions had been persistent throughout the decade of 2000s and that they have been one of the key drivers in the decline of sedge and rush species (Table 9). *Ptaeroxylon obliquum*, *Vachellia karroo* and propalis are the only species that have increased or stayed the same. It was highlighted that *Ptaeroxylon obliquum* is native to the village of Jojweni and that it had always been stable and available while *Vachellia karroo* had increased or stayed the same particularly in areas where distant farming activities used to take place. All the respondents agreed that from 2000s, there had been a significant decline in the number of harvesters for all the species in the list. The production of exotic crops was linked to the decline of medicinal plants. Urbanization and greater access to health care and education are factors that have contributed to the decline in number of harvesters and decrease in indigenous knowledge base.

Table 9. Trend-line of Jojweni village were participants were asked to indicate the abundance/availability for key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Trees *Olea europaea* subsp. *africana* and *Codddia rudis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	10	8	7	5	6
The decades of 1960s-1970s were reported to have good rains and high harvest of *Olea europaea* subsp. *africana* and *Codddia rudis* to fulfil various household and cultural functions. Similarly, there were more adequate rains from 1980s and 1990s as well as significant harvest. From 2000s-2010s, there were shorter rainy seasons, prolonged dry periods and increased winds. From 2010s, there was a slight increase in the abundance of *Olea europaea* subsb. *africana* and *Codddia rudis* because of the significant decline in number of harvesters despite decline in rains. Moreover, the respondents felt that these resources can now be purchased instead of travelling long distances to collect them (e.g. poles).					
Tree *Acacia karroo*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	7	5	6	7	13
In the 1960s-1970s *Vachellia karroo* was stable despite wide use during this period. From the 1980s, strong and turbulent rains decreased the abundance of *Acacia karroo* but slightly increased again in					

<table>
<tr><td colspan="6">1990s because of good rains. However, from 2000s, rains were lighter as a result farming activities declined significantly. The decade of 2010s was described as having high temperatures that were often accompanied by frequent prolonged drought periods. However, this did not significantly impact its abundance particularly in areas where farming activities used to take place. It is common in old fields.</td></tr>
<tr><td colspan="6">Tree
Ptaeroxylon obliquum</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>12</td><td>10</td><td>10</td><td>8</td><td>6</td><td>7</td></tr>
<tr><td colspan="6">From the 1960s, rains were frequent but Ptaeroxylon obliquum had been stable despite wide use that led to a slight decrease in Ptaeroxylon obliquum from 1970s. Strong and turbulent rains from 1980s-1990s are one of the key drivers that led to a significant decrease in the abundance of Ptaeroxylon obliquum. From the early 2000s, rains continued to decline as well as the number of harvesters in the village. From 2010s, the decline in the number of harvesters because people no longer value trees the same way as in the previous decades. Social changes such as government grants was attributed to this decline. Regardless of these factors, most respondents felt that Sneezewood had always been stable and available at Jojweni.</td></tr>
<tr><td colspan="6">Sedge
Cyperus textilis</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>12</td><td>10</td><td>10</td><td>8</td><td>6</td><td>4</td></tr>
<tr><td colspan="6">From 1960s, 1970s and 1980s, rains were frequent as a result Cyperus textilis thrived and wasfound in significant amounts. From 1990s, such conditions changed as rains were lighter and less frequent eventually causing a decline in Cyperus textilis from the start of 2000s. Frequent dry climatic conditions in 2010s resulted in a noticeable decline of Cyperus textilis discouraging people from being involved in its craft production.</td></tr>
<tr><td colspan="6">Rush
Bobartia orientalis</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>11</td><td>10</td><td>9</td><td>8</td><td>6</td><td>4</td></tr>
<tr><td colspan="6">The decades of 1960s-1970s were characterized as periods of abundant moisture and mild temperatures that promoted excellent growth of Bobartia orientalis. Such conditions continued from 1980s-1990s but high harvest pressures from 2000s resulted in a decline of Bobartia orientalis but this decline was more noticeable from 2010s because of frequent burning around the village.</td></tr>
</table>

Propalis					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	9	8	8	7	8
Despite fires caused by human activities around the village, respondents felt that Propalis had always been stable and abundant in Jojweni village.					
Medicinal plants *Helichysum odoratissimum*, *Haemanthus albiflos* and *Silene undulata*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	10	8	7	6	6
The 1960s-1970s, where characterized as having abundant moisture and mild temperatures that promoted excellent growth of *Helichysum odoratissimum, Haemanthus albiflos* and *Silene undulata*. Adequate rains continued up until the 1980s but from 1990s weather patterns that bring rain became less frequent and signs of drought conditions began to manifest by early 2000s. From 2010s, respondents stated that forests are now filled with what they refer to as "inwele" plant species that have made it difficult to find and collect medicinal plants. Most felt that democracy came with easy and reliable access to health facilities as a result many people opt to consult doctors in town and not traditional leaders.					

4.1.4 Willowvale

4.1.4.1 Ranking of key NTFPs

Forty community members participated in the workshop, 28 females and 12 males. Five members (12.5%) were traditional healers and twelve (30%) owned livestock. All participants were involved in the collection of natural resources and one of the members had formal employment. The focus group discussions revealed that the most widely used NTFPs in Willowvale were grass species, tree species, wild leafy vegetables, wild date palms and sedges (Table 10) (species were listed from most important to least important).

Table 10. The top ten widely used species at Willowvale village.

isiXhosa name and Common name	Species	Life form	Use
uMqungu/Turpentine grass	*Cymbopogon caesius*	Grass	Craft
iNtsasela/Cyperus	*Cyperus congestus*	Sedge	Craft and Customs
uMsingizane/Rastail dropseed	*Sporobolus africanus*	Grass	Craft
uMthala/Daba dropseed grass	*Miscanthus capensis*	Grass	Craft
iNcaluka/Rush lily	*Bobartia orientalis*	Rush	Craft
uNomdlomboyi/Amaranth	*Amaranthus blitoides*	Herb	Consumption
uMzi/Tall star sedge	*Cyperus textilis*	Sedge	Craft
iNtsinde/Bone apple	*Coddia rudis*	Shrub	Domestic
uMsimbithi/Umsimbeet	*Milettia grandis*	Tree	Stick making
iSundu/Wild date palm	*Phoenix reclinata*	Palm	Craft

4.1.4.2 Seasonal availability

Amaranthus blitoides, Bobartia orientalis, *Millettia grandis, Phoenix reclinata* and *Coddia rudis* are harvested all year while grass, rush and sedge species are harvested in specific seasons. *Cymbopogon caesius* and *Miscanthus capensis* are harvested from autumn-winter because they tend to be dry and brown in colour and that is when they are suitable for use. On the other hand, *Sporobolus africanus* is harvested in autumn because in the other seasons it tends to get dry and brittle. *Cyperus congestus* does not depend on seasons because it is always available to gather and only less plentiful when there are low rainfall conditions. *Cyperus textilis* is harvested from autumn-spring and avoided in winter because of cold weather conditions.

4.1.4.3 Changes in abundance of key NTFPs over the last five decades

The majority of the harvesters felt that rains had decreased over the past five decades (Table 11). Despite this, the majority of respondents felt that the listed grass species had increased particularly in areas where distant farming activities used to take place. The change began from the 1990s to the present decade. *Bobartia orientalis* had significantly increased because of its ability to withstand difficult weather conditions. Similarly, *Cyperus textilis* had slightly increased from 2010s despite the decline in rains over the years. More than half of the respondents stated that *Phoenix reclinata*, *Millettia grandis* and *Coddia rudis* had always been stable, even during the years where they had been heavily harvested. Herbs were the only key species from the list that had significantly declined over the past decades.

Table 11. Trend-line of Willowvale where participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Grasses *Cymbopogon caesius, Cyperpus congestus*, *Miscanthus capensis* and *Sporobolus africanus*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
4	4	5	6	7	7
In the 1960s and 1970s, rains were frequent and distant farming activities were common and took most of the land. As a result, one would have to travel long distances and even travel to other villages to collect the above mentioned grass species because they were difficult to find, with some harvesters even resorting to using palms as a substitute. From 1980s-1990s, there was abundant moisture and mild temperatures that promoted their growth but from 2000s-2010s, rains were less frequent and dry climatic conditions were common.					
Rush *Bobartia orientalis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
6	7	7	9	10	12
The 1960s were described as periods that had good rains as well as widespread harvest of *Bobartia orientalis*. This was also the case for the decades of 1970s-1980s. From 1990s, there was a noticeable increase in the abundance of *Bobartia orientalis.* This increase was attributed to frequent rains and mild temperatures which continued up until the 2000s. From 2010s, rains were less frequent and dry climatic conditions were persistent. According to the respondents, despite the decline in rains, *Bobartia orientalis* had always been stable and available in Willowvale mainly because of its ability to withstand difficult weather conditions.					

<table>
<tr><td colspan="6">Herb
Amaranthus blitoides</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>15</td><td>7</td><td>7</td><td>5</td><td>3</td><td>3</td></tr>
<tr><td colspan="6">From 1960s, rains were frequent and people valued livestock farming as a result wild leafy vegetables thrived. Livestock farming persisted throughout the 1970s and there was also a heavy reliance on herbs in the village. In the late 1980s, distant farming activities declined but not significantly and heavy reliance on herbs still continued up until the 1990s causing resulting in a noticeable decline in the abundance of Amaranthus blitoides. Rains became lighter and less frequent in 2000s and 2010s, as a result distant farming declined significantly because of factors such as dry climatic conditions, social grants as well as young people migrating to big towns. Fields have now become forests and most wild leafy vegetables are found in small home gardens or near kraals.</td></tr>
<tr><td colspan="6">Wild date palm
Phoenix reclinata</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>15</td><td>12</td><td>12</td><td>10</td><td>10</td><td>11</td></tr>
<tr><td colspan="6">The 1960s had abundant moisture accompanied by frequent rainfall events. These conditions were common up until the 1970s and 1980s but harvest of palms caused an insignificant decline of Phoenix reclinata. In the 1990s, rains were lighter but this did not impact the abundance of Phoenix reclinata. The 2000s, were years of dry weather conditions and also were there had been a noticeable decline in the number of harvesters. Regardless of the decline in rainfall events, from 2010s, most harvesters felt that wild date palm in Willowvale had always been stable even during the years where it had been heavily harvested.</td></tr>
<tr><td colspan="6">Tree
Millettia grandis</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>6</td><td>7</td><td>7</td><td>7</td><td>8</td><td>8</td></tr>
<tr><td colspan="6">The 1960s were years of heavy harvest and good rains that continued up until the 1990s. From 2000s, according to the respondents, Millettia grandis had always been stable and available in Willowvale. There had never been periods of decline or difficulty in gathering it despite heavy harvest that stopped in 2010s largely because of the decline in the number of harvesters as a result Millettia grandis is still abundant in Willowvale.</td></tr>
<tr><td colspan="6">Sedge
Cyperus textilis</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>12</td><td>10</td><td>8</td><td>7</td><td>5</td><td>8</td></tr>
</table>

The 1960s were years of heavy harvest and that rains were frequent as a result *Cyperus textilis* thrived. These conditions continued up until the 1980s with heavier harvest levels. From 2000s, rains were lighter and less frequent contributing to the significant decline in the abundance of *Cyperus textilis.* Such climatic conditions persisted up until 2010s but during this period, the abundance of *Cyperus textilis* increased with decreasing use.					
Shrub *Coddia rudis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
5	5	6	6	5	4
The decades of 1960s and 1970s were regarded as having periods of frequent rains and mild temperatures. During this period, *Coddia rudis* was greatly valued by villagers and harvested for domestic use. These conditions persisted throughout the 1980s and 1990s but from 2000s, rains were lighter but mild temperatures were still common. From 2010s, more land was cleared for housing and forests are now dominated by invasive as well as woody species. The decline in the number of harvesters has also contributed to the shrub's recruitment and growth. More people can afford to purchase poles although reported to be less durable than *Coddia rudis.*					

4.1.5. Bholani village

4.1.5.1 Ranking of key NTFPs

Forty-five community members participated in the workshop, 35 females and 10 males. Ten members (47%) owned livestock and the rest were involved in the collection of natural resources. Only one respondent had formal employment. The focus group discussions revealed that the most widely used species in Bolani were grass species, tree species and medicinal plants (Table 12) (species were listed from most important to least most important).

4.1.5.2 Seasonal calendar

All species that are largely dependent largely on the availability of a water resource such as grass, rush and sedge species are usually harvested in summer and spring while the trees and climbers are harvested throughout the year.

Table 12. The top ten most widely used species at Bolani village

IsiXhosa name and Common name	Species	Life form	Use
uDuli/Matting rush	*Juncus kraussii*	Rush	Craft
uMnqungu/Turpentine grass	*Cymbopogon caesius*	Grass	Craft
uMnga/Sweet thorn	*Vachellia karroo*	Tree	Fuel
Umzi/Tall star sedge	*Cyperus textilis*	Sedge	Craft
uGonothi/Climbing bamboo	*Flagellaria guineensis*	Climbing bamboo	Craft
uBuka/Narrow-leafed secamone	*Secamone filiformis*	Climber	Craft
iKhiwane/ Wild fig	*Ficus capensis*	Tree	Consumption and Wood carving
uMthathi/Sneezewood	*Ptaeroxylon obliquum*	Tree	Stick making
uBubazi/River nettle	*Laportea peduncularis*	Herb	Medicinal
iNtongwane/ Clearing-nut tree	*Strychnos henningsii*	Tree	Consumption

4.1.5.3 Changes in abundance of key NTFPs over the last five decades

According to the respondents, decades of 1960s-1980s were characterized by periods of frequent rains. Results from the trend line exercise revealed that over the past five decades, rush, sedge, climbers and tree species had gradually increased or stayed the same. While grass and medicinal species had gradually decreased. The majority of the respondents stated even though rains had become lighter and less frequent from 2000s, Port St. Johns is generally an area rich of natural resources as a result the majority of NTFPs from the list have increased or stayed the same.

Table 13. Trend-line of Bolani where participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Grass *Cymbopogon caesius*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	8	5	7	6	6
The decades of 1960s and 1970s were characterized as having frequent rains and mild temperatures that					

<table>
<tr><td colspan="6">promoted excellent growth of Cymbopogon caesius. On the other hand, the 1980s were years of strong and turbulent rainfall levels that contributed to a noticeable decline in Cymbopogon caesius along with high harvest pressures. Climatic conditions in the 1990s were milder and accompanied by adequate rainfall events but long dry spells from 2000s to 2010s as well as frequent intense fires (created by people) caused a decline in its abundance.</td></tr>
<tr><td colspan="6">Rush
Juncus kraussii</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000</td><td>2010s</td></tr>
<tr><td>6</td><td>6</td><td>6</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td colspan="6">From 1960s-1980s, there were high harvest levels and rains were frequent as well as abundant moisture. From the 1990s, harvest levels decreased or stayed the same even from 2010s.</td></tr>
<tr><td colspan="6">Sedge
Cyperus textilis</td></tr>
<tr><td colspan="6">From 1960s-1970s, rains were frequent and accompanied by mild temperatures. As a result, Cyperus textilis thrived and was widely available. The 1980s-1990s came with more rains that resulted in the abundance of Cyperus textilis to increase even more. However, the years of 2000s and 2010s were reported to have less frequent and lighter rains. These factors however did not have a negative impact or decrease the abundance of Cyperus textilis.</td></tr>
<tr><td colspan="6">Tree
Ficus sur</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>5</td><td>5</td><td>6</td><td>6</td><td>5</td><td>5</td></tr>
<tr><td colspan="6">Because of its drought resistant nature, Ficus sur had been pretty much stable and available in Bolani. Regardless of the decline in rainfall over the past decades.</td></tr>
<tr><td colspan="6">Tree
Vachellia karroo</td></tr>
<tr><td>1960s</td><td>1970s</td><td>1980s</td><td>1990s</td><td>2000s</td><td>2010s</td></tr>
<tr><td>6</td><td>5</td><td>5</td><td>6</td><td>7</td><td>7</td></tr>
<tr><td colspan="6">The years of 1960s-1990s were characterized as having good rains and heavy harvest of Acacia karroo for household fuel purposes and distant farming took most of the land. From the beginning of 2000s, distant farming activities declined significantly and from 2010s the majority of households no longer practised farming activities. This land-use change was believed to have resulted in an increase in the abundance of Vachellia karroo.</td></tr>
</table>

Climbers *Flagellaria guineensis* and *Secamone filiformis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
4	5	6	8	10	10
Crafts made from *Flagellaria guineensis* and *Secamone filiformis* are important for income generation for villagers of Bolani. The decades of 1960s-1980s were periods of heavy rains as well as significant harvest but many forests were protected and not easily accessible to harvesters. From 1980s-1990s, there were less strict regulations from local government officials in protecting/guarding the forests resulting in a significant decline in both *Flagellaria guineensis* and *Secamone filiformis*. From 2000s-2010s, South Africa's democratic transition resulted for many forests to be less protected and the introduction of social government grants contributed to the decline in number of harvesters in Bolani.					

Tree *Strychnos henningsii and Ptaeroxylon obliquum*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
6	6	7	7	7	8
From 1960s-1980s, there was a heavy reliance on *Strychnos henningsii and Ptaeroxylon obliquum* for building purposes as a result heavy harvest of *Strychnos henningsii* and *Ptaeroxylon obliquum* prevailed. Rains and mild temperatures were frequent which favoured their growth. Gradually from 1990s to the late 2000s, their collection decreased. Then from 2010s, the decrease in their collection was noticeable as sizeable amounts were found around the village. There had been a decrease in use because most people choose to purchase poles in town instead.					

Medicinal plant *Laportea peduncularis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
9	9	7	6	5	5
Laportea peduncularis was reported to be abundant during the years of 1960s-1970s. These were periods of good rains and *Laportea peduncularis* was valued and harvested by many households during this time. Harvesting continued from the 1980s but harvest slightly decreased compared to the previous decades. From 1990s, distant farming activities declined and declined even more from the beginning of 2000s. From 2010s, forests were reported to be dominated by invasive plant species as well as *Acacia karroo* especially in areas where distant farming used to take place as a result it has been difficult to gather and access medicinal plants.					

4.1.6 Noqhekwane village

4.1.6.1 Ranking of key NTFPs

Forty-one community members participated in the workshop, 10 females and 31 males. Twenty-three members (56%) owned livestock and all the participants were involved in the collection of natural resources. None of the participants had formal employment. The focus group discussions revealed that the most widely used species in Noqhekwane are grass species, tree species and herbs (Table 14) (species were listed from most important to least important).

4.6.1.2 Seasonal availability

The majority of the respondents stated that *Vachellia karroo, Ficus sur, Flagellaria guineensis* and *Millettia grandis* established from the list are harvested all year. *Juncus kraussi, Cymbopogon caesius, Amaranthus blitoides* and fruits of *Strychnos potatorum* are harvested in summer and spring seasons while *Sympogon caesius* and *Cyperus textlis* are harvested in winter seasons.

Table 14. The top ten mostly used species at Noqhekwane

IsiXhosa name and Common name	Species	Life form	Use
uMnga/Sweet thorn	*Vachellia karroo*	Tree	Fuel
uGonodi/Climbing bamboo	*Flagellaria guineensis*	Climbing shrub	Craft
uBuka/Narrow-leafed secamone	*Secamone filiformis*	Climber	Basket weaving
uDuli/Matting rush	*Juncus kraussi*	Rush	Craft
uMnqungu/Turpentine grass	*Cymbopogon marginatus*	Grass	Craft
uNomdlomboyi/Amaranth	*Amaranthus blitoides*	Herb	Consumption
iNtongwane/Clearing-nut tree	*Strychnos potatorum*	Tree	Consumption
iMizi/Tall star sedge	*Cyperus textilis*	Sedge	Craft
iKhiwane/Wild fig	*Ficus sur*	Tree	Consumption
Umsimbithi/Umsimbeet	*Millettia grandis*	Tree	Walking stick

4.1.6.3 Changes in abundance of key NTFPs over the last five decades

Results from the trend-line exercise revealed a general decrease in the abundance of *Ficus capensis, Strychnos potatorum, Amaranthus blitoides* and *Ficus sur* (Table 15). The decline in distant farming activities, increased incidences of dry climatic conditions and the production of exotic crops were listed as the key drivers to their decline. On the other hand, *Vachellia karroo, Millettia grandis, Cymbopogon caesius, Juncus kraussi, Flagellaria guineensis* and *Secamone filiformis* were perceived to be stable or even increased over the past five decades.

Table 15. Trend-line of Noqhekwane where participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance. (Many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Tree *Vachellia karroo*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
5	6	6	5	5	6
Acacia karroo had always been harvested extensively as there had never been electricity supply in the village but had remained stable and even increased in some sites over the past five decades.					
Climbers *Flagellaria guineensis* and *Secamone filiformis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
7	6	5	6	6	7
Throughout the decades of 1960s-1970s, *Flagellaria guineensis* and *Secamone filiformis* gradually decreased. These were also periods of significant harvest levels but not at a concerning rate. But things changed dramatically when a noticeable decline occurred in the late 1980s as a result of heavy harvesting. From 1990s, good rains and mild rains persisted but controlled harvest in proctected forests continued throughout these years. The beginning of 2000s where described as having variability in rainfall amounts s well as a significant decrease in number of harvesters. It was put forward that South Africa's democratic transition resulted for many forests where harvests takes place to no longer have strict protection.					
Tree *Millettia grandis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
6	6	7	7	7	6

Millettia grandis had always been stable and abundant in Noqhekwane village					
Trees *Ficus sur* and *Strychnos potatorum*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
10	9	9	6	5	3
According to the participants, *Ficus sur* and *Strychnos potatorum* were abundant in the 1960s-1980s. Largely because of frequent rainfall events and mild temperatures and that the large use of these trees by the villagers promoted their growth and recruitment. Mild temperatures continued till the late 1990s, the number of harvesters slightly declined and continued to decline up to the late 2000s-2010s because of prolonged and increased incidences of dry climatic periods making the availability of wild fruits to be difficult. Forests are dominated by invasive plant species which started along the times when people stopped collecting wild fruits. The youth do not have knowledge about wild fruits and majority in the village are not eager to learn about them.					
Grass *Cymbopogon marginatus*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
6	5	5	5	5	5
According to the respondents, other than fires that started from the decade of 2010s, *Cymbopogon* had always been stable and there has never been a period where there had been a drastic decline or difficulty in obtaining the resource.					
Herb *Amaranth blitoides*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010**
10	8	7	7	4	3
From 1960, there were longer rainy seasons and significant harvest levels for *Amaranth blitoides* as it was an important food staple. This herb continued to be an essential nutrient to the villagers of Noqhekwane till the early 2000s. However, by this time its abundance had started to gradually decline because of persistent dry climatic conditions as well as significant declines in distant farming activities that contribute to its growth and distribution. Therefore, by 2010s, *Amaranth blitoides* was found in low quantities.					
Sedge *Cyperus textilis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	8	7	6	5	4

From 1960s-1970s, rains were frequent and accompanied high moisture conditions that promoted the growth of *Cyperus textilis*. Good rains and mild temperatures continued to persist till the 1980s. From the 1990s, rains were light but still frequent. Noticeable declines in abundance began in 1990s and 2000s because of even more lighter rains and heavy harvesting practises. From 2010s, dry climatic conditions began to be persistent and common.					
Rush *Juncus kraussi*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
6	6	5	5	5	5
According to the respondents *Juncus kraussi* had always been stable and that there has never been a period where there had been a decline or difficulty in obtaining the rush species.					

4.1.7 Dedeni village

4.1.7.1 Ranking of key NTFPs

Fifty-three community members participated in the workshop, 31 males and 20 females. Twenty-three members (45%) owned livestock and all the participants were involved in the collection of natural resources. None of the members had formal employment. The focus group discussions revealed that the most widely used species in Dedeni are grass species, tree species, sedges and wild leafy vegetables (Table 16) (species were listed from most important to least important).

4.1.7.2 Seasonal availability

Flagellaria guineensis and the *Ficus capensis* tree species are harvested all year. The rest of the herbs, medicinal plants and fruits of *Strychnos potatorum* are harvested in spring and in summer. *Cymbopogon caesius* was the only species harvested in winter season.

Table 16. The top ten most widely used species at Dedeni village

IsiXhosa name and Common name	Species	Life form	Use
uGonodi/Climbing bamboo	*Flagellaria guineensis*	Climbing shrub	Craft
uMqungu/Turpentine grass	*Cymbopogon caesius*	Grass	Craft
uDuli/Matting rush	*Juncus kraussii*	Rush	Craft
uNomdlomboyi/Amaranth	*Amaranth blitoides*	Herb	Food
uMhlabangubo/Blackjack	*Bidens pilosa*	Herb	Food
iMizi/Tall star sedge	*Cyperus textilis*	Sedge	Craft
iNtelezi/Gasteria	*Gasteria croucheri*	Succulent	Medicinal
iKhiwane/Wild fig	*Ficus capensis*	Tree	Fruit and Medicine
Intongwane/Clearing-nut tree	*Strychnos potatorum*	Tree	Fruit
iMpepho/Everlasting	*Helichysum odoratissimum*	Herb	Rituals

4.1.7.3 Changes in abundance of key NTFPs over the last five decades

Results from the trend-line exercise revealed a general decline in the abundance of all key species listed (Table 17). It was reported that the decline began from the late 2000s to the present decade largely because rains had become less and lighter accompanied by dry climatic conditions. *Flagellaria guineensis* was the only species that respondents felt had been stable over the past decades.

Table 17. Trend-line of Dedeni village where participants were asked to indicate the abundance/availability of key NTFPs within the last five decades. Pebbles were placed next to each date to indicate the abundance (many pebbles indicate high abundance, while fewer pebbles indicate low abundance).

Climber *Flagellaria guineensis*					
1960s	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
8	8	6	7	7	8
From 1960s-1970s, *Flagellaria guineensis* was harvested significantly with good rains and mild temperatures that excellently promoted its growth. From 1980s, opportunities for trade and income					

<table>
<tr><td colspan="6">generation in tourist markets were at peak as a result there was heavy harvest of Flagellaria guineensis during this period. These ecotourism market opportunities were prevalent until the late 2000s and there was even more significant harvest rates especially in forests were there used to be strict harvest regulations. From 2010, there was a noticeable decline in the number of harvesters because people relied more on government social grants because there was no stable income from selling at tourism markets.</td></tr>
<tr><td colspan="6">Tree
Ficus capensis</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>8</td><td>9</td><td>8</td><td>8</td><td>6</td><td>5</td></tr>
<tr><td colspan="6">The collection of wild fruits was a huge part of the childhood of many of the participants. From 1960s-1990s, the wild fruits of the Ficus capensis was widely available and abundant in the village of Dedeni. Shorter rainy seasons began to be common from late 1990s -2000s. Rains were shorter and stopped early. From 2010s, high temperatures and stronger winds were prevalent as well as prolonged dry conditions that caused drying up of trees, making the availability of wild fruits to be difficult.</td></tr>
<tr><td colspan="6">Wild leafy vegetables
Amaranth blitoides and Bidens pilosa</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>10</td><td>8</td><td>8</td><td>7</td><td>6</td><td>4</td></tr>
<tr><td colspan="6">From 1960s, there were longer rainy seasons and adequate rainfall events that prevailed up until the 1980s. These climatic conditions promoted their growth despite wide usage and collection. The decade of the 1990s was described as having shorter rainy seasons that resulted in a noticeable decline in Amaranth blitoides and Bidens pilosa which further declined from 2000s-2010s as a result of prolonged dry conditions.</td></tr>
<tr><td colspan="6">Grass
Cymbopogon caesius</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>10</td><td>9</td><td>7</td><td>7</td><td>6</td><td>7</td></tr>
<tr><td colspan="6">Cymbopogon caesius is an important grass used for craft purposes around the village of Dedeni. The decades of 1960s, were described as decades with adequate rains, mild temperatures and extensive use of Cymbopogon caesius for construction purpose of roofs for rondavels and mud houses. Adequate rains and extensive household use of Cymbopogon caesius continued till the 1980s. By 1990s to the late 2000s, ecotourism opportunities in Port. St Johns resulted in a more extensive use of Cymbopogon caesius to build tourism/holiday lodges as a result it gradually declined but not significantly. The climatic conditions from 2010s, had lighter rains and prolonged dry climatic conditions but this did not affect its abundance as a variety of grass species are incorporated into the building of houses. According to the respondents, there had never been a concerning decline.</td></tr>
</table>

<table>
<tr><td colspan="6" align="center">Rush
Juncus kraussii</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>9</td><td>9</td><td>7</td><td>7</td><td>6</td><td>6</td></tr>
<tr><td colspan="6">Juncus kraussii is a water source depended resource. Good rains and mild temperatures prevailed from 1960s to 2000s and promoted the growth of Juncus kraussii despite significant harvest levels by households for building purposes around the village. Rains went from being lighter from 2000s to prolonged drought periods in 2010s resulting in Juncus kraussii to significantly decline.</td></tr>
<tr><td colspan="6" align="center">Sedge
Cyperus textilis</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>10</td><td>9</td><td>7</td><td>7</td><td>6</td><td>7</td></tr>
<tr><td colspan="6">The decades of 1960s-1970s were described as having longer rainy seasons and extensive harvest of Cyperus textilis. These conditions continued up until the 1980s-2000s, with Cyperus textilis gradually decreasing in abundance but picking up again from 2010s because of the significant decline in number of harvesters. Moreover, people incorporated purchased building materials instead.</td></tr>
<tr><td colspan="6" align="center">Medicinal plants
Gasteria croucheri and Ficus capensis</td></tr>
<tr><th>1960s</th><th>1970s</th><th>1980s</th><th>1990s</th><th>2000s</th><th>2010s</th></tr>
<tr><td>10</td><td>10</td><td>8</td><td>6</td><td>6</td><td>3</td></tr>
<tr><td colspan="6">From 1960s-1970s, good rains and mild temperatures were common. This was also a period of significant harvest levels for Gasteria croucheri and Ficus capensis. Throughout the 1980s, rains continued to be frequent as well as the wide usage of these medicinal plants. The decades of 1990s-2000s were described as periods that had turbulent winds and light rains that resulted in a noticeable decline in Gasteria croucheri and Ficus capensis. From 2010, forests of Dedeni were reported to be dominated by invasive plant species.</td></tr>
</table>

4.2 Population inventories in refuge and non-refuge sites

Of the seventy species listed across the seven villages, the following seven species were, according to participants, not harvested uniformly. In other words they may have one or more refugia. These were; *Ptaeroxylon obliquum, Millettia grandis*, *Olea europaea* subsp. *africana, Cyperus textilis, Cyperus congestus* and *Phoenix reclinata* (Table 18).

Table 18. Species and categories of refugia across the study village.

Area	Village	NTFPs	Refuge type		
			Cultural/ Spiritual	Spatial	Habitat
Tsholomnqa	Kampini	*Olea europaea* subsp. *africana*		√	√
	Jojweni	*Ptaeroxylon obliquum*		√	
	Dowu	None			
Willowvale		*Cyperus textillis*	√		
		Phoenix reclinata	√	√	
		Millettia grandis		√	
		Cyperus congestus		√	
Port St. Johns	Noqhekwane	*Millettia grandis*		√	
	Bholani	None			
	Dedeni	None			

4.2.1 Tsholomnqa

4.2.2.1 Transect walks

Transect walks were done in Kampini, Jojweni and Dowu village for approximately 3 hours in each village. The villages are in a forestland of clay loam soil, providing the villagers with resources such wildlife meat, medicinal plants such as the *Amaranthus hybridus* and *Kedrostis foetidissima* as well as other resources such as the *Olea europaea* subsp. *africana* and *Ptaeroxylon obliquum* leaves that contribute to upholding some important Xhosa cultural practices. According to the participants, the majority of the communal land is abandoned agricultural land that has ended up being filled with *Vachellias.* The removal of the support that farmers used to receive from pre-1994 governments was attributed as one the main reasons for the decline. During the transect walk we were able to see a total of two NTFPs species in refuge, namely *Olea europaea* subsp. *africana* and *Ptaeroxylon obliquum*. Although the majority was aware of their value, the participants stated that they do not know of any spiritual/cultural sites in the area of Tsholomnqa.

Ptaeroxylon obliquum and *Olea europaea* subsp. *africana* were the only species identified to be in refugia in Tsholomnqa villages (Table 19). For *Olea europaea* subsp. *africana,* tree density ($t=2.82$, $p<0.05$) and tree height ($t=3.0$, $p<0.05$) where the only measures where significant differences were found between the refuge and non-refuge sites. *Olea europaea* subsp. *africana* had a high abundance in the non-refuge 1 430 ± 1 019 stems ha^{-1} site with a density approximately two times greater than in the refuge site 646 ± 351 stems ha^{-1} ($t=2.82$, $p<0.05$). With respect to the percentage of stems cut, 15% cent of *Olea europaea* subsp. *africana* stems were cut in the non-refuge site and only 1% was cut in the refuge site. There was no significant difference in the stem density and tree density of *Ptaeroxylon obliquum* between the refuge and non-refuge sites. *Ptaeroxylon obliquum* had a density of 733 ± 373 stems ha^{-1} in the refuge site and 733 ± 570 ha^{-1} in the non-refuge site ($t= 0.00$, $p= 1.000$). Similarly, its stem density was 780 ± 401 ha^{-1} in the refuge site which was a little less from 908±650 ha^{-1} in the non-refuge site ($t=0.22$, $p=0.821$). Tree height, was the only measure were a significant difference was observed between the refuge and non-refuge site ($t=2.97$, $p<0.05$).

Table 19. Population assessments of species in refuge and non-refuge sites in Kampini and Jojweni villages

Species	Measure	Refuge	Non-Refuge	Stats
Olea europaea subsp. *africana*	Tree density (ha^{-1})	647 ± 351	1 430 ± 1 019	t=2.82 p<0.05
	Stem density (ha^{-1})	708 ± 401	1 920 ± 1 140	t=2.07 p<0.05
	Tree height (m)	3.3 ± 5.2	2.1 ± 2.1	t= 2.97 p<0.05
	Stem diameter (cm)	7.2 ± 8.6	6.6 ± 4.3	t=1.0 p=0.323
	% of stems cut	1.0	6.8	
Ptaeroxylon obliquum	Tree density	733 ± 373	733 ± 570	t=0.00 p= 1.000
	Stem density (ha^{-1})	780 ± 401	908 ± 650	t=0.22 p=0.821
	Tree height (m)	3.3 ± 5.2	2.1 ± 2.1	t=3.7 p<0.05
	Stem diameter (cm)	6.6 ± 8.6	7.2 ± 8.6	t=0.98 p=0.328
	% of stems cut	0	15.4	

The size class profile of *Olea europaea* subsp. *africana* indicated a reverse J-shaped curve, illustrating a relatively stable population and a high regeneration potential (Figure 3). Generally, the refuge and non-refuge site had large proportions of smaller diameter size classes (<5 cm). The refuge site was the only site with individual trees with the highest diameter size class (e. g. ≥30 cm). On the other hand, individual trees in the highest height size classes (e.g. ≥30) were found both in the refuge and non-refuge sites. A significant difference was found between the height size profile in refuge and non-refuge site (χ^2 =19.7, p<0.05) but not for the diameter size class profiles (χ^2 = 7.99, p= 0.239).

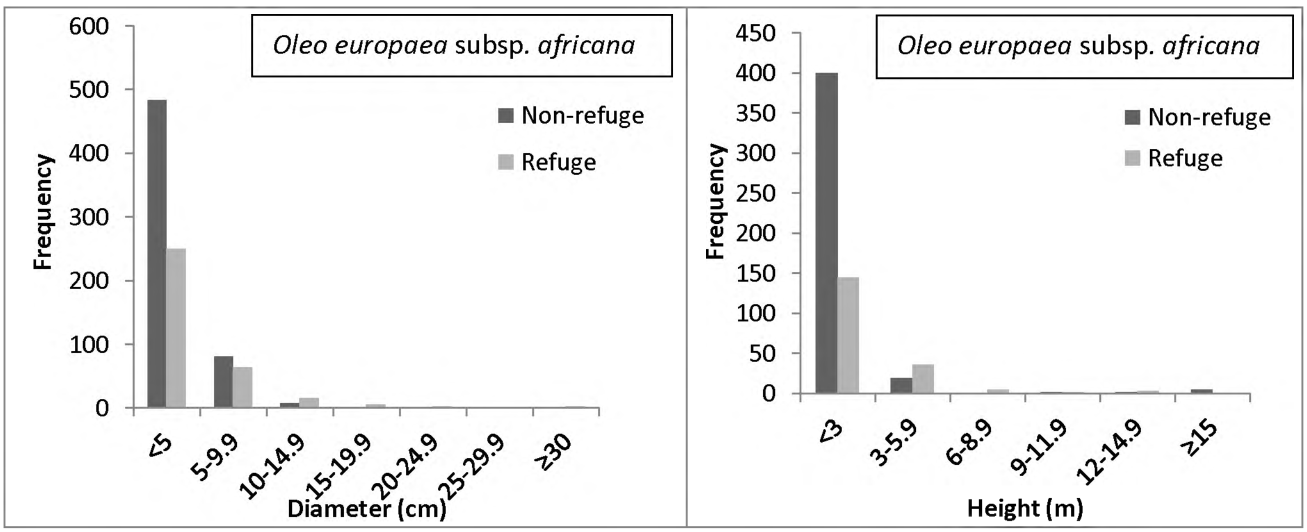

Figure 3. Size class distributions for *Olea eauropeae* subsp. *africana* in Kampini village.

Ptaeroxylon obliquum had a reverse J-shaped curve indicating a relatively stable population (Figure 4). Individual trees within the largest diameter and height classes were only found in the refuge site. Respectively, both diameter and height size class profiles in refuge and non-refuge were significantly different (χ^2 =32.2, p<0.05) (χ^2 = 20, p= 0.05). Harvesters of Jojweni seemed to prefer size class diameters of less than 20 cm as they were the most exploited in the non-refuge site, moreover there was a marked absence of large diameter and height size classes in the non-refuge site.

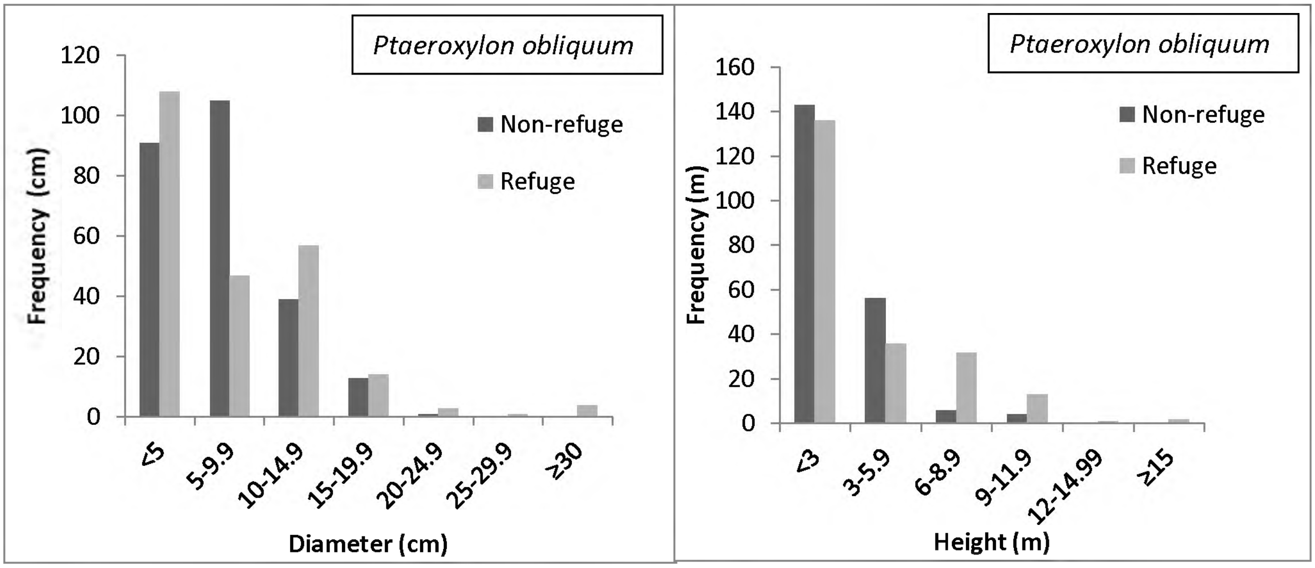

Figure 4. Size class distributions for *Ptaeroxlyon obliquum* in Jojweni village.

4.2.2 Willowvale

4.2.2.2 Transect walks

The area consists of rural settlements surrounded by communal lands used for agricultural production and grazing. However, according to the participants the majority of the communal land is abandoned agricultural land because of three main reasons; (i) gradual decrease in rainfall levels over the years, (ii) introduction of government social grants and (iii), the youth disinterest in farming activities. During the transect walk we were able to see a total of four NTFPs species in refuge, namely *Cyperus textillis, Phoenix reclinata, Millettia grandis* and *Cyperus congestus*.

Some of the challenges highlighted by the participants were that villagers often travel long distances for firewood and water because communal taps have not been installed in some areas. During the course of the transect walk the participants shared some of the most useful plants for crafts, these included Phoenix reclinata for hand brushes and *Cyperus textilis* for mats and baskets. As we moved through the village we were able to see that the majority of the houses are made of mud brick and concrete brick for those who can afford to. *Millettia grandis*, *Phoenix reclinata, Cyperus congestus* and *Cyperus textillis* were the four species identified to have refugia in Willowvale area (Table 20).

Table 20. Population assessments of species in refuge and non-refuge sites in Willowvale

Species	Measure	Refuge	Non-Refuge	Stats
Millettia grandis	Stem density (ha^{-1})	2 691 ± 1407	2 937 ± 1 208	t=0.478 p=0.637
	Tree density (ha^{-1})	1 809.1 ± 993.2	1 790.0 ± 766.9	t=0.06 p=0.956
	Tree height (m)	2.4 ± 1.4	2.4 ± 1.5	t=0.47 p=0.64
	Stem diameter (cm)	6.1 ± 5.0	6.5 ± 4.6	t=1.87 p= 0.06
	% of stems cut	18.3	27.0	
Phoenix reclinata	Stem density (ha^{-1})	2 473 ± 1 111	3 727 ± 2 465	t=1.824 p=0.079
	Tree density (ha^{-1})	850 ± 623.9	556.7 ± 284.6	t=1.657 p=0.109
	Tree height (m)	3.2 ± 2.5	3.0 ± 1.6	t=1.20 p=0.231
	Stem diameter (cm)	11 ± 4.1	10.5 ± 3.5	t= 2.63 p<0.05
	% of stems cut	0	62.0	
Cyperus congestus	Mean density (m^{-2})	8.3 ± 5.6	8.4 ± 3.9	t= 0.11p=0.914
	Height (cm)	189.8 ± 54.2	132.1 ± 55	t=4.40 p<0.05
Cyperus textillis	Mean cover (%)	31 ± 17	19 ± 14	
	Density (m^{-2})	33.4 ± 9.9	7.7 ± 9.2	t=8.69 p<0.05
	Height (m)	1.5 ± 0.2	1.8 ± 9.5	t=0.109 p=0.91

For *Millettia grandis*, there were no distinct differences for all the measures between refuge and non-refuge sites and no statistical difference was found between the two sites sites (Table 20). For example, tree height had a similar value in refuge 2.4 ± 1.4 m and in non-refuge sites 2.4 ± 1.5 m. Similarly, stem diameter in refuge site 6.1 ± 5.0 cm was only slightly different from the non-refuge site 6.5 ± 4.6 cm. However, compared to the refuge site, generally for all the measures the non-refuge site tended towards higher values. With respect to the proportion of stems cut of stems cut, 27% of the stems in non-refuge site showed evidence of cutting and 18.3% showed in the refuge site. Between refuge and non-refuge site, no significant differences were found in its diameter size profile and height size profile (χ^2 =10.7, p=0.10) (χ^2 = 1.3, p= 0.932), respectively. *Millettia grandis* had a reverse J-shaped curve indicating a relatively stable population (Figure 5). All diameter classes were present both in the refuge and non-refuge sites. Harvesters of Willowvale seemed to prefer harvesting *Millettia grandis* trees within <5, 5-9.9, 10-14.9.9 and ≥ 15 cm diameter classes. Only intermediate to the largest size class were absent in the height size class distribution of *Millettia grandis.* Between refuge and non-refuge site, no significant differences were found in the diameter size profile and height size profile (χ^2 =10.7, p=0.10) (χ^2= 1.33, p=0.932), respectively.

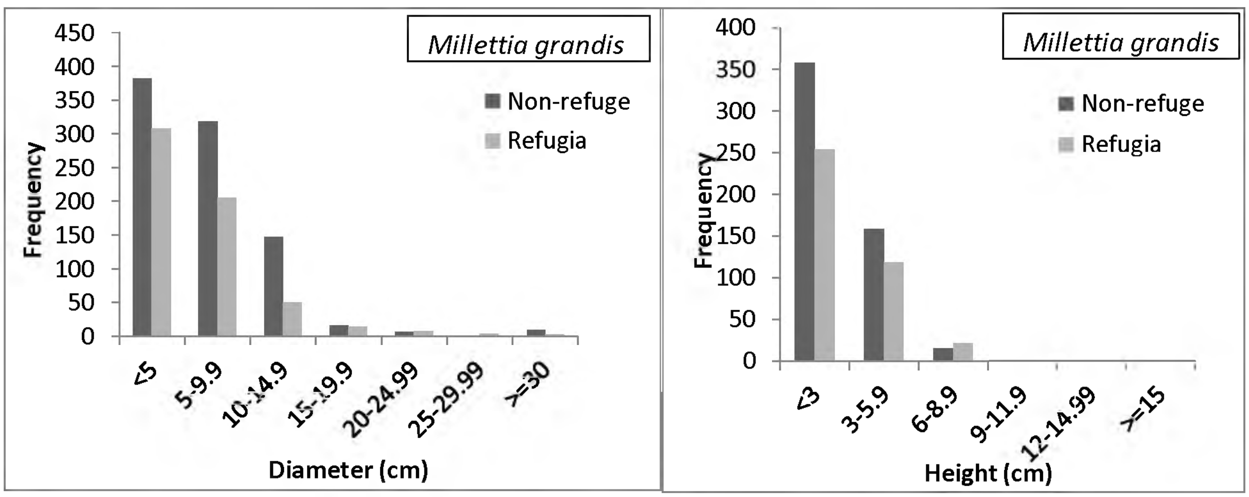

Figure 5. Size class distribution for *Milletia grandis* in Willowvale.

For *Phoenix reclinata,* stem density was lower in refuge site while tree density was higher in refuge site (Table 20). Stem diameter was the only measure that was significantly different between the refuge and the non-refuge site (t = 2.63, $p<0.05$). Sixty-two per cent of the stems in non-refuge site showed evidence of cutting while there was no such evidence in the refuge site. The population distribution was skewed more to the right with the majority being in the smallest class (<3 m), followed by medium (3-5.9 m), semi-medium (6-8.9 m) and by large (>9 m) (Figure 6). No significant differences were found in the height size class distribution between refuge and non-refuge site (χ^2 =146.7, p=0.08). The diameter size class had a unimodal distribution with the majority being in the semi-medium size class (10-14.9 cm) and the largest diameter size class (25.29.9 and ≥30 cm) found in refugia. No significant differences were found in the diameter size class distribution between refuge and non-refuge site ($\chi^2 = 3.03$, $p = 0.553$).

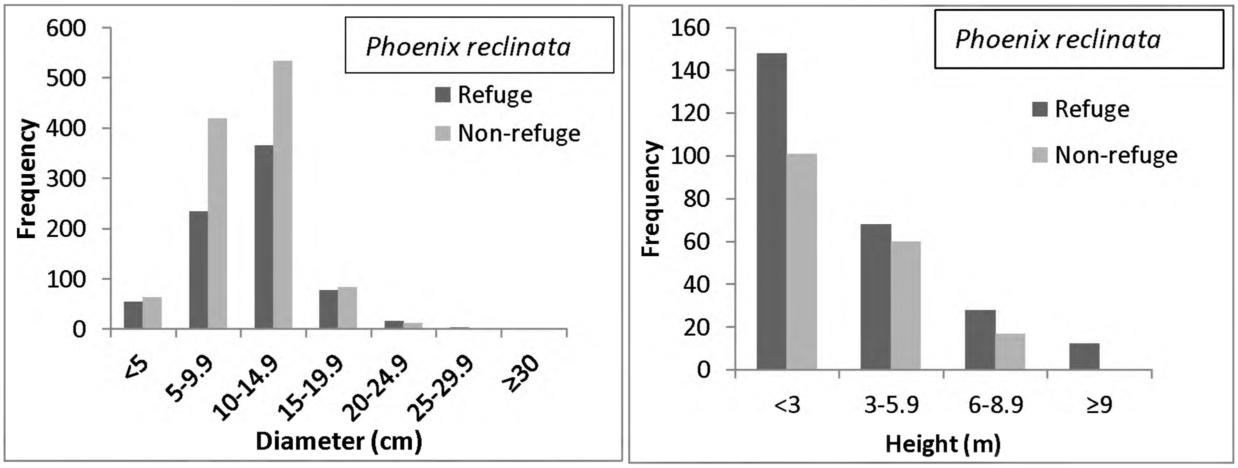

Figure 6. Size class distributions for *Phoenix reclinata* in Willowvale.

Cyperus congestus and *Cyperus textillis* were the only two sedge species assessed in Willowvale (Table 20). The mean density of *Cyperus congestus* in refugia 8.3 ± 5.6 m^{-2} did not differ much from that of non-refugia 8.42 ± 3m^{-2} ($t= -0.11$, $p=0.914$). The mean height was taller in refuge sites (189.8 ± 54.2 cm) compared to the non-refuge sites (132.1 ± 55 cm). The size class profile of *Cyperus congestus* indicated a relatively stable population (Figure 7). Compared to the non-refuge site, larger diameter classes were recorded for *Cyperus congestus* in the refuge site as well as a higher percentage cover 31 ± 17% than in the non-refuge site 19 ± 14%. Between refuge and non-refuge site, a significant difference was found in the diameter size profile and height size profile (χ^2 =146.7, $p<0.05$) (χ^2 =116.8, $p<0.05$) respectively. *Cyperus textillis* had a high abundance in the refuge site 33.4±0.2 m^2 with a density approximately four times greater than that in the non-refuge 7.7 ± 9.2 m^2 ($t= -8.69$, $p<0.05$) (Table 20) .There was no significant difference in the mean height between the non-refuge site 1.8 ± 0.9 m and the refuge site 1.5 ± 0.2 m ($t=0.109$, $p=0.91$) (Figure 8). Yet, a significant difference was found between the height size profile (χ^2=16.3, $p<0.05$).

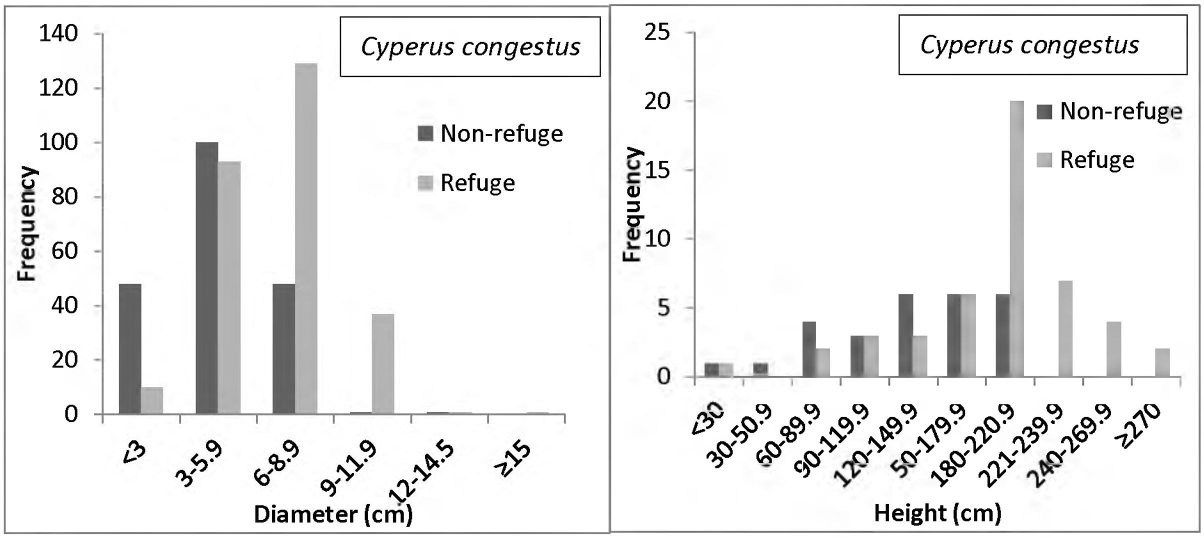

Figure 7. Size class distributions for Cyperus congestus in Willowvale.

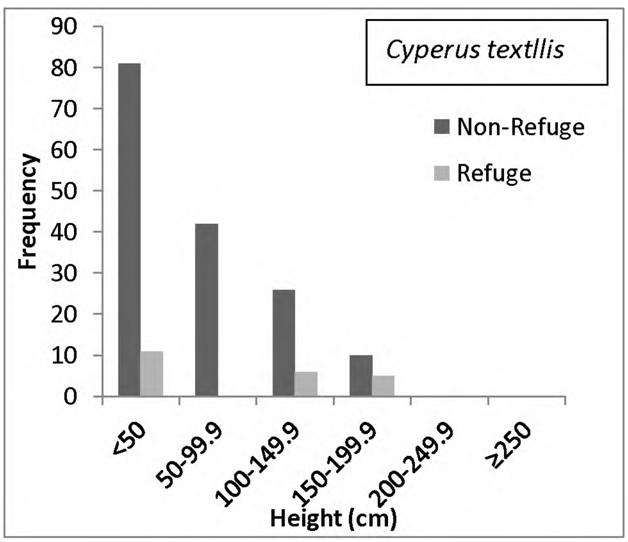

Figure 7. Size class distributions for *Cyperus textllis* in Willowvale.

4.2.3 Port St. Johns

4.2.2.3 Transect walks

Tree transect walks were done in three randomly selected villages in Port St Johns, namely Noqhekwane, Bolani and Dedeni village. The area consists of uphill rural settlements surrounded by natural vegetation where evergreen forests and grassy hilltops cover can be found in every hill. Wild banana trees and other fruit trees are within a short walking distance for the majority of the households in the area. According to the participants the area's proximity to the sea has been a contributing factor for the area's evergreen shrubs. Communal lands used mostly for animal grazing and home gardens. However, the majority of the communal land is abandoned agricultural land because production is hampered by lack of infrastructure and financial support. Spatial refugia for *Millettia grandis* was the only type of NTFP refuge found among the three villages.

The village has brick and a mixture of grass, tree poles and mud brick houses. The participants informed us that the reeds are collected from the nearest swamp. The majority of the households have piped water either inside their yards or from communal taps while houses with corrugated iron roofs have water tanks where rain water is trapped or collected from the roof. During the transect walk we were able to see the following projects belonging to local women; the production of jam from a variety of subtropical fruits as well as a basket weaving project from *Flagellaria guineensis* stems. The women told us that the project supplies jam for local businesses and schools and the baskets for local tourist markets in Port St Johns. The main challenge highlighted for the jam project was the lack of infrastructure and reliable machinery. The basket makers told us that the lack of capital and opportunities to showcase their work to areas outside of Port St Johns. *Millettia grandis* was the only tree species assessed in Willowvale (Table 21).

Table 21. Population assessments of *Millettia grandis* in refuge and non-refuge sites in Noqhekwane village.

Species	**Measure**	**Refuge**	**Non-Refuge**	**Stats**
Millettia grandis	Tree density (ha^{-1})	957±666	1 410±913.4	t= 1.553 p=0.132
	Stem density (ha^{-1})	1 750±1 299	1 977±1478	t=0.446 p=0.659
	Stem diameter (cm)	8.2±6.3	6.0±7.2	t= 5.43 p <0.05
	Tree height (m)	3.2±2.1	2.3±2.9	t= 4.37 p<0.05
	% stems cut	8	2	

No significant difference in the density of *Millettia grandis* between the refuge site and non-refuge site (t=1.553, p=0.321) (Table 21). Tree height (t=4.37, p<0.05) and diameter (t=5.43, p<0.05) were the only measures that were significantly different between refuge and non-refuge site and were also generally larger in the refuge site than in the non-refuge site. There were more individual trees in the largest size diameter class category (e.g ≥30 cm) in the non-refuge site than in the refuge site (Figure 9). However, the majority of trees in the non-refuge site were in the smallest diameter size category (e.g <5 cm) while the majority of trees in the refuge were found more in the 5-9.9 cm diameter size category All trees in both sites were found to occupy all the size diameter size classes. The majority of trees in the non-refuge site were concentrated in the smallest size height class while trees in the refuge site were evenly distributed. Between refuge and non-refuge site, no significant differences were found in its diameter size profile and height size profile (χ^2 =10.7, p=0.099) (χ^2 = 1.33, p=0.932), respectively.

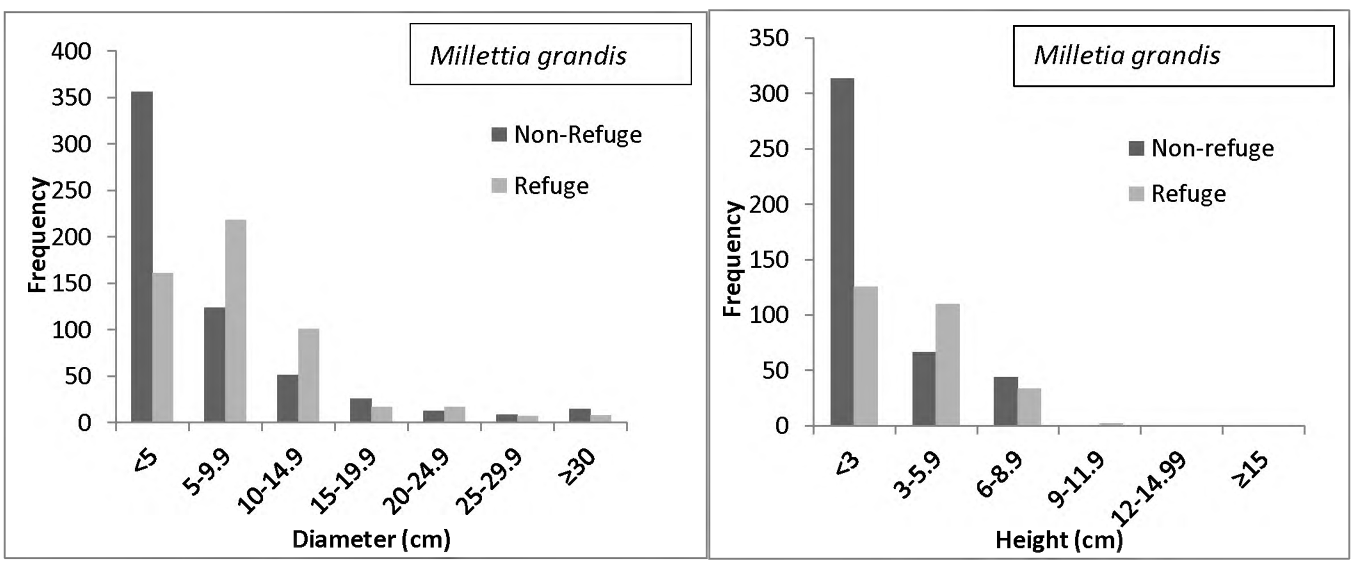

Figure 8: Size class distributions for one tree species in Noqhekwane village

5. Discussion

5.1 Perceptions of changing contexts and NTFP abundance across study sites

Perception is vital in understanding the key elements that contribute to changes in forest resource use. According to Van den Ban and Hawkins (1996; 282), perception is the process by which we receive information or stimuli from our environment and transform it into physiological awareness. The outcomes from the focus groups discussions revealed that relatively few of the most common NTFPs used had any form of refugia. Of the approximately seventy species mentioned across the different sites, only seven occurrences of refugia were mentioned, spanning six species namely: *Cyperus congestus, Cyperus textillis, Millettia grandis, Olea europaea* subsp. *africana, Phoenix reclinata* and *Ptaeroxylon obliquum.* The most common form of refugia was spatial refugia, followed by cultural/spiritual refugia and physical/habitat refugia. This indicates that refugia may not be particularly common, but may be important for specific species.

The focus group discusscions revealed three consistent descriptions of perceived changes in the abundance of top ten widely used NTFP species from the past five decades. The first was that distant farming activities had declined significantly over the past two decades (2000s-2010s). Although it was noted that a gradual decline in engagement in agriculture had been a longer term process, a very marked decline had occurred after the democratic transition in the early 1990s, which facilitated increased migration to rural areas and increased receipt of government social grants. This corroborated the findings of Shackleton *et al*. (2013) were they revealed that many farmers in Willowvale had stopped farming on distant fields about 18-20 years ago. Work from Kepe (2014) and Andrew and Fox (2004) also suggested a decline in distant farming activities, particularly extensive arable farming, with a few people still cultivating home gardens as opposed to distant arable fields. In the Ciskei region Hebinck and Lent (2007) and Mtati (2014) showed those periods of disengagement and subsequent re-engagement in agriculture, although the longer-term trend was a decline, and this had been strong in the last two decades. This decline in cultivation has resulted in a decline in the availability of wild edible herbs because many of them were harvested from disturbed lands and fields. According to the participants, many of the old fields are now dominated by *Vachellia karroo* or have reverted to forests and that most wild leafy vegetables that were commonly found in cultivated environments are now mostly found in small patches in small home gardens or around kraals. The villagers' perceptions about the declining availability of wild leafy vegetables have been reported by many others in South Africa (Smith and Eyzaguirre, 2007; van Rensburg *et al.*, 2007; Voster and Jansen Rensburg, 2005). For example, Smith and Eyzaguirre (2007) found that more than half of the respondents in Bushbuckridge, South Africa, perceived a decrease in traditional wild leafy vegetables in the area. Similarly, in selected rural communities of South Africa, Hart and Vorster (2006) and Vorster *et al*. (2002) found a decline in household consumption and harvest of wild leafy vegetables. Some of the reasons and associations for the decline of leafy vegetables is the strong competition between commercial and traditional leafy vegetables as well as the production of exotic crops (Nekesa and Meso, 1997). Factors such as urbanisation, migrant labour, greater access to health care and education, government social grants, introduction of new species and land use change have contributed to the decreasing availability of indigenous resources of many rural communities and as well as the erosion of indigenous knowledge (Hart and Vorster, 2006; Vorster and Jansen van Rensburg, 2005). Most widely used leafy vegetables in South Africa are gathered from fields and are not cultivated (van Rensburg *et al.*, 2007 such as the *Amaranthus* which appears naturally in disturbed soils (van Rensburg *et al.*, 2007). Many people nowadays prefer to buy food staples and tend to avoid walking long distances to gather wild leafy vegetables or even to harvest them (Vorster and Jansen van Rensburg, 2005). However, they may remain important in times of household stress such as reduced cash availability or sickness (Ncube *et al*., 2016).

The second clear trend mentioned in most of the participatory workshops across the three sites was a sense of decreasing rainfall. Rains from the decades of 1960s-1980s were reported to be adequate and enough to support a variety of crops grown in each season. From there on, more than half of the respondents reported that from 2000s to the present decade, unpredictable seasons began to be common such as prolonged dry periods especially during periods when rain would normally be anticipated. Explanations provided highlighted that drought conditions resulted in poor crop production, contributed to livestock deaths and the drying up of water sources. According to the Intergovernmental Panel on Climate Change (IPCC) (2014), global temperatures of about 1-3°C are expected to increase by 2100 and will be accompanied by inconsistent changes in rainfall in various regions of the world. Research from South Africa's

Second National Communication under the United Nations Framework Convention on Climate Change (2010) highlights that over the past half century, there has been a half degree average increase over 50 years in South Africa's temperature records across the country, matched by increases in average maximum and minimum temperatures This trend has been characterized by a frequent occurance of warm days and few cold days. The consequence has been a decline in the availability of water as well as unpredictable weather events and seasonal conditions.

However, limited research has been undertaken to understand how climate changes affect the distribution and productivity of wild species in South Africa (Shackleton, 2014). Locally these perception echo those reported by Makhuvha and Mballa (2012) for three villages on the Wild Coast, where respondents stated that the rainy season was starting later and that periods with dry spells were longer and more frequent, all of which constrained farming activities and actual yields. My results are also consistent with those of Balama *et al*. (2016) who found that more than half of the respondents in Kilombero district, Tanzania perceived the climate of the area to be hotter (75%) and with unpredictable and shorter rainfall events (62%). These changes significantly affected the abundance of fibre plants such as thatch grass used for building purposes in the area.

Thirdly, according to the respondents, many medicinal plants are nowadays scarcer than in the past. The majority of participants felt that it had been difficult to find and harvest certain herbaceous medicinal plants because many areas have been invaded by unfamiliar plant species that respondents' referred to as "inwele", meaning new or unusual plants in isiXhosa language. Some examples of medicinal plants affected were *Amaranthus hybridus*, *Kedrostis foetidissima*, *Drimia altissima, Helichysum odoratissimum, Haemanthus albiflos* and *Rhoicissus tomentosa*. Many rural communities in South Africa still depend and make use of indigenous medicinal plants despite the availability of western medicine as well as access to healthcare centres. According to the IPCC (2007), changes in land use practises have resulted for many indigenous medicinal plants to be susceptible to environmental changes). Studies in Africa highlight that various alterations in species composition and distribution are because of changing land use practices (Anyinam, 1995; Alves and Rosa, 2007), socio-economic and cultural changes (Arnold and Pérez, 2001). More specifically, I assume that the "inwele" may refer to observations of invasive alien species that are increasing in most parts of the Transkei Wild Coast, with old fields being nucleus areas for invasion. Shackleton *et al.* (2013) recorded several woody invasive alien species in abandoned fields as well as some intact forests in the Willowvale area. Subsequently, Jevon and Shackleton (2015) reported at invasion of the invasive *Lantana camara* was associated with lower densities and species richness of indigenous forest species.

5.2 Stable or common species across study sites

The majority of the respondents felt that *Vachellia karroo*, *Olea europaea* subsp. *africana, Ptaeroxylon obliquum* and *Phoenix reclinata* had increased or remained the same over the past five decades mainly because over the years the number of people who harvest and collect them had declined. The reasons for the decline was that young people are migrating to big cities and those that remain often lack the indigenous knowledge about their importance. Moreover, the inability by the middle-aged to elderly members in the group to walk long distances was also cited as one of the reasons for the decline in the use of particular species. There was a consistent description in each of the study villages that *Vachellia karroo* had always been stable and that areas that were once used for agricultural activities had promoted its growth and recruitment. For *Phoenix reclinata,* more than half of the respondents felt that its abundance had been stable. Our findings were similar to those of Mjoli and Shackleton (2015) who found that most harvesters in Willowvale felt that the number of palm plants had remained stable or even increased over the same period despite an increase in the number of harvesters during the last decade. Of the harvesters who had been involved in the trade for ten years or longer 44% felt that the abundance of *Phoenix reclinata* plants had decreased, 39% felt it had remained the same, and 17% felt it had increased. The wild date palm is an important livelihood resource that is widely distributed throughout southern Africa and tolerant to harvesting (Barrow, 1998; Cunningham and Terry, 2006; Gyan and Shackleton, 2005). Therefore, it was not surprising to find that respondents perceived it as stable. The leaves and branches of *Olea europaea* subsp. *africana* and *Ptaeroxylon obliquum* are used as platters specifically for consecrated meat (instonyana) of ritually sacrificed animals to facilitate communication with the ancestors through vivid dreams (Cocks and Dold, 2008) while the wood of *Ptaeroxylon obliquum* and *Olea europaea* subsp. *africana* are sometimes used to build and maintain cattle kraals. These are among the many traditional rituals that are on decline amongst rural communities in the Eastern Cape. The harvesting of *Ptaeroxylon obliquum* and *Olea europaea* subsp. *africana* was perceived to have declined largely because the long-term persistence of Xhosa traditional practices and cultural knowledge over time has remained with uncertainty particularly in the face of changing society beliefs and cultures. These NTFP tree species are used in traditional ceremonies which are practised once or twice in a year by households who choose to still practise and uphold Xhosa traditions and in most cases, the inability to walk long distances by the middle-aged to elderly members in the communities also contributes to the decline in their harvest. In addition, we often refer to local settlements as "communities" forgetting that culturally they are heterogeneous with different value and systems and knowledge (Chalmers and Fabricius 2007). Changes in cultural knowledge within the community can influence use and attitude towards wild forest resources.

Juncus kraussii, Cymbopogon caesius, Cyperus textilis, Flagellaria guineensis and *Millettia grandis* were common NTFP species across all study villages. According to the majority of the respondents it is not unusual to find traditional mud rondavels with roofs made from various grass species even along modern dwellings on the same property. This is because the use of fibrous plants is crucial in uplifting and maintaining Xhosa customs and rituals (Pereira *et al.*, 2006). Similarly, *Flagellaria guineensis* was identified as a common and important species used to weave baskets for income generation (Cawe and Ntloko, 1999). However, the majority of the respondents highlighted that access to cash resources via social grants over time had decreased people's dependence on forest resources. According to Cawe and Ntloko (1999), between 1979 and 1989, 56 tonnes of *Flagellaria guineensis* was harvested in the forests of Port St. Johns. This information coincided with the trend-line analysis that was constructed by the focus group participants of Bolani and Noqhekwane which revealed a decrease in abundance of *Flagellaria guineensis* from 1970s, 1980s and 1990s compared to decades of 2000s and 2010s where it increased. According to von Breitenbach (1976), *Millettia grandis* is among the dominant and most common tree species in the coastal forests of Transkei and tends to be locally abundant wherever found. Similarly, a participatory management study on the attitudes of forest coastal users in the Eastern Cape reported *Millettia grandis* to be the most common and used forest resource (Obiri and Lawes, 2002).

5.3 Decreasing NTFPs species across study sites

Many wild leafy vegetables as well as medicinal plants discussed above where perceived by the respondents to have decreased across study sites. In contrast, most of the tree NTFP species study can be categorized as having remained stable or even increased over the past five decades. However, the number of fruit (NTFPs) producing trees was perceived to have declined and scarcer than in the past. For example, fruit from *Ficus sur* was perceived to have decreased. According to the participants, forests and woodlands closer to their homes are changing. They put forward that they are significantly increasing and that the key drivers for this are: (i) wild fires from prolonged dry spells, (ii) decline in distant farming activities/agriculture as well as (iii) the decrease in NTFP use over time. Moreover, it was mentioned that along with the changes that came with the democratic government in 1994 such as government child support grants, old age grants and disability grants as well as the decline in livestock farming might have resulted in reduced browsing and trampling and more growth of woody plants.

Trend-line exercises highlighted various long-term changes that affected the livelihoods of people across the different study sites. From the group discussions, more than half of the respondents felt that local employment opportunities had gradually decreased over the past five decades. Prior to the 1980s, most people worked as migrant workers on mines or in white owned farms in nearby areas. According to the majority of respondents, political pressure resulted in many people being retrenched from mines and that changes that led to a democratic government in 1994 resulted for many white farms to stop productivity. Livestock farming was listed as an important livelihood option that has helped sustain many rural households despite reported drought years. During the formation of Ciskei and Transkei, fields used for farming activities made a substantial contribution to livelihood security at the time. According to the respondents, there have been recognizable efforts by the government to make land available but the amount of produce or rather the productivity has declined as a result of factors such as poor rainfall, lack of access to monetary resources and markets to sell produce, cost of seed and introduction of government grants. It is also important to highlight that respondents across the study sites were aware of unpredictable environmental changes and the effects these changes have on the abundance of NTFPs species.

5.4 What is the prevalence of refugia in maintaining or protecting NTFP populations?

Most species fell into the categories of building material and craft across all study sites. Plants in refugia were generally more mature, had larger size classes and most had stable size-class distributions indicating good rejuvenation and continuous replacement of themselves (Lykke, 1998). However, this method tends to get complicated when applied to grass and shrub species. It was apparent that populations in refugia are currently not threatened, or are at least not harvested at high rates because, (1) there was a high proportion of the largest size classes, (2) there were no signs of harvesting for majority of species in refugia and, (3) there were clear signs of recruitment and size class profiles of species in refugia that followed a similar pattern namely a reverse J-shaped curve, suggesting relatively stable populations although truncated in the case of *Olea europaea* subsp. *africana.* However, it was not so clear-cut as there were some indications of harvesting in some of the refugia, albeit at levels lower then neighbouring non-refuge sites. However, one must also note that sampling was restricted to spatial refugia because access was not granted to cultural/spiritual sites of Tsholomnqa and Willowvale and physical/habitat refugia in Tsholomnqa.

5.5 Which form of refugia is the most common?

The most common form of refugia encountered were spatial refugia, followed by cultural/spiritual refugia and habitat refugia. At Tsholomnqa there are two spatial refugia, four at Willowvale and one spatial refugia at Port St. John's. Spatial refuge was found to be the most common because although the Xhosa language is spoken in all the study sites, some rituals are practiced and valued differently or not practiced at all largely because of their history in being previously separate regions referred to as Bantustans; Transkei (Willowvale and Port St. Johns) and Ciskei (Tsholomnqa). The people living in the area of Port St John's are known as Amampondo, a group that formed resistance against colonial rule from the nineteenth century (Beinart 1982). For example, Noqhekwane, Dedeni and Bholani villages of Port St. Johns were different from the rest of the selected study villages because there were no cultural/spiritual sites reported as well as belief in them. The practise of *intonjane* (rite of passage to womanhood) was only reported in Willowvale. *Cyperus congestus* is one of the grass species used by girls during part of the ceremony as they are required to sit behind on during *intonjane.*

Non-timber forest product species in cultural/spiritual sites of Tsholomnqa and Willowvale were not sampled because of the local taboos in vising the sites. The participants stated that it is also taboo to harvest any species in these sites and that harvesting is associated with bad luck and misfortune. It is believed that ancestors reside in these sites and that adhering to this notion is a sign of being respectful and acknowledging the powerful role that ancestors play in Xhosa cultural rituals. Local belief systems are founded on recognition of the spirit world and that ancestors have a significant role in shaping physical and mental health and the opportunities or misfortunes that one experiences (van Dyk and van Dyk, 2015). Only a few designated people are allowed to visit the sites. According to Keppel *et al.* (2015) size is very important when it comes to assessing refugia capacity because it determines its ability to sustain populations of the target species. Ashcroft *et al.* (2009) states that the minimum size of a refuge depends on the size and ecology of the species. For example, larger refugia are expected to sustain larger populations (Gaston and Blackburn, 1996). It would have been ideal to have informed generalizations or detailed information on the targeted species in cultural/spatial refugia and understand if the results corroborate existing knowledge (e.g. Bhagwat *et al.*, 2005).

Another problem was that the physical/habitat refugia in Tsholomnqa was too steep to actually sample. It was located on the side of steep mountain slopes, which we could observe from a neighbouring slope, but could not physically access. I assume that this inaccessibility would have also prevented any, or much, harvesting of the NTFP species there, which would provide seeds and fruits to neighbouring, harvested sites. This finding is similar to the physical refuge described by Gyan and Shackleton (2005), where harvesters of *Phoenix reclinata* could not access steep slopes, nor did they want to because they were above riverine pools where spirits were believed to reside.

5.6 How do NTFP populations in refugia compare to harvested populations?

Across most of the paired comparison, populations in the refuge sites were characterised by larger individuals, a wide range of size classes and lower rates of harvesting. If refuge sites manage to harbour larger individuals, NTFP populations can therefore be maintained and potentially be conserved, because larger individuals are usually associated with a longer duration of flowering and greater reproductive output (Ollerton and Lack, 1998; Valenica *et al*., 2016). For several of the comparisons, the populations in the refugia had a wider size class profile when compared to the harvested sites. This indicates that some of the harvested populations are experiencing truncated profilers (e.g. Shackleton *et al*., 2005) in which the largest individuals are removed, and that there is insufficient throughput across the different size classes to replace them. This may be further exacerbated in species with episodic recruitment, possibly associated with fluctuating rainfall or heavy pressures exerted by livestock.

Interestingly, the abundance of individuals or stems was often similar between the harvested and refuge populations. Indeed, the number of stems for tree species was often higher in harvested populations. I interpret that to be a reflection of the coppice response of many tree species in disturbance prone environments of southern Africa (Kaschula *et al*., 2005; Syampungani *et al*., 2016). Such disturbances are both cutting by harvesters as well as fire. Thus, the heavier harvesting evident in the non-refuge sites may result in a larger number of stems, albeit not individuals. However, not all harvesting was of entire stems or trunks. For some species, only the leaves or fronds are harvested. Even woody trees like *Olea europaea* subsp. *africana* and *Ptaeroxylon obliquum* are not always fully harvested. For ceremonies in Kampini and Jojweni villages it is usually just a ranch with leaves that is cut and used as a platter specifically for consecrated meat (*instonyana*) from sacrificed animals to facilitate communication with the ancestors through vivid dreams (Cocks and Dold, 2008). But at other times they are used to construct kraals, which then requires harvesting of the entire stem.

Amongst the five tree NTFP populations compared between refuge and non-refuge sites, four showed a lower proportion of stems with signs of harvesting damage relative to their harvested populations. One, *Millettia grandis* at Port St. John's, showed higher harvesting in the refuge site than the non-refuge site. These findings indicate that the refuge sites were experiencing lower levels of harvesting. However, it also indicated that spatial refugia are necessarily immune from harvesting, in contrast to the spiritual/cultural refugia were participants said no harvesting was allowed. During transect walks, harvesters in all the study villages stated that there are no spatial areas that they consider too far or inaccessible for them to harvest resources if they really needed. It was observed that due to a variety of undesirable living circumstances such as lack of electricity and reliable water supply, walking long distances to gather resources from areas far away from the village and to even other villages is not uncommon and has been a way of life for many.

There has been considerable progress in the acknowledgement of the potential role of refugia (Ashcroft *et al.,* 2012; Benner and Provan, 2008; Barnosky, 2008; Keppel *et al.,* 2015). Shackleton *et al*. (2015) defines spatial refugia as individual NTFP populations that are in places that are not easily accessible or are in places from which harvesters keep away. Although some harvesters may avoid going to certain sites because of distance or because of their inaccessibility, these factors do not necessarily mean that harvesters do not go to these types of areas when they need certain NTFP species. For example, one harvester in Willowvale stated, "If I hear that there are longer *Cyperus textilis* in other parts of the village I decide on a perfect day to go gather them and if it is too far, I make sure I wake up early in the morning and prepare for my long journey". This definition encouraged a set of questions aimed at understanding a criteria or a set of categories that make a species to be in spatial refuge. Could a population in a spatial refuge be defined as area with little to no harvesting in the refuge site? Should there be no signs of harvesting or simply reduced levels? My study suggests the latter, but at what level of harvesting would it be deemed as no long a refuge. It might also be useful to introduce a temporal element into the definition because demand fluctuates in response to changes in the socio-economic settings of each village.

More than half of the respondents felt that the abundance of each species in their respective refugia had remained static or increased over the last five years because of the decline in the number of people harvesting. This ties back to the previously described narrative of a declining reliance on NTFPs in response to uban migration and increased cash incomes. However, this is unlikely to be the case for those with growing commercial markets, such a brushes made from *Phoenix reclinata* fronds (Mjoli and Shackleton, 2015).

Lastly, it is important to note that both the refuge and non-refuge sites experience a variety of other pressures besides just harvesting of NTFPs by local populations. Spatial distance or steep slopes might also result in lower livestock pressures, but in turn may experience greater fire frequencies or intensities due to higher biomass. Other pressures that affect the density or recruitment of some NTFPs could be invasive alien species (e.g. Sinasson *et al*., 2017; Ticktin *et al.*, 2012), as well as differential availability of pollinators or pests that might be affected positively or negatively by general anthropogenic disturbance. Thus, it is not necessary to only investigate the responses of important NTFPs to harvesting, but also the interactive effects of a range of pressures on NTFPs and their ability to withstand and recover from harvesting.

5.7 Policy recommendations

The importance of NTFPs in rural livelihoods cannot be overemphasized because not only do NTFPs help meet subsistence needs but they also act as local adaptive strategies during times of land-use and socio-economic changes (Hebinck and Lent, 2007; McSweeny, 2003). Some policy recommendations to help advocate for the importance of refugia in relation to NTFP use can be made and are categorized below.

- **Fostering local attitudes towards forest resource management**

Communities across study sites generally had a positive and optimistic attitude towards natural resource management. The maintenance of refugia across the study sites is contingent in the current and future demand for NTFPs as well as local people's attitudes towards them. Along with conservation knowledge, attitude equally plays important roles in the sustainable management of forest resources. We believe that a positive attitude towards natural resources contributes to positive results in terms of their management. The focus group interviews revealed that local communities are willing to participate in forest management initiatives. Building community confidence through local monitoring programmes with set objectives regulated and managed by the local people should be encouraged to monitor NTFP populations likely to be at threat from overharvesting as a basis for collecting data such as habitat, perceptions, trends and changes in abundance. This can be encouraged to form part of local municipal development goals. However, given the dynamic nature of local livelihoods and the changing trajectories an adaptive approach is necessary to learn from experiences, respond to new challenges (such as invasive alien species) and accommodate new perspectives and needs (Armitage, 2005). This is particularly pertinent in the era of climate change (Tompkins and Adger, 2004). Examples already exist of both adaptive and participatory monitoring and management of NTFPs in southern Africa and elsewhere (e.g. Setty *et al.*, 2008; Dyer *et al.*, 2014) which could be used are a starting point.

- **Preserving cultural traditions and education**

According to Keppel *et al*. (2015), refugia protect species against long-term changes and that the time span should generally be as long as possible. Local interventions on improving cultural education and awareness of sacred sites should be encouraged and communicated through school syllabi or relevant programmes. The aim is to make sacred sites and locally protected sites relevant to young people because cultural knowledge of sacred sites can play an important role in the conservation of cultural heritage as well as the protection of the NTFP species from potentially being damaged or destroyed (Byers *et al*., 2001). The awareness programmes must be appropriately targeted and take account of the low levels of education and literacy amongst rural communities of the Eastern Cape. Young people often do not engage or participate in traditional practices as a result cultural knowledge tends to be valued more by the elderly than young people.

- **Increased examination of the role of refugia in NTFP protection and conservation**

There has been considerable progress in the acknowledgement of the potential role of refugia in relation to climate change impacts (Ashcroft *et al.,* 2012; Barnosky, 2008; Bennet and Provan, 2008; Keppel *et al.,* 2015). However, few studies have critically analyzed the concept of refugia in relation to how NTFPs can be safeguarded under household use. Most of the literature on refugia referenced is from the northern hemisphere and very few (e.g. Gyan & Shackleton, 2005; Shackleton *et al*., 2009; Shackleton, 2015) have explicitly considered their application to NTFP use and protection. This study has provided some new insights but a once-off inventory is not enough to have a nuanced understanding of the potential significance of refugia in safeguarding NTFPs. More information is needed in assessing the effects of various harvesting practises on the ecology of specific NTFPs as well as studies that incorporate other types of inventory measures or assessments. For example, knowledge on the reproductive capacity (e.g. flowers or fruits production) can contribute to understanding ecological differences in populations in refugia and help guide management decisions. Moreover, although it has been more than three decades since NTFPs have been shown to be important in the livelihoods or rural communities, there have been few studies that have focused on the ecology and physiology of NTFPs. As a result, this has been a major hindrance to the progress of conservation projects and programmes that are aimed at managing NTFP resources (Ticktin, 2004). One of the steps in addressing this challenge is through the promotion of consistent engagement and documentation of people's reliance on wild forest resources, whereby information is identified and quantified.

The poorest people of South Africa reside in rural areas (Kepe, 2009). Forests of the Eastern Cape supply rural communities with a wide array of non-timber forest products (Bokwe and Bhat, 1998; Paumgarten and Shackleton, 2011; Shackleton *et al.*, 2002). Information about the status and ecological sustainability of widely used NTFPs are necessary to help guide management decisions and understand changes in plant populations. It is projected that under global climate, most regions of the Eastern Cape will become hotter and drier and accompanied by frequent floods (Solomon *et al.,* 2007). These, along with factors such as short-term stresses such as death of a family member, HIV/AIDS or job losses, it is likely that rural households will continue to engage in the extraction of NTFPs as a form of response to the vulnerability that comes with the problems highlighted above.

- **Assimilation of refugia into sustainability estimates**

Although there are insufficient autecological studies in NTFPs, those that have been done typically examine the levels of demand relative to the supply or abundance of the NTFP in question. A usually unstated assumption in such an approach is that all the areas where the NTFP is located, or all populations, are available for harvest. The presence of refugia, whilst not common as revealed in this study, can nonetheless mean that all populations or individuals are not available for harvesting; that some will be safeguarded whatever the demand. It is these spaces and populations that can allow species to persist but also to provide seeds or recruits into harvested areas, thereby providing some degree of replenishment of even harvested populations. Thus, sustainability estimates must explicitly determine if there are refugia in the area for the NTFP being studied and if present, adjust modelling trajectories and scenarios accordingly.

5.8 Concluding remarks

This thesis presented findings on the perceptions of the abundance of common, widely used NTFP species as well as population inventory assessments across three coastal study sites in the Eastern Cape. Building on the work of Shackleton *et al.* (2015), this study has demonstrated that, whilst not applicable to every species or every location, refugia can be found in different forms and that the harvesting pressures in refugia is typically lower than in non-refuge populations. Consequently, refugia can potentially play an important role in conserving NTFP species.

Rural communities have their own values and cultural knowledge systems that not only affirm identity, but also play a key role in sustaining livelihoods and consequently conserving wild natural resources. South Africa's shift to having comparatively well-developed systems of state cash transfers (e.g. gorvenment social grants) has not changed the rural households described in the study from depending or making use of wild natural resources to sumplement livelihoods needs. Moerver, there is a clear evidence of de-agrarianisation in rural areas. These findings have important implications for policy makers and understanding livelihood opportunities

The "refuge for NTFP concept" is exciting and challenging. I argue that the trajectory of refugia analyzed in this study remains unclear given the suit of uncertainties highlighted in this chapter. However, it can be an opportunity for long-term research on this concept to be explored and also add to the complex understating of sustainable harvesting for NTFP. I conclude there is little doubt that all species in refugia are currently not at threat and that populations in non-refuge areas are harvested at higher rates. I appreciate that this is a fairly new concept and that recognizing the role played by refugia in safeguarding NTFPs under household use will require further research.

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Appendices

Focus groups - PRA workshops

1. Transect walks

Objectives

- To identify and ground truth current land uses for livelihood purposes within each study site.
- To identify different land tenure systems.
- To identify changes over time in land use and perceived effects over livelihood functions.
- To provide additional information about stocks of NTFP.

With whom?

- Two-three participants.

Instruments used

- A notebook to take notes
- A camera

How?

- Decide on a direction with the guidance of the selected community members and along the way ask questions such as:
  - What is the most common land-use in this area?
  - Where can these resources be found? Who owns them? How are they managed? Are there any restrictions?
  - How are conflicts resolved when they arise?

2. Trend-trend exercises

Objectives

To facilitate a discussion around understanding the participants' perception about:

- The abundance of NTFPs within each study site and how they changed over time.
- The changes in livelihood uses for each NTFP discussed.
- The current uses of land in fulfilling various livelihood functions.

With whom?

- Eight-ten senior members of the community (including men and women).

Instruments used

- A spacious area/room
- Pebbles to signal scores
- A flipchart
- A digital recorder
- Coloured pen

How?

- Initiate the discussion around the present situation of land use in the area (e.g types of crops cultivated, current rules and regulations, knowledge on any infrastructural improvements, conflicts etc.).
- Initiate a discussion related to some land-use aspects such as:
  - Changes in land tenure
  - Changes in land-uses for livelihoods or food security purposes
  - Changes in crops cultivated
  - Forest resources collected
- Facilitate the selection of time periods to discuss trends established from land-use changes (e.g 50 years ago) using a method agreed upon with participants.
- Ask participants to construct a matrix where the x-axis will outline the abundance of the NTFP selected and the different time-periods established in the y-axis.
- Quantify changes using pebbles.
- Review the content with the participants, discuss the findings and make amendments if necessary.

3. Seasonal calendars

Objective

- To identify seasonal changes in NTFP harvest and use.

With whom?

- Eight-ten senior members of the community (including men and women).

Instruments used

- A spacious room
- Pebbles
- A flipchart
- A digital recorder
- Drawing materials
- A notebook to take notes

How?

- Depending on the preference of participants, discuss the different seasons or months of the year with participants.
- Draw a table with the seasons/months. The months of the year in the top row.
- Ask participants to highlight the different times of year they harvest forest resources.
- Ask participants to list the different activities they are involved in around the villages. If NTFPs related activities are not mentioned, ask why and whether they can be added to the list.