Understanding Plant Resource Use by the ≠Khomani Bushmen of the southern Kalahari

by

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Declaration

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Abstract

Previously, conservation activities were mainly focussed upon the establishment of protected areas that safeguarded and shielded the natural world from misuse, often resulting in the forced removal of indigenous communities. In South Africa, the ≠Khomani Bushmen, were one such group forcibly evicted from their homelands. Today, the community has regained access to their ancestral lands in the form of a land claim, settled in 1999, that awarded the community land rights in the form of six farms and land use rights within the now Kgalagadi Transfrontier Park (KTP). This gave them the right to use and manage their property falling within the park together with the conservation authority responsible for the Park, South African National Parks (SANParks).

This study aims to improve our understanding of the use of resources by the ≠Khomani Bushmen. By obtaining insight on resource use and how knowledge of this use is transferred and shared, information on how to better involve and integrate the community in management processes is generated. The study identified the most important plants currently used within the ≠Khomani community and assessed this use. Additionally, social network analysis (SNA) was used to investigate how the social network structure depicts the distribution of knowledge which affects the community's ability to manage their natural plant resources effectively. In an ethnobotanical survey, over 90 individuals were interviewed, using semi-structured interviews, on the farms awarded to the community. In total, 59 plant species from 28 families were found to be in use. Medicinal plants were most frequently cited (60%), with edible plants comprising a further 20%. Data was also collected on social relations surrounding the acquisition, generation and transfer of plant use knowledge. The knowledge networks all depict isolated individuals on the periphery and a few individuals loosely connected to central structures.

This study demonstrates that wild plant use remains an important practice for the ≠Khomani people, primarily for medicinal purposes. It serves as baseline data on plant resources being used by the community and adds to our understanding of how traditional knowledge is being transmitted. The insight provided by SNA depicts the current distribution of knowledge and should be used by the community, as supported by network weavers and SANParks, to achieve their joint management goals. Network weaving can potentially counteract ecologically unsustainable practices, promoting collaboration and the transfer of traditional ecological knowledge.

Opsomming

Voorheen was bewaringsaktiwiteite meestal gefokus op die vestiging van beskermde areas wat die natuurlike wêreld beveilig en beskerm het van misbruik wat dikwels die gevolg was van die geforseerde verwydering van inheemse gemeenskappe. In Suid-Afrika was die ≠Khomani Boesman groep een van die sodanige groepe wat op 'n indrukwekkende manier van hulle tuislande uitgesit is. Vandag het die gemeenskap weer toegang gekry tot die land van hulle voorvaders in die indiening van 'n grond eis wat in 1999 vasgestel is, en wat die gemeenskap grond regte toegeken het in die vorm van ses plase en grond regtelike gebruik binne die sogenoemde Kgalagadi Transfrontier Park (KTP). Dit het hulle die reg gegee tot die gebruik en bestuur van hulle eiendom wat binne die park val saam met die bewaringsowerhede wat verantwoordelik is vir die Park, Suid-Afrikaanse Nasionale Parke (SANParks). Die doel van hierdie studie is om ons begrip te verbeter van die gebruik van hulpbronne deur die ≠Khomani Boesman. Met die verkryging van insig oor hulpbron gebruik en hoe die kennis van hierdie gebruik oorgedra en gedeel word, is inligting oor hoe om 'n beter betrekking en integrering van die gemeenskap in die bestuursprosesse gegenereer. Die studie het die belangrikste plante geïdentifiseer wat tans gebruik word binne die ≠Khomani gemeenskap met die doel om die gebruik van hierdie plante te assesseer. Sosiale netwerkanalise (SNA) is addisioneel gebruik om ondersoek in te stel oor hoe sosiale netwerk struktuur die verspreiding van kennis uitbeeld wat die gemeenskap se vermoë om hulle natuurlike plant hulpbronne effektief te bestuur affekteer. In 'n etnobotaniese opname, was oor 90 individuele ondervra op die plase wat aan die gemeenskap toegeken was, met die gebruik van semi-gestruktureerde onderhoude. Dit is gevind dat in totaal 59 plant spesies uit 28 families gebruik word. Medisinale plante was meer dikwels aangehaal (60%) met eetbare plante bestaande uit 20%. Data was ook versamel oor sosiale verwantskappe omringende die verkryging, generering en oordra van kennis in die gebruik van plante. Hierdie netwerk van kennis word alles uitgebeeld in geïsoleerde individue op die periferie en 'n paar individue wat losweg verbonde is tot sentrale strukture. Hierdie studie identifiseer dat die gebruik van wildeplante 'n belangrike praktyk bly vir die ≠Khomani mense, hoofsaaklik vir medisinale doeleindes. Dit dien as basis inligting van plant hulpbronne wat tans gebruik word deur die gemeenskap en wat by ons begrip gevoeg word oor hoe tradisionele kennis oorgedra word. Die insig wat deur SNA voorsien word beeld die huidige verspreiding van kennis uit, wat deur die gemeenskap gebruik moet word, as ondersteuning van "network weavers" en SANParks om hulle gesamentlike bestuur doelwitte te bereik. "Network weavers" kan potensieel ekologiese onvolhoubare praktyke teenwerk, wat die samewerking en die oordra van tradisionele ekologiese kennis bevorder.

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Dedication

To Michaela, may you too find joy in improving our common future

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Chapter 1

Introduction

Globally, the formation of protected areas has often led to the forced dispossession of indigenous people of their land and natural resources (West and Brechin 1991, Geisler 2003, Brockington and Igoe 2006, Galvin and Haller 2008). In the past few decades, attempts have been made by academics, non-government organisations (NGOs) and governments to reconcile the rights of local communities to use natural resources with nature conservation activities (Hulme and Murphree 1998, de Villiers 1999, Fortwrangler 2003). What has become apparent is that social-ecological systems are unique, and so context-specific solutions must be formulated individually for conservation problems (Berkes et al. 2003, Folke et al. 2005b, Ostrom 2007). Furthermore, lessons need to be shared with regard to what works, and what does not work, in different social-ecological systems (Gunderson and Holling 2002). What needs considerable attention, according to Kepe et al. (2005), is an improvement of understanding between those dealing with nature conservation and those dealing with human and land rights. Valuable lessons can be learnt from South Africa, the country with the third highest level of biodiversity in the world (Mittermeier et al. 2004), and which has recently emerged from decades of rule under the Apartheid regime (i.e., separate development; in which advantages were given to whites over non-whites), which included periods of extensive land dispossession in the name of conservation, but which now has embraced land reform and restitution of formerly disadvantaged people as a fundamental right under the Constitution (Statutes of the Republic of South Africa 1996, DLA 1997).

In 1994, consequent to the end of Apartheid, the South African government instigated an ambitious, policy-driven land reform and restitution programme intended to reduce social disparities and to improve the lives of those marginalised by the Apartheid system of segregation and discrimination (Williams 1996, Levin and Weiner 1997, Ramutsindela 1998, Bradstock 2004, Kepe 2004). The aim of land reform is to ensure security of land tenure for all South African residents, thereby providing a sustainable and equitable foundation for land-based economic development. The South African Constitution, however, not only caters for a right to land reform and equitable redress but, enshrined in the Bill of Rights, is the right to environmental protection (Statutes of the Republic of South Africa 1996, Kepe et al. 2005). All South Africans are entitled to have the environment

protected, for the benefit of both present and future generations, achievable through sound legislative and/or other means that, among others, promote nature conservation and sustainable natural resource use. Major challenges, however, lie in reconciling policies concerned with land reform and the need to improve livelihoods through development and nature conservation (Kepe et al. 2005).

Since 1994, a large number of land reform projects have been initiated which affect conservation areas. A significant land claim was submitted over Simangaliso, formerly known as the St Lucia Wetland Park, a World Heritage Area. Several land claims have also been settled regarding land rights in South African national parks (Ramutsindela 2003). Many of these are concerned with the restitution of land rights, typically where people were dispossessed of their land to further the goals of Apartheid. This has resulted in the conservation and land reform sectors (including government departments and NGOs) often coming into conflict. Overcoming mistrust and poor understanding between the historically distinct land and conservation sectors is a matter requiring urgent attention. However, the most important issue is ensuring that people whose land rights were violated by Apartheid policies – and sometimes by the creation of conservation areas – do not become victims of ideological battles.

Early in 1995, a Bushmen group indicated to their labour lawyer that they longed to return to the Kalahari (Chennells 2002, Holden 2007), seeking restoration of their traditional land in terms of the Restitution of Land Rights Act of 1994 (Statutes of the Republic of South Africa 1994, DLA 1997). Due to the proclamation of the Kalahari Gemsbok National Park (KGNP) in 1931, the Bushmen residing in the area were forcibly removed and denied access to their traditional hunting and gathering grounds (Kepe 2004). Prior exclusionist policies governing protected areas and private game reserves resulted in the alienation of the Bushmen from their traditional land and natural resources. For the Bushmen people, land is an essential source of livelihood (Bregin and Kruiper 2004). As a result, they lodged a land claim requesting the reinstatement of their land and land use rights, surrounding and within the KGNP, respectively, as well as compensation for the land and commercial rights to the park (Chennells 2002). This claim reflected the Bushmen's prior origins in the KGNP (now the Kgalagadi Transfrontier Park, KTP) and their symbolic ownership thereof.

The land claim gained a high political profile, and was settled in 1999 (Chennells 2002, Kepe et al. 2005). The settlement afforded the scattered members of the now named ≠Khomani Bushmen (an estimated 1500, named ≠Khomani after the name of the largest of the original Southern Kalahari Bushmen groups) recognition of their land rights in the form of six farms (37 000 hectares) as well as land use rights within the KTP (Chennells 2002, Mackay 2002). The ≠Khomani are now entitled to the restoration of those rights to land uses on the condition that it is congruent to the prevailing practices of SANParks (Kepe 2005; SANParks 2006).

The community in question now own land surrounding the former KGNP, now the Kgalagadi Transfrontier Park (KTP). They also have symbolic and land use rights within the KTP and are entitled to the restoration of their traditional land use practices in the area, provided that it is congruent to the prevailing conservation model practiced by SANParks under the National Parks Act of 1979 (Statutes of the Republic of South Africa 1979, Kepe et al. 2005, SANParks 2006). By obtaining a deeper understanding of resource use and how knowledge of this use is transferred and shared between and within generations, light is shed on how to better involve and integrate the community in management processes, and to gradually integrate traditional knowledge and practices and potentially achieve social justice alongside environmental sustainability. In so doing, I hope to provide an analysis from the ≠Khomani Bushmen's experiences that others can learn from when implementing land reform projects aimed at co-management of natural resources in and surrounding conservation areas.

The request for the study came from the ≠Khomani Bushmen, together with SANParks and the members of the Joint Management Board (JMB), who are responsible for the running of the contractual park (the !Ae!Hai Kalahari Heritage Park, 25 000 ha on the southern boundary of the KTP). Initially, the general objective was to examine plant use by the community, specifically to map plant harvesting localities and frequency of use throughout the KTP. The latter part of the objective became redundant when it was realised that plant use within the park itself is minimal due to a lack of transport from the ≠Khomani settlements to the KTP and a SANParks permitting system which does not facilitate easy access to the KTP. Although the study still aims to provide baseline data that will eventually inform the development of a monitoring and evaluation system for plant resource use, it also provides an analysis of how knowledge about plant use is acquired, generated and transferred. This is therefore not a study on the ≠Khomani Bushmen and their plant use but rather a study conducted collaboratively with the ≠Khomani Bushmen, examining plant resource use and how

knowledge of plant use is shared. The study has been designed so as to assist the JMB to improve co-management efforts.

According to Cunningham (2001), joint research efforts such as this one, are beneficial for three reasons:

1. The knowledge and perceptions of resource users (e.g., medicine men or craft makers) provide valuable insight into the scarcity of useful species while their knowledge can provide a practical and cost-effective method for identifying key species.
2. To develop effective conservation and resource management proposals, it is better to do so with, rather than for, resource users. This includes interaction with the resource users to obtain their perceptions on issues involving scarcity, quotas and carrying capacities, and to identify appropriate alternatives and implementation methods.
3. Rural communities are not homogeneous, rather they are complex networks, divided on the basis of power, gender and specialist interest groups and by involving resource users as research partners, these specialist groups can be identified.

Hypotheses, aims and key questions

Hypotheses

Several underlying propositions are made in this study that influenced the design and outcomes:

1. Members of the ≠Khomani community possess a rich but diminishing traditional ecological knowledge (TEK) of plants.
2. The loss of this TEK potentially leads to unsustainable resource use, cultural breakdown and dependence on other resources.
3. The distribution of TEK is dependent on the structure of social networks and affects the likelihood that the ≠Khomani community will reach a common understanding of resource-related problems. Ultimately, this will influence their ability to self-organise around regulations of plant resource extraction and use.
4. Adaptive co-governance of plant resources in and around the KTP is an appropriate approach for ensuring that both South African National Parks (SANParks), the conservation authority responsible for the park and the ≠Khomani community are able to simultaneously achieve their goals.

Aims

- Identify the most important plants currently used by the ≠Khomani Bushmen for day-to-day purposes.
- Assess plant use by the ≠Khomani Bushmen in terms of gender and age as well as regularity, type, season and purpose.
- Investigate how the ≠Khomani Bushmen social network structure depicts the distribution of knowledge within the community.
- Determine the structures of the knowledge networks within the ≠Khomani Bushmen community.

Key research questions

The following research questions were addressed to meet the specific objectives of the study:

1. What plants are currently being used by the ≠Khomani Bushmen and for what purposes? (Chapter 4)

2. What are the demographic characteristics of ≠Khomani Bushmen plant users (Chapter 4) and what are their perceptions toward issues pertaining to plant use (Chapter 5)?

3. What is the frequency and seasonality of plant use by the ≠Khomani Bushmen? (Chapter 4)

4. When and how was knowledge about plant use obtained by individuals (Chapter 4) within the ≠Khomani Bushmen community and from whom was it acquired (Chapter 5)?

5. What are the structures of the knowledge networks within the ≠Khomani Bushmen community that might facilitate the implementation of sustainable plant harvesting regimes (Chapter 5)?

Thesis structure

The thesis is divided into six chapters: four synthesis chapters (introduction, two literature reviews and the conclusion) and two data chapters. All the chapters contribute to understanding plant resource use by the ≠Khomani Bushmen in and around the Kgalagadi Transfrontier Park. Chapters have been written as stand-alone manuscripts for publication and so there is some duplication in the introductory and conclusion material. The thesis is trans-disciplinary in nature and combines natural and social science approaches.

Chapter 1 – the current chapter introduces the key problem of land reform and nature conservation. It introduces the ≠Khomani Bushmen and their status as co-managers of their land within the KTP, together with SANParks and the use of their resources within and surrounding the Park. It sets out the underlying assumptions and the main objectives of the research and the key research questions to address these objectives.

Chapter 2 – reviews the literature surrounding the ≠Khomani Bushmen land claim, examining the reasons for dispossession and the effects this has had on the ≠Khomani Bushmen people. The chapter also looks at the current situation of the ≠Khomani Bushmen, in particular, and how conservation can now offer an opportunity for the inclusion of the local community in the management of natural resources.

Chapter 3 – synthesises the historical use of natural resources by hunter-gatherers and the Bushmen of southern Africa, particularly the Southern Kalahari Bushmen. Emphasis is placed on the ways in which understanding of hunter-gatherers has evolved through time, and hence also how they have been recorded.

Chapter 4 – assesses the types of plants used by the ≠Khomani Bushmen for day-to-day needs, aiming to document this information. Ethnobotanical methods and analysis were used to design a questionnaire for gathering plant use data and to analyse the findings. ≠Khomani community members were interviewed in months preceding and following the region's rainy season on the farms awarded to them in the land claim settlement. The ethnobotanical data documented also serves as a benchmark of plant resource use by the ≠Khomani Bushmen.

Chapter 5 – addresses the challenges involved with integrating the ≠Khomani Bushmen community in the KTP management process through the Joint Management Board (JMB) so as to achieve social justice alongside ecological sustainability. To better understand the complex dynamics involved in co-management of natural resources, a social network analysis (Freeman 2004) was conducted. Due to its intense effect on the acquisition, generation and transfer of information and knowledge, the structural characteristics of the social network of individuals and groups in the community were analysed to investigate the potential for effective natural resource management.

Chapter 6 – this concluding chapter summarizes the major findings of the thesis, and outlines future research directions which might usefully contribute towards the establishment of an adaptive co-management approach to managing the KTP and the lands owned by the ≠Khomani Bushmen.

Chapter 2

The ≠Khomani Bushmen Land Claim: a review

Abstract

This paper summarizes the dispossession of the ≠Khomani Bushmen of the southern Kalahari of their ancestral lands, due to prior exclusionist principles, colonization and the Apartheid policies of South Africa. The Bushmen are believed to be the first peoples of southern Africa, known to have practiced a hunter-gatherer mode of production and to have lived nomadically in egalitarian bands. With the formation of the Kalahari Gemsbok National Park in 1931, their rights to live and hunt on the land were gradually eroded, until their final eviction from the park in the mid 1970's. Under the new democratic government, a land claim was submitted; later vindicated and formally settled in 1999. The aim of this paper is to scrutinise the linkage between Bushman land dispossession and the ≠Khomani Bushmen land claim, looking at the effect this has had on the community and how conservation can provide the opportunity for integration and involvement of the local people in the management of natural resources. Above all else, cultural and spiritual values need to be mainstreamed so that conservation can be holistically perceived and a true appreciation of indigenous knowledge systems and the relationship between people and the earth be developed.

Keywords: dispossession, proclamation, protected areas, Bushmen, SANParks

Introduction

In the 20th century, conservation activities were primarily focussed upon the establishment of formally protected areas in 'pristine' locations and strongly exercised exclusionist policies (McNeely and Miller 1984, Anderson and Grove 1987, Western and Wright 1994, Kramer et al. 1997, Brockington 2002, Brockington and Igoe 2006). Authorities generally adopted top-down, 'command-and-control' approaches, with governments taking command of conservation initiatives and controlling access to wildlife and resources for traditional subsistence use (Western 1989, West and Brechin 1991, Holling and Meffe 1996). Human activities were assumed incompatible with wilderness preservation and strong emphasis was placed on safeguarding and shielding the natural world from misuse and preserving it for future generations (Ives and Messerli 1979, Makombe 1993). This often resulted in governments forcibly removing indigenous communities from their traditional lands for the proclamation of protected areas (Hitchcock and Holm 1983, Kemf 1993, MacKay 2002, Brockington and Igoe 2006). In South Africa, the ≠Khomani Bushmen, the subject of this thesis, are one such group forcibly evicted from their homelands. Today, the community has regained access to their ancestral lands, as part of recent restitution efforts in post-apartheid South Africa. In a twist of events, conservation can now potentially provide an opportunity for the long-overdue emancipation of a marginalised and suppressed group of people.

The conservation policies previously practiced in South Africa were founded upon Western philosophies, values and ethics brought over by European colonialists (Anderson and Grove 1987, Gall 2001, Beinart 2003). The imposition of these conservation values was applied uncritically by Europeans, who viewed Africa as an untouched paradise which required protection from desertification and the ravages of human exploitation (Anderson and Grove 1987). Initially, during the 16th and 17th centuries, the colonial authorities allowed indigenous communities to coexist with wild game since Africans were, in effect, equated with wildlife and were permitted to remain on the land as a consequence (Carruthers 1995, Kothari et al. 1996, Schroeder 1999, Gall 2001). It was however determined during the late 1800's that joint habitation of the land by livelihood seekers and wildlife was impossible if wildlife was to be preserved for the recreational needs of the colonial settlers (Carruthers 1995, Schroeder 1999, Grossman and Holden 2005, Holden 2007).

Characteristic of the exclusionist ethos was the policy of fencing off most protected areas, which, in the short term, had the advantage of 'protecting' wild nature from people. However, this approach diminished the opportunities of sharing the benefits accrued from wildlife management with local communities, with such benefits only reaching a minority of the population (Ghimire and Pimbert 1997, Adams and Hulme 1998, Borgerhoff-Mulder and Coppolillo 2005). Authorities also viewed indigenous communities as a threat to protected areas, disregarding and undermining local traditional access rights, knowledge and their contribution to environmental management (Lewis and Carter 1993, Carruthers 1995, Munthali 1996, Colchester 1997, Hitchcock 2002, Ramutsindela 2003, Madzwamuse and Fabricius 2004). As a result, South Africa, as with many countries previously under colonial rule, has suffered a history of conflict over its natural resources and the displacement of its indigenous communities.

According to Cernea (2005) displacement for the sake of conservation encompasses two processes: 1) forced removal of individuals from their homes, and 2) economic displacement (i.e., the exclusion of people from certain areas in their pursuit of a livelihood). Other salient features defining displacement for the sake of conservation include marginalisation (Cernea and Schmidt-Soltau 2003, Ohta and Yintiso 2005), impoverishment (Geisler 2003, Brockington and Schmidt-Soltau 2004), injustice and disempowerment (Sibanda 2010). Apart from the tangible losses incurred, there is the symbolic and cultural abolition of local people from the landscape and their removal from its history, memory and representation (Schama 1996). In addition, local communities suffer a loss of power and control over their environment while conservation regulations interfere with their lives in manners over which they have limited control (Theodossopoulos 2002, Novellino 2003). The impacts of protected areas are, however, part of a whole variety of social, economic and political consequences too diverse and complex to be classified as simply positive or negative.

The history of forced removals in South Africa has led to a relationship of suspicion and sometimes even hatred between communities and conservation authorities (Boonzaier 1996, Cock and Fig 2000, Steenkamp 2000, Reid 2001, Robins 2001, Thornton 2002, Ramutsindela 2003). The creation of reserved forests in parts of the Eastern Cape Province during the 19th and early 20th centuries meant that local villagers were initially restricted and later entirely prohibited from using natural resources in defined areas (King 1941, Beinart 2002, Tropp 2003). Another example of conservation-related land alienation by the state was the soil rehabilitation scheme known as betterment planning (Kepe 2004). An estimated 4 million people were dispossessed of their land

rights through the scheme (Yawitch 1981, De Wet 1995, Beinart 2002). Also, the demarcation of a 1 km zone along the coast, as means of conserving the marine environment by restricting access to the sea, resulted in the loss of land by many in the then Transkei (now Eastern Cape Province; Whande and Kepe 2003). The evictions of entire communities due to the proclamation of National Parks occurred nationwide, from communities in and surrounding the present day Kruger National Park (Steenkamp 1998; 2000, de Villiers 1999, Reid 2001, Ramutsindela 2003), to those in the Northern Cape Province such as the Richtersveld community (Boonzaier 1996, Isaacs et al. 2000) and the Riemvasmaak people from the Augrabies National Park (Cock and Fig 2002) to communities in Kwa-Zulu Natal (Barker 1998).

A complex history of the relationship between conservation authorities and communities living in or adjacent to protected areas is not unique to South Africa. Research has shown that the establishment of both private and public protected areas has had profound impacts on indigenous peoples (West and Brechin 1991, Ghimire and Pimbert 1997, Fortwrangler 2003, Geisler 2003). In the United States, the proclamation of National Parks led to the disintegration of many indigenous groups (Hough 1991, Stevens 1997, Hamin 2001, Jacoby 2001). In the case of other previously colonial domains, the pronouncements of conservation areas meant the loss of land and resource use rights to communities in Australia (Toyne and Johnston 1991, Brown 1992, Australia 1993), Canada (Overton 1979, Fortin and Gagnon 1999, Knight 2000, Natcher 2001), New Zealand (Stokes 1992, Mead 2004), India (Kothari et al. 1989, Raval 1994, Dangwal 1999) and across Africa (Ellis 1994, Beinart 2000, Gbadegesin and Ayileka 2000, Nelson and Hossack 2003).

Consequent to the end of Apartheid, in 1994, the South African government instigated a land reform and restitution programme intended to reduce social disparities and to improve the lives of those marginalised by segregation and discrimination (Williams 1996, Levin and Weiner 1997, Ramutsindela 1998, Kepe 2004). Due to decades of land dispossession, displacement and injustice, this reform is centred on a sustainable and equitable foundation for land-based economic development. Also enshrined in the Bill of Rights, is the right to environmental protection (Kepe 2004), with all South Africans entitled to having the environment protected. Through equitable legislation and conservation initiatives, the environment should be protected, for present and future generations. The challenge thus lies in reconciling policies concerning land reform and the need to improve livelihoods through development and nature conservation.

In recent years, there has been an acknowledgment that conservation should integrate the needs of local communities. This is based largely on the premise that *"if conservation and development could be simultaneously achieved, the interests of both could be served"* (Murphree 2002). The main aim is to achieve social justice alongside environmental sustainability by involving and integrating the community in the management of protected areas (Tsing et al. 1999, Fortwrangler 2003). This integrated concept of people in nature, referred to as the social-ecological system (Berkes and Folke 1998, Berkes et al. 2003) refers to the practical engagement of people with each other and with their environment (Ingold 2000). Important here is the mainstreaming of cultural and spiritual values of protected areas so that conservation agencies and the public can perceive conservation more holistically, developing a true appreciation of indigenous knowledge systems and the relationship between people and the earth. Inimical to the conservation cause, successes can ultimately only occur when the fences are down. As Adams (2004) expressed:

> *"the challenge is not to preserve (or restore) 'the wild', but peoples relationships with the wild … [W]ithout contact with nature, peoples capacity to understand it and engage with it withers. The future of conservation will turn on the extent to which a strong individual connection to nature and natural processes is maintained."*

This, together with building knowledge and fostering an ecological relationship with ones surroundings, forms the foundation for putting people back into the ecosystem. To achieve this requires using all possible sources of ecological knowledge and understanding (Berkes 2004). Using knowledge and perspectives from the community in itself can help build a more complete information base than may be available from scientific sources (Berkes et al. 2000, Olsson and Folke 2001, Blann et al. 2003). Hand in hand with the inclusion of humans in the ecosystem are the shifts from reductionism to a systems view in ecology and from an expert-based approach to participatory conservation and management (Levin 1999, Bradshaw and Bekoff 2001, Ludwig 2001). This is captured in the concept of co-management, where the underlying rationale is that by involving a diversity of stakeholders, with a diversity of perspectives and knowledge, the inherent complexities of ecosystems and communities constructed around these (i.e., the social-ecological system) can be more adequately addressed (Berkes and Folke 1998, Carlsson and Berkes 2005). Adaptive co-management explicitly focuses on the adaptability of the co-governance concept in response to environmental change and continuous acquisition of new knowledge (Armitage et al. 2009).

The ≠Khomani Bushmen, the community in question, now own land surrounding; and have land use rights in; the Kgalagadi Transfrontier Park (KTP) and are entitled to the restoration of their

traditional land use practices. The aim of this review is to examine the displacement of indigenous communities and their dispossession of land and the subsequent restitution thereof, particularly in the case of the ≠Khomani land claim. This review also inspects the present-day situation of the community and looks at how conservation, in the form of contractual national parks, aspires to integrate the needs of local communities by involving them in the management of protected areas.

Bushmen of southern Africa

Known as the 'first people' of the African subcontinent (Gall 2001), the Bushmen prevailed for millennia, forming part of the vast natural Kalahari ecosystem (Bregin and Kruiper 2004, Barnard 2007). They comprised a distinct population in southern Africa relying on a subsistence economy based primarily on hunting and gathering (Lee and DeVore 1976, Tanaka 1980). They have been described as a group of light-skinned people, smaller in physique compared to their neighbours, speaking several phonetically highly complex Khoisan click languages (Barnard 1992). Two fairly recent migrations, by the Khoikhoi and Bantu-speaking peoples - around 2000 and 800 years ago, respectively, forced the Bushmen into the desolate arid regions of the African subcontinent (Smith 1992, Smith et al. 2000, Huffman 2006). It is believed that most relations between the hunter-gather Bushmen and the Khoi and Bantu-speaking agro-pastoralist peoples were amicable (Tanaka 1980), and included intermarriage (Smith at al. 2000, Holden 2007).

Their social organisation was based on small family groups united in flexible egalitarian structures, with a leadership ethos based on consensus (Tanaka 1980, Barnard 1992). Bushmen traditionally managed their land and natural resources on a band basis (Heinz 1966, Lee and DeVore 1976, Barnard 1992). Bands (or family groups) would meet and join other groups from time to time to form larger clans (Barnard 1992). Being a member of a band afforded individuals the right to exploit the resources of the band territory. Land tenure was held in the name of the band and every individual member, theoretically, had the right to adequate land and resources to support themselves. Under these systems of occupancy, land was not allowed to be bought or sold, nor could it be pledged as collateral for a loan. Individuals could only use available resources, permit others to utilise them or, in some cases, discourage access. Between the 1960's and the 1980's Lee (1965; 1968; 1969; 1976;

1979, Lee and DeVore 1976) studied the landholding and land use practices among the Bushmen and identified five structural characteristics that defined a foraging mode of production. These were:

- Hunter-gatherers had to be mobile and able to cover a wide area in order to find sufficient food.
- The environment set the upper limit on group size.
- Due to the seasonal and regional variation in resources, the hunter-gatherer group structure had to be flexible enough to adjust to changing opportunities.
- The necessity to move around set limits on the material wealth a family could possess.
- Despite a variety of ideologies of land ownership, all hunter-gatherers developed elaborate rules for reciprocal access to resources.

In accordance to this system, land and its resources were collectively owned, whereas tools and other possessions were the property of the individual owner (Thomas 1989).

To summarise Barnard's (1978; 1988a; 1988b; 1988c; 1989) ethnographic findings, the Bushmen had a sophisticated, diverse culture – in their social organisation, in aesthetics, in language and even in their traditional knowledge of plants and animals. For instance, he found that their ecological knowledge base could rival that of many Western biologists. They could identify and name, in their traditional language, several hundreds of different species of plants, their seasonal locations, ecological associations with other species, including how to prepare them as food and medicine (Tanaka 1980, Barnard 1992). They intricately knew hundreds of animals, their migration patterns, social behaviours and psychologies, anatomy and physiology and their life cycles (Barnard 1992). According to Wiessner (1984), many Bushmen were skilled artists, musicians and interpreters of human and animal thought. Kinship systems and rules of etiquette also appeared to be complicated, with different groups having different rules about how people were classified (Barnard 1992). Some languages were phonologically complex (Traill 1994) while others were syntactically complex (Visser 2001, Barnard 2007).

A history of dispossession and marginalisation for Bushmen

The pre-colonial era (prior to the 16th century) in Africa was distinguished by tribal migrations and wars that relocated Bantu-speaking people from West Africa to the central highlands and southern regions of the continent (Schapera 1959, Gutherie 1967). On re-occupation, Bantu-speaking people rapidly established settlements and introduced agro-pastoralism. These Bantu tribes had stratified systems of hereditary chiefs and headmen soon introduced new sets of land use practices to suit their culture (Nthomang 2002). According to Barnard (1992) the incursion by non-hunter-gatherer populations did not lead to the explicit defence of territorial boundaries nor to widespread displacement of the Bushmen while Guenther (1986) points out that early Bantu-Bushmen relations was regulated by some degree of reciprocity and that the two groups lived together fairly amicably. Despite this, history has shown that the Bantu-speaking people made no attempt to recognise Bushmen land use practices. Instead, they engaged in a subtle process of land dispossession that gradually led to the displacement of the Bushmen from their ancestral land (Nthomang 2002). Thus, initially, contact was based on exchange while gradually relations took the form of subjugation. The end result was a progressive dehumanisation of the Bushmen until they were regarded simply as assets useful for their productive potential (Hitchcock 1987; 1995; 2002, Nthomang 2002, Holden 2007).

With the arrival of European settlers and explorers in the 16th and 17th centuries, land was progressively divided into freehold farms, relocating indigenous people into smaller tracts of communal land (Tanaka 1980, Gall 2001, Beinart 2003, Thomas 2006). A colonial system of authority and knowledge was imposed and a slave-society was developed, with the settlers depending on both the labour and the environmental knowledge of those they had elbowed aside (Ross 1983). The expansion of European colonisation during the late 1800's also resulted in a strain on natural resources, while the Bushmen were victimised simultaneously by the new European settlers, the KhoiKhoi and the Bantu-speaking groups as competition for resources intensified in the face of European territorial expansion (Marks 1972, Tanaka 1980, Beinart 2002). This continued into the 20th century, with the last permit to hunt Bushmen being issued by the South African pre-apartheid state in 1927 (Gall 2001, Thomas 2006, Holden 2007).

During the expansion of European colonialism (ca 1835 – 1870), the situation remained relatively stable. However, with the discovery of diamonds in Kimberly and later gold on the Witwatersrand during the 1860's, the European administration became concerned by the fact that the Bushmen

disregarded private ownership, as the concept of land as a commodity was foreign to them - a dynamic the colonial administration wanted altered (Thompson 2001). Apartheid intensified in the 1930's with the declaration of South Africa as a 'sovereign independent state' (Thompson 2001). In accordance with the policies in place at the time, a key approach to agricultural and economic progress in South Africa was the privatisation of land, a process which, it was argued, would provide individual whites with the incentive to invest more labour and capital while simultaneously managing and conserving resources (Hitchcock 1980). Due to this, the new Afrikaner dominated administration chose to ignore the Bushmen's foraging way of life and allocated themselves large tracts of land for private use (Hitchcock 2002).

Discomforting notions that wildlife was being extirpated added momentum to the establishment of protected areas in South Africa. Existing laws of the mid-1900's were inadequate in protecting wildlife and the government created reserves as an alternative wildlife protectionist strategy (MacKenzie 1988, Adams 2003, Plumwood 2003). Informing the creation of reserves were the principles that proclaimed that game reserves should comprise state, not private, land and that hunting should be managed (i.e., restricted) in some way (Carruthers 1995). The mechanisms through which the state acquired land would define the post-apartheid era (Thompson 2001). In most cases the state purchased land from white landowners, but did not apply the same policy to non-white South Africans (Hitchcock 2002).

In particular, the Kalahari Gemsbok National Park (KGNP) was proclaimed which had colossal cultural and social implications for the Bushmen originally living within the Park boundaries, as their communities were evicted. Established in 1931, the KGNP replaced the Gordonia Game Reserve and primarily sought to prevent what was considered the immanent extinction of the gemsbok, *Oryx gazella* (Kepe et al. 2005). The selected area was inhabited by several groups sharing the Park, including the Bushmen who traditionally used the land as their hunting grounds and for the collection of bush foods. Subsequent to the proclamation of the Park, the inhabitants were relocated, with white farmers granted alternative farms along the Kuruman river bed, whilst other groups, such as the Bushmen, were forcibly removed between 1936 and 1974 and widely dispersed over an extensive area today comprising South Africa, Botswana and Namibia (Kepe et al. 2005).

When colonialism ended (ca 1930's) the Bushmen found themselves under new governance, but with essentially comparable sets of laws and policies to those of their European predecessors. At that time, pressure on land from farmers, mining companies and conservationists all but cut the Bushmen

off from their traditional lands (Beinart 2002). Comprehensive tenure reforms for arid lands were initiated resulting in dispossession of Bushmen from large areas of their traditional lands, which were gazetted as protected areas (Hitchcock 1996). The liberation struggle in South Africa also displaced a large number of the Bushmen from their lands as military bases with clearly defined user groups were established and fences were erected, thereby further blocking the Bushmen from access to their traditional lands (Ngóngóla and Moeletsi 1996, Ellis 1994, Biesele and Hitchcock 2000). Thus, decades of genocide, dispossession, disease and exploitation by other more assertive tribes, the authoritarian colonialists and later the Apartheid state, resulted in the decimation of most Bushmen clans (Tanaka 1980, Beinart 2003, Holden 2007).

Today, the Bushmen are spread across southern Africa living in small groups, totalling only a few hundreds and at most a few thousands (Woodburn 1997). They generally live in abject and landless poverty, isolated from other Bushman groups and mostly unaware that there are others akin to them elsewhere on the subcontinent (South African San Institute 1996, Bregin and Kruiper 2004). They do however; all share historical continuity with pre-colonial societies, strong links to territories (i.e., a strong spiritual identification to the landscape), distinct social, economic and political systems, culture and beliefs, non-dominant societies and no distinct national identity (Barnard 2007). In addition to this, many Bushmen have become ever more dependent upon private and government-sponsored aid programmes. This has also resulted in accelerated cultural transition to low self-esteem and substance abuse, reinforcing rather than redressing forms of marginalization. It is therefore chiefly for these reasons that the Bushmen remain among the poorest of the poor in southern Africa and the concept of self-reliance seems a distant reality (Robins et al. 2001, Suzman 2001).

This discrimination and persecution has resulted in the quality of life of Bushmen declining drastically since the pre-colonial era (Holden 2007). This was further exacerbated by the failure of the modern South African state to recognise their unique qualities and distinct identity; in particular, their strong attachment to land as a means of survival (ICIHI 1987). Aggravating the situation even further was the fact that governments were reluctant to recognise the Bushmen as "indigenous peoples". Before the 1990's, one of the most conspicuous features of Bushmen identity was their common experience of dispossession, mistreatment, exploitation and neglect by those more economically and politically powerful than themselves (Hitchcock 2002). During this time, many Bushmen still remained in their traditional territories, but had lost all rights to land and other natural resources, as the more recent occupants were more successful in obtaining legally recognised ownership, a concept unfamiliar to the Bushmen culture.

The ≠Khomani Bushman Land Claim

In April 1994, following transition to democracy, the new South African government instigated policy changes concerning the rights of previously disenfranchised South Africans, having profound effects on the management and future of the country's protected areas. The negotiated political settlement sought to address the injustices of Apartheid whilst promoting national reconciliation. Fundamental to the objectives of the new government was the process of land reform where the government aimed to return large areas of land to Africans (Carnegie et al. 1998). A three-pronged market-assisted land policy aimed at land redistribution, tenure reform and restitution (DLA 1997) was instigated.

In March of 1995 a Bushmen group, then employed as a 'tourist attraction' at a private game farm in the Western Cape, indicated to their labour lawyer that they longed to return to the Kalahari (Gall 2001, Chennells 2002, Bregin and Kruiper 2004, Holden 2007). They sought the restoration of land in terms of the Restitution of Land Rights Act of 1994 (Statutes of the Republic of South Africa 1994, DLA 1997). They applied for: 1) ownership of farms in the vicinity of the then Kalahari Gemsbok National Park; 2) compensation for the land; 3) commercial rights to the National Park; and 4) symbolic rights in, and adjacent to, the National Park (Chennells 2002). This claim reflected the Bushmen's prior origins in the Park and their symbolic ownership thereof.

The land claim gained a high political profile, and in 1999 the South African government concluded an out-of-court settlement, based on legal proceedings filed under the post-apartheid Restitution of Land Rights Act 1994 (DLA 1997, Chennells 2002, Kepe et al. 2005). The settlement afforded the scattered members of the now named ≠Khomani Bushmen (an estimated 1500, named ≠Khomani after the name of the largest of the original Southern Kalahari Bushmen groups) recognition of their land rights in the form of six farms (37 000 hectares) as well as land use rights within the then Kalahari Gemsbok National Park (Chennells 2002, Mackay 2002, see Appendix 1). The settlement of the claim was signed on 21 March 1999, Human Rights Day in post-apartheid South Africa. Shortly after this settlement, on 12 May 2000, Botswana and South Africa signed an agreement to establish the world's first formally-designated transfrontier park; the Kgalagadi Transfrontier Park, KTP (Hanks 2003). The Park integrates the 28 400 km² Gemsbok National Park in Botswana with the 9591 km² Kalahari Gemsbok National Park in South Africa. While both countries retain territorial sovereignty and separate legal systems for their respective areas, the park is managed and controlled as a single

protected area under a unified system, with tourists being able to move freely across the international boundaries between the two countries (Hanks 2003).

The land claim - a decade later

Due to the requirement for further detail in the agreement, title to the 25 000 ha of land in the park was not handed over to the community until August of 2002. In the interim, members of the community initiated the novel process of managing communally owned farms according to the Communal Property Association (CPA) Act No. 28 in 1996 (Statutes of the Republic of South Africa 1996, Holden 2007). A major challenge derived from the community being assembled from original claimants and individuals of Khoisan decent drawn from across southern Africa since the original claimant group had agreed to expand their numbers so as to meet the criteria for claiming such a large expanse of land (Holden 2007). According to Chennells (2002), the absence of any authoritative body, such as a recognised community council, meant that the ≠Khomani community were legally required to function according to Western notions of 'representative democracy'. According to Holden (2007), this complex process was seriously undermined by a lack of adequate post-restitution support from government and to date this support has not been achieved.

Problems are characteristically encountered with the land reform process throughout South Africa (Cousins 1997). The dysfunctional implementation of the ≠Khomani land claim can mainly be attributed to a failure to adhere to democratic and equitable practices, deficiencies in the design and establishment of bodies generated under the CPA Act, failure to allocate land rights to individual members and other complexities involved in land management and relating to communal land holding (Holden 2007). This has led to uncertainty with regard to who should be managing and benefiting from natural resources in the area and how this should be achieved. Moreover, the acknowledged status of the Bushmen, in general, as being the most poor and dispossessed in southern Africa (Gordon 1992, Suzman 2001) has raised the question of why they have been collectively unable to contend and thrive in the present day and age. This led Chennells et al. (2009) to conclude that their current marginalisation is largely due to a) the legacy of a hunter-gatherer worldview, b) pervasive poverty and land dispossession and c) collective trauma leading to societal problems.

Firstly, the hunter-gatherer world view refers to lack of interest shown by such groups in attaining material wealth. This is a direct result of the basic feature shared by hunter-gatherer groups, *viz*. a

focus on the present, little interest in long-term planning, a discomfort with formal organisational structures and a poor understanding of material wealth (Diamond 1999, Brody 2001). Secondly, and consistent with Suzman's (2001) regional assessment, the Bushmen of southern Africa are typified by widespread poverty and a severe reliance on welfare services, casual labour, begging and charity. This is especially the case in situations where they were forcibly removed from their ancestral lands (Chennells 2002, Holden 2007). Ingstad and Fugelli (2006) have concluded that a 'loss of land results in loss of health via loss of self-esteem'. This is expressed in an air of lethargy and hopelessness and deeply entrenched social dysfunction leading Chennells et al. (2009) to conclude that poverty lies at the core of a variety of societal problems, perpetuating and exacerbating the meagre circumstances of the Bushmen. Thirdly, the Bushmen as a group have been subjected to dispossession, genocide, loss of language, loss of traditional lifestyles and values, slavery and humiliation (Chennells et al. 2009). In a study on the collective trauma suffered by indigenous peoples, Abadian (1999) highlights that cultural dispossession is linked to alienation and that present-day dysfunction is a result of unresolved collective trauma. She also stresses that the experience of trauma intensely extorts individual perceptual filters, values and behaviours, while collectively, low personal capacity driven by low self-esteem, leads to dysfunctional communities whose members are unable to constructively interact with each other.

Other factors contribute and intensify the challenges facing the ≠Khomani Bushmen in particular (Gordon 1992, Robins et al. 2001, Suzman 2001, Holden 2007, Chennells et al. 2009):

- Families and clans have developed in different directions after decades of dispersion with some maintaining traditional ways, others totally immersed in modern life, and with some living as an 'underclass' in dismal conditions, surviving appalling destitution and desolation. These disparate groups were reunited virtually overnight resulting in tensions and differences stemming from inconsistent perceptions, mistrust and a lack of awareness of each other.
- The plight of the Bushmen is aggravated by racial discrimination in the area, perpetuating their sense of disempowerment.
- Social issues in the area include domestic violence, child abuse, HIV, depression and malnutrition, with social dysfunction exacerbated by substance abuse.
- Meagre formal education leaves the community poorly equipped to deal with these challenges.
- Poor service delivery and neglect by government, few income generating opportunities, and a lack of infrastructure and communication promotes physical and virtual isolation.
- Inadequate post-settlement support.

Holden (2007) draws attention to the draft protocols for sustainable resource use that have been brought forward by the ≠Khomani Bushmen representatives at successive meetings and workshops. While it is accepted that 'modern/Western science' is currently incapable of endowing exact answers on what constitutes sustainable use for each of the hundreds of plant species in question, there is reticence on the part of Park Management to accept the very practical (and conservative) guidelines that have been proposed, even given that an adaptive management approach has been adopted with a monitoring and evaluation system being put in place to support this. Also of concern, and rightfully so, is the right to undertake traditional hunting activities with the Bushmen questioning whether they can be Bushmen without hunting and gathering. As they so eloquently express, the hunt, the dance, the healing and the connection to the land are all integral to their cultural identity and when one component falls away, the whole slowly starts to fade – and it has been a long time already.

Contractual National Parks

Consequent to the end of Apartheid in 1994, the pressure on SANParks to be more community-friendly has increased. To date, it acknowledges the need to integrate human needs more with conservation and make South Africa's National Parks of relevance to the majority of South Africans, so that effective conservation can thrive (Fourie 1991, Ledger 1998, Robinson 1998). To achieve this, requires a holistic and more comprehensive approach, including a respect for local cultural and spiritual values, since environmental degradation and the loss of cultural diversity are closely connected (Maffi 2005). This is made possible by the acceptance that controlled levels of tourism, ownership by local people, and community access to areas of spiritual and economic importance need not necessarily compromise conservation objectives (Robinson 1995, Steenkamp 1998). Furthermore, where indigenous peoples possess knowledge over the local environment and where sustainable use of natural resources are embedded in their cultural and spiritual beliefs, it becomes necessary to promote traditional knowledge of natural resources (Berkes 1993, Gadgil et al. 1993, Berkes et al. 2000).

Contractual national parks provide one model through which SANParks hopes to meet social, development, and economic objectives and prevent alienation of local people (Tsing et al. 1999, Reid 2001, Reid et al. 2004). Contractual national parks, declared under section 2B (1) (b) of the National Parks Act (Statutes of the Republic of South Africa 1979), allows for the establishment of a national park on privately-owned land. Fundamental to the contractual national park notion is the drawing up of a joint management agreement which lays out the rights and responsibilities of the landowners and

the conservation authority responsible for the area (Reid 2001, Reid et al. 2004). Subsequent to the legal establishment of a joint management committee, usually comprising elected landowner representatives and conservation officials, a joint management plan is drawn up detailing how the contractual national park will be managed (Robinson 1995). The contractual national park model was initially developed, however, as a way to meet conservation objectives and extend South Africa's protected area network without heavy investment in land purchase. It was envisaged that contractual national parks would be applied in areas on the periphery of state-owned, core conservation areas managed by SANParks, and that they would help meet the conservation objectives of SANParks rather than simply acting as a buffer zone and increasing the size of the protected area (Reid et al. 2004).

In terms of the KTP, a Joint Management Board (JMB) comprising members of SANParks and ≠Khomani Bushmen was constituted shortly after the claim was settled in 1999. Difficulties were encountered from the start attributed to the inability of SANParks to acquaint itself with and implement the settlement agreement as well as a dysfunctional CPA management committee. Initially, all the parties involved failed to assist any of the claimants to visit their land within the park and to re-establish their ancestral connections with their land (Holden 2007) since most claimants lived on their farms 60 km from the park with no transport.

Conclusion

The Bushmen were forcibly removed from their traditional lands, with adverse consequences for their economic, social, family and spiritual life. This chapter has attempted to examine land dispossession in South Africa, as a result of protected area proclamation, land restitution and the possibility of involving the local community in conservation management through contractual parks. Crucial and long overdue is the paramount need for conservation authorities and policymakers to develop inclusive policies that respect local communities as equal partners in the conservation management processes that directly affect their lives.

At present, although the farms surrounding the KTP are independently managed by the ≠Khomani community, the contractual national park is managed by the JMB. This body is responsible for the drafting and implementation of a management plan and decides on matters pertaining to

management. This Western management framework, however, is technical and bureaucratic and could potentially inhibit effective joint management. Similar to the Makuleke community of the Kruger National Park (Reid et al 2004), the ≠Khomani representatives lack fluency in English, especially regarding matters pertaining to conservation and technical matters, while their low competencies in Western skills limits the power they can exert over the management of their land and resources (Smith et al. 2000). The dominant colonial and neo-colonial assumptions about the inferiority and backwardness of the Bushmen must be abandoned and a commitment made to relationships based on equality and solidarity. The area that needs urgent action is the development of a model that will recognise the Bushmen traditional landholding and use practices.

Conservation in and surrounding the KTP needs to focus on cultural conservation of the ≠Khomani as much as it does on ecological conservation, viewing the entire area as a living cultural landscape (Anthony and Bellinger 2007). Nature and culture are inextricably interrelated and in order to conserve and sustainably use the environment and its resources, an improved understanding of how communities interact with their environment is needed (Harmon 1996, Sutherland 2003, Loh and Harmon 2005, Maffi 2005). A further need lies in understanding how this interaction has developed through history so as to shed light on present trends. More information is needed on how individuals value and use nature in order to discuss environmental issues, so as to reach a mutual understanding of what constitutes sustainable resource use. This common ground needs to be based on both scientific and local knowledge with a shared appreciation of human values and ethics, including a respect and affection for life.

There is more to land reform than giving out hectares of land. It is about rebuilding communities. For the Bushmen, the loss of land just about resulted in the end of their people. The concept of co-management of protected areas propagates the idea that there should be a 'harmony of interests' between people and parks. Whilst the notion makes sense at the level of policy objectives, it does not follow that such a harmony of interests comes into being simply because the policy makers will it to be. Challenging, especially for scientists and professionals, is the incorporation of non-scientific ways of comprehending our surroundings into our work, in the context of nature conservation and sustainable resource use. Furthermore, the bridging of current gaps between different disciplines, academic or non-academic, is imperative in order to enable the synthesis of knowledge, meaningfully, so as to respond to current social-ecological changes and challenges, both locally and globally.

Clearly, it will take time and unrelenting dedication to change prevailing mindsets and to give effect to the sentiments of human rights, religious freedom and the eradication of racial discrimination and inequality. Conservation agencies, however, cannot be expected to carry the burden of ensuring social justice as this and human development is not their core function. Alone they cannot save the day - they need suitable policy and tangible support from all tiers of government, NGO's and the community, requiring cooperation and shared accountability. Also fundamental is capacity building at a community level and empowerment of both community members and park employees. In order to mainstream issues such as co-management, access and benefit sharing, these agencies need to become entirely capacitated to address, become aware and respectful of, the rights held by people regarding protected areas.

Chapter 3

A Review of Natural Resource use by Southern African Bushmen

Abstract

Before European colonialism, the hunter-gatherer Bushmen of southern Africa lived in what was believed to be autonomous, isolated and nomadic groups. They fought displacement, slavery and decimation; persisting and now attempting to restore their historical roots. Although studies have been conducted on the subsistence ecology of some Bushman groups, the emphasis has been on plants used for food and water while medicinal plants and their uses have remained poorly understood. Following the forced removals of many of the southern African Bushman groups up until the 1970's, there is a paucity of data on the ethno-botanical knowledge and plant lore of these people. This review summarises available scientific records on natural resource use by the southern African Bushmen, particularly plant resource use by Southern Kalahari Bushmen. .

Keywords: hunter-gatherers; Kalahari Debate; medicinal plants; subsistence ecology;

Introduction

> *"What can we deduce ... about the life of early man? … The best procedure to follow, and the one which I believe is relied on implicitly by most students of the subject, is to extrapolate backward from living hunter-gatherer societies."*
>
> Wilson (1975)

The term hunter-gatherer refers to human societies that acquire sustenance from the bounty of nature, by hunting animals and gathering wild plants (Lee and Daly 2004). Mostly practiced by early cultures, this subsistence lifestyle was characteristic of nomadic family units that moved from place to place as determined by food supplies (Schrire 1984, Barnard 1992). This mobile existence generally meant there was no storing of surplus food and no specialisation of labour beyond the division of tasks between men, hunting, and women, gathering (Lee and DeVore 1976, Lee 1979, Silberbauer 1981, Biesele et al. 1989, Tanaka 1989, Lee and Daly 2004, Barnard 1992; 2007). Where food became plentiful and dependable, a hunter gatherer clan may have become sedentary, in which case a combination of hunting and gathering with agriculture or horticulture, animal husbandry or herding was common (Barnard 1992, Lee and Daly 2004). Socially, these nomadic societies also tended to have relatively non-hierarchical, egalitarian structures, in which permanent leaders, bureaucrats or artisans were seldom maintained (Dahlberg 1975, Erdal and Whiten 1996, Gowdy 1998). Anthropologists Lee and DeVore (1968) suggested at the 1966 'Man the Hunter' conference that egalitarianism was one of several key features of such societies since mobility compelled minimisation of material possessions throughout the group and a surplus of resources could not be accumulated by any single individual. Other characteristic features include a flux in territorial boundaries and in demographic composition (Fagan 1989, Panter-Brick et al. 2001, Barnard 2004).

In Africa today, the nomadic lifestyle is woven into the fabric of life through fables, myths, place names and the imagination of the continent's people, while their pasts are interlaced into contemporary political consciousness. Ancestral DNA markers (Shreeve 2006), together with the archaeology of Africa's hunter-gatherer peoples provide some of the earliest evidence of human existence anywhere in the world (Barnard 1992, Deacon 1992). This legacy is found in the widespread relics of ancient sites and in the rock art of the African subcontinent and in the Sahara (Tobias 1964, Jenkins 1972, Clark 1959, Inskeep 1969, Barnard 1992). Up to half a million Africans classify themselves as hunter-gatherers or former hunter-gatherers, while only a small proportion, roughly 25 000, presently subsist mainly by hunting and gathering (Hitchcock 1999). These people differ markedly, ethnically, linguistically, socially and economically (Kopytoff 1987, Lee and Hitchcock 2001). African hunter-gatherers include the Pygmies of central Africa, tropical forest foragers (Cavalli-Sforza 1986, Bailey and DeVore 1989), the east African hunter-gatherers, whose diverse homelands range from savanna to dry forests (Turnbull 1961, Woodburn 1970, Stiles 1981, Blackburn 1982, Ndagala 1988), the Mikea forest foragers of Madagascar (Kelly et al. 1999) and the Bushmen of the semi-arid savannas of southern Africa (Lee and DeVore 1976, Marshall 1976, Lee 1979, Biesele et al. 1989, Barnard 1992, Lee and Hitchcock 2001). Despite

the apparent diversity in origin and current circumstances, similarities do exist between these groups (Kent 1997). Each display features common to other societies in their region, and speaks local languages and adopts local customs while attempting to maintain their distinct cultural identity.

The two African groups that have captured the imagination of the world and that are the most intensely documented are the 200 000 Pygmies of central Africa and the Bushmen of southern Africa (Lee and Daly 2004). Like most African peoples, hunter-gatherer groups are not essentially restricted to specific countries. The Bushmen reside in six countries of southern Africa: Angola, Botswana, Namibia, South Africa, Zambia, and Zimbabwe (Hitchcock 1996, Robins et al. 2001, Suzmen 2001, Hitchcock et al. 2009). Pre-colonially, they are thought to have numbered over 250 000 and still number close to 100 000 today (Hitchcock et al. 2009). The Bushmen share physical characteristics and linguistic affinities with the pastoral KhoiKhoi, (Schapera 1930, Elphick 1977, Nurse and Jenkins 1977), and are collectively referred to as the Khoisan (Lee and DeVore 1976, Barnard 1992, Gall 2001, Beinart 2003). (See Appendix 2 for a basic classification of Khoisan peoples by language).

Southern African Bushmen are primarily known through the !Kung, specifically the Ju/'hoansi of Botswana and Namibia (Guenther 2006, Appendix 2). The abundant, much-referenced work of ethnographers working among the !Kung has made this particular Bushman group one of the most high-profile foraging groups and a paradigmatic representative of hunter-gatherer societies (Lee and Devore 1976, Marshall 1962; 1976; 1999, Lee 1965; 1969; 1979; 1984). The work of Richard Lee, a member of the 'Harvard Project" is featured in just about every anthropology text and reader (Guenther 2006) and as a result, the Bushmen tend to be equated with the !Kung, specifically the Ju/'hoansi (Barnard 2007). Extreme variability, however, is found in Bushmen social formations, with economics, societies and polities ranging from small to large, loose to tightly organised, egalitarian to politically centralised (Barnard 1992; 2007, Kent 1997, Guenther 2006). Such diversity has often been overlooked, partly due to researchers and people working with, or interested in, the Bushmen, being fixated by the !Kung. While others tended to only describe and analyse the particular group they were working on, rather than conducting comparative studies of several groups (Smith et al. 2000, Barnard 2007).

Furthermore, the prevailing theory that all Bushmen groups lived as simple, foraging and egalitarian societies until the turn of the previous century (Fritsch 1872; 1880; 1906, Passarge

1907, Wilmsen 1983; 1997) has been questioned (Smith et al. 2000, Barnard 2007). The debate, popularly referred to as the *Kalahari Debate* started in the 1980's after Edwin Wilmsens' 1989 publication *Land Filled with Flies* was released. Two radically opposed images of the Bushmen were presented. The one viewed the Bushmen as more or less isolated, culturally autonomous and politically free (Wilmsen 1989). Their foraging lifestyle was technologically simple, they were nomadic and possessions were shared. This was the traditionalist stance and was opposed by the revisionist viewpoint in which the Bushmen were considered as dominated by regional agro-pastoral state societies and as part of their incorporation into larger society, they too took on material traits and social values and institutions that revolve around accumulation, power and hierarchy (Barnard 2006).

This dichotomy in how the Bushmen were viewed affects how they were studied and thus recorded, throughout history (Robins 2001, Denbow 2009). Any comparison between contemporary findings and historical records is therefore complicated, making it difficult to understand and analyse current trends, especially those involving natural resource use, which, in this arid ecosystem, are time and space dependent (Noy-Meir 1973). The aim of this review is to summarise available records on the natural resource use by southern African Bushmen, focusing primarily on the Southern Kalahari Bushmen, so as to better construe current findings. Furthermore, due to their history of displacement and dispossession, there is now a dearth of information on the ethno-botanical knowledge of the Southern Kalahari Bushmen.

Southern African Bushmen

Historically, the Bushmen inhabited most of the subcontinent south of the Zambezi River (Lewis-Williams 1981, Dowson 1992). Their presence is attested to, archaeologically, in the hundreds of rock paintings and engraving sites related to Later Stone Age tool assemblages (Lewis-Williams 1981, Dowson and Lewis-Williams 1994). The Bushmen were the exclusive occupants of large expanses of the subcontinent, living in what was believed to be autonomous, nomadic groups in parts of the Kalahari and Namib Deserts (Biesele and Weinberg 1990, Solway and Lee 1990, Guenther 2005). For much of this period there is evidence of trade relations between the Bushmen peoples and their non-Bushmen neighbours (Phillipson 1985, Wilmsen 1983; 1989, Wilmsen and Denbow 1990). To the southwest they interacted with the closely related

KhoiKhoi pastoralists from whom they differentiated linguistically sometime before the first millennium AD; in fact, well over half of all the Bushmen today speak KhoiKhoi languages (Silberbauer 1981, Tanaka 1989, Beinert 2003). In the east and southeast they coexisted, intermarried, and were eventually assimilated with powerful Bantu-speaking chiefdoms that now form the majority of South Africa's population (Lee and Hitchcock 2001).

Generally, the Bushmen of southern Africa are grouped into the Central, Northern and Southern Bushmen (Barnard 1992). The details of the life and customs of the Southern Kalahari Bushmen, in particular, are sparse in comparison to the anthropological records of the other two Bushmen groups and the Khoisan peoples as a whole (Barnard 1992). Collectively, Southern Kalahari Bushmen contributed substantially to the genetic and linguistic make up of South Africa's majority population, but in recent centuries, has decreased substantially in number (Stow 1905, Schapera 1930, Barnard 2007). When they were first recorded, during the late 17th century, their way of life was already subject to pressures of cultural assimilation and warfare (Burrow 1801-4, Lichtenstein 1928-30 [1811-12], Campbell 1815; 1822). The ethnography of the Southern Bushmen was comprehensively recorded in the middle of the 19th century and deeply contested the classic 'Bushmen' of European imagination (Barnard 1992). The latter was a caricature of Cape Bushmen, biased toward mythology and folklore with such stereotypes continuously perpetuated through the writings of Sir Laurens van der Post (1958, van der Post and Taylor 1984).

By the end of the 19th century one of the best known Southern Kalahari Bushmen populations was the /Xam, belonging to the !kai language group (Bleek and Lloyd 1911). They inhabited several areas of the north western Cape Colony, south of the British Bechuanaland and were already dying out when first encountered by ethnographers (Barnard 1992). (See Hewitt (1986) for a overview and reconstruction of the unpublished Bleek and Lloyd texts and Barnard (1992) for an outline of /Xam social organisation and mythology). The //Xegwi of the eastern Transvaal are one of the least well known groups, with the short monograph by E. F. Potgieter (1955) serving as the only major source on the group. It describes their culture, language and genealogy. The /'Auni - ≠Khomani of the southern Kalahari, was the subject of intensive research in the 1930's (Dart 1937a, 1937b, Kirby 1936a; 1936b, Bleek 1937a; 1937b, Doke 1936). These studies mainly focused on their settlement and how it was arranged as well as their music, dances and games. Steyn (1984) visited the /'Auni - ≠Khomani area in 1982 and 1983 and discovered a remnant population still hunting and gathering there. Although they all identified themselves as ≠Khomani, all the members of the community then spoke Nama (Steyn 1984).

Natural Resource use by the southern African Bushmen

Subsistence use

For subsistence, the Bushmen relied entirely on natural products, meat obtained by hunting, and fruits and vegetables gathered in the form of edible wild plants (Story 1958; 1964, Silberbauer 1965, Tanaka 1969; 1978). Large game was the most favourable source of meat, but other sources included, hare, spring hare, guinea fowl, partridge, korhaan and ostrich (Lee 1968; 1969, Lee and DeVore 1976). Anteaters, aardvark, porcupines, tortoises, frogs, snakes and lizards were also depended on while locusts, scorpions, beetles, young bees and honey, termites, flying ants and ant's eggs have also been reported (Barnard 1992, Smith et al. 2000). Additionally, fish was caught and eaten by the Bushmen of the Okavango Swamps (Passarge 1905). According to Lee (1979) *"in fact all kinds of living animals are made use of as food, with the most universal exception of the baboon and the hyena – the former on account of its being so like man and the latter because it eats human corpses"*.

Studies on the use of plants by various Bushmen groups have also been conducted. Wehmeyer et al. (1969) described in detail the morphology and nutritional value of three plants used by the !Kung Bushmen of the Dobe area in the north of Botswana, as a food source, namely the mongongo or mangetti fruit (*Ricinodendron rautanenii*), the tsi bean (*Bauhinia eselllenta)* and the tuber, sa (*Vigna dinteri*). Heinz and Maguire (1974) surveyed the plant lore of a group of Bushmen occupying the Takatshwane valley in western Botswana. Here 192 species were recognised by one female collector, 68 of which provided food. They depicted the relationship between the Bushmen and their often inhospitable environment as strictly utilitarian. This particular group depended on plants for the making of most of their artefacts and everyday materials, relying particularly on the productivity of plants for most of their food and often for much of their water (Heinz and Maguire 1974). In '*The !Kung San: men, women and work in a foraging society'*, Lee (1979) inventoried plant resources utilised by the !Kung, documenting over 100 species. This included fruits and nuts, berries, gum, roots and bulbs, as well as 'rare' and 'problematic' plants.

Another extensive example of plant subsistence use includes that of Tanaka (1980) who studied the Central Kalahari Bushmen in Botswana in an area known as the ≠Kade Area for a period of two years. The author found that most species used by the Central Kalahari Bushmen were for food, medicine and material for various tools. He concluded that the number of species

used as food totalled 80, 11 of which constitute major foods although he mentions that had he extended his visit, this total would have been higher. Tanaka alleged that virtually 100 percent of the food used by this group of Bushmen consisted of wild plants and animals. He also described in detail the plants used for material culture (e.g. implements for hunting, drinking, digging, construction, clothing and ornaments in addition to musical instruments and toys). Steyn (1984) studied the subsistence ecology of the /'Auni - ≠Khomani of the southern Kalahari. He found them to focus on gemsbok (*Oryx gazella)* and non-migratory game, a relatively small number of dependable plant foods, although he fails to name how many, and a particular reliance on moisture-bearing plants, specifically the tsamma melon (*Citrullus lanatus*).

Both Tanaka (1980), and Heinz and Maguire (1974) as well as Lee (1979; 1981; 1984) mention that, despite the adverse consequences of frequent periods of drought in the Kalahari, plant foods are, more often than not, more regularly procurable than meat. In terms of energy returns, hunting is a less rewarding activity than gathering, and vegetable foods provide the major part of most hunter-gatherer diets (Lee 1979).

Medicinal use

Unlike in other African cultures, the Bushmen and the KhoiKhoi as a group do not worship their ancestors (Barnard 1992). They do involve the spirits of the dead in curing rituals, such as during the medicine dance, practiced by Bushmen and KhoiKhoi medicine men (Lee 1968, Marshall 1969, Katz 1976, Lewis-Williams 1992). Here, one or more men enter a trance state, in which they are believed to possess the power to remove illnesses from the bodies of those present (Eibl-Eibesfeldt 1974, Heinz 1975, Barnard 1992). These illnesses are then transmitted to a spirit, who takes them away. Although the Bushmen people generally consider the essential nature of spirits to be evil, in this sense, the spirits are invoked as good (Barnard 1979).

The earliest inventory of medicinal plant use by the Southern Bushmen appears to be the Bleek and Lloyd collection, an archive of /Xam oral literature and ethnography collected by W.H.I Bleek and Lucy C. Lloyd between 1870 and the early 1880's (Prada-Samper 2007). Entry 109 of Wilhelm Bleek's '*A brief account of Bushmen folk-lore and other texts'* (1875) reads:

'Different Bushmen Medicines; where found; and their uses . . . only the names of these medicines are given in Bushmen, and the remarks respecting them in English . . . These specimens were found in the hut of a Bushmen sorcerer. . .'

Medicine men were, mostly, men who cured with either herbal medicines or by trance or who harmed people through sorcery (Barnard 1979, Lewis-Williams 1992). Disease was considered an amorphic substance, of which there were many different types (i.e., the different kinds of diseases, that occurred naturally or as a result of sorcery by a person or a spirit). Just as there are good and evil spirits, good and evil medicine also existed and those medicine men who were skilled in good medicine often knew how to make evil medicine too (Barnard 1979). Furthermore, physical medicine made use of tangible substances, and can be good or evil. Spiritual medicine required the medicine man to enter a trance state (Barnard 1979; 1992, Lewis-Williams 1992). Most Bushmen groups believed that spiritual medicine required cooperation, either wiling or unwilling, of a dead person's spirit.

The 'good' physical medicine involved natural substances extracted by the medicine man from plants or, at times, animals and administered to the patient (Barnard 1979). Generally, these plant extracts were prepared by boiling the roots or leaves in water or by scorching the leaves of a specific plant and then rubbing the resultant substance into the patients' skin. A variety of ailments were cured or treated by using the various parts of numerous plants, all prepared in different ways. Barnard (1979) was of the opinion that any medicine could be prepared and used by the patient themselves and not necessarily by an herbal medicine specialist. Greater skill, however, was required to prepare rain medicine used to invoke rain (Lee 1968, Katz 1976, Barnard 1979). Similarly, the use of charred leaf substances was also commonly left to the more experienced medicine men. *Grewia flava* leaves or those of *Acacia erioloba*, if the former was unavailable were partially burnt and blackened, ground, and then applied to incisions made on the patient's skin to relieve pain or to promote healing (Bleek 1928, Heinz 1966, Marshall 1969).

When herbal treatments or the application of charred leaves failed, curing rites were performed in the form of medicine dances. These were held at auspicious occasions, such as after a successful hunt, following good rain or at full moon. Frequently, upon the arrival of a huge number of visitors from another band and especially upon the arrival of a renowned medicine man, these medicine dances were held, while they were very rarely performed specifically for treating a single individual (Marshall 1962, Heinz 1966, Lee 1968, Katz 1976, Barnard 1979).

Medicinal plants and their uses by Bushmen have remained poorly understood (van Wyk and Gericke 2000, von Koenen 2001, Prada-Samper 2007). This led van Wyk (2008) to conceptualise the unique healing system of Cape herbal medicine by compiling the first *materia medica* based on KhoiKhoi and Bushmen cultures fused with European influences. Studies on specific species as medicine plants have also been conducted. Examples include that of Gericke and Viljoen (2008) on *Sceletium* species. They found these plants to have a wide range of uses including that of a masticatory, tea, appetite suppressant, sedative, hypnotic, analgesic and mood-elevator. This followed up on the first ethnopharmacological review of this genus by Smith et al. (1996) which led to the establishment of commercial *Sceletium* plantations in order to address the need for sustainable supplies of this high quality raw material. Despite the dangers of the commercial exploitation and biopiracy of Bushmens' traditional ecological knowledge, they have, at times, shared their knowledge of wild plants. *Hoodia gordonii*, a spiny succulent used traditionally, has significant commercial value as an appetite suppressant and water source. (see Appendix 3 for an overview of the Bushmen-*Hoodia* case).

Conclusion

By the end of the 19th century, Africa and the Bushmen had not yet been studied by the anthropologists and ethnographers and the main sources on the continent and its peoples came from travelogues and romantic literature (Barnard 2007). African exploration, especially adventures through the Kalahari, and involving the Bushmen, include travelogues Livingstone 1912 [1857], Galton 1853 and Anderson 1856. Tabler (1973) recorded 333 biographies of self-proclaimed 'pioneers' of the region. Even more popular were African romances (Barnard 2007), a genre invented and made fashionable by H. Rider Haggard (e.g. include *King Solomon's Mines* (1885) and *She* (1887). Although these and many other successful African romances were novels, based on realistic tales, they were *"more fanciful, sometimes, mystical, and related to the later developments of science fiction and sword and sorcerer"'* (Barnard 2007). Initially, during the Victorian Era and the first few centuries of contact, the Bushmen and the Khoisan as a group, were more commonly displayed through artwork than literature (see Stow 1905, Stow and Bleek 1930, Schapera 1930, Steyn 1981, 1990, Smith and Pheiffer 1993, Gordon 1997, Barnard 2007).

Most historical accounts record the Bushmen as having lived for millennia without any substantial alteration in their manners of existence (Volkman 1986, Barnard 2007). The foundation of their nomadic, hunter-gatherer lifestyle is largely influenced by the need to survive as an intrinsic part of nature, and not as conquerors thereof (Gall 2001, Bregin and Kruiper 2004). Hunter-gatherers have also been described as accepting nature and adapting to it as they encounter it, in contrast to pastoralists who surmount and transform nature so as to feed their expansionist desires (Brody 2001). Leadership by any one individual was an unknown concept in Bushmen society, rather, and in all matters, whether it was medicine and healing, custom and ritual, trading, politics or hunting, leadership was shared amongst different individuals (Marshall 1999, Chennells et al. 2009). All myths, laws, norms and customs were orally preserved and transmitted, while institutional arrangements were circumstantially determined under informal and flexible contexts (Barnard 1992, Tanaka 1980, Bregin and Kruiper 2004). Conflict in any form was frowned upon, and the withdrawal of any individual from a conflict situation was the accepted and culturally appropriate response (Marshall 1976; 1999, Chennells et al. 2009). Their gentle and humour-loving nature is what led Lorna Marshall to name them the 'harmless people', traits that make them fundamentally ill-equipped to compete in a money-orientated society (Marshall 1976).

The Bushmen of southern Africa are considered the oldest inhabitants of Africa and the progenitors of all of mankind. They lived in small family bands of hunter-gatherers for millennia as the sole occupants of the region in non-hierarchical, egalitarian social arrangements. They practiced a nomadic way of living, moving from place to place depending on provisions and thus neither the specialisation nor the storing of surplus food was feasible. The rise and spread of agriculture and later of territorial invasion by Bantu tribes and European colonialists led to extensive periods of genocide and slavery, resulting in a loss of land and consequently to extreme poverty and marginalisation and a loss of identity. The Bushman egalitarian and consensus-based hunter-gatherer way of life had to adapt to rapid sedentarisation, resulting in societal breakdown and culture loss. In keeping with modern politics, groups have been forced to elect leaders, which in turn have led to the formation of new elites and ultimately the associated jealousies and power struggles related to present day political and social life. Some believe that their hunter-gatherer legacy leaves them significantly incapacitated to better themselves materialistically while others regard the consensual nature of decision-making in non-hierarchical nomadic societies as being pivotal to their continued powerlessness.

Significant variation, however, exists among Bushmen groups and this has often been overlooked (Guenther 2006). The *Kalahari Debate* puts forward two radically opposed images of

the Bushmen. These two positions, postulating the reasons for the modern-day vulnerabilities of the Bushmen, pitch the 'traditionalist' stance against that of the 'revisionists'. The traditionalists consider the Bushmen as vestiges of our early man, ancient hunter-gatherers who have lived in isolation and in harmony with nature. Until recently, they have remained resilient to changes and their culture has remained static over time. Conversely, the revisionists essentially view them as an impoverished underclass, constant victims of an unrelenting war waged against infiltration and more dominant peoples. Two visions, one of independence, equality as well as social and ecological harmony versus a vision of dependence, oppression and adoption of patterns of inequality.

An important feature to this discourse is the temporal aspect, since our portrayal of the Bushmen has changed over the last century. Man's fascination with our hunter-gatherer origins and the primitive or exotic has idolised the Bushmen in popular culture, positioning them in the anthropological literature and in film media and artistic representations of ancient Africa. They are seen as exemplars of environmental use, custodians of plants and animals due to their deep understanding of their surroundings, in addition to their superior native skills and ingenuity, lack of interest in material possessions coupled with spiritual insight. They are also viewed as the most oppressed, impoverished and marginalised victims in southern Africa, having lost their cultural values and traditional lifestyle and their language.

Whatever the view taken, a common misconception is that there is homogeny amongst the Bushmen. Although similarities do exist in language, mythology, use of resources, and social structures, there is in no way uniformity.

Chapter 4

An ethnobotanical survey of wild plant use by the ≠Khomani Bushmen of the southern Kalahari

Abstract

The study investigates wild plant use by the ≠Khomani Bushmen of the southern Kalahari. Over 90 individuals were interviewed in months preceding and following the region's rainy season on six farms awarded to the community in a land claim settlement. The information was gathered through semi-structured interviews. In total, 59 species from 28 families and one fungal species were found to be commonly in use. Medicinal plants were most frequently cited (60%), with edible plants comprising a further 20%. Participants mentioned on average 7.01 ± 1.10 species per person. Similar patterns of plant use were found between young and old people, while no significant difference in plant use occurred between genders. Learning about wild plant use occurred at an early age, with this knowledge acquired practically in the field.

Keywords: frequency of use, medicinal use, semi-structured interviews, traditional knowledge

Introduction

To promote the ongoing, healthy functioning of ecosystems and their processes, we need to recognise the value of traditional ecological knowledge (Cunningham 2001). An ethnobotanical study, scientifically assessing the dynamic relationship between people, biota and their environment (Berlin 1992) can provide new insights into ecological processes, supply new directions for conservation monitoring and evaluation and offer significant benefits for natural resource management (Berkes 1999, Berkes et al. 2000). Furthermore, the incorporation of traditional ecological knowledge, involving ecological relations, into ecological and biological studies, strengthens the link between man and the environment, potentially shedding light on sustainable resource use (Jarić et al. 2007).

A central challenge for sustainable living is balancing the individual use of shared natural resources with sustaining the 'public goods' inherent in resources. Indigenous groups have been studied, by conservation scientists and anthropologists, to establish knowledge bases and norms on which to premise ecologically sustainable relationships and give deeper insight into finding that balance (Nabhan 1997). The literature shows that indigenous knowledge and practices can contribute to the conservation of biodiversity (see Gadgil et al.1993 and Becker and Ghimire 2003 for a review). Additionally, indigenous knowledge has been shown to contribute to the conservation of rare species (Colding 1998), protected areas (Johannes 1998), and ecological processes (Alcorn 1989) and to sustainable resource use in general (Schmink et al. 1992, Berkes 1999). Local communities and indigenous peoples play a central role in biodiversity management (Mauro and Hardison 2000), since their use of natural resources is an everyday practice, while the frequent use of these resources indicates an extensive knowledge thereof (Berkes et al. 2000).

Broadly defined, the term indigenous knowledge refers to local knowledge held by indigenous peoples or local knowledge unique to a particular culture or society (Berkes et al. 1995) and is used interchangeably here with traditional knowledge. Traditional ecological knowledge is a subset of indigenous knowledge and is a cumulative body of knowledge, beliefs and practices, evolving by adaptive processes and transferred through generations by cultural transmission and specifically pertains to the relationship of people with one another and with their environment (Berkes 1993, Gadgil et al. 1993). Furthermore, indigenous knowledge is an attribute of societies with historical continuity in resource use practices (Dei 1993, Williams and Baines 1993).

Ecologically, not all traditional practices are sagacious and communities have been shown to cause environmental degradation (Diamond 1993; 2003, Krech 1999; 2005). However, communities have been shown to persist in their areas using detailed adaptive indigenous knowledge (Mauro and Hardison 2000, Borgerhoff-Mulder and Coppolillo 2005, Nyong et al. 2007). The manner in which many indigenous peoples have conceptualised and acted in their environment are expressions of possible ways of endowing the world with meaning and self-fulfilment that offer alternative values to the dominant consumptive ideals of Western societies (Cocks 2006, Hunn 1999).

Wild plant use is a fundamental element of traditional ecological knowledge and is based on traditions and oral transmissions which are inevitably vulnerable to decay and transformation through globalisation (Brodt 2001). Such knowledge is influenced by aspects such as gender, age

(e.g., Begossi et al. 2002, Garro 1986), kinship (e.g., Ohmagari and Berkes 1997), bilingualism (e.g., Berlin 1992), and degree of acculturation in addition to other socio-cultural factors (Atran et al. 1999, Benz 1994), all of which may generate variability in a particular context. Due to the fast pace of acculturation and urbanisation in rural South Africa (Cox et al. 2004), the ethnobotanical documentation in an area not previously studied is important. Regarding conservation and sustainable and equitable use of plant resources, such documentation can also make a valuable contribution to the scientific base for management decisions and policy implementation.

In southern Africa, rural households harvest and process a wide variety of plant resources for both domestic consumption and sale (e.g. Clarke et al. 1996, Cunningham 1997, McGregor 1995, van Wyk et al. 1997, Shackleton et al. 2000, Shackleton and Shackleton 2000, Dold and Cocks 2002). Poorer and more vulnerable households, such as those headed by women, are more dependent on natural resources and tend to use a greater abundance and variety of resources compared to households that have access to income (Campbell et al. 1997, Shackleton and Shackleton 2004). Southern Africa has over 30 000 species of higher plants, with an estimated 3 000 species being used for medicinal purposes in South Africa and a further 650 for fuel wood, construction, food plants in addition to those used for skills and crafts (van Wyk et al. 1997).

Not only is knowledge of these plants critical for their direct uses, but also for ensuring their conservation. Plant knowledge is also important from a cultural perspective due to the threat of poor intergenerational transfer, thus making the documentation of this knowledge critically important, especially for future generations who may need this information (Thring and Weitz 2006). Finally, where plants are under threat as a result of over-harvesting, measures must be employed to try and ensure sustainable utilisation of useful species.

Several sources of information exist in the literature that focuses primarily on medicinal plant use in South Africa (Watt and Breyer-Brandwijk 1962, Watt 1967, Cunningham 1988, Hutchings 1989, Hutchings et al. 1996, Mander 1998, van Wyk et al. 1997, and van Wyk and Gericke 2000). The country's diverse assemblages of people depend on a variety of medicinal plants for the treatment of ailments in both humans and animals (Masika and Afolayan 2002). According to Stafford et al. (2008) traditional healers make use of a plethora of plants to treat various mental illnesses, while numerous remedies are believed to cure external wounds and ailments, diabetes, gynaecological complaints even venereal diseases (Kelmanson et al. 2000, Steenkamp 2003, Erasto et al. 2005, Buwa and van Staden 2006). Indigenous medicines are also used to enhance

personal wellbeing, serving a number of traditional beliefs ranging from blood cleansing to removing poison inflicted through witchcraft (Cocks and Møller 2002, Ndawande et al. 2007). van Wyk and Gericke (2000) provide a broad review of plants used as food and other more general purposes. Very little, however, has been recorded on the traditional plant uses by the Bushmen (van Wyk 2008) and available information is dispersed generally throughout the literature (Watt and Breyer-Brandwijk 1962, Smith 1966, Eiseb et al. 1991, van den Eynden et al. 1992, Rood 1994, Shearing and van Heerden 1994, Thring and Weitz 2006, van Wyk et al. 1997, van Wyk 2008).

Comprehensive studies on plant use by Central and Northern Kalahari Bushmen were conducted by Tanaka (1980); Lee (1979; 1981; 1984) and Heinz and Maguire (1974) who found that plants were primarily used as a source of food and water. Findings are highly dependent on time and space however, salient dimensions in such an arid environment. Steyn (1984) attempted a reconstruction of the southern Kalahari Bushmen ecology, in 1982 and 1983, based on information provided by a few individuals residing in the Rietfontein and Welkom (Northern Cape Province) area at the time. He noted that although they no longer practiced a hunter-gatherer lifestyle, they had been raised to lead such an existence and had retained knowledge of that tradition. The most commonly used plants, by Bushmen in the area, were for food and water and to a lesser extent, for subsistence technology. Steyn (1984) emphasised that the southern Kalahari Bushmen, like the central (Tanaka 1980) and the northern (Lee 1979; 1981; 1984, Heinz and Maguire 1974) Kalahari Bushmen practised a basic division of labour. Men were the hunters and women had the main subsistence task of gathering plant foods and fuel wood.

The only mention by Steyn (1984) of plants used as medicine was that of *Citrullus lanatus*, commonly known as the tsamma, the root of which was also used for stomach ailments. Steyn (1984) concluded that hunting played a more important subsistence role for the southern Kalahari Bushmen, more so than among the central and northern groups. This was due to the abundance of wild game in the area and the fact that the range of dependable plant foods was relatively small (Bothma and De Graaff 1973, Keith and Renew 1975). Permanent water sources were available for brief periods only, therefore moisture-bearing plants such as *Citrullus lanatus* and *Acanthosicyos naudinianus* were permanent features of the southern Kalahari Bushmen plant use (Steyn 1984). Although the extent of the role played by these species was never recorded, they were undoubtedly a main source of water. According to MacCrone (1937) the tsamma (*Citrullus lanatus)* "*forms the staple part of their food and drink especially in lean times . . . a man can live for six weeks on an exclusive diet of tsamma . . .*" Herbst (1908) also indicated their indispensability

by describing the southern Kalahari as a " *waste land . . . an absolute desert closed to man should the tsamma fail*".

In an ethnobotanical study performed by Gedif and Hahn (2003) in rural central Ethiopia, plants were found to be in common use in traditional medicine. Here mothers were interviewed due to them being the healers of the family as is the case in many developing countries (Gedif and Hahn 2003). Twenty-five species out of 21 plant families were found to be used with a third of these species being available in Ethiopian markets and already have recorded uses in cooking (Gedif and Hahn 2003). In a survey conducted in Mexico, 119 people were interviewed, 88 of which stated that they relied on plant-based medicines to treat stomach conditions. This information was gathered using informal interviews and then semi-structured interviews. In this case, a wide range of people were interviewed, such as housewives, farmers and healers (Herńandez et al. 2003). In Central Serbia, an ethnobotanical survey was carried out in the Kopaonik mountain territory, an area characterised by great plant diversity. In total, 83 wild species from 41 families were recorded for medicinal use. The most frequently reported medicinal uses were for treating gastrointestinal ailments, skin injuries and problems, followed by respiratory, urinary-genital and cardiovascular problems. Additionally, 10 wild species were recorded as being used in veterinary medicine, as well as 25 herbs used for human nourishment (Jarić et al. 2007). Malasar tribals from various tribal villages of Coimbatore district, Tamil Nadu, India were surveyed and a total of 75 species of plants belonging to 71 genera and 40 families were reported for medicinal purposes, using standardised questionnaires among 15 tribal informants between the ages of 48 to 74. The study showed a high degree of ethnobotanical novelty while the use of plants among the Malasars reflects the revival of interest in traditional folk medicine (Venkataswamy 2010)

In the southern Overberg region of South Africa over 40 individuals were interviewed using questionnaires. In total, 36 plant species from 19 families were found to be in general use in the area with only 58% being indigenous to the country. The dominant families were Asteraceae, Lamiaceae, Alliaceae and Solanaceae. Many of the plants recorded are commonly used in traditional medicine around South Africa and share many of the same uses. For this region in particular *Artemisia afra* and *Ruta graveolens* were the most popular species (Thring and Weitz 2006). In the south eastern Karoo in the Graaff-Reinet and Murraysburg regions, a survey conducted by van Wyk (2008) on elderly people of Khoisan and Cape Dutch decent recorded a wealth of traditional knowledge on medicinal plants and their uses. Here 86 species, most of which appear to be still in everyday use were recorded while the use of exotic plants (12 species) have

noticeable similarities to the Xhosa healing culture indicating that the traditional system is dynamic and adaptive. Plants cited the most were those used as medicines to treat problems of the stomach, back, kidneys, bladder, as well as colds and other minor ailments. The study also presented an overview of the most important plants and their uses, which shows several interesting records that have previously remained undocumented.

The ≠Khomani Bushmen were entirely dispossessed of their ancestral land during the colonial and Apartheid era (Beinart 2003) and dispersed over the subcontinent (Kepe et al. 2005, Chapter 2). They became thoroughly fragmented as a group while their freedom to hunt and collect bush foods declined and practices and rituals began to fade (Chennells 2002). Following the end of Apartheid in 1994, a land claim was lodged, which was ultimately settled in 1999, affording the ≠Khomani recognition of their land rights in the form of six farms and land use rights within the KTP (Chennells 2002, MacKay 2002, Chapter 1). The ≠Khomani were dispossessed of their land, ultimately reinstated and now entitled to the restoration of those rights to land uses, provided that it is congruent to the prevailing practices of SANParks (Kepe 2005, SANParks 2006).This study aimed to identify the most important plants currently used for day-to-day needs within the ≠Khomani community of the southern Kalahari. The underlying assumption here is that members of this community possess a rich but dwindling knowledge of plants with the loss of this knowledge potentially leading to unsustainable resource use, cultural breakdown and dependence on other resources.

Methods

Study area

The study was conducted in the southern Kalahari, a semi-arid region with an average rainfall of 150 mm in the southwest to 350 mm in the northwest (Figure 1). The unreliable and irregular rains fall between November and April, during dramatic thunderstorms accompanied by strong winds and dust-storms. Annual average temperatures range from 4 to 32 °C with winter lows dropping to -11 °C and summer highs reaching 45.4 °C (van der Walt and le Riche 2001, van Rooyen et al. 2008).

Although seven major vegetation types occur within the study area (Mucina et al. 2006), the southern Kalahari is fairly homogeneous and can be broadly classified as a bioregion characterised by *Acacia erioloba, Rhigozum trichotomum* and *Schmidtia kalihariensis* (van Rooyen 2000). The vegetation structure is predominantly shrubby grassland.

Topographically and edaphically, the area can be divided into dunes, sandy plains, rivers and pans. The southern Kalahari is described as a floristically impoverished area with a relatively low number of species and a low level of endemism, the vegetation and landscapes around pans and along the rivers being most diverse (van Rooyen et al. 2008). The checklist compiled by van Rooyen and van Rooyen (1998) for the then KGNP (the South African portion of the KTP) contains 397 plant species representing 191 genera and 51 families.

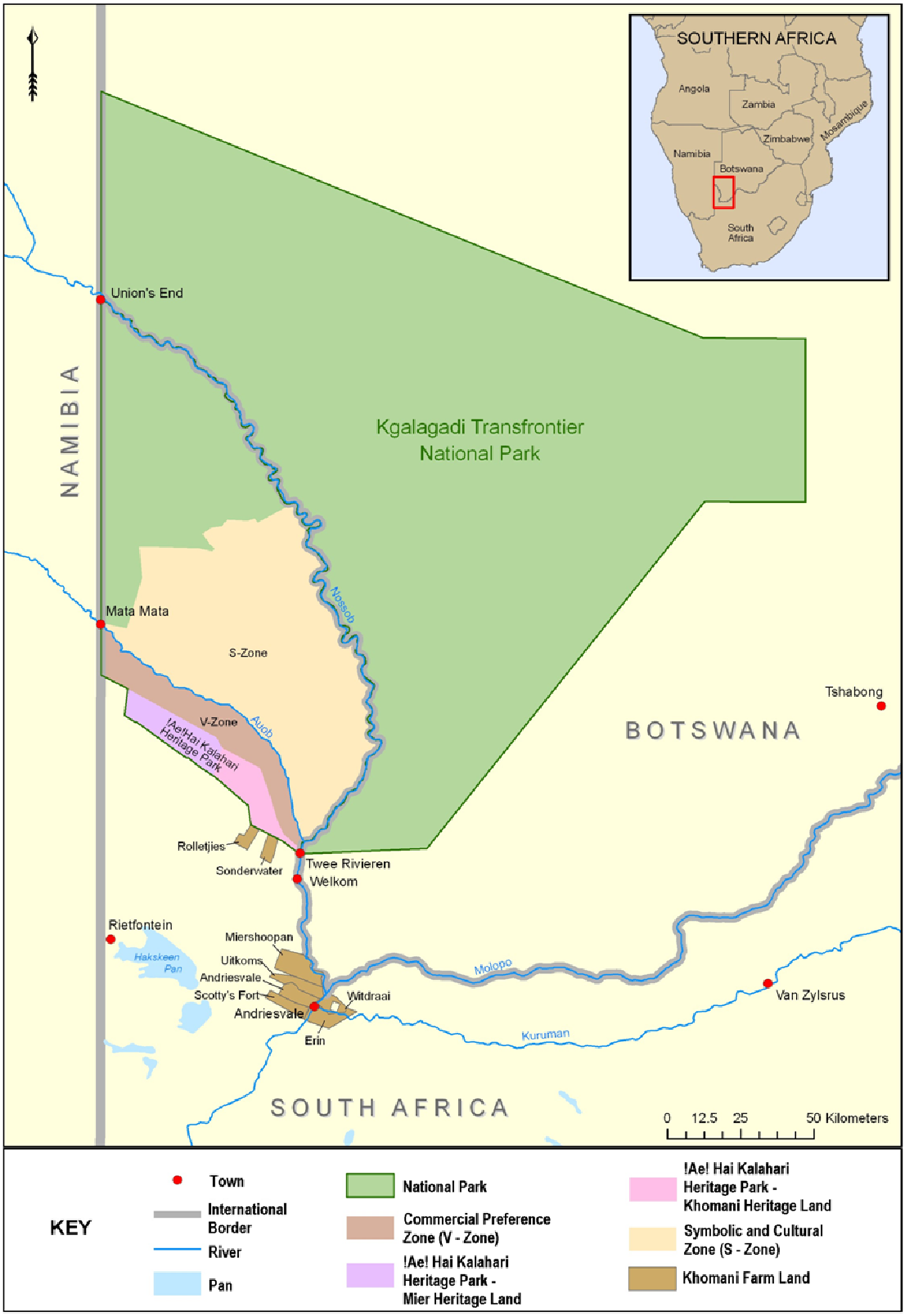
The study sites comprise six farms awarded to the ≠Khomani in their 1999 land claim (Chennells 2002) covering some 37 000 hectares, and are located to the northwest of the town of Askham (26°58'52" S; 20°46'56"E) in the Siyanda District of the Northern Cape province, South Africa. Eighty-one percent of the people in this district speak Afrikaans, while the population density of the Northern Cape Province is two inhabitants per km^2 (www.northern-cape.gov.za accessed June 2009). The economy of the area is based on livestock farming, handcrafts and tourism (Community Survey 2007 www.statssa.gov.za accessed June 2009). An information and health centre and a police station are situated at Witdraai while schools, clinics and shops are located in both Askham and Rietfontein.

Ethnobotanical survey

Ethnobotanical studies were undertaken on the farms as well as in the surrounding settlements of Rietfontein, Welkom and Twee Rivieren. Apart from Rietfontein and Erin, these are all situated on the road (R31) between Askham and the entrance to the KTP, Twee Rivieren (Figure 1). The fieldwork was conducted during August and September 2009 (spring) and repeated in April and May 2010 (autumn) subsequent to the region's rainy period to account for possible seasonal variation. A special characteristic of the Kalahari ecosystem is the occurrence of a large number of ephemerals, annuals distinguished by a short life cycle, and which provide valuable resources to both man and animal (Eloff 1984). Face to face interviews were conducted in Afrikaans to allow for the capturing and accurate recording of subtle nuances that would normally be lost during interpretation and translation.

All the homes on the farms and the surrounding towns/settlements were visited and one respondent per household (the household head, or the person responsible for the dwelling) was approached and invited to participate in an interview. An estimated 150 households belong to the ≠Khomani community and reside in the area. In some cases, people refused, requested payment, or, occasionally, the house was unoccupied during the research period. The remainder participated voluntarily and were at least 18 years of age. A total of 94 people were interviewed in 2009 during the first round of interviews and 86 people in 2010.

The study had been outlined and the fieldwork explained in detail to the community representatives and SANParks employees during the pilot visit to the area in June 2009. It was appealed that the details be explained to the rest of the community by the representatives. During fieldwork, introductions were made and the purpose of the visit explained again before initiating the interviews. During the second round of interviews the reason for repeating the interview, which was to factor in any differences with regard to seasonality, was explained to the participants. Here, respondents were simply asked what they were using at that time and were not asked to differentiate between plants used pre- or post-rainy season.



(Source: Katharina Dierkes)

Figure 1 Map of study area depicting the farms and settlements where interviews were conducted

The questionnaire comprised a basic demographic section (background on the interviewees themselves) and plant use sections, and used a combination of open-ended questions and Likert statements (Likert 1932). (See Appendix 4 for questionnaire template).

All plants were identified by their common name and were later taxonomically classified. Plants were classed as native or exotic in accordance with their bioregional origins. Plants obtained outside the local area but native to the Kalahari were classed as native. Species were classified following the nomenclature of Arnold et al. (2002) and categorized as food, medicine, cultural, art, fuel wood and household use (Table 1). A combination of observation, casual discussions and informal interviews provided additional insight to interviews and involved partaking in activities such as the gathering of wild plants and walkabouts with community members.

Table 1 Plant use categories (van Wyk and Gericke 2000)**.**

Category	Definition
Medicine	plants used to treat therapeutic effects and ailments, including tonic plants and psychotropic plants
Food	edible roots, bulbs, tubers, fruits and berries etc in addition to plants used for water and beverages
Household	all plants and parts thereof utilised to construct living structures and/or to clean with
Fuel wood	plant species used as fuel for cooking, lighting and heat.
Art	plant species and/or parts thereof utilised to make jewellery, decorative objects and crafts

Analysis of ethnobotanical data

The sampling effort and quantification of species richness cited by the ≠Khomani Bushmen was tested using an accumulation curve performed with the assistance of the EcoSim 700 programme (Gotelli and Entsminger 2000). In order to evaluate consensus among individuals the number of people who cited a plant species as useful was simply counted. This was then documented as the consensus index for each plant species. Additionally, the Mann-Whitney test ($p < 0.05$) was used to compare differences in numbers of plant species used between men and women (Höft et al. 1999). Use of species across gender was compared using the Jaccard Index. The Spearman correlation coefficient was used to analyse plant knowledge (i.e., number of plant species cited) in relation to age and gender (Höft et al. 1999). Nonparametric tests were utilised as the data were not normally distributed.

Results and Discussion

Plant species used by the ≠Khomani Bushmen

The accumulation curve of utilised plant species richness reached an asymptote (Figure 2) suggesting that by adding more respondents, no significant increase in plant richness would be observed. It was thus concluded that the estimation of ethnobotanical knowledge was based on an adequate sampling effort. In addition, this finding indicates that there is a clear consensus with regard to existing ethnobotanical knowledge in this population.

Plants are used on a daily basis in more than 30% of cases (2009 = 34%; 2010 = 36%; N = 94 and 86, respectively) and a further third of households reported weekly use (2009 = 33%; 2010 = 31% (Figure 3). When asked how frequently plants were collected, the most common response was monthly (2009 = 40%; 2010 = 44%) while 32% and 20% of respondents in 2009 and 2010 respectively, do not collect their own plants (Figure 4). In more than 60% of households, plant collection occurs throughout the year, with most people responding that "*plants are collected as and when they are needed"*, while less than 20% of collections occur after the area's rainy period (Figure 5). In both seasons, before and after the rains, the most frequently reported use was for medicinal purposes (60%). This is in contrast to Steyn's (1984) findings, in which plants were recorded as primarily being used for water and food in this area. Edible plants comprised less than

20% of all plants used; while fewer than 2% of the citations were classified as cultural use, and were used to ensure good luck and spiritual protection (Figure 6).

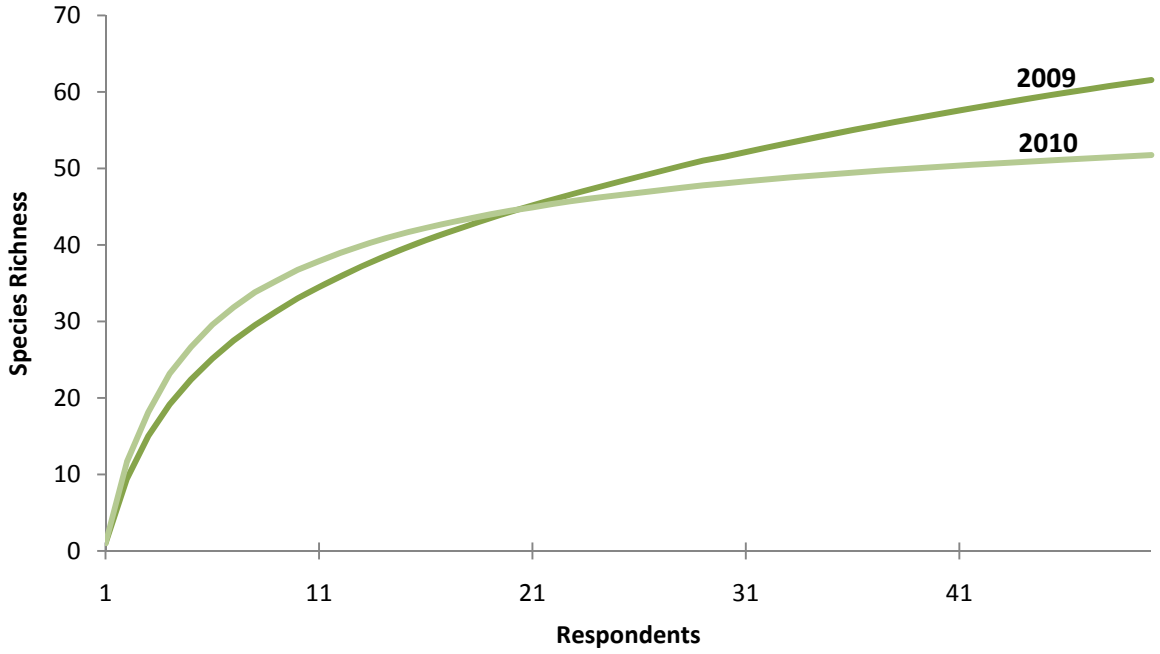


Figure 2 Accumulation curve based on the number of plants cited per respondent (N_{2009} = 82; N_{2010} = 77)

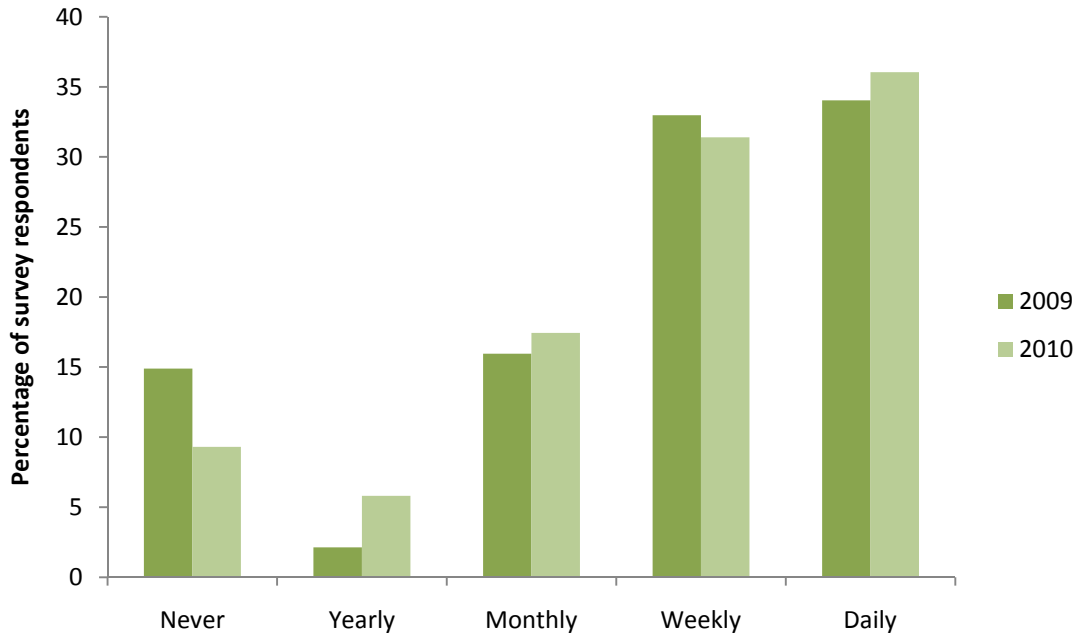


Figure 3 Frequency of wild plant use by all ≠Khomani Bushmen survey respondents during the 2009 and 2010 study periods, expressed as a percentage (N_{2009} = 94; N_{2010} = 86)

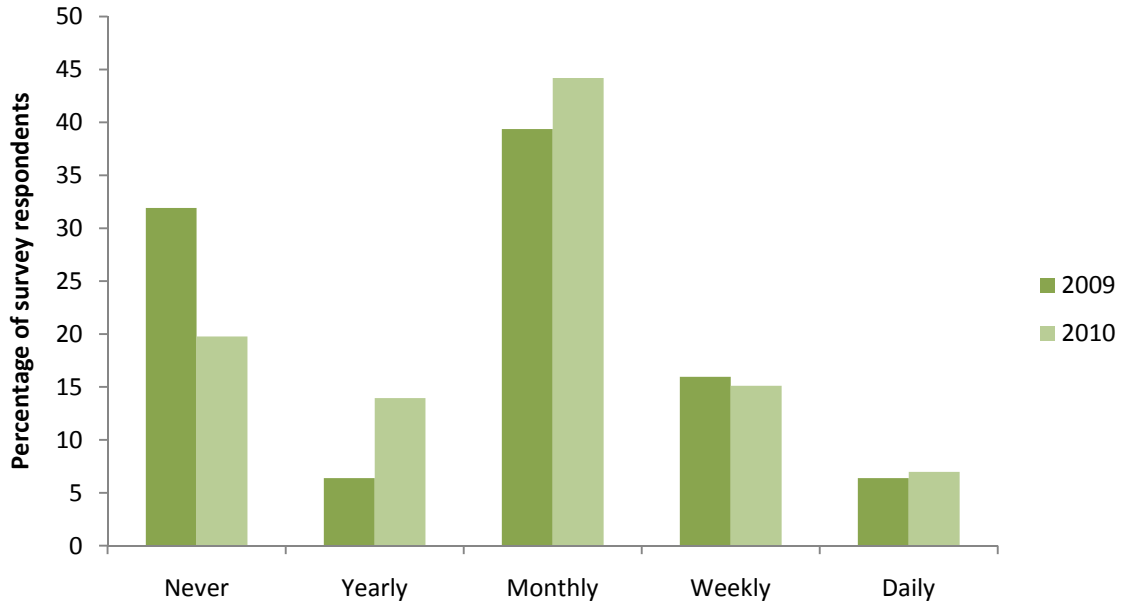


Figure 4 Frequency of wild plant collection by all ≠Khomani Bushmen survey respondents during the 2009 and 2010 study periods, expressed as a percentage (N_{2009} = 94; N_{2010} = 86)

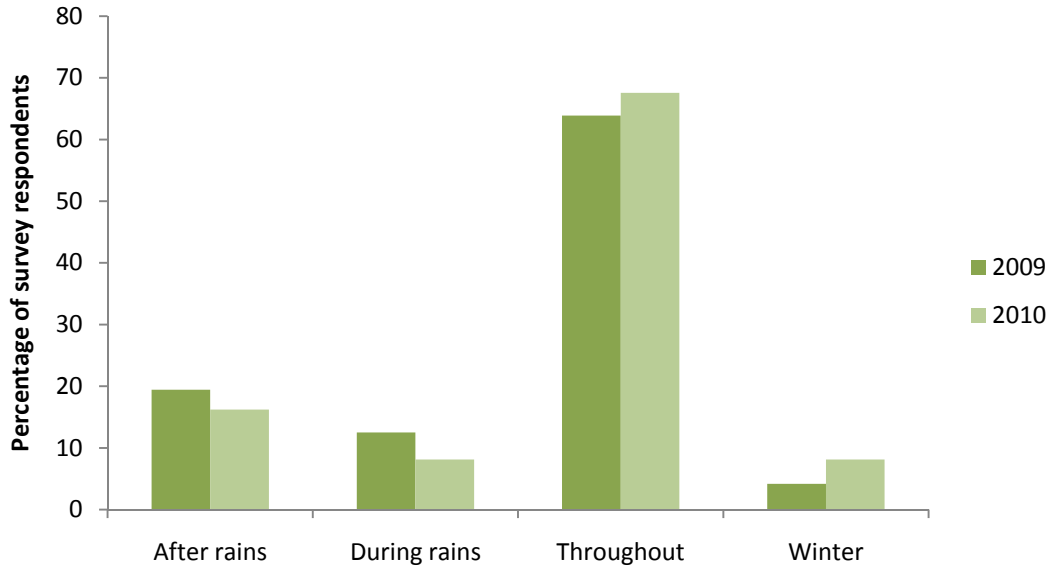


Figure 5 Period of the year when those ≠Khomani Bushmen survey respondents who do use wild plants, cited that they collect wild plants (N_{2009} = 82; N_{2010} = 77)

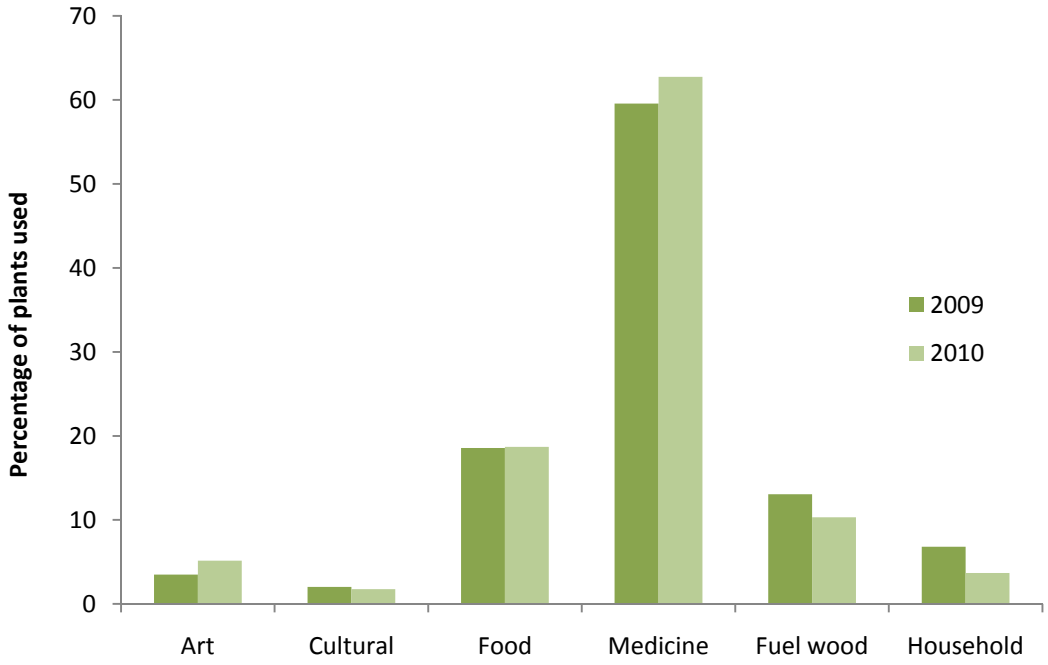


Figure 6 Percentage of wild plants used by ≠Khomani Bushmen survey respondents who do use plants classified according to plant use category (N_{2009} = 82; N_{2010} = 77)

Plant species used included both native (55 spp.) and exotic species (4 spp.), giving a total of 59 species from 28 families in 2009. Data collected after the rainy season showed a decrease in richness, with 44 plant species cited, 5 exotic species, totalling 49 plant species from 25 families and one fungal species (Table 2). Based on growth forms, plant species were classified into dwarf shrubs, shrubs, grasses, herbs, succulents and trees (Table 3). The majority of the species used are herbs (29%) and shrubs (19%). The most common plant part used is the stem (33%), with roots (25%) and leaves (24%) also comprising considerable portions (Table 4).

In spite of present day access to Western medicine, respondents frequently cited medicinal plant use, referring to species like *Harpagophytum procumbens* subsp. *procumbens* as an overall cure and general immunity booster (Figures 7 and 8, consensus index = 59 and 65 in 2009 and 2010, respectively). While *Dicoma capensis* appears to be the cold and flu remedy of choice, with a consensus index of 36 before the rainy season and 44 thereafter (Table 2). Plants with several reported uses include *Acacia erioloba* which is used as fuel wood and for construction, the seeds are roasted and crushed and used as a coffee substitute or in porridge. Others use the burnt seeds as crafts while some reported medicinal use of the gum. The pods are also used as fodder for goats (Figures 9 - 12). The roots of *Boscia albitrunca* are edible and also used in porridge or roasted and ground to be used as coffee. Some use the fruit to brew beer while many cited medicinal properties of the leaves and roots. The tree provides shade for humans and animals. Another plant with many uses is *Elephantorrhiza elephantina* the leaves of which are primarily used as a medicine. The rhizomes are used to dye animal skin, while some burn and grind the pods and use it as coffee.

The ≠Khomani Bushmen were recorded as using 5.91 ± 5.40 species per person on average in 2009 and 8.13 ± 6.26 per person in 2010 (Figure 13). No significant difference in plant use was found between men and women (Mann Whitney test, $p < 0.05$). On average, men cited more plants than women (Figure 14). When comparing species similarity across gender, a 35% agreement (Jaccard Index) was found in 2009 and in 2010 a 33% agreement. When analysing gender consensus through the Spearman correlation, to assess whether there is any variation in plant use based on gender, a weak positive association of the cited species was found ($r_{2009} = 0.11$, $p < 0.05$ and $r_{2010} = 0.19$, $p < 0.05$). This indicates that there is variation in terms of plant use between the sexes, with only a third of the plants used, overlapping. Several studies have shown that gender is a trait that frequently generates intracultural variation, given that women are the main gatherers (e.g. Garro 1986, Begossi et al. 2002). However, this study, found that men use more plants on average.

The total number of plants cited by the ≠Khomani was not correlated to age ($r_{2009} = 0.09$, $p < 0.05$) and $r_{2010} = 0.10$, $p < 0.05$). However, when assessed according to age class, a correlation was found, in the 2010 results, between the number of plants cited for the '29 – 38' age group and that of the '59 – 68' and '69 – 78' age classes ($r_{'29\text{-}38'(2010)} = 0.54$ and 0.80, respectively $p < 0.05$). Implying that, during the after-rain season, individuals of age 29 to 38 years use the same number of plants as individuals between the ages of 59 and 78 years. All plants used are classified as

'least concern' under the IUCN Red List (Raimondo et al. 2009) except for *Boophane disticha* and *Acacia erioloba* which are classified as 'declining'.

Figure 7 Main root of *Harpagophytum procumbens* subsp. *procumbens.*

Figure 8 Side roots of *Harpagophytum procumbens* subsp. *procumbens* and the dried fruit

Figure 9 *Acacia erioloba*

Figure 10 *Acacia erioloba* used as fuel wood

Figure 11 *Acacia erioloba* pods used as fodder

Figure 12 *Acacia erioloba* pods and seeds used to make crafts

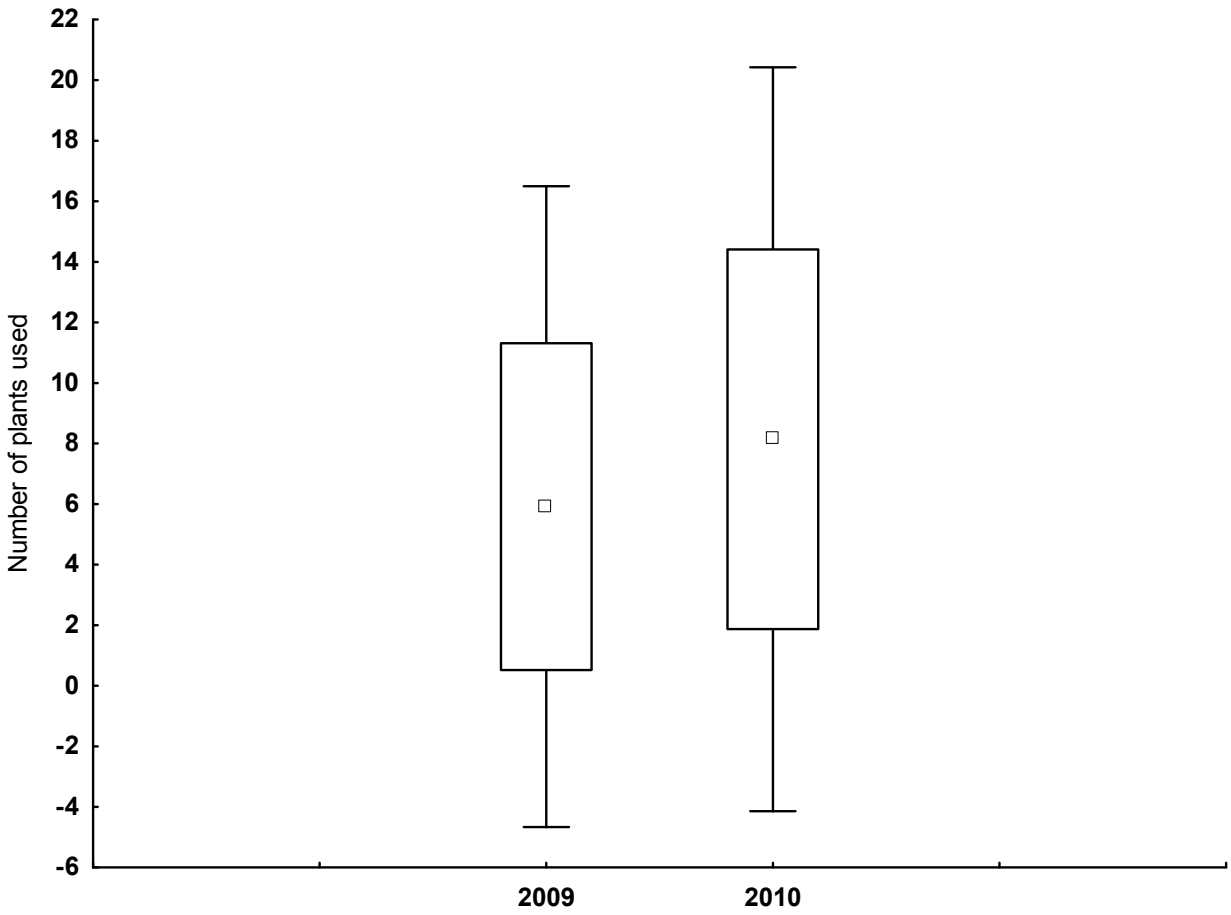


Figure 13 Average number of plants used by the ≠Khomani Bushmen during both study periods. □ indicates the average and ┬ and ┴ the standard deviation (N_{2009} = 82; N_{2010} = 77).

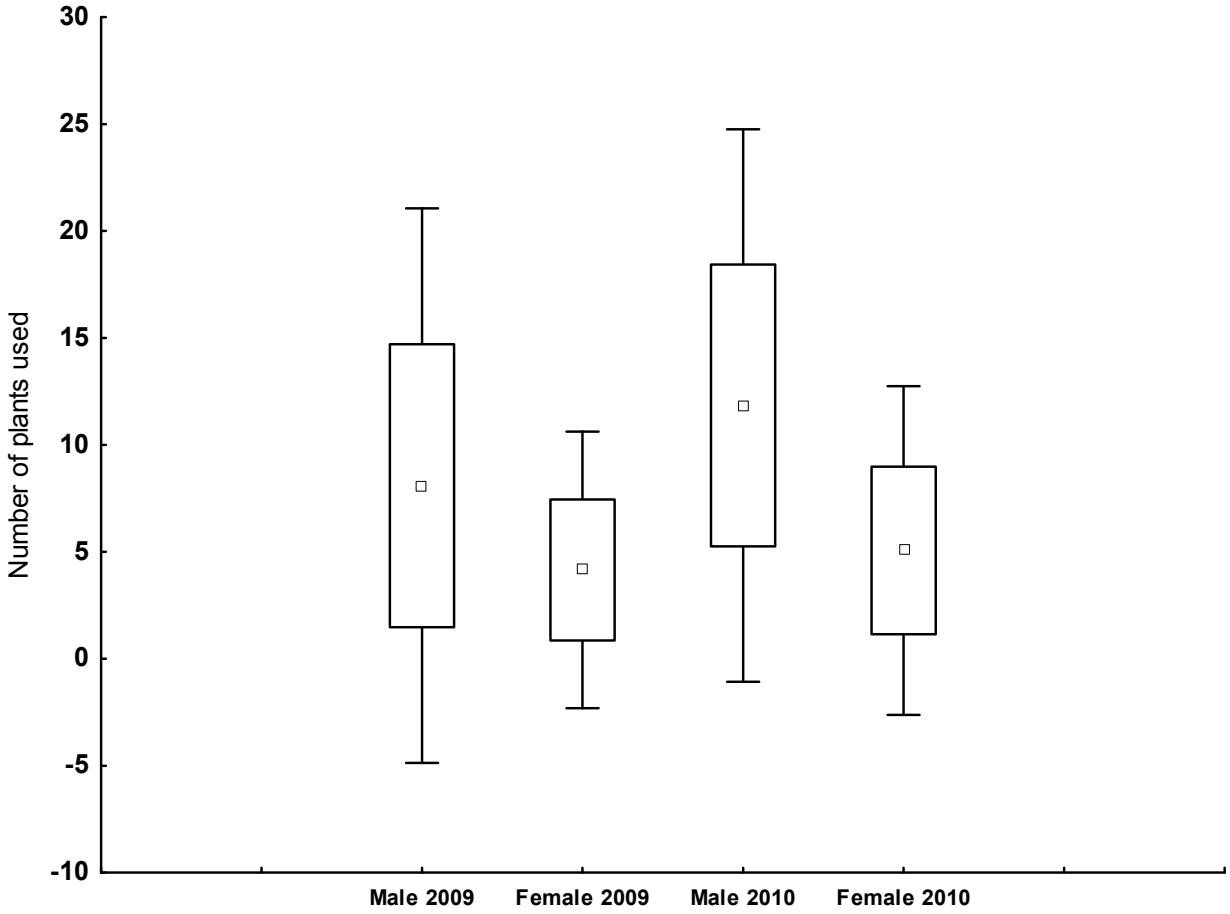


Figure 14 Average number of plants used by ≠Khomani Bushmen men and women during both study periods. □ indicates the average and ┬ and ┴ the standard deviation (N_{2009} = 82; N_{2010} = 77)

Plant use knowledge

An overwhelming majority of plants users (> 90%) answered that they had learned about wild plants during their childhood, with the remaining respondents stating they acquired this knowledge only once reaching adulthood. Interestingly, when asked this question, most claimed they have used plants their entire lives as a Bushman custom. This might suggest that, although the ≠Khomani had been translocated and subsequently relocated, wild plant use knowledge has remained among its members.

When questioned about who had taught them about the use of plants, the most frequent response in both cases was that this knowledge was commonly transmitted within the family, with some interviewees stating that there lies a risk in teaching people not related to oneself as this could lead to them using the acquired knowledge against you or your family. Ohmagari and Berkes (1997) also observed a higher proportion of familial transmission of plant knowledge among subarctic Canadian woman. Mostly parents and grandparents were mentioned as knowledge transmitters. Grandparents were mentioned 29.79% (2009) and 25.58% (2010) of the time, while parents were cited in 52.13% (2009) and 45.35% (2010) of cases. This highlights the importance of family networks given the community's isolation, there is a clearly identified need to evaluate social network structure and function (see Chapter 4).

Most respondents answered that they had learned about using wild plants in the field. This central role of outdoor contexts, to the acquisition of traditional plant knowledge was also found in other studies (Boster 1985, Ohmagari and Berkes 1997, Salik et al. 1997). All responses showed that the plant users within the ≠Khomani community learned 'by doing', by participant observation and by sharing activities, corresponding to the results of Lozada et al. (2006).

Table 2 All the plants cited by the ≠Khomani Bushmen arranged in order of frequency of use. Consensus index refers to the number of times a particular plant was cited by participants during each survey period (N_{2009} = 82; N_{2010} = 77). The consensus index is also expressed as a percentage, indicating the proportion of times a species was cited out of all the citations made during each study period.
* refers to naturalised species and # designates a cultivated plant.

	Family	Consensus Index		%		Plant Use
		2009	2010	2009	2010	
Harpagophytum procumbens (Burch.) DC. ex Meisn. subsp. *procumbens* (gamaghoe, devil's claw, duiwelsklou, kloudoring)	Pedaliaceae	59	65	10.85	9.57	Medicine
Aptosimum albomarginatum Marloth and Engl. (!koegab)	Scrophulariaceae	56	56	10.29	8.25	Medicine
Solanum L. sp. (jakkalsbos)	Solanaceae	37	38	6.80	5.60	Medicine
Hoodia gordonii (Masson) Sweet ex Decne. (//choba, bitterghaap, wilde ghaap)	Apocynaceae	36	44	6.62	6.48	Food
Dicoma capensis Less. (verkouebos, korsbos)	Asteraceae	36	41	6.62	6.04	Medicine
Acacia erioloba E.Mey. (kameeldoring)	Fabaceae	35	32	6.43	4.71	Fuel wood
Citrullus lanatus (Thunb.) Matsum. and Nakai (tsamma, !samma)	Cucurbitaceae	24	25	4.41	3.68	Food
Galenia sp. (slangneus)	Aizoaceae	22	24	4.04	3.53	Medicine
Acanthosicyos naudinianus (Sond.) C.Jeffrey (gemsbokkomkommer)	Cucurbitaceae	16	21	2.94	3.09	Food
*Stipagrostis amabilis (*Schweick.) De Winter (duinriet, duinsteekriet)	Poaceae	15	12	2.76	1.77	Household
Senna italica Mill. subsp. *arachoides* (Burch.) Lock (swartstorm)	Fabaceae	15	21	2.76	3.09	Medicine
Rhigozum trichotomum Burch. (driedoring)	Bignoniaceae	15	18	2.76	2.65	Art
Aristida diffusa Trin. subsp. *burkei* (Stapf) Melderis (besemgras)	Poaceae	15	11	2.76	1.62	Household
Acacia mellifera (Vahl) Benth. subsp. *detinens* (Burch.) Brenan (gnoibos, haakdoring, swarthaak)	Fabaceae	15	13	2.76	1.91	Fuel wood
Kohautia caespitosa Schnizl. subsp. *brachyloba* (Sond.) D.Mantell (bitterhout, vadershout, David Staan)	Rubiaceae	12	22	2.21	3.24	Medicine
Hermbstaedtia fleckii (Schinz) Baker and C.B.Clarke (grashout)	Amaranthaceae	12	14	2.21	2.06	Medicine
Selago L. sp. (moedershout)	Scrophulariaceae	10	17	1.84	2.50	Medicine
Pergularia daemia (Forssk.) Chiov. subsp. *daemia* (kgaba)	Apocynaceae	10	13	1.84	1.91	Food, medicine
Catophractes alexandri D.Don (ncha, gelukshout, swartdoring, gabbabos)	Bignoniaceae	7	10	1.29	1.47	Cultural
Boscia albitrunca (Burch.) Gilg and Gilg-Ben. (witgat, shepard's tree)	Capparaceae	7	9	1.29	1.33	Fuel wood
Adenium oleifolium Stapf (ouheip, bitterkambro)	Apocynaceae	7	27	1.29	3.98	Medicine
Acacia luederitzii Engl. var. *luederitzii* (rooihaak, nchugras, swartbas)	Fabaceae	7	10	1.29	1.47	Fuel wood
Rhynchosia cf. *holosericea* Schinz (leeuhout)	Fabaceae	6	13	1.10	1.91	Medicine

Table 2. Continued

Scientific Name and Common Name	Family	Consensus Index		%		Plant Use
		2009	2010	2009	2010	
Mentha longifolia (L.) Huds. subsp. *capensis* (Thunb.) Briq. (teebos, kruisement)	Lamiaceae	5	4	0.92	0.59	Food
Cucumis africanus L.f (small wild cucumber)	Cucurbitaceae	5	12	0.92	1.77	Food
Aloe hereroensis Engl. var. *hereroensis* (alwyn)	Asphodelaceae	5	4	0.92	0.59	Medicine
Kohautia cynanchica DC. (wit vergeet)	Rubiaceae	4	9	0.74	1.33	Medicine
Virgilia oroboides (P.J.Bergius) T.M.Salter subsp. *oroboides* (wilde keur)	Fabaceae	3	5	0.55	0.74	Medicine
Syringa sp. (syringa)	Oleaceae	3	2	0.55	0.29	Fuel wood
Sutherlandia frutescens (L.) R.Br. (kalkoen, kalkoenbos, kankerbos)	Fabaceae	3	7	0.55	1.03	Medicine
Parkinsonia africana Sond. (lemoendoring, n!cams bos)	Fabaceae	3	-	0.55	-	Household, Medicine
Grewia flava DC (rosyntjiebos, n!oubessie, bessiebos)	Malvaceae	3	8	0.55	1.18	Art
Elephantorrhiza elephantina (Burch.) Skeels (rooibas, elandsboontjie)	Fabaceae	3	15	0.55	2.21	Medicine
Vinca major L. * (opklim)	Apocynaceae	2	2	0.37	0.29	Medicine
Stipagrostis uniplumis (Licht.) De Winter var. *uniplumis* (Boesman gras)	Poaceae	2	1	0.37	0.15	Household
Sarcocaulon salmoniflorum Moffett (kersbos)	Geraniaceae	2	5	0.37	0.74	Medicine
Echinopsis pachanoi # (San Pedro)	Cactaceae	2	1	0.37	0.15	Cultural, Food
Cissampelos capensis L.f. (dawedjies)	Menispermaceae	2	4	0.37	0.59	Medicine
Boophone disticha (L.f.) Herb. (gifbol)	Amaryllidaceae	2	6	0.37	0.88	Medicine
Acacia karroo Hayne (soetdoring, sweet thorn)	Fabaceae	2	1	0.37	0.15	Fuel wood, Cultural
Acacia haematoxylon Willd. (vaal kameeldoring)	Fabaceae	1	3	0.18	0.44	Fuel wood
Sceletium tortuosum (L.) N.E.Br. (kanna, channa, kougoed)	Mesembryanthemaceae	1	-	0.18	-	Food
Ruta graveolens L. * (wyn riet)	Rutaceae	1	2	0.18	0.29	Medicine
Rhus tenuinervis Engl. (nguni boom, kuniebos)	Anacardiaceae	1	-	0.18	-	Food

Table 2. Continued

Scientific Name and Common Name	Family	Consensus Index		%		Plant Use
		2009	2010	2009	2010	
Radyera urens (L.f.) Bullock (pampoenbossie, wilde kalbas)	Malvaceae	1	-	0.18	-	Medicine, Fuel wood
Phylica sp. (bitterbessie)	Rhamnaceae	1	-	0.18	-	Medicine
Petroselinum crispum (Mill.) A.W.Hill * (pieterselie, parsley)	Apiaceae	1	-	0.18	-	Food
Nestlera conferta DC. (volstruisbos)	Asteraceae	1	1	0.18	0.15	Medicine
Mesembryanthemum spp. (vygies)	Mesembryanthemaceae	1	-	0.18	-	Medicine
Melhania burchelli DC. (goeiemanshout, frankhout)	Malvaceae	1	4	0.18	0.59	Medicine
Galenia africana L. (kraalbos)	Aizoaceae	1	-	0.18	-	Medicine
Euryops multifidus (Thunb.) DC. (skaapbos)	Asteraceae	1	-	0.18	-	Medicine
Dicerocaryum eriocarpum (Decne.) Abels (elandbos)	Pedaliaceae	1	-	0.18	-	Medicine
Berula erecta subsp. *thunbergii* (DC.) B.L.Burtt (wolbos, tandpynbossie)	Apiaceae	1	-	0.18	-	Medicine
Asparagus sp. (katdoring)	Asparagaceae	1	9	0.18	1.33	Art
Asclepias fruticosa (L.) W.T.Aiton (tontelbos, kapokbossie)	Asclepiadaceae	1	1	0.18	0.15	Household, Medicine
Artemisia afra Jacq. Ex Willd. (wilde als)	Asteraceae	1	2	0.18	0.29	Medicine
Aristida meridionalis Henrard (steekgras)	Poaceae	1	-	0.18	-	Household
Aptosimum elongatum Engl. (magatho, washout)	Scrophulariaceae	1	-	0.18	-	Medicine
Terfezia pfeilii (Kalahari truffle)	Fungus (Ascomycetes)	-	7	-	1.03	Food
Agathosma Willd. *betulina* (P.J. Bergius) Pillans (boegoe, buchu) *	Rutaceae	-	2	-	0.29	Medicine
Leonotis leonurus (L.) R.Br. (wilde dagga) *	Lamiaceae	-	2	-	0.29	Medicine
Tridentea marientalensis subsp.*marientalensis* (kopseer, chipchebie)	Asclepiadaceae	-	4	-	0.59	Medicine

Table 3 All the plant species used by the ≠Khomani Bushmen classified according to growth forms and use categories

growth form	Total	medicine	food	household	fuel wood	art/culture
dwarf shrub	9	8	1	1		2
shrub	11	8	4	1		4
grass	4			4		1
herb	18	16	3	1	1	2
succulent	8	5	4			2
tree	10	4	1	6	6	5
other	3	2	2			
total	63	43	15	13	7	16

Table 4 All the plant species used by the ≠Khomani Bushmen classified according to the parts used

Plant species	root	stem	leaf	flower	fruit	seed	bulb
Acacia erioloba	x	x			x	x	
Acacia haematoxylon		x					
Acacia karroo	x	x	x				
Acacia luederitzii var. *luederitzii*	x	x					
Acacia mellifera. subsp. *detinens*		x					
Acanthosicyos naudinianus					x	x	
Adenium oleifolium	x						
Agathosma betulina							x
Aloe hereroensis var. *hereroensis*	x						
Aptosimum albomarginatum	x	x	x				
Aptosimum elongatum		x	x	x			
Aristida diffusa subsp. *burkei*		x	x				
Aristida meridionalis		x					
Artemisia afra			x				
Asclepias fruticosa		x	x			x	
Asparagus sp.		x	x				
Berula erecta subsp. *thunbergii*	x		x				
Boophone disticha			x				x
Boscia albitrunca	x	x			x	x	
Catophractes alexandri	x	x					
Cissampelos capensis	x	x					
Citrullus lanatus					x	x	
Cucumis africanus					x		
Dicerocaryum eriocarpum			x				
Dicoma capensis	x	x	x				
Echinopsis pachanoi		x					
Elephantorrhiza elephantina	x		x			x	
Euryops multifidus			x				
Galenia africana		x	x				
Galenia sp.	x						
Grewia flava		x					
Harpagophytum procumbens	x						
Hermbstaedtia fleckii	x						
Hoodia gordonii		x					
Kohautia caespitosa subsp. *brachyloba*	x						
Kohautia cynanchica	x						
Leonotis leonurus			x				
Melhania burchelli	x						
Mentha longifolia subsp. *capensis*			x				
Mesembryanthemum spp.		x	x				
Nestlera conferta	x	x					
Parkinsonia africana		x					
Pergularia daemia subsp. *daemia*		x	x				
Petroselinum crispum		x	x				
Phylica sp.					x		
Radyera urens		x					
Rhigozum trichotomum		x					
Rhus tenuinervis					x		
Rhynchosia cf. *holosericea*	x						
Ruta graveolens	x	x	x				
Sarcocaulon salmoniflorum		x					
Sceletium tortuosum		x	x				
Selago sp.	x						
Senna italica. subsp. *arachoides*	x						
Solanum. sp.	x						
Stipagrostis amabilis		x	x				
Stipagrostis uniplumis var. *uniplumis*		x	x				
Sutherlandia frutescens	x		x	x			
Syringa sp.		x					
Terfezia pfeilii							x
Tridentea marientalensis subsp. *marientalensis*		x					
Vinca major	x						
Virgilia oroboides subsp. *oroboides*		x	x				

Conclusion

The community has mostly been living on their land, returned to them from the South African government in a land claim, for the past ten years. This has seemingly not affected their use of plants with respect to regional natural resources while a clear consensus exists in the community regarding existent ethnobotanical knowledge. This is evident where plant resources are used on a daily or weekly basis in a majority of households. Thus, in spite of their turbulent history, transmission of wild plant knowledge has occurred within this community. There has however been a decrease in the dependence of plants as a source of food and water, when compared to Steyn's (1984) recordings. In the early 1980's the ≠Khomani, according to Steyn (1984) relied primarily on *Citrullus lanatus* and *Acanthosicyos naudiniana* during periods when game and drinking water were in short supply. The present study, however, shows a decrease in dependence on these plant species, with the former having a consensus index of 24 and the latter that of 16 in 2009, implying that the species were only mentioned by that many respondents during the area's dry season.

The study indicates that wild plant use remains an important practice for the ≠Khomani people, primarily for medicinal purposes. It serves not only as documentation for wild plant species used by this community, but also adds to our understanding of how traditional knowledge is presently being transmitted. The present study also showed that the ≠Khomani have been learning about useful plants from an early age as a family tradition, mostly transmitted through family dissemination.

Significant differences occur in wild plant richness related to gender, with men using more plants, possibly attributable to the present day medicine men active in the community. Alternatively, SANParks offers training to trackers and park guides on local plants and historical Bushmen plant use which could be responsible for the differences between men and women in terms of the number of plants used and knowledge thereof.

Wild plant use appears to be traditional and fairly frequent despite increased Western influence. Presently, there is greater access to schools and Western medicine, factors that have led to the erosion of traditional plant knowledge elsewhere (Ohmagari and Berkes 1997, Benz et al. 2000, Brodt 2001). However, in the case of the ≠Khomani, plant knowledge conservation can potentially be

associated to the fact that its acquisition occurs at an early age when customs and habits are assimilated and hardly influenced by incursions of the mainstream culture. Alternatively, the preservation of plant knowledge could be attributed to their political history and denial of access to schools and primary medical care in previous decades which maintained their dependence on natural resources (Chennells 2002, Holden 2007).

In spite of present day access to Western medicine, respondents frequently cited medicinal plant use. Outdoor scenarios were also mentioned as highly significant, highlighting the importance of this setting to the community. Not only are physical and functional features learnt in the field, but ecological knowledge is acquired. The transmission of this wisdom entails learning 'traditional ecological knowledge', as found in other cases (Berkes et al. 2000), in addition to the sharing of traditional knowledge (Ohmagari and Berkes 1997). This is especially relevant in the case of the ≠Khomani since they now own land in an area that is highly important for nature conservation in the Kalahari region.

Chapter 5

The use of social network analysis to map traditional knowledge exchange amongst the ≠Khomani Bushmen

Abstract

The ≠Khomani Bushmen occupied the southern Kalahari at the turn of the 20th century. Like other indigenous peoples in southern Africa, they were dispossessed of their ancestral territories due to processes of social-political change. Following the end of Apartheid in South Africa, a land claim was lodged which ultimately reinstated their land use rights. The settlement legally entitled them the right to manage their property falling within the Kgalagadi Transfrontier Park (KTP) together with the conservation authority responsible for the Park, South African National Parks (SANParks). Social network theory can advance our understanding of social-ecological systems since social networks have been identified as critical to the outcome of natural resource governance. A social network survey was conducted on the six farms awarded to the ≠Khomani, in the southern Kalahari. Semi-structured questionnaires were used to collect information on social relations surrounding the acquisition, generation and transfer of plant use knowledge. The knowledge networks all have multi-hub structures, with many individuals loosely connected to the central cluster or completely isolated. Calculations of the density of relations in the networks highlight the limited spread of information and inaccessibility to knowledge. Having few social relations hampers the possibilities of joint action and hinders the development of knowledge and understanding through exposure to new ideas, innovations and an increased amount of information.

Keywords: degree, density, land claim, network maps, semi-structured interviews

Introduction

Both the natural environment and human societies are characterised by complex dynamics, uncertainties, natural variations and scale dependencies, making the governing of ecosystems an inherently difficult task (Levin 1998, Berkes et al. 2003). As complex adaptive systems, ecosystems require flexible governance that is able to respond to environmental feedback (Levin 1998, Olsson et al. 2004). Adapting to changing conditions and learning how to deal with uncertainty is crucial due to the changes humanity have affected upon biological processes (Falkowski et al. 2000, Folke et al. 2002, Palumbi 2002). To effectively implement adaptive ecosystem management approaches under uncertainty, it is important to 1) improve knowledge and understanding of resource and ecosystem dynamics, 2) develop practices that interpret and respond to ecological feedback and 3) support flexible organisations and adaptive management processes (Berkes and Folke 1998). Research has shown that top-down centralised management is inadequate in applying adaptive management approaches (Ostrom 1990, Gunderson et al. 1995, Holling and Meffe 1996, Berkes and Folke 1998, Pretty and Ward 2001) and the current focus is on governing systems such that multiple individuals, to varying degrees, are involved in the governing process (Bodin and Crona 2009). This concept, referred to as co-management (Carlsson and Berkes 2005) is based on the rationale that by involving various individuals in the governing process, the inherent complexities of both ecosystems and human societies (i.e., the social-ecological system) can be more adequately addressed (Berkes and Folke 1998, Gallopin et al. 2001, Holmes 2001, Turner et al. 2003, Waltner-Toews et al. 2003, Bodin and Crona 2009).

Adaptive co-management occurs when knowledge generation of ecosystems are incorporated into management practices and evolve with the organisational facets of management (Dale et al. 2000, Walker et al. 2004). In other words, when the explicit focus is on the adaptability of the co-management process in response to environmental change and the continuous acquisition of new knowledge; adaptive co-management takes place (Armitage 2009). Olsson et al. (2004) define adaptive co-management of ecosystems as *"flexible community-based systems of resource management tailored to specific places and situations and supported by, and working with, various organisations at different levels"*. While Folke et al. (2002) define the process of adaptive co-management as one in which ecological knowledge and organisational arrangements are tested and revised in ongoing and dynamic self-organised procedures of learning-by-doing. This recognises the role played by human societies in shaping ecosystem processes and dynamics (Dale et al. 2000,

Waltner-Toews and Kay 2005) while the social-ecological system emphasises the integrated concept of humans in nature and stresses that the demarcation between social and ecological systems is artificial and arbitrary (Folke at al. 2005). Furthermore, research suggests that social-ecological systems have powerful reciprocal feedbacks and act as complex adaptive systems (Gunderson and Holling 2002, Costanza et al. 2001, Berkes et al. 2003, Janssen et al. 2004, Waltner-Toews and Kay 2005).

As an important component of resilience in social-ecological systems, the need to continuously test, learn and develop knowledge and understanding to cope with change and uncertainty has also been highlighted (Carpenter and Gunderson 2001, Berkes et al. 2003). Adaptive co-management enables individuals to reorganise the system within desired states in response to changing conditions and disturbance events (Walker at al. 2004). In terms of sustainable use of natural resources and ecosystem services, this is unlikely without a better understanding of the capacity of ecosystems to provide these goods and services (Gunderson and Holling 2002). As complex adaptive systems, ecosystems are characterised by higher level properties and patterns that emerge from localised interactions and selection processes that act at lower scales and may subsequently influence the development of those interactions through feedback mechanisms (Levin 1998). Ecosystems are further characterised by nonlinear relations, threshold effects, historical dependency, multiple possible outcomes and limited predictability (Scheffer et al. 2001) further stressing the importance of adaptive management. Significant progress in understanding the social dimension of ecosystem management has occurred, including organisational and institutional flexibility for dealing with uncertainty and change (Lee 1993, Grumbine 1994, Westley 1995, Berkes and Folke 1998, Danter et al. 2000, Gunderson and Holling 2002, Berkes et al. 2003, Dietz et al. 2003, Anderies et al. 2004, Ostrom 2005) and social capital (Scoones 1999, Abel and Stepp 2003, Pretty 2003).

Adaptive co-management requires social capital (Wasserman and Faust 1994) as it is an important source of resilience and essential for the capacity of social-ecological systems to adapt to and shape change (Folke et al. 2003). The basic idea of social capital is that relationships among individuals bring about an intangible value that can then be drawn upon to improve individual and collective well-being (Bourdieu 1986, Coleman 1988; 1990, Putnam 1993; 1995, Carney 1998, Pretty 1998, Scoones 1998, Uphoff 1998). It captures the idea that social bonds and social norms are important in promoting sustainable livelihoods (Coleman 1988, Grootaert and van Bastelaer 2001,

Pretty and Ward 2001) since social capital lowers the transition costs of working together, thereby facilitating cooperation (Pretty 2003). Important features of social capital include 1) relations of trust, 2) reciprocity and exchanges, 3) common rules, norms and sanctions and 4) connectedness in networks or groups (Pretty 2003, Pretty and Smith 2004). Structurally, social capital facilitates information sharing, and collective action and decision-making through established roles, social networks and other social structures supplemented by rules, procedures, and precedents (Grootaert and van Bastelaer 2001). Many regard social capital as the glue for adaptive capacity and collaboration (Baland and Platteau 1996, Pretty and Ward 2001, Brown 2002, Adger 2003, Olsson et al. 2004). Furthermore, social capital may have its foundations in ethnicity, religion, shared history or other group membership (Katz 2000). It is manifested in collective knowledge, including environmental knowledge, respect for group rules and norms and the creation and maintenance of self-governing institutions (Katz 2000).

Traditional ecological knowledge

It has been shown that community-based management systems have co-evolved with resource and ecosystem dynamics, developing knowledge and practices on how to live with change and uncertainty (Gadgil et al. 1993, Berkes and Folke 1998, Berkes et al. 2003). Traditional ecological knowledge (TEK), a subset of indigenous knowledge (IK), is a cumulative body of knowledge, beliefs and practices that evolve through adaptive processes and which are passed down from one generation of people to the next via cultural transmission (Gadgil et al. 1993, Berkes et al. 1995, Nabhan 1997). IK and TEK describe knowledge that is specific to a given culture or society (Warren and Rajasekaran 1993) and differs from scientific ecological knowledge (SEK) in that it is largely dependent on local social mechanisms and has evolved over many generations of experimentation, trial, and error (Berkes et al. 2000). The development of IK is a dynamic process that changes with the availability of resources and the demands of local communities (Becker and Ghimire 2003). TEK is acquired by local people through the accumulation of experiences, informal experiments, and through an intimate understanding of the environment in a given cultural context (Gadgil and Berkes 1991, Nabhan 1997). TEK can be an information base for communities which facilitates communication and decision-making, and which serves as a foundation for local institutions (Warren and Rajasekaran 1993). Institutions, in the case of norms, rules and regulations of use, provide the means by which communities can act on their traditional knowledge and use it to sustain a livelihood

from the environment (Berkes 1989). Both knowledge and institutions require mechanisms of cultural internalisation (i.e., ways of acquiring TEK and knowledge of the functioning of institutions) so that learning can be encoded and remembered by the group (Berkes et al. 2000). TEK encompasses everything from cursory awareness of natural histories associated with local wildlife to cultural norms for land management and resource allocation (Berkes et al. 2000).

It has also been put forward that the management of complex adaptive systems may benefit from the combination of different knowledge systems (McLain and Lee 1996, Johannes 1998, Ludwig et al. 2001, Berkes and Jolly 2001, Gadgil et al. 2003). While the Malawi principles of the Biodiversity Convention stress that the ecosystem approach should consider all forms of relevant information, including scientific and indigenous knowledge and local knowledge, innovations and practices (UNEP 1998). The role of community-based knowledge systems in ecosystem assessment and management is presently addressed in the Millennium Ecosystem Assessment (www.millenniumasessment.org accessed December 2010).

Assuming that a practical level of common understanding among individuals on the status of natural resources (e.g. level of availability, importance, decline) increases the probability that they will then self-organise and agree upon general rules for managing resources (Ostrom 2005), it can be deduced that the facilitation of individuals to establish such a mutual understanding through group relations, becomes crucial (Schneider et al. 2003). The successful governance of natural resources is critically reliant upon the acquisition and exchange of information and knowledge among individuals (Berkes et al. 2000). The existence of group relations and a mutual understanding is also believed to be important for a community's potential for collective action (Granovetter 1973) and conflict resolution (Carlsson et al. 2001). Due to its intense effect on the acquisition, generation and transfer of information and knowledge, the structural characteristics of the social network of individuals and groups in the community influence its potential for successful natural resource management. It has been demonstrated qualitatively that including diverse stakeholders and promoting the development of relations among them, increases the likelihood of collaborations and joint action (Gunderson 1999, Olsson et al. 2004, Hahn et al. 2006). The existence of social ties also enhances the development of knowledge and understanding by allowing exposure to new ideas and an increased amount of information (Bodin and Crona 2009). However, it has been shown that too many social ties can lead

to the homogenisation of information and knowledge, leading to less efficient resource use and a potential reduction in capacity to adapt to changing conditions (Bodin and Norberg 2005).

The ≠Khomani Bushmen and SANParks

The Bushmen of southern Africa, members of the most ancient family of man, the hunter-gatherer, have lived for millennia as part of the vast natural Kalahari ecosystem. With a cultural history characterised by mobility and living lightly off the land, they are considered an elemental part of the vast natural Kalahari ecosystem (Twyman 2001, Bregin and Kruiper 2004, Barnard 2007). Here rain occurs sporadically, in the form of high intensity convectional showers, and soaring daily temperatures and drought are commonplace (van Rooyen and van Rooyen 1998). As a result, hunter-gatherers, with their foraging mode of livelihoods, adapted to this harsh environment, persisting through a series of climatic vicissitudes (Grey and Cooke 1977) as attested to by the widespread occurrence of Stone Age artefacts (Campbell 1982, Hitchcock 1982, Denbow 1983, Barnard 1992). The persistence of Bushmen for millennia in this inhospitable arid landscape is a tribute to their hard-won ability to learn to survive (Cooke 1985).

The ≠Khomani Bushmen, the focus of this thesis, form part of an assemblage of distinct Bushmen tribes that occupied the southern Kalahari at the turn of the 20th Century, collectively known as the Southern Kalahari Bushmen (Barnard 1992). Like other indigenous peoples in southern Africa, they were significantly challenged by European colonization and processes of environmental and social-political change. The particulars of the persecution and decimation of this group goes beyond the scope of this chapter, but by the early 1970's they had been entirely dispossessed of their ancestral land (Beinart 2003) and dispersed across the African subcontinent (Kepe et al. 2005). As they became increasingly sedentarised and extensively fragmented as a group, their freedom to practice a traditional way of life through gathering wild plants and hunting declined, leading to the erosion of their traditional cultural practices and rituals (Chennells 2002).

Following the end of Apartheid in South Africa, in 1994, a land claim was lodged by the ≠Khomani, which was finalised in 1999 (Chennells 2002, Holden 2007). Several ≠Khomani Bushmen

elders provided oral testimonies of crucial importance, which were supported by initial research, and which indubitably confirmed that the ≠Khomani were one of the Bushmen clans who had traditionally lived, hunted and gathered throughout the southern Kalahari (Chennells 2002). The resolution of the claim afforded the ≠Khomani, with an estimated 1500 members, recognition of their land rights in the form of six farms and land-use rights within the now Kalahari Transfrontier Park (KTP) (Chennells 2002, MacKay 2002) (See Appendix 1). The land claim not only provided the ≠Khomani the opportunity to return to their ancestral lands, it also legally entitled them to be actively involved in managing the lands to which they access within the KTP in collaboration with South African National Park (SANParks), the conservation authority responsible for the Park. The ≠Khomani now co-operatively make decisions with SANParks on matters pertaining to heritage use, traditional use of fauna and flora, as well as other facets of traditional knowledge (Chennells 2002), which is slowly being formally integrated into the management of the Park (Bosch and Hirschfeld 2002). Presently, management practices are primarily driven, and informed, by scientific information, but now that the ≠Khomani are partners in the conservation of the Park, their traditional voice needs to be incorporated in policies and thus also in management (Twyman 2001).

Through an adaptive planning process (Rogers 2003), SANParks has adopted an overarching park management strategy focused on developing, alongside various stakeholders, and consequently managing, towards a 'desired state' (SANParks 2006). Reinforced in their biodiversity values are the 'desired set of varying conditions' (SANParks 2006) and it is accepted that change in ecosystems are ongoing and desirable. Such a 'desired state' seeks refinement through constant learning and ongoing reflection. In accordance to the Protected Areas Act of 2003 (Statutes of the Republic of South Africa 2003) SANParks has set out in their KGNP mission statement (SANParks and DWNP 2003, SANParks 2006) the following:

> *The Kalahari Gemsbok National Park, as an integral part of the Kgalagadi Transfrontier Park, will be managed by SANParks to maintain and/or recreate the ecological processes, faunal and floral assemblages, landscape characteristics and cultural resources representative of the area, to foster international co-operation through a transfrontier conservation area, and offer long-term benefit to the people of the area.*

Integral to this is the unique cultural heritage attributes that the area and the Park itself shares with the ≠Khomani Bushmen, since the KGNP is their traditional home (Kepe et al. 2005, Chennells 2002). This relationship, however, should not oppose the biodiversity attributes, such that the

cornerstones of the mission statement (i.e., maintenance of ecological and cultural attributes, transfrontier co-operation and human benefits) can be sufficiently implemented in an integrated manner (SANParks 2006).

The implementation of the Ae!Hai Kalahari Heritage Agreement (Bosch and Hirschfeld 2002) forms part of the ≠Khomani land claim settlement (Chennells 2002, Chapter 2). Herein lies the establishment and development of a contractual park contributing toward the fulfilment of several obligations, including current legislation (NEMA: Protected Areas Act 57 of 2003; The Restitution of Land Rights Act 22 of 1994), relevant SANParks policies (SANParks 2006); and South Africa's formal endorsement of international instruments including the IUCN Durban Accord on the promotion of Community Conserved Areas and the co-management of Protected Areas (IUCN 2003), as well as the UN Declaration on the Rights of Indigenous Peoples. In 2002 a Joint Management Plan was prepared and appended to the agreement between the ≠Khomani Bushmen and SANParks (SANParks 2006). It laid down the foundation for the lower-level, operational plan required to ensure effective co-management of the contractual park, in line with the above statutory requirements. Furthermore, the Joint Management Plan contains the Vision for the contractual park; objectives; functions of the Joint Management Board (JMB), conservation principles resonant with the rights and obligations of the parties and emphasises sustainability and community development objectives and priorities (SANParks 2006). The JMB oversees all matters pertaining to the Ae!Hai Kalahari Heritage Park, while SANParks remains responsible for the management of biodiversity within the contractual park (SANParks 2006). The ≠Khomani Bushmen not only obtained compensation for their land and the right to co-manage their contractual park together with SANParks, but an opportunity to ensure that age-old skills such as story-telling and tracking, wild plant knowledge and cultures are instilled and maintained by present and future generations. Fundamental prospects thus lie in them recapturing their culture and language and for them to reconstruct their identity.

Adaptive co-governance of natural resources

Knowledge of ecosystem dynamics exists amongst people of communities that depend on and interact with the environment for their benefit and livelihood (Berkes et al. 2000, Fabricius and Koch 2004, Folke et al. 2005b). The manner in which such knowledge is organised and culturally

embedded, and the part it plays in generating new ways of managing natural resources have all become important topics in community-based natural resource management systems (Kellert et al. 2000, Fabricius and Collins 2007). Community-based natural resource management (CBNRM) focuses on the collective management of ecosystems to improve human well-being, aiming to devolve authority for ecosystem management to the local community level and thereby empowering communities to manage their own resources without permanently damaging, depleting or degrading them (Fabricius 2004, Fabricius and Collins 2007). As the primary resource users in CBNRM, the governance role of local communities is to create and implement local codes of conduct for natural resource use, monitor trends in natural resources, while benefiting from CBNRM through improving their livelihoods and well-being (Fabricius and Collins 2007). Additionally, local communities are able to detect fine-grained changes in ecosystems before any other stakeholders can, and are potentially able to respond to feedback from the ecosystem (Fabricius and Collins 2007). Due to the high incidence of collapse of CBNRM initiatives over the past decade (Fabricius 2004, Magome and Fabricius 2004), the importance of governance has been identified (Borrini-Feyerabend 1997, Agrawal and Gibson 1999, Agrawal 2001, Bohensky et al. 2004, Koch 2004, Bohensky and Lynam 2005) with the focus now shifting to adaptive co-management components during project implementation (Fabricius and Collins 2007).

It is believed that the management and governance of complex adaptive systems could potentially benefit from the combination of different knowledge systems (McLain and Lee 1996, Johannes 1998, Ludwig et al. 2001, Berkes and Jolly 2001, Gadgil et al. 2003). By engaging various stakeholders in the management process, those inherent complexities in ecosystems and societies constructed around these (i.e., the social-ecological system) can be addressed to ensure sustainable resource use (Berkes and Folke 1998). In a synthesis of case studies from Chile, Costa Rica, Egypt, India, Peru, Portugal, the Philippines, Papua New Guinea, South Africa and Sweden, Folke et al. (2005a) found that local communities are active managers of the capacity of ecosystem to deliver services. Local people's knowledge about social-ecological interactions affects the sustainability of ecosystem services (Fabricius et al. 2007) and can be harnessed to manage and promote the ecosystem's capacity to generate services by establishing adaptive institutions that share knowledge (Brunckhorst 2004, Carlsson and Berkes 2005). Conversely, local knowledge can also be used destructively to undermine ecosystem resilience such as when local experts use their superior knowledge to over-exploit dwindling wildlife or plant populations (Fabricius et al. 2007).

Important, in terms of resilience, is diversity in ecosystems and livelihood strategies since this provides a buffer against shocks and surprises (Berkes et al. 2003, Tompkins and Adger 2004, Folke 2006). Land use and spiritual practices that foster diversity can maintain the adaptive capacity of social-ecological systems, simultaneously enhancing intangible values such as a sense of place, identity and pride (Fabricius et al. 2007). An erosion of a community's collective identity and culture can, however, have the opposite effect (Fabricius et al. 2007). According to Fabricius et al. (2007), communities offer valuable information to the management of complex social-ecological systems. These include: the value of flexible livelihoods; the importance of cultural practices in maintaining the resilience of ecosystems; the value of learning and adaptation; the role of historical events and practices in shaping contemporary ecosystem function and structure; the role of biodiversity in maintaining or enhancing ecosystem resilience and sustainable livelihoods; and the value of social and institutional networks between communities and actors or institutions at local, sub-national, national, and international levels in maintaining and enhancing adaptive capacity of social-ecological systems. Also important is that communities strengthen the capacity of the social-ecological system to adapt to change (Adger 2006).

Social networks form the basis for adaptable local institutions (Olsson et al. 2004) and are maintained and strengthened by governance structures which build trust, formalise relationships and promote communication (Fabricius and Collins 2007). Such governance structures put into effect the rules and codes of conduct associated with social institutions (Anderies et al. 2004), while monitoring compliance with these rules (Gottret and White 2001). Consequently, it is essential to invest heavily in the development of functioning and resilient governance systems (Fabricius and Collins 2007) and to focus on knowledge networks that draw on the experience and wisdom of a wide range of key individuals (Berkes and Folke 2002) or 'knowledge stewards' (Olsson 2003) who work at different hierarchical levels. Such key individuals or 'knowledge stewards' are important in establishing functional links within and between organisational levels and therefore facilitating the flow of information and knowledge from multiple sources to be applied in the local context of ecosystem management (Olsson et al. 2004). Social networks develop for this purpose (Scheffer et al. 2001) and through these social networks; local users can draw on external sources of information and knowledge (Olsson et al. 2004). Furthermore, these stewards and their functional roles in ecosystem management are part of the social memory and capacity of the social-ecological system to deal with change (Folke et al. 2003).

The ≠Khomani were dispossessed of their land, ultimately reinstated, and are now entitled to the restoration of those rights to access land and its resources, provided that it is congruent with the prevailing conservation model as practiced by SANParks and imposed by the National Parks Act of 1979 (Statutes of the Republic of South Africa 1979, Kepe et al. 2005, SANParks 2006). The complex history of resource use and dispossession, combined with the preservationist conservation policies employed in the past by SANParks, has led to the disenfranchisement, and the social and cultural disruption, of the ≠Khomani (Holden 2007). The challenge thus lies in involving and integrating the community into management processes, within a structured policy framework, so as to gradually integrate traditional knowledge and practices into the parks management structures and processes, thereby ultimately achieving social justice alongside environmental sustainability (Tsing et al. 1999). The joint management of ecosystems by historically divided groups is innately complex and complicated, since both the environment and the community embodies traumatic histories, complex dynamics, natural heterogeneity, high levels of uncertainty and scale dependencies (Levin 1998, Berkes et al. 2003). Stakeholders need to establish general rules and practices, coordinate use, resolve conflicts, negotiate trade-offs, share information and develop a common knowledge base (Ostrom 1990; 2007, Folke et al. 2005b, Bodin and Crona 2009).

Social network analysis

The importance of social networks has been recognised as critical to implementing sustainable natural resource governance. Social networks are part of the societal framework that allows different stakeholders to collaborate in order to effectively solve natural resources problems (Gunderson 1999, Pretty and Ward 2001, Folke et al. 2005b, Grafton 2005, Hahn et al. 2006, Scholz and Wang 2006, Olsson et al. 2008). Social network theory can advance our understanding of social-ecological systems, especially when trying to comprehend the role played by social networks and social capital in adaptive forms of co-management and natural resource governance (Berkes et al. 2003, Adger et al. 2005, Dale and Onyx 2005, Bodin et al. 2006, Armitage 2007). According to Holling (1978), knowledge about ecosystems can be improved and increased, unremittingly, such that natural resource governance can be updated and adapted accordingly to environmental changes. Strong links between individuals within the network are needed to transfer traditional, as well as tacit, knowledge (Reagans and McEvily 2003) and complex knowledge, such as that involving interpretation of nonlinear and non-causal variables (Bodin et al. 2006). Access to numerous diverse individuals from, and to, which knowledge can be accumulated and distributed, is also an important feature. By

facilitating the creation, transfer and diffusion of information and thereby building the knowledge base of the natural system being governed, social networks can improve joint management processes (Crona and Bodin 2006, Isaac et al. 2007, Schulser and Decker 2003). Social networks can also improve resilience of the social-ecological system and increase the adaptive capacity of communities to manage changes in the environment (Tompkins and Adger 2004). The manner in which individuals are inter-related or arrange themselves, i.e., the topology of the social network, impacts how they essentially behave (Wasserman and Faust 1994, Degenne and Forsé 1999) which led Newman and Dale (2005) and (Bodin et al. 2006) to affirm that not all network structures are created equal.

Social network analysis (SNA) focuses on the patterns and characteristics of relationships between individuals and not on the specific characteristics of those individuals (Fredericks and Durland 2005). Thus the social network perspective is expressed in terms of relational concepts or processes (i.e., relations defined by linkages among units) (Wasserman and Faust 1994). Additionally, individuals and their actions are perceived as interdependent, rather than independent, autonomous units while relational ties (linkages) between individuals are channels for transfer or 'flow' of resources, either material or non-material (Wasserman and Faust 1994). There are three main paths of investigation, namely 1) the total structure, 2) the subsets formed within the total structure, and 3) the individuals (or 'nodes') that make up the network (Burt 1982, Knoke and Kuklinski 1982). Put differently, the unit of analysis can be the parts that make up the whole, either individually or in clusters, or the entire network itself. When considering the complete network, key notions include (Kilduff and Tsai 2003, Fredericks and Durland 2005):

- *dyad*: two individuals that have a connection, a relationship
- *triad*: three individuals that have a connection, a relationship
- *cluster*: a subset of individuals within a network who have ties with other individuals within the cluster
- *density*: number of ties in a network, expressed as a proportion of the total available ties connecting individuals

At the individual (node) level of analysis, important concepts include:

- *degree*: the number of ties an individual has
- *centrality*: the degree to which an individual occupies a central role in the network
- *isolate*: an individual with no ties to other individuals

SNA is a technique that defines relationships between individuals, and quantitatively identifies the context of individuals and their relationships (Durland 2005). To elaborate, SNA explores social networks through the perspective of a particular relationship with this relational information, in the form of data, creating the network structure (i.e., the lines connecting individuals). A network then defines the boundaries within which a relationship is measured (Wasserman and Faust 1994). After a relationship has been defined and the network identified, measures are selected to explore the specific relationship in more detail (Durland 2005). Social network theory stands apart from other methodological theories since it is centred on the social context and behaviour of relationships among individuals rather than on the relational choices individuals make.

In the present study, the social networks of the ≠Khomani Bushmen community of the southern Kalahari were mapped, focusing upon the communication of natural resources information and knowledge. In the land claim settlement, the ≠Khomani were compensated for the loss of their ancestral land so as to 1) rectify an historical injustice of dispossession and 2) ensure the persistence of their culture. However, complications arise by the need, under the restitution agreement, to, firstly, jointly co-manage land within the KTP with SANParks and so balance the achievement of conservation goals as identified under the National Parks Act of 1979 (Statutes of the Republic of South Africa 1979), against sustainable utilisation of resources by the Khomani. Secondly, the Khomani community now represents an amalgam of various Bushmen bands, virtually reconstituted overnight, which may have resulted in an inequitable distribution of power (Chapter 2). The hypothesis is that the distribution of traditional knowledge, which is dependent on the network structure, affects the likelihood that the ≠Khomani will reach a common understanding of resource-related problems. Ultimately, this will influence their ability to self-organise around regulations of plant resource extraction and use. The aim of the study is to use social network analysis to investigate how the social network structure depicts the distribution of knowledge which affects the community's ability to manage their natural plant resources sustainably. To achieve this, the structure of the Khomani

social networks were mapped, and presented visually so as to better understand the patterns of relationships. The study also measured density and centrality, within and between the networks, respectively.

Methods

Study area

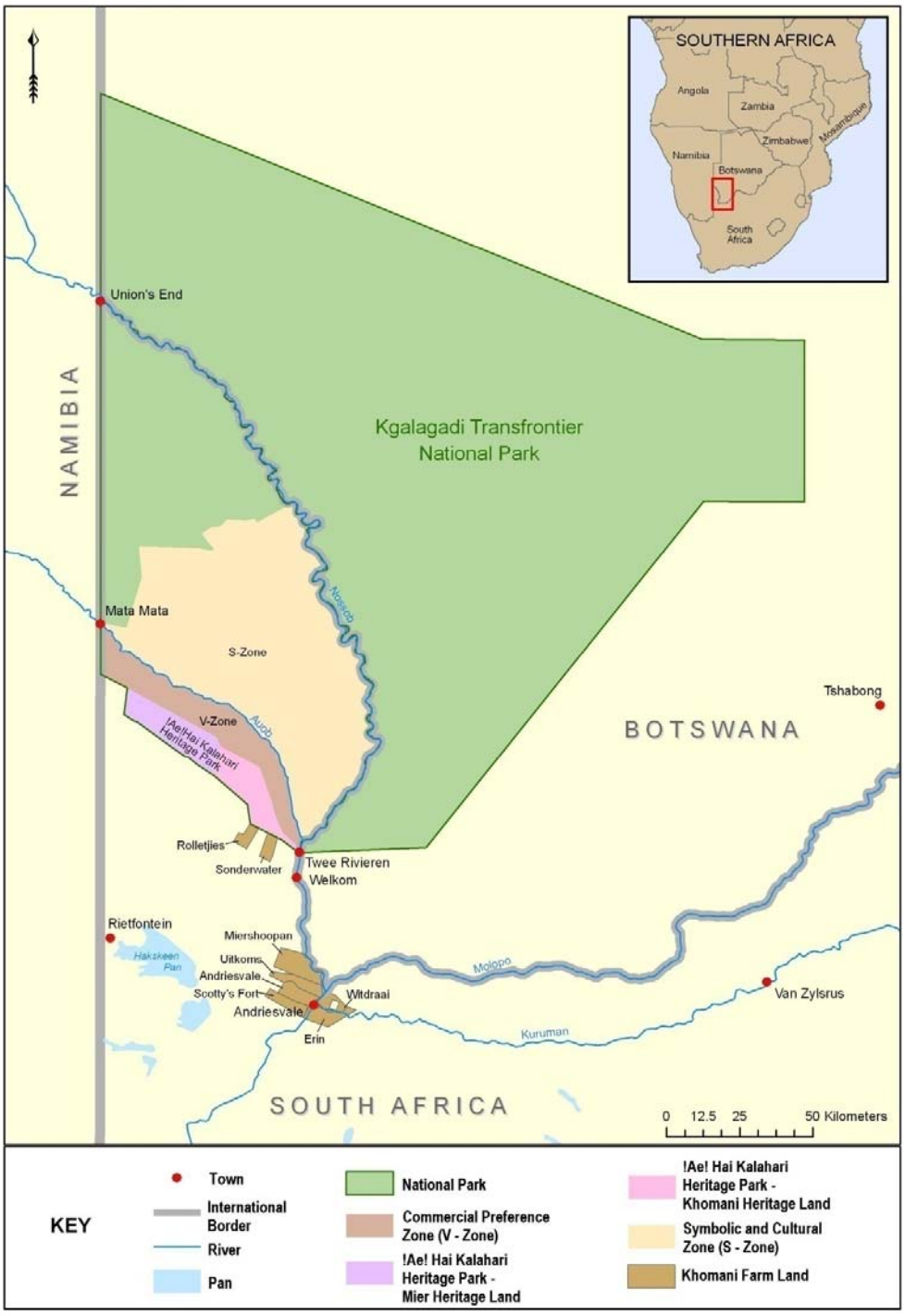
The study was conducted on the six farms awarded to the ≠Khomani, in the southern Kalahari, South Africa. The farms lie northwest of the town of Askham (26°58'52" S, 20°46'56"E) in the Northern Cape Province (Figure 15). The Kalahari is a large sand filled basin in the west of the southern African subcontinent, covering nearly one third of the area (van Rooyen 1984). The KGNP (i.e., the South African portion of the KTP) is situated in the arid to semi-arid southern Kalahari region (van Rooyen and van Rooyen 1998). The annual rainfall increases from 150 mm in the south-west of the KGNP to 350 - 400 mm in the north-east (van der Walt and le Riche 2001). Annual rainfall has a high coefficient of variation and the rain often falls as short-duration, high-intensity, thunderstorms (van der Walt and le Riche 2001). The relative humidity is low and the annual evaporation rate is high. Summer air temperatures are high (over 35°C) although, in winter it often falls to below freezing at night (van der Walt and le Riche 2001).

The sands are predominantly of aeolian origin, emanating from within the basin itself. In the drier south-west, the sands are piled into vegetated linear or seif dunes (Malherbe 1984). Immediately beneath the sand lies a vast sheet of calcareous or silicified sand or sandstone which contains grits and minor conglomerates (Malherbe 1884). The soils can be divided into sandy and fine soils with the variability in fertility and water holding capacity between the two soil types having a direct effect on the vegetation and hence animal utilisation (van Rooyen and van Rooyen 1998). A characteristic of the Kalahari is the number of large shallow depressions or pans, which hold water periodically during the wet season (Parris 1984). Within the predominantly sandy southern Kalahari the availability of natural supplies of drinking water is strictly seasonal, being restricted to the harder bottomed pans and fossil

riverbeds for short periods during the rainy season (Eloff 1984). Historically, the region was generally devoid of water in the dry season. The indigenous wildlife had to either move to permanent sources of drinking water or use alternative sources such as underground storage organs or melons (van der Walt and Retief 1984). Increasing human settlement around the periphery of the park interfered with the natural movement patterns of wildlife and it was believed that this interference prevented access to permanent natural water sources and, to compensate, artificial water points, fed from boreholes, were introduced (van der Walt and Retief 1984). By 2006, 88 boreholes had been erected within the KGNP, predominantly along the riverbeds (SANParks 2006).

The whole area of the KTP is fairly homogenous and can broadly be classified as a bioregion characterized by *Acacia erioloba*, *Rhigozum trichotomum* and *Schmidtia kalihariensis* (van Rooyen 2000). The KTP is an important refuge for large raptors and bustards (Parris 1984, van der Walt and Retief 1984). The introduction of the permanent water supplies within the KGNP has probably also artificially increased the number and species composition of water dependent bird species. Sixty mammal species have been recorded from the KGNP with Rodentia (27%) and Carnivora (33%) the largest families (SANParks 2006). Ecological conditions dictate that the large herbivores need to be highly mobile giving rise to a nomadic existence for many species (Eloff 1984). Mammalian carnivores are well represented in the KGNP. Due to its size, habitat and pristine status, the KTP is one of the few areas where these species can exist under near natural conditions and exhibit their full range of behavioural and ecological evolutionary adaptations in the purest form of biodiversity conservation (SANParks 2006).

The South African portion of the KTP is situated in the municipal districts of the Mier Municipality and the Siyanda District Municipality. The area around the KTP is characterized by sparse populations of people, and long distances for infrastructural lines of support (SANParks 2006). Main income-generating activities are small-stock herding, craft manufacture and cultural performances (www.statssa.gov.za accessed June 2009) with 81% of inhabitants speaking Afrikaans and a population density of 2 persons per km^2 (www.northern-cape.gov.za accessed June 2009). Along the Namibian border and further to the south in South Africa are a number of commercial stock farmers.



(Source: Katharina Dierkes)

Figure 15 Map of study area depicting the farms and settlements where interviews were conducted

Network survey design and data collection

The questionnaire (Appendix 5) was intended to elucidate patterns of relationships people have with each other pertaining to their use of natural plant resources (i.e., wild plants), particularly individuals' knowledge, and the elements of this knowledge they share, and with whom they share it. All interviews were conducted in Afrikaans and the questionnaires completed through personal, face-to-face, interviews over a period of two months (May and June 2010). All the homes on the farms and the surrounding areas belonging to ≠Khomani Bushmen were visited and one respondent per household (the household head, or the person responsible for the dwelling) was approached and invited to participate in an interview. An estimated 150 households belong to the ≠Khomani community and reside in the area. In some cases, people refused, requested payment, or, occasionally, the house was unoccupied during the research period. The remainder participated voluntarily and were at least 18 years of age. The questionnaire content was informed by available literature on Bushmen anthropology, social networks and the sharing of traditional knowledge.

Data on various types of ties were collected to investigate different social networks, including knowledge exchange, collaboration and dependency networks (see Appendix 5). In this study, however, only information and knowledge exchange networks relating to the state of natural plant resources are reported. Collection of network data included recognition and recall methods (Marsden 1990, Wasserman and Faust 1994). The recognition method involves respondents identifying names from a list, while the recall method involves them remembering and naming relationships. In the case of the recall method, respondents were asked to describe the relation, the type of exchange and the frequency and location of the interaction. Attribute data was also collected relating to plant use, for example, whether or not an individual collects plants themselves, how much knowledge of importance for using plants sustainably they believe they possess, and barriers to plant use. Demographic information such as age, gender, occupation, and ethnicity and residence time in the area, among others, was collected for each respondent. The data from the survey was digitally captured in Microsoft Office Excel® and the names of individuals were cross-referenced throughout the dataset to ensure consistent and accurate identification of all the individuals named by multiple respondents. Alphanumerical codes were used ensure anonymity of both the interviewees and the individuals they named.

Analysis of network data

SNA was conducted using both quantitative and qualitative methods to assess structural aspects of social networks (Wasserman and Faust 1994, Scott 2000, Freeman 2004). Networks were constructed and analysed using Smart Network Analyzer (Krebs and Holley 2004). Maps of the knowledge networks were generated (i.e., acquisition, generation and diffusion; Table 5) based on the information and knowledge sharing practices applied in the collection of wild plants.

Density and degree indices were calculated to provide measures of connectivity and centrality, respectively. Density is a network measure, while degree is measured at the level of the individual (Kilduff and Tsai 2003). Density, a measure of connectivity, is the total number of ties divided by the total number of possible ties (de Nooy et al. 2005). Density is the number of relations, expressed as a proportion of the maximum possible number of relations. The formula for density is:

$$density = \frac{l}{n(n-1)}$$

Where

l = the number of links and;

n = the number of nodes.

Density is the number of links divided by the number of possible links (Scott 2000).

It measures how many connections exist in a network out of all the possible ties that could exist. The measure is expressed as a percentage where values closer to 100% reflect higher density (Newman and Dale 2005, Bodin et al. 2006).

Degree, a measure of centrality, refers to the number of ties an individual has. Centrality provides an indication of the distribution of ties among individuals as well as their structural importance (Wasserman and Faust 1994). Since it is independent of network size, degree can be used to evaluate similarity between individuals of the networks (Faust and Skvoretz 2002).

It represents the number of connections an individual has, measuring the extent to which a person is embedded in the network (Wasserman and Faust 1994). Degree can further be separated into in-

degree and out-degree (de Nooy et al. 2005). In-degree is the number of people that indicate that they are connected to an individual while out-degree refers to the number of people to which a particular individual indicates they are connected to. Degree was averaged for all individuals in each network and used to compare the networks (Freeman 1979, Degenne and Forsé 1999).

Table 5 Interview questions used to collect relational data and the networks indentified as a result

Interview Question	Method used	Knowledge network
From whom did you obtain your knowledge of wild plants and their use?	Recall	**acquisition** knowledge is captured and retained for use and further treatment
With whom do you discuss important matters pertaining to your use of plants?	Recall	**generation** knowledge is organised, transferred, discussed and developed through learning, innovation and creativity
With whom do you exchange information which is useful for you to carry out your use and/or collection of plants?	Recall	**diffusion** knowledge is distributed though teaching, and/or exchanges

Adapted from the *Institutional Knowledge Evolution Cycle* Wiig (1999).

Results and discussion

Demographic data

Eighty-six individuals partook in the survey, of which 48.8% were male and 51.2% female. Overall, and including those that were named but did not take the survey, 48% were male and 48% were female with the remaining 4% referring to institutions. The ages of the individuals who took part in the survey are fairly evenly distributed among the age-groups, each with at least 15 respondents, apart from the '18 – 25' year old group, with only 2,32 respondents (Figure 16). Concerning income generation, 38% of individuals are dependent on others, and include those who classify themselves as housewives and pensioners, 30% are employed and 32% generate their own income, including craftsmen, medicine men and farmers (Figures 17 and 18). Of those individuals who reported collecting plants, more than 70% primarily use it for general purposes (i.e., food, water, fuel wood, construction) while the majority (64%) of individuals do not use plants for a secondary purpose (Figure 19).

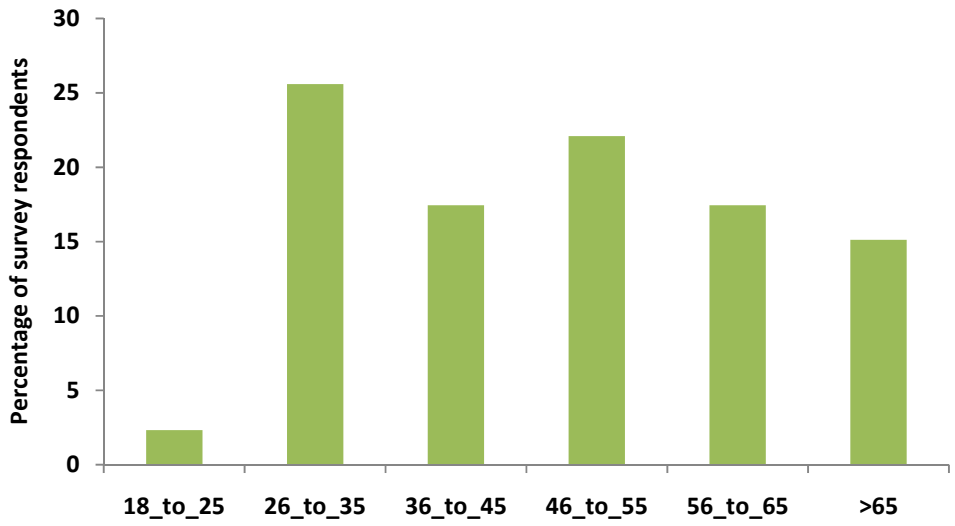


Figure 16 Percentage of ≠Khomani Bushmen survey respondents per age group (N = 86)

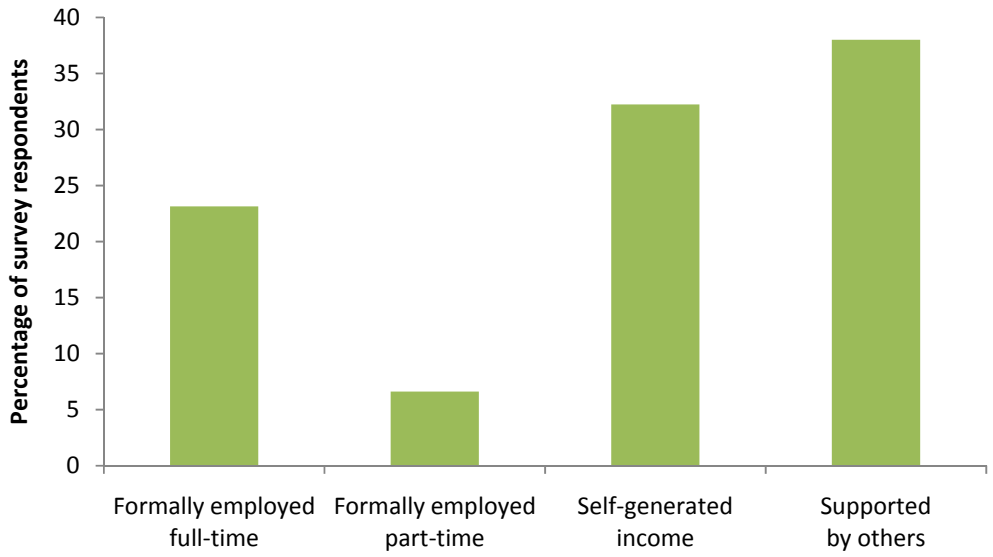


Figure 17 Percentage of ≠Khomani Bushmen survey respondents categorised per income generation (N = 86)

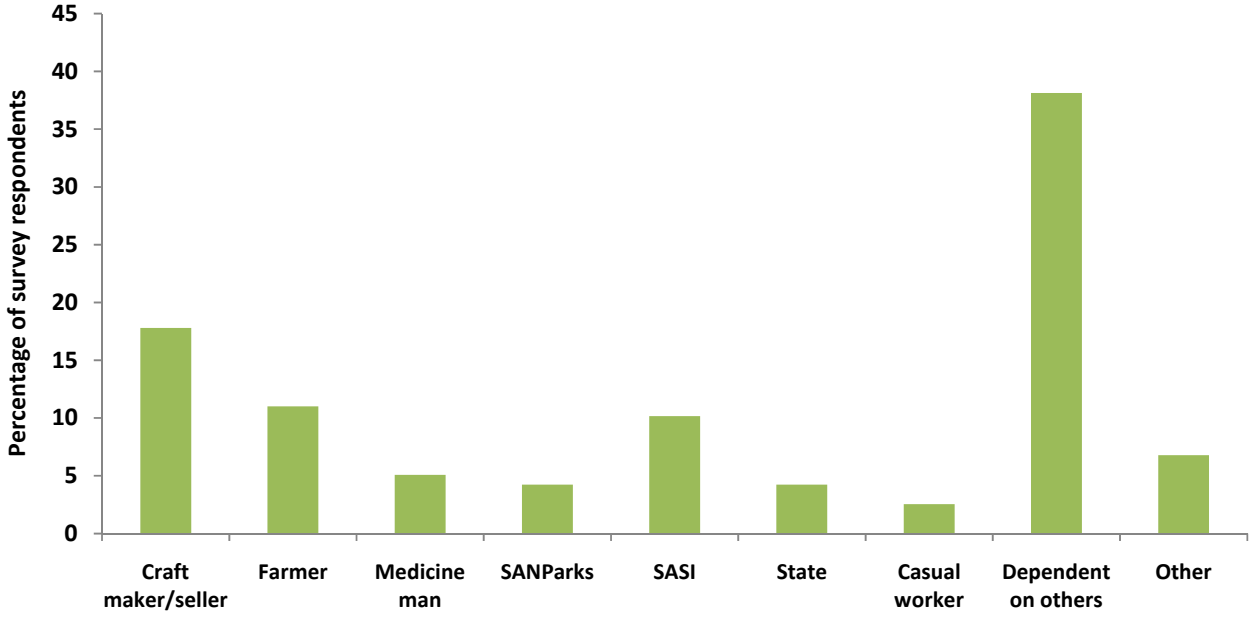


Figure 18 Percentage of ≠Khomani Bushmen survey respondents categorised according to occupation/employer (N = 86)

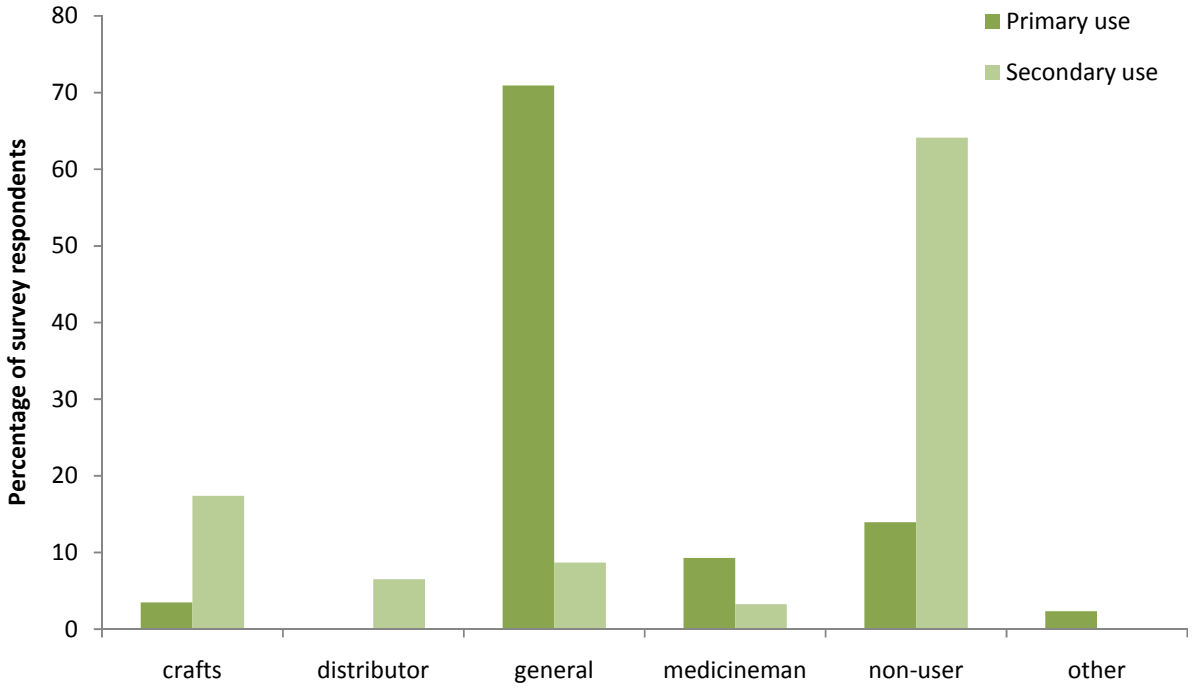


Figure 19 Percentage of ≠Khomani Bushmen survey respondents who use plants, either primarily or secondarily, in the different plant use categories (N = 86)

Network maps

In total, 225 nodes (i.e., individuals identified as comprising the network) and 1632 reported links (i.e., relations) were recorded. For the knowledge networks in particular, the knowledge acquisition network involved 138 nodes with 125 links (Figure 20), the knowledge generation network involved 96 nodes with 109 links (Figure 23) and the knowledge diffusion network involved 101 nodes with 121 links (Figure 25).

Regarding the knowledge acquisition network (Figure 20) in which respondents were asked from whom they obtained their knowledge of wild plants and their use, most dyads and triads (connections between two and three individuals, respectively) do share information. They are not, however, connected to the large cluster (i.e., a subset of individuals within a network who have ties with other individuals within the cluster). The network map illustrates considerable isolation of these small groups which suggests considerable fragmentation. When asked the question from whom they obtained their knowledge of wild plants and their use, instead of mentioning the specific name, most respondents would reply *"from my now deceased grandparents and/ or parents"*, which was recorded as such. These responses were noted and a map depicting this particular network as illustrated by 'deceased' or 'not deceased' individuals was generated (Figure 21). Cases, in which this information was not volunteered, are classified as 'unknown'. These connections occur in isolation since knowledge sources (mostly parents 44.4% and grandparents 34.7%) have died and were therefore not surveyed. The study also found that plant knowledge transfer occurred at an early age (12.4 $\pm$ 8.7 years, n=66) with a further possibility being that some respondents had an incomplete recall of knowledge sources.

Looking at the network structure of only those that were surveyed, it shows that 26 (92.9%) out of the 28 isolates are individuals who use plants primarily for general purposes while two are individuals who principally use plants as medicine (Figure 22). Of all those surveyed, six of the eight respondents (75%) who primarily use plants as medicine are connected to the central cluster and thus acquire knowledge within this structure. This implies that people who mostly use plants for general purposes have acquired knowledge (from deceased grandparents or parents or individuals not present in the community) but are not further doing so. Those that mostly use plants as medicine, however, are continuing to acquire knowledge amongst them, possibly attributable to them being 'consulted' on medicinal plant knowledge. Almost two thirds (58.8%) of this network are connected to others and are

acquiring plant knowledge from others. This, however, is a poor representation of the community itself since only 66 nodes (i.e., individuals who responded to the survey question) out of a possible 225 (i.e., individuals who responded to the survey question plus those that were mentioned by respondents, including deceased grandparents or parents or individuals not present in the community) are represented in this network. Furthermore, some people may not have comprehensively reported all individuals from whom they acquired plant knowledge.

With reference to the knowledge generation network (Figures 23 and 24), when respondents were asked who they discuss important matters pertaining to their use of plants with, the resultant map depicts several clusters. Here several individuals are connected to an individual (i.e., the hub) who in turn connects the cluster to other clusters within the network. The hub is viewed by Krebs and Holley (2004) as a weaver, a person with vision, energy and social skills who actively connects diverse individuals and groups, enabling information exchange. Where multiple hubs exist, clusters can potentially connect and information can flow between various groups with common or complementary knowledge and practices. Here the hubs are classified as individuals with at least four or more ties, incoming and outgoing, that also connect to other hubs. Four of the seven hubs in the knowledge generation network primarily use plants as medicine; two are general users while the remaining hub is an individual not surveyed (Figure 23, Table 6 hubs in italics). All the hubs are male, while four are over 56 yrs of age (Figure 24). Those with the most links (*A102* and *A36*) are named mostly as discussants and do not name many others with whom they themselves discuss matters with. *A102* has eight incoming links and one outgoing link, while *A36* has 15 incoming links and only four outgoing links of which three are with other 'medicine as primary use' individuals (Figure 23). It thus seems that the individuals to whom community members mostly turn to in order to discuss important matters pertaining to their use of plants, are male (100%), over 56 yrs of age (57,1%) and for the most part (57,1%), those who primarily use plants as medicine. Although Barnard (1979) recorded traditional medicine men as being *"a man or (less often) a woman who cures either with herbal medicines or by trance"*, the present community depicts only elderly men in this role. The only individual with equal outgoing as well incoming links is A50, with three each. The individual is a female in the 46–55 years age class. According to the ethnobotanical survey conducted (Chapter 4), no significant difference in the number of plants used was found between men and women, although, on average, men cited more plants than women. In terms of species similarity across gender, only a 30% agreement was found indicating variation in terms of plant use between the sexes, with only a third of the plants used, being similar.

When interviewees were asked with whom they exchange information which is useful for them to carry out their use and/or collection of plants, the structure of the knowledge diffusion network (Figures 25 - 27) is similar to that of the knowledge aqcuired network, with isolated links on the periphery and a multi-hub arrangement at the centre. Four of the nine hubs mainly use plants as medicine, another four as general users and one person mostly uses plants for crafts. Seven of the hubs are male (77.8%), aged 36 years and older (two are aged between 36 – 45 years, two are aged between 46 – 55 years, two are aged between 56 – 65 years and three are >65 years of age; Figure 26). Within the central structure, hubs are exchanging plant information and are assumed to hold common knowledge around plant use, but the more peripheral and isolated groups are not. When asked how much knowledge they believe they hold so as to ensure plants are used sustainably, 14 of the 17 individuals (82.3%) who believe they possess 'all' known knowledge are positioned in the central cluster, two occur in an isolated dyad and one in a small cluster unconnected to the main cluster (Figure 27). For the community to successfully govern their resources through self-organisation and agreeing on rules and regulations around plant extraction and use, they will need to effectively exchange information to reach a practical level of mutual understanding amongst themselves on the issue (Berkes et al. 2000, Ostrom 2005). This will not be possible if individuals and groups remain on the periphery, especially not if the majority of isolated links, 12 out of the 20 (60%) consider themselves as possessing only 'some' or 'none' of the known knowledge necessary to use plants sustainably. The groups are not being informed by central individuals, while the central individuals do not appear to be seeking them out to discuss important plant use matters. However, this serves as a best case scenario, since those who believe they have 'all' known knowledge needed to manage plant resources sustainably may not have all the sufficient knowledge to do so.

Shared social characteristics are presumed to reduce conflict as well as facilitate communication due to common background and shared life experience (Reagans and McEvily 2003). Such homogeneity, the tendency to have more connections to others of your own kind, is also believed to enhance tacit knowledge transfer (Cross et al. 2001). Conversely, high levels of homogeneity could reduce diversity and limit access to distant information resources (Krackhardt and Stern 1988). In this study, homogeneity can mostly be found between older males and to a lesser extent those that use plants primarily as medicine (Figures 25 - 27). This suggests that age and gender play an important role in defining communication of plant resource information and knowledge. Furthermore, 62% of the individuals connected to the central structure of the knowledge diffusion network consider themselves as having either 'all' or 'most' of the known knowledge needed for sustainable plant use, as compared

to 28% of individuals not connected to the central structure. Crona and Bodin (2006) found that fishermen's groups with strong links among each other tend to have similar knowledge. Those not tied to these groups possessed a lack of ecological knowledge and are deemed unlikely to acquire such knowledge through direct personal experience, ultimately remaining with a poorer conception of resource status. Intense interactions, such as those occurring in central clusters, are required for tacit or complex knowledge transfer (Hansen 1999, Reagans and McEvily 2003) while only well-connected groups are expected to develop complex group-specific knowledge (Crona and Bodin 2006). It would seem that more knowledgeable individuals are attracted together while, at the same time, being part of the central structure further increases knowledge.

Network density

Recall that density, a measure of connectivity, is the total number of ties divided by the total number of possible ties (de Nooy et al. 2005) and that it is the number of relations, expressed as a proportion of the maximum possible number of relations. For the knowledge acquisition network, there are 138 nodes, therefore 18906 possible reciprocal relations, while the reported number of relations is 125, thus the density is 0.0066. Expressed as a percentage, density is 0.66% (Table 6) meaning that less than 1% of all possible links are present. Although it is possible to find low density scores in large networks since density is inversely related to network size (de Nooy et al. 2005), here it is most likely attributable to respondents naming people that are no longer alive or present in the community as having taught them about plants and their use. In Figure 21, nearly a third of the nodes (31. 88%) are classified as 'deceased'. This highlights the importance of encouraging knowledge transfer to the youth, since valuable environmental knowledge and age-old skills are dying out as the older generation become deceased.

In the knowledge generation and diffusion networks, density is also relatively low (0.0116; or 1.20% and 0.0119 or 1.20%). According to Reagans and McEvily (2003), high densities may have a negative effect on heterogeneity since it promotes homogeneity of experience and attitudes among individuals, thus reducing the potential for innovation. However, pertaining to trust, central to co-management (see Olsson 2003), many links tend to foster feelings of belonging and group identity (Coleman 1990). This is not the case for the three knowledge networks which mostly have the same

individuals in the central structure of the networks, while the majority (>80%) of the community only have few or no connections to the central structure. Apart from reduced distribution of information, the possibility also exists that those not connected to the central structure might start perceiving plant use practices and decisions made regarding the matter as undemocratic and unfair. Numerous network connections can allow access to diverse and dispersed knowledge (Wegner 1987, Moreland et al. 1996, Rulke and Galaskiewiscz 2000) and decrease levels of internal conflict (Muñoz-Erickson 2010). Conversely, this can lead to a homogenous belief system (Krackhardt and Stern 1988, Ibarra 1992, Reagans and Zuckerman 2001) and when these homogenous beliefs foster polarized 'us versus them' mentalities between individuals of a network, conflict can become deeply entrenched (Krackhardt and Stern 1988).

The low density knowledge networks can potentially have negative effects on the transfer and sharing of information and knowledge (e.g. Shaw 1981). Bodin and Norberg (2005) have however shown that low density can potentially increase diversity in practices, crucial to the management of resilience in complex systems. Networks with few links are potentially vulnerable to the loss of a single individual, as this structure may manifest a reduced resilience, especially in the event of that person possessing knowledge that no one else does. For example, the loss of *A102* in the knowledge generation network (Figures 23 and 24) would leave 26 individuals from three different clusters unconnected. A high density would provide buffering capacity in the case of loss (Bodin et al. 2006), e.g. if an individual is weakened or lost, since others could then fill that position (Janssen et al. 2006). Intuitively, the ability of the community to 'hold together' in the face of such an event will increase with the number of independent ways that group members are linked. The removal of *A73* in the knowledge diffusion network (Figures 25 - 27) will not leave those grouped around *A71* isolated, since they are still connected to the centre via *A116*. Promoting multiple relationships for knowledge exchange should increase network resilience in the event that one or a few individuals are lost.

Network degree

Degree, a measure of centrality, refers to the number of ties an individual has. Centrality provides an indication of the distribution of ties among individuals as well as their structural importance (Wasserman and Faust 1994). Degree can further be defined as in-degree and out-degree, where in-degree is the number of incoming ties while out-degree refers to outgoing ties. The average degree of

all ties measures the structural cohesion of a network (Nooy et al. 2005). Structural cohesion is the minimum number of individuals, who if removed from a group, would disconnect the group (Moody and White 2003). The measure of degree does not depend on network size and allows for a comparison of networks of different sizes. Networks yielding a higher average degree imply a denser network because the number of ties is greater. All three knowledge networks have average in-degrees and out-degrees lower than 2, implying low centrality and a lack of cohesiveness (Moody and White 2003, Bodin and Crona 2009; Table 6).

The advantages of high degree is improved accountability since central individuals, those with higher than average measures of degree, can to some extent be held responsible for the group (Janssen et al. 2006). The low averages of degree in all three knowledge networks, however, imply a possible lack of control and accountability (Janssen et al. 2006) for the network as a whole. Also, those well connected individuals (i.e., the hubs) in the central structure have a significantly higher number of ties which promote the diffusion of innovation and ideas (Abrahamson and Rosenkopf 1997) throughout the group, but this ease of spread decreases toward the periphery. This central cluster of highly connected individuals may facilitate coordination and control but reduces the diversity of the nodes with regards to information exchange since all the individuals are closely connected to the few central nodes and all of them receive similar information (Janssen et al. 2006).

This could lead to everyone in the central cluster knowing what everyone else knows and no one knowing what is going on in the periphery. The lack of incoming information from individuals not connected to the core, and dense cohesion in the central cluster itself, removes all possibilities for new ideas and innovations (Krebs and Holley 2004). Unless central individuals undertake regular discussions with the peripheral members, their ideas may be slower in penetrating and being adopted in the centre. Furthermore, a high number of links to many others may also lock those central individuals into assumed political positions as a result of peer-pressure, for example, potentially limiting their ability to innovate and act (Frank and Yasumoto 1998).

Lastly, social psychologists have shown that centralised networks complete simple tasks more efficiently than do decentralised ones in cases where one or just a small cluster of individuals are centrally positioned and others are on the periphery (Leavitt 1951, Shaw 1981). But, they also showed that the performance of decentralised structures improves with complex tasks. This is due to the contribution from all individuals to a solution, providing diversity of information and knowledge.

Co-governance of social-ecological systems is a complex task and less centralised network structures are preferred for long-term ecosystem management (Crona and Bodin 2006). Centralised structures do however play an important role in mobilising and coordinating people for collective action. In order to improve resilience in this context, the following aspects of governance should be focused on:

1) Knowledge networks that take advantage of experience and wisdom of a wide range of key individuals or 'knowledge stewards' (Olsson 2003) who operates at different hierarchical levels. These individuals need to be nurtured and responsibilities should be spread as widely as possible to avoid dependence on single individuals.

2) Formalised decision-making structures with clear constitutions and codes of conduct, with clearly defined terms of reference should be constituted (Fabricius and Collins 2007).

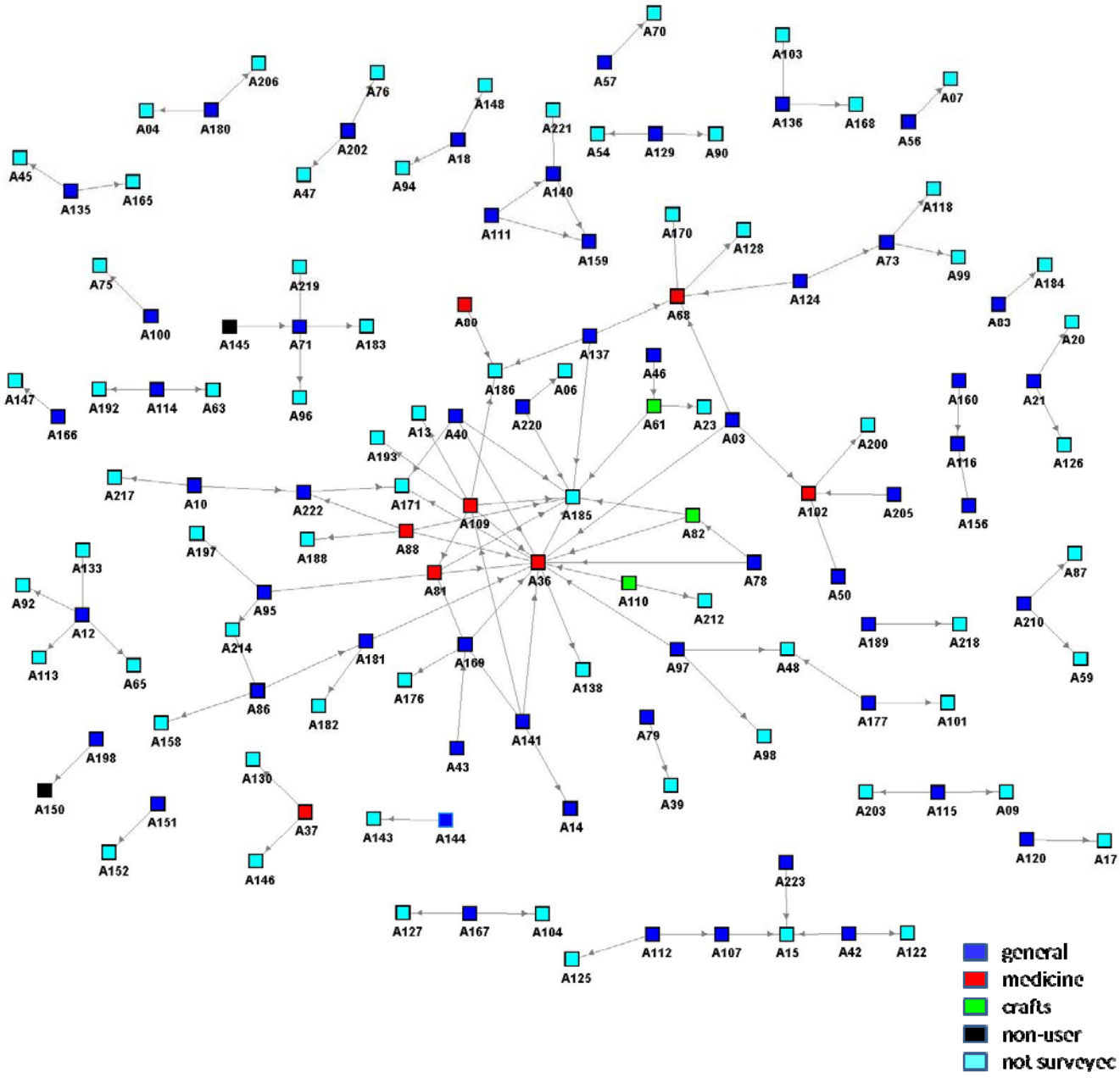


Figure 20 Map of knowledge acquisition network (from whom did you obtain your knowledge) based on the attribute of 'primary use of plants', as cited by the ≠Khomani Bushmen survey respondents (n = 66)

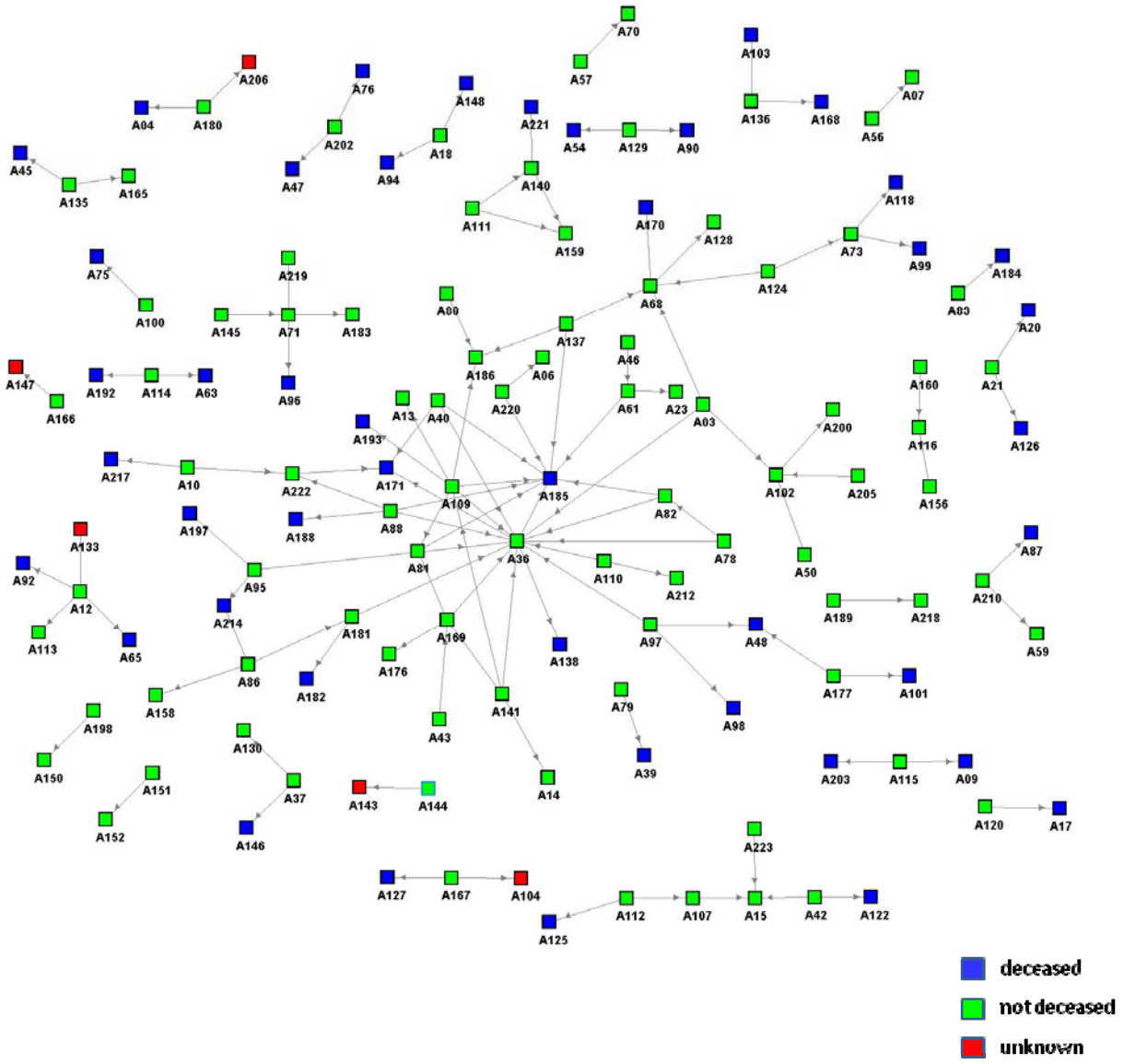


Figure 21 Map of knowledge acquisition network (from whom did you obtain your knowledge) based on the attribute of 'deceased/not deceased', as cited by the ≠Khomani Bushmen survey respondents (n = 66)

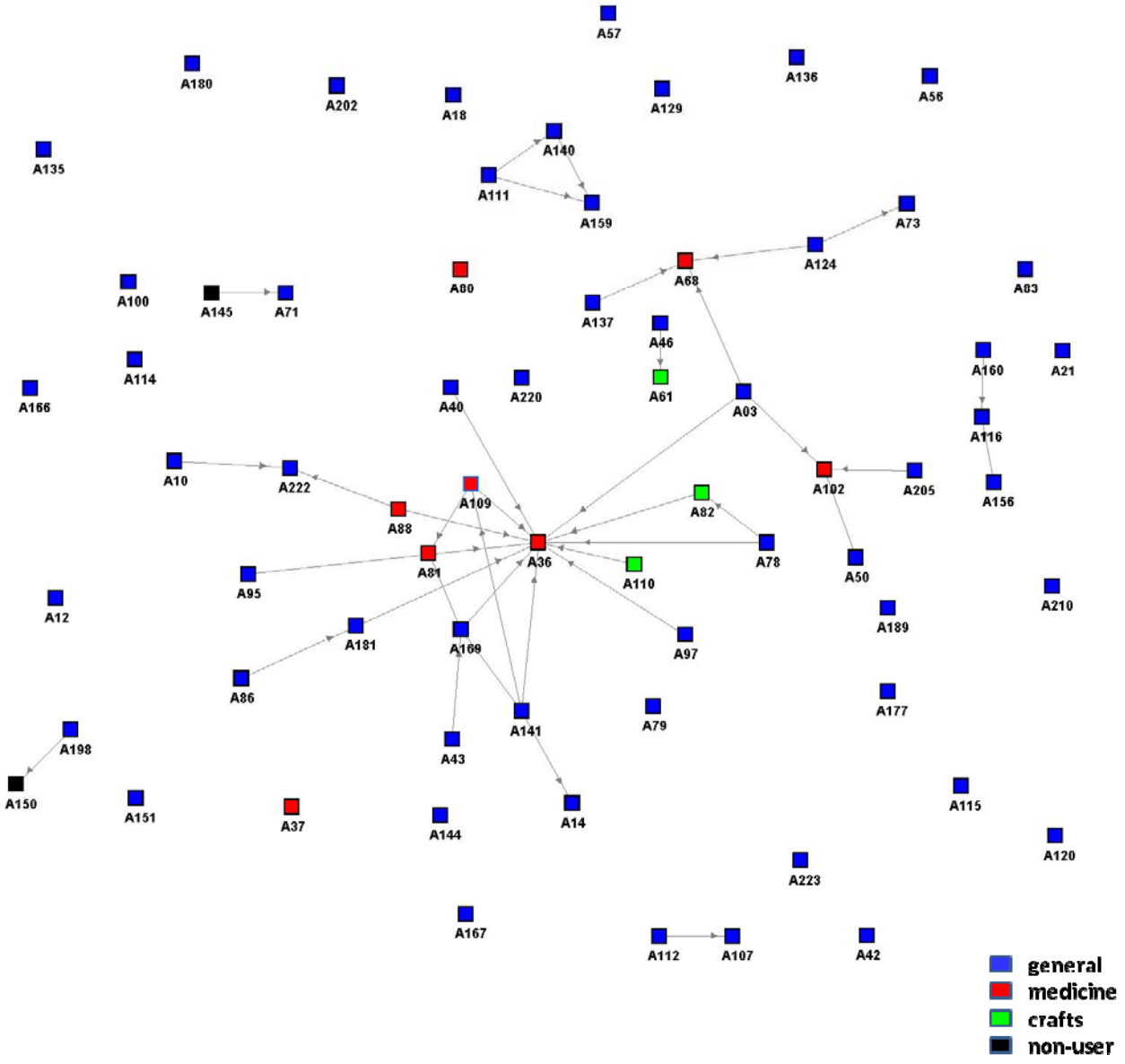


Figure 22 Map of knowledge acquisition network (from whom did you obtain your knowledge) of only the survey respondents and based on the attribute 'primary use of plants' (n = 66)

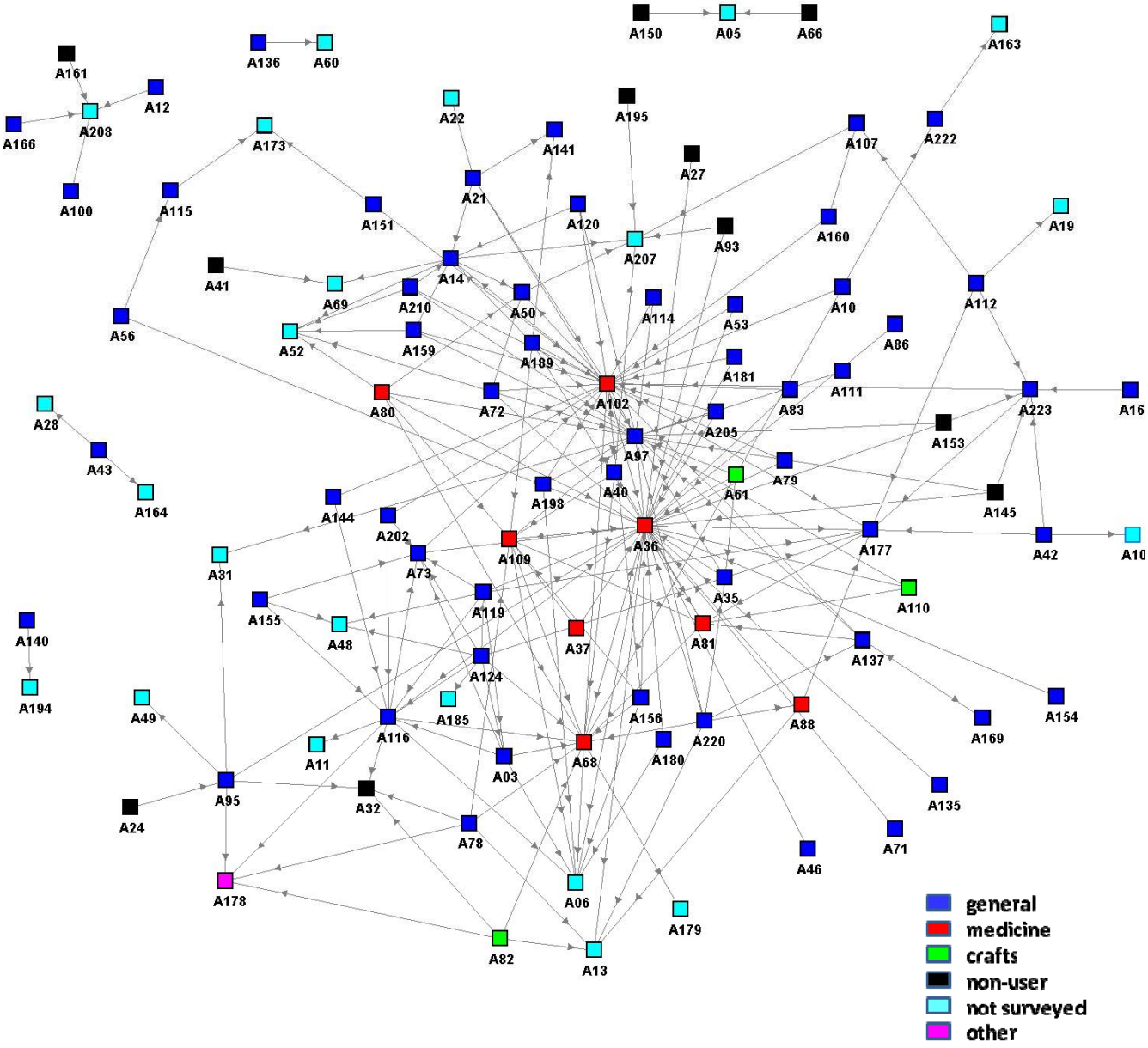


Figure 23 Map of knowledge generation network (discuss changes in environment with) based on the attribute of 'primary use of plants', as cited by the ≠Khomani Bushmen survey respondents (n = 78)

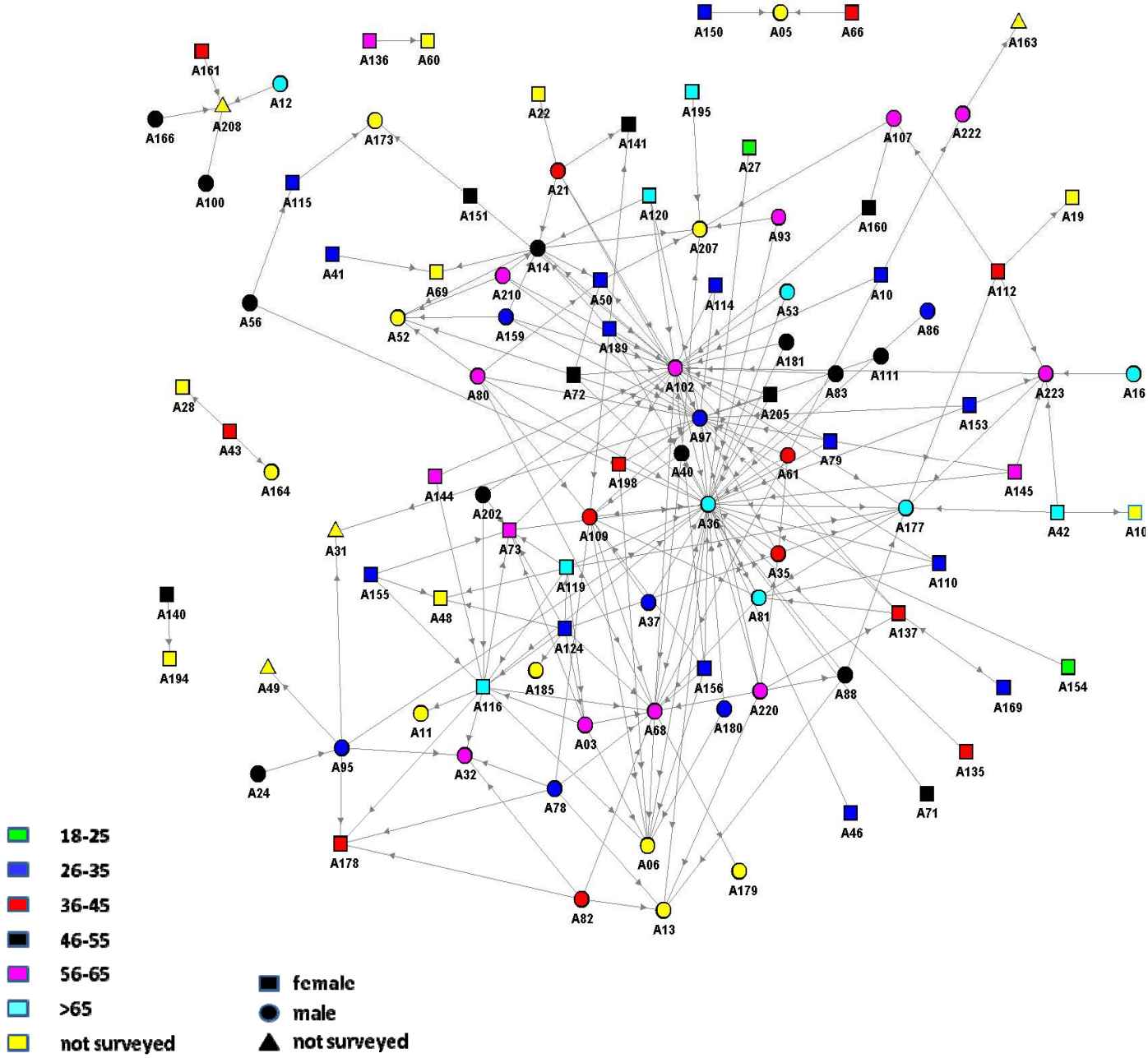


Figure 24 Map of knowledge generation network (discuss changes in environment with) as per age class and gender (n = 78)

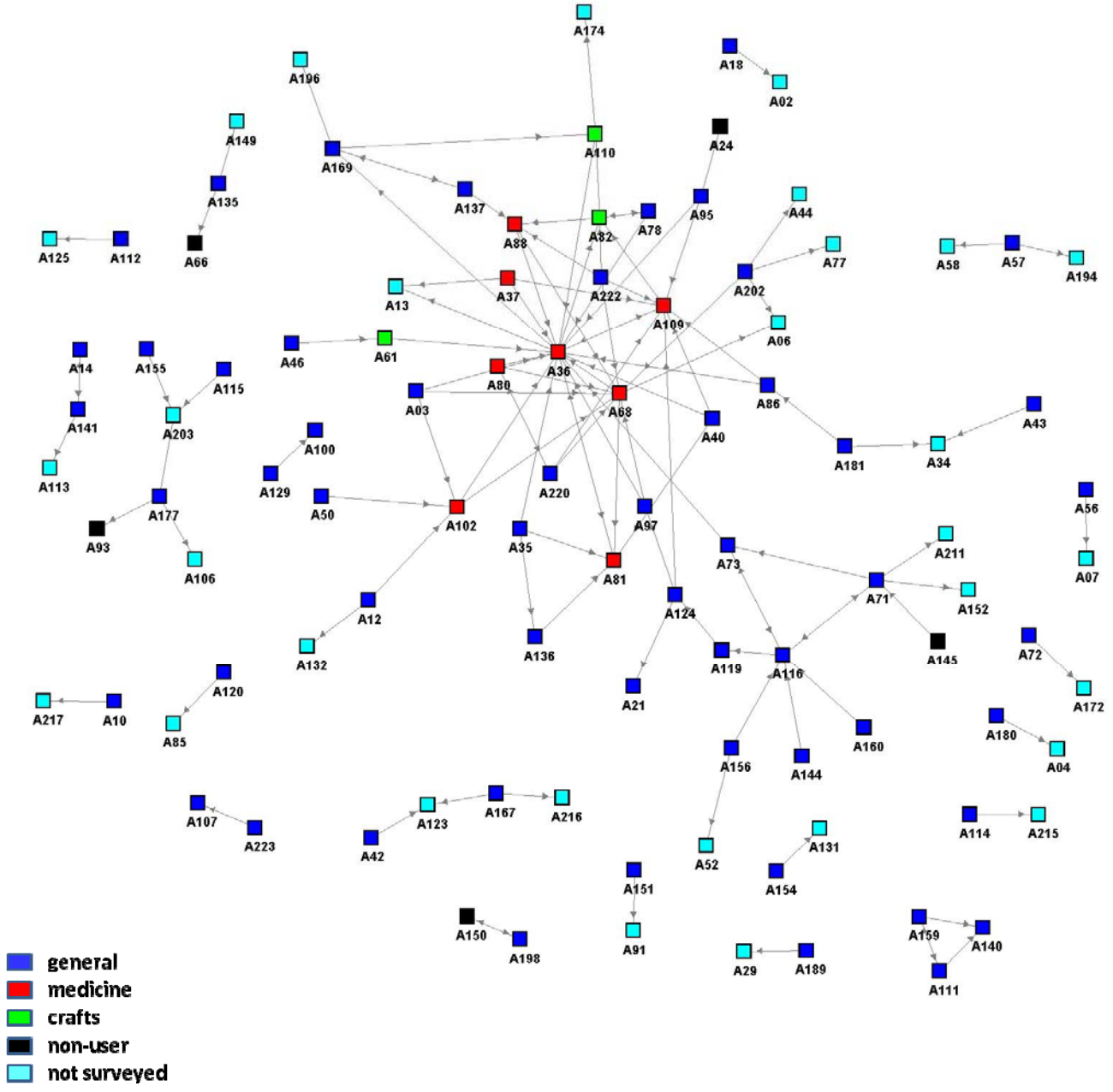


Figure 25 Map of knowledge diffusion network (exchange important plant information with) based on the attribute of 'primary use of plants', as cited by the ≠Khomani Bushmen survey respondents (n = 64)

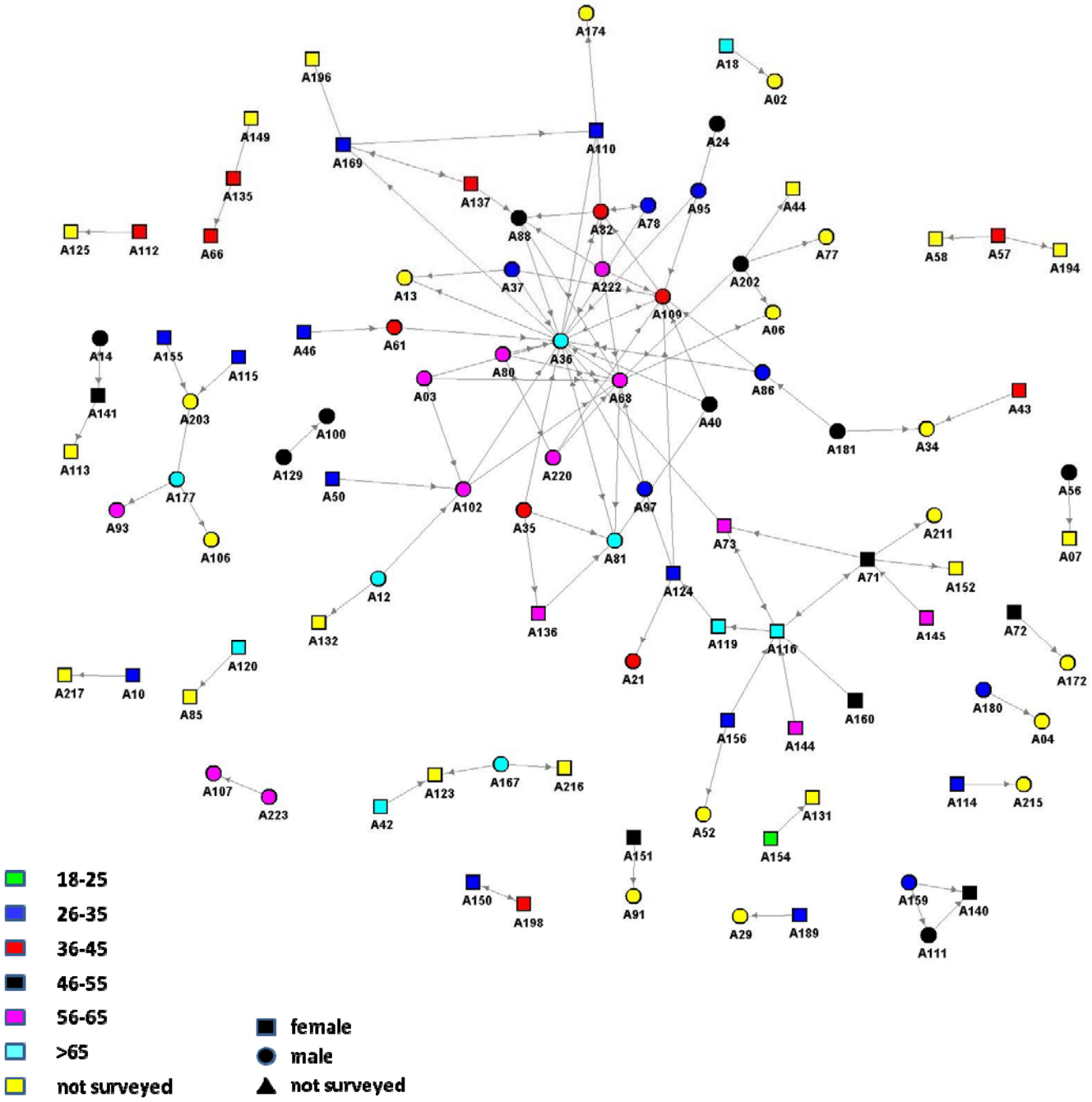


Figure 26 Map of knowledge diffusion network (exchange important plant information with) as per age class and gender (n = 64)

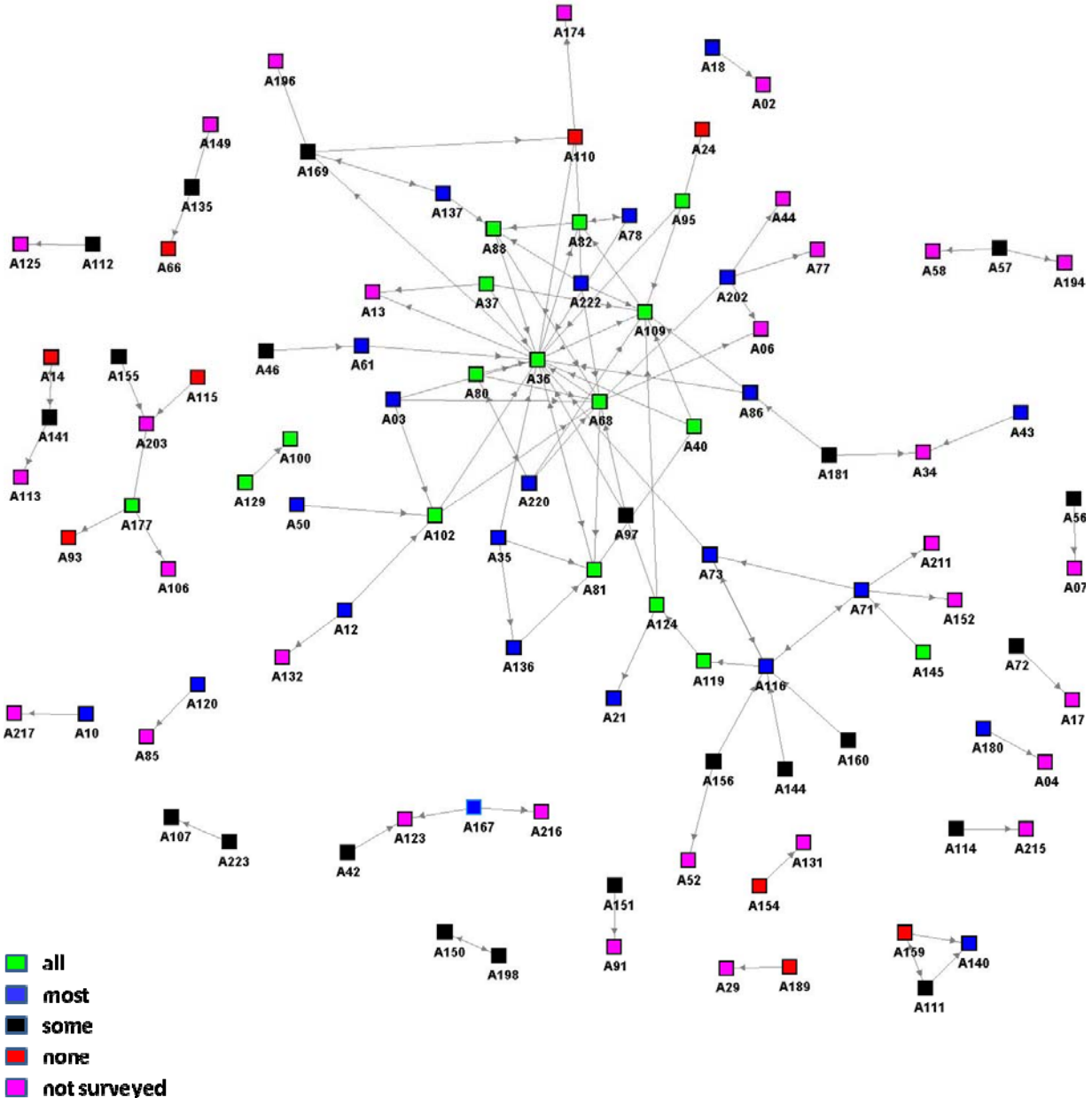


Figure 27 Map of knowledge diffusion network (exchange important plant information with) based on the attribute of 'knowledge needed to use plants sustainably', as cited by the ≠Khomani Bushmen survey respondents (n = 64)

Table 6 Density and average degree measures of the knowledge networks and individual degree scores according to the (Individual hubs in italics)

Map		Figure 6			Figure 7			Figure 8		
Network		**knowledge acquisition**			**knowledge generation**			**knowledge diffusion**		
Question		knowledge obtained from			important matters discussed with			discuss changes in the environment		
Density										
number of nodes		138			96			101		
number of links		125			109			121		
(%)		**0.66**			**1.20**			**1.20**		
		N	**Mean**	**Std dev**	N	**Mean**	**Std dev**	N	**Mean**	**Std dev**
Degree	Out	66	1.89	0.98	63	1.73	0.94	64	1.89	0.99
	In	87	1.44	1.52	60	1.82	2.19	64	1.89	2.41
Individual measures										
	Node	**out**	**node**	**in**	**node**	**out**	**node**	**in**	**node**	**out**	**node**	**in**
	A109	***6***	*A36*	***12***	*A177*	***5***	*A36*	***15***	*A36*	***5***	*A36*	***17***
	A12	***4***	*A185*	***9***	*A36*	***4***	*A102*	***8***	*A71*	***4***	*A68*	***8***
	A88	***4***	A15	**3**	A03	3	*A68*	***6***	*A202*	***4***	*A109*	***8***
	A141	***4***	A68	**3**	A14	3	*A97*	***5***	*A222*	***4***	*A81*	***5***
	A03	**3**	A102	**3**	A50	3	*A52*	***4***	A03	3	*A116*	***5***
	A36	**3**	A171	**3**	A73	3	*A88*	***4***	A35	3	*A82*	***4***
	A40	**3**	A186	**3**	A80	3	A50	3	A37	3	A88	3
	A71	**3**	A48	**2**	A110	3	A116	3	A40	3	A102	3
	A86	**3**	A81	**2**	A112	3	A223	3	A68	3	A203	3
	A95	**3**	A116	**2**	A124	3	A06	2	A80	3	A06	2

(See Appendix 6 for individual degree of the entire networks)

Conclusion

Ancestral land-use rights have been returned to the ≠Khomani Bushmen and they are now at liberty as a community to access the natural resources within, and outside of, the KTP. However, their use and governance of these natural resources must be compatible with the conservation policies employed by SANParks, the National Environmental Management Act of 2004, and the South African constitution. Furthermore, natural resource use must be negotiated within the community and through the JMB. The innate complexity and dynamism of the Kalahari social-ecological system makes governance, and more specifically, co-governance, of these natural resources, a challenging task. Achieving effective and adaptive co-governance will be facilitated through information and knowledge exchange. The ≠Khomani Bushmen community interact with, and depend on, the environment for their livelihoods, and as an integral part of their cultural practices. Such TEK needs to facilitate communication and decision-making and serve as a foundation for the regulation of plant use. As a common point of interest, TEK can be used as a mechanism to get people to start talking to each other more openly.

Additionally, to meet their objective of maintaining cultural resources representative of the broader Kalahari and to offer long-term benefit to the people of the area (SANParks 2006), SANParks needs to develop management regulations that complement traditional cultural practices. To successfully manage their resources, information and knowledge needs to be acquired, generated and exchanged. This requires a mutual understanding amongst community members of resource use, while conflict resolution and group relations also play a vital role. Here it is important to understand not only the attitudes and knowledge of individuals, but also the relationships between individuals and to have an overview of the patterns and processes of interactions of the community as a whole. Social network theory and the analysis of social networks allows managers, particularly the JMB in this immediate case, to better understand the Kalahari social-ecological system, specifically the use of plants by individuals and the flows of TEK within the community as they influence plant resource use.

The knowledge networks of the ≠Khomani Bushmen community all have multi-hub structures, with many individuals loosely connected to, or even completely isolated from, the central cluster. This could be a deliberate structure created by individuals or small groups to maintain exclusivity over knowledge within their small group (i.e., to maintain power) or it could be an effect of individuals

maintaining stronger ties within different primary plant user groups. A further possibility lies in this being a reflection of the traditional social structure of the Bushmen clan. The structure of the knowledge acquired network, in particular, suggests considerable fragmentation, potentially due to the dislocation and subsequent relocation of people, as well as many knowledge sources (32,1%) now being deceased. For the knowledge generation network, four out of seven hubs primarily use plants for medicinal purposes, four hubs are elderly (>56 years of age) and all hubs are male. This suggests that the generation of knowledge through discussions on important matters regarding plant use, involve mainly elderly men, who primarily use plants medicinally. This is inconsistent with the findings of Dovie et al. (2008) who studied knowledge of locally useful woody plant species in South African savannas and reported young people and middle-aged females to be highly knowledgeable. Results of a study conducted on knowledge of traditional plant medicine in northeast Brazil indicates that women are more knowledgeable of the local flora than are men, with this division more pronounced among older participants (Voeks 2007).

Studies conducted on the subsistence ecology of Bushmen bands indicate historical gender divisions of space and labour (with women gathering plants close to the dwelling while men travelled further away to hunt) (Lee and DeVore 1976, Lee 1979, Silberbauer 1981, Biesele et al. 1989, Tanaka 1989, Lee and Daly 2004, Barnard 1992; 2007) men have traditionally taken the position of 'shaman', 'curer' or ‘medicine man’ (Barnard 1979, Lewis-Williams 1992, Prada-Samper 2007). This implies that plant knowledge, particularly of medicinal plants, is held by older, male members of the community who mostly discuss important plant information amongst them. The generation of new information is more likely to occur within these groups than in isolated cases. Older males need to exchange information and discuss matters pertaining to plants and their use not only amongst themselves but also with females and with younger individuals. Specialised traditional ecological knowledge will be shared, possibly reinforcing social capital and ultimately making the community more resilient to cultural and environmental change.

Regarding the knowledge diffusion network, hubs comprise both general and medicinal plant users, again, mostly men (77.8%). Here more than 80% of individuals who consider themselves as possessing ‘all’ of the known knowledge needed to use plants sustainably are positioned in the main cluster, suggesting a break down in the spread of this knowledge to the periphery. It also suggests that those external to the central structure recognise that there is a main cluster which has ‘all’ the

known knowledge. As with the knowledge acquisition and the knowledge generation networks, the poor exchange of information and knowledge among individuals impedes the ecologically sustainable use of plant resources since strong ties are needed to transfer traditional, tacit and complex knowledge. The existence of only a few links between central and peripheral individuals impairs effective management since co-ordinated collective action, which is a prerequisite for ensuring ecologically and culturally sustainable plant resource use is highly challenging to achieve.

Pertaining to the density of relations within the networks, representative of the level of connectivity, the study found that for the knowledge acquisition network, less than 1% of all possible links are present. For the knowledge generation and diffusion networks, only 1.20% of links are present. These low levels of relations between members of the networks seem to explain the limited spread of information and many individuals inability to access knowledge. Having few social relations not only hampers the opportunities for collective action and the development of knowledge and understanding through exposure to new ideas, innovations and an increased quantity of information, but also of ensuring the effectiveness of the KTP Joint Management Board. For degree, a metric of centrality, which not only gives an indication of the distribution of links between individuals but also their structural importance, the study found that the average in- and out-degrees of all three networks to be low (<2). Some relatively high-ranking individuals do exist (i.e., hubs), with higher-than-average number of ties (Table 6, bolded) with only one individual, (*A36*), providing an important link between the different groups and who is present in a central role in all three knowledge networks. This may facilitate coordination and control, but reduces the diversity of information and knowledge exchange since most exchanges are occurring within the few closely connected central nodes, with all of them sharing similar information.

The isolation of most individuals and the overall low levels of connectivity and centrality can have a detrimental effect on knowledge generation and exchange (Wasserman and Faust 1994, Bodin and Crona 2009). This, in turn, may impair ecologically sustainable management of plant resources. In the event of harvesting regimes being agreed to by the community, then a highly connected network promotes 1) identifying sustainable harvesting regimes, and 2) the comprehensive and rigorous adherence by individuals to these regimes. It is important to note that different network structures influence the social dynamics considered necessary for effective management in different ways (Crona and Bodin 2006). Many social ties and high centralisation, for instance, might be initially

beneficial to coordinate and instigate collective action (Bodin and Crona 2009), while increased levels of collective action over time leads to increased levels of reciprocity and mutual trust (Putnam 1993, Axelrod 1997, Pretty and Ward 2001, Janssen and Ostrom 2006). Later, decentralised structures may provide access to the diversity of knowledge needed for sustainable adaptive co-management (Gunderson 1999, Pretty and Ward 2001, Folke et al. 2005b, Grafton 2005, Hahn et al. 2006, Scholz and Wang 2006, Olsson et al. 2008).

A common finding in community driven initiatives is that of elite capture (Platteu 2004). At the community level, elite capture can be defined as the appropriation, by individuals in a dominant position in a community, of a share of the benefits of a collective action significantly larger than their contribution to the collective action (Manssouri and Sparacino 2009). Generally, the risk of elite capture is low in the case of shared or public resources (Platteu and Gaspart 2003), as is the case here, yet a risk lies in those dominant individuals, occupying positions in the central structures, from excluding others from access to resources and knowledge. An important factor is the capacity of individuals within a heterogeneous community to build their own social capital since this can balance the influence of dominant groups and counter a potential tendency for elite dominance (Manssouri and Sparacino 2009). Those well connected individuals (i.e., the hubs) in the central structure, who have a significantly higher number of ties, could potentially be members of the initial claimant group, or their relatives, who originally lived in the area prior to the proclamation of the KGNP. They thus have a closer relationship to their surroundings and advanced knowledge of plant resources when compared to those individuals of Khoisan descent who are not initially from the area. It is necessary to determine what constitutes an acceptable level of elite dominance; that is, what is the 'fair' share of benefits that compensates this central structure for their function in facilitating knowledge generation and diffusion, beyond which elite capture occurs.

The community itself needs to identify those individuals with several ties, the hubs, who are willing and have leadership skills and who Krebs and Holley (2004) consider 'network weavers' to actively connect individuals and groups from the periphery to the central cluster. This should start information flowing to, and from those individuals on the periphery, connecting individuals and clusters that can collaborate or assist one another with matters regarding plant use, while simultaneously encouraging others to become hubs and ultimately network weavers too. When coupled with mutually agreed common goals, this will not only improve support from the JMB, and SANParks, but will also

counteract knowledge loss and the ecologically unsustainable use of plant resources. Presently, the only individual with a higher-than-average number of ties and who is present in a central role in all three the knowledge networks (i.e., acquisition, generation and diffusion) is *A36* providing an important link between the different groups. This person is a prospective network weaver and can potentially advise the JMB on which community members to approach to become network weavers. According to Krebs and Holley (2004) network weaving involves 1) relationship building, which gives individuals access to innovative and important information, such as how to use plants sustainably; as well as 2) learning how to facilitate collaboration for mutual benefit. This, according to them, creates a state of emergence, where the outcome is a healthy community, one which is greater than the sum of the many collaborations. This is especially vital in the case of the ≠Khomani, since more aged members of the community represent a reservoir of traditional plant knowledge that is in danger of disappearing and that needs to be transferred to the younger generation before it is lost. By facilitating collaboration and relationship building, the network weaving process can potentially counteract the loss of traditional plant knowledge.

Ultimately, and more desirably, the networks need to emulate a 'core/periphery' configuration, where the core includes individuals with developed ties amongst themselves and the periphery comprises individuals who are connected to the core, albeit through weaker ties (Krebs and Holley 2004). The network weaving process will require collaboration, by community members, JMB representatives and SANParks, as well as researchers and NGO's involved in the area. Collaboration can lead to better decisions that are more likely to be implemented and will better prepare the joint management effort for future challenges (Wondolleck and Yaffee 2000, Knight et al. 2010). Future research thus needs to assess the community's willingness and capacity to engage 1) social learning and 2) network weaving while and the ability of the JMB to promote adaptive co-governance needs to be reviewed. Research should also be focussed on understanding whether traditional 'sustainable' knowledge is sufficient when compared to scientific ecological knowledge and ecological limits of plants being harvested needs to be determined.

Over the last decade, social networks have been increasingly considered instrumental in enabling communities in the adaptive co-management of natural resources (Olsson et al. 2004, Bodin and Norberg 2005, Folke et al. 2005b, Hahn et al. 2006, Bodin and Crona 2009). Here the study provides a 'snapshot' of social networks based on plant use information and knowledge acquisition, generation

and diffusion within the ≠Khomani community. The insights provided by maps and measures of centrality and connectivity depicts the current distribution of knowledge and should be used by the network participants themselves, as supported by network weavers and SANParks, to achieve their joint management goals. Any tensions that may arise between the ≠Khomani community's right to harvest plant resources needs to be balanced against the requirements of SANParks to ensure the persistence of nature within the Park. The relationship building and communication that network weaving promotes, can foster improved collaboration between all stakeholders involved in the governing process The social network has the potential to be instrumental in the successful transfer of information and knowledge throughout the ≠Khomani community and could provide a foundation for community-based adaptive management.

Chapter 6

Conclusion

The Southern Kalahari Bushmen prevailed for millennia as an integral part of the vast Kalahari ecosystem. Their social organisation was based on small family groups governed through flexible egalitarian structures, with a leadership philosophy founded on consensus. For subsistence, the Bushmen, as hunter-gatherers, relied entirely on natural products, meat obtained by hunting, and fruits and vegetables gathered in the form of edible wild plants. According to anthropological findings, the Bushmen had a sophisticated, diverse culture – in their social organisation, in aesthetics, in language, and even in their traditional knowledge of plants and animals (Chapter 3).

During the pre-colonial era the Bushmen were displaced by the Khoikhoi and Bantu-speaking peoples - around 2000 and 800 years ago, respectively, forcing them into the desolate arid regions of sub-Saharan African. With the arrival of European settlers and explorers in the 16th and 17th centuries, land was progressively divided into freehold farms, further displacing the Bushmen (and other indigenous people) into smaller tracts of communal land. Later, processes of social-political change forcibly dispossessed the Bushmen of their ancestral territories. In particular, the proclamation of the Kalahari Gemsbok National Park (KGNP) had colossal cultural and social implications for the Bushmen living within the park boundaries. They were widely dispersed over an extensive area comprising South Africa, Botswana and Namibia, isolated from other Bushman groups and mostly unaware that there are others akin to them elsewhere on the subcontinent. Many have become ever more dependent upon private and government-sponsored aid programmes which have accelerated cultural transition to low self-esteem and substance abuse, reinforcing rather than redressing forms of marginalization. As a result, the Bushmen remain among the poorest of the poor in southern Africa and the concept of self-reliance seems a distant reality. Apart from being alienated from their land, and therefore from their history, the disempowerment suffered by the Bushmen resulted in the loss of their culture and language.

In 1994, consequent to the end of Apartheid, the South African government instigated an ambitious, policy-driven land reform and restitution programme intended to reduce social disparities and to improve the lives of those marginalised by the Apartheid system of segregation and discrimination. In March of 1995, a Bushmen group, then employed as a tourist attraction at a private game farm in the Western Cape, indicated to their labour lawyer that they longed to return to the Kalahari. They sought the restoration of land in terms of the Restitution of Land Rights Act of 1994 and applied for: 1) ownership of farms in the vicinity of the then KGNP; 2) compensation for the land; 3) commercial rights to the National Park; and 4) symbolic rights in, and adjacent to, the National Park. This claim reflected the Bushmen's historical origins in the KGNP and their symbolic ownership of these lands.

The claim was settled in 1999 and afforded the scattered members of the then named ≠Khomani Bushmen recognition of their land rights in the form of six farms (37 000 hectares) as well as land use rights within the KGNP. Shortly after this, Botswana and South Africa signed an agreement to establish the world's first formally-designated transfrontier park; the Kgalagadi Transfrontier Park (KTP). The land claim not only facilitated the ≠Khomani with the opportunity to return to their ancestral land, it also entrenched their right to manage their lands within the KTP together with the conservation authority responsible for the Park, SANParks. They therefore now have a legal right to be actively involved, through the Joint Management Board (JMB) overseen by SANParks, in management matters pertaining to heritage use, traditional use of fauna and flora as well as other facets of traditional knowledge, which is planned to be gradually integrated into the management of the Park.

The ≠Khomani are now entitled to the restoration of land use rights, provided those uses are congruent to the prevailing conservation model as practiced by SANParks and imposed by the Protected Areas Act of 2003. The complex history of resource use dispossession, combined with the preservationist conservation policies employed in the past by SANParks, has led to the disenfranchisement and social and cultural disruption of the ≠Khomani. The challenge thus lies in involving and integrating the community in management processes, within a structured policy framework, set to gradually integrate traditional knowledge and practices and ultimately aiming to achieve social justice alongside environmental sustainability. The joint management of ecosystems, as such, is innately complicated since both the environment and the community functions through

complex dynamics where non-linear interactions, natural heterogeneity, high levels of uncertainties and scale dependencies are the norm.

Local communities and indigenous peoples play an important role in nature conservation (Mauro and Hardison 2000), since their use of natural resources is an everyday practice, while the frequent use of these resources indicates an extensive knowledge thereof (Berkes et al. 2000). In the case of the ≠Khomani Bushmen, who depend on natural resources as a source of livelihood, knowledge of plants is critical not only for their direct uses, but also for ensuring their conservation. Plant knowledge is also important from a cultural perspective due to the threat of poor intergenerational transfer, thus making the documentation of this knowledge critically important, especially for future generations who may need this information. Furthermore, the loss of this knowledge can potentially lead to unsustainable resource use, cultural breakdown and dependence on other resources. Finally, where plants are under threat as a result of over-harvesting, measures must be employed to try and ensure sustainable utilisation of useful species.

A comparison between current findings and that of historical records, important in understanding present-day trends, is however complicated. This is due, firstly, to the dichotomy in how the Bushmen have been viewed, and thus recorded, throughout time. Secondly, the large scale dispossession and displacement endured by the Bushmen of southern Africa during the colonial and Apartheid eras have left us with a dearth in ethnobotanical knowledge and Bushmen plant lore. One of the main aims of this study therefore was to identify and document the most important plant species currently being used by the ≠Khomani Bushmen community. This will a) aid in the conservation of these natural resources (e.g. monitoring and evaluation efforts), b) help counteract plant knowledge loss, and c) inform the implementation of sustainable plant use measures. Together with the identification of plant species being used, is the assessment of this use so as to establish current trends. The study evaluated use patterns between and within age groups and across gender, as well as the regularity, type, season and purpose of plant use.

In most ≠Khomani households, plants were found to be used on a weekly, if not daily basis, primarily for medicinal purposes. Although this contradicts Steyn's (1984) findings, which recorded the community as using plants mainly as a source of food and water, they do still, however, use plant

resources. This is in spite them being forcibly removed from the landscape from as early as the 1930's and notwithstanding improved access to Western sources of food and medicine. Differences were found in the number of plants being used between men and women, with men using more plants on average. Although this deviates from other ethnobotanical finding across South Africa, it is in line with Bushmen mythology and the role of the 'medicine man' commonly being occupied by older males. Plant knowledge acquisition occurred hands on, in the field and during early childhood in the majority of cases, highlighting the importance of outdoor scenarios and the transmission and sharing of traditional ecological knowledge to the community. This assessment in plant resource use is important for SANParks and the JMB in that it informs decisions regarding extraction and use, providing baseline information for monitoring and evaluation activities.

The ability of not only the JMB, but the entire community as a whole, to self-organise around issues pertaining to plant resources is influenced by the distribution of traditional ecological knowledge within the community. This distribution of knowledge is dependent on the structure of social networks and affects the likelihood that they will reach a common understanding of resource use. This study therefore also aimed to investigate how the ≠Khomani social network depicts the distribution of knowledge, in particular that of plant resource use. Additionally, the JMB needs to jointly manage natural resources in order to ensure that both SANParks and the ≠Khomani community's needs are met. It was thus imperative to also determine the structures of the knowledge networks in order to identify individuals or groups that will hinder or aid co-governance in this setting. Therefore this study determined the structure of the knowledge networks, presenting them visually so as to better understand the patterns of relationships.

In terms of knowledge acquisition, the social network of this community demonstrates that most dyads and triads (i.e., connections between two and three individuals, respectively) do share information and knowledge but are however not connected to the larger cluster, illustrating considerable isolation. Concerning the knowledge generation network, community members mostly turn to older males who primarily use plants for medicinal purposes to discuss important matters pertaining to their own use of plants. This again highlights the role of 'medicine man' primarily belonging to older men and emphasises the importance of these individuals to the community. Furthermore, by visually depicting the knowledge generation network, potential hubs (i.e., an individual to whom several other individuals are connected and who connects clusters to each other) are also

portrayed. Regarding knowledge diffusion, the network structure resembles that of the knowledge generation network with isolated links on the periphery and a multi-hub arrangement at the centre. For the community to successfully govern their resources, they will need to effectively exchange information and knowledge in order to reach a practical level of mutual understanding. This will be hindered if individuals or groups remain on the periphery. Furthermore, the existence of only a few links between central and peripheral individuals impairs effective management since co-ordinated collective action, which is a prerequisite for ensuring ecologically and culturally sustainable plant resource use is highly challenging to achieve.

This in turn impairs the ability of the community, through the JMB, to implement sustainable utilisation of plant resources, and could potentially result in unsustainable use, in the case of isolated or loosely connected community members not being informed about agreed upon sustainable harvesting practices. The JMB needs to identify those individuals with several ties, the hubs, who are willing and have leadership skills and who are considered 'network weavers' to actively connect individuals and groups from the periphery to the central cluster. This will start information flowing to and from them, connecting individuals and clusters that can collaborate or assist one another with matters regarding plant use, while simultaneously encouraging others to become hubs and ultimately network weavers themselves. This will not only counteract knowledge loss but also the inappropriate use of plant resources.

Rather than reverting back to protectionism, both the ≠Khomani Bushmen and SANParks representatives need to build on the experiences of other contractual national parks, by analysing what lessons can be learnt in order to meet their conservation and social objectives. Presently, the control of natural resources in the KTP is externally imposed. Plants, in particular medicinal plants, may be harvested by the community in the contractual park area, on condition that a permit has been issued. The ≠Khomani need full access to their resources in the Park, and should be allowed to dictate their own levels of resource use. Although contractual status has the potential of exacerbating problems relating to the effective conservation of the environment, SANParks, in reality, has less cause for concern than it imagines about the involvement of the community in the Park and that this will lead to compromised conservation objectives. An acknowledgement needs to be made, however, on behalf of all parties concerned, that the contractual park agreement will almost inevitably mean that some conservation objectives will be compromised.

Additionally, cultural conservation needs to be at least as important as biodiversity conservation, and social issues should have higher priority in joint management endeavours than ecological issues. Pivotal to long-term nature conservation is the continued maintenance and application of traditional knowledge, innovations and practices. Essential here is the acknowledgement that, like conservation, cultural traditions and belief systems are not static and it is therefore not necessary to 'preserve' them from changes. Rather, a concerted effort needs to be made to integrate them as a distinct, dynamic part of the cultural landscape, since like conservation, they are continually adapting to changing social, economic, political and environmental conditions. Furthermore, mechanisms need to be put in place to ensure that community representatives play a meaningful role in joint management despite the power imbalances due to their having to operate within an almost entirely Western policy and management framework. Their collective history of displacement and marginalisation, that have left them dealing with collective trauma and heavy dependence on aid, have led to cultural transition and low self-esteem. The opportunity to manage their own land and natural resources, alongside an established organisation like SANParks, affords the community a certain degree of self-sufficiency, reiterating the importance of involving their indigenous knowledge and practices into management policies. Finally more self-expression regarding ownership and use rights by the community needs to be encouraged.

Major contributions of the thesis

The ethnobotanical survey documents the plant resources used by the ≠Khomani community and serves as baseline data to inform future research and monitoring and evaluation efforts. Presently, little is known about what constitutes 'inappropriate' or 'unsustainable' plant resource use in the Kalahari ecosystem and research needs to be conducted to determine the ecological limits of those species being harvested. Importantly, in terms of traditional knowledge, much of the relevant plant use information is held by more aged members of the community and hence there is a clear need to capture this knowledge before it is lost.

This study demonstrates that wild plant use remains an important practice for the ≠Khomani people, primarily for medicinal purposes. It serves not only as documentation for wild plant species used by this community, but also adds to our understanding of how traditional knowledge is presently being transmitted. The insight provided by the network maps and measures of centrality and connectivity depicts the current distribution of knowledge and should be used by the network participants themselves as supported by network weavers as well as by SANParks to achieve their joint management goals. Predominantly, individuals on the periphery need to be engaged, since the homogeneity present in central clusters can potentially impede knowledge transfer.

The ethnobotanical knowledge of the ≠Khomani Bushmen community has now been documented while the information provided by the social network analysis will be presented to the community in the form of a feedback meeting. This is important in terms of network weaving, as it demonstrates the outcome of the research to the community as a whole and allows for a response, on their behalf, as to the next step.

Recommendations

- It is recommended that current JMB operations and behaviours, which are based on technical and bureaucratic management frameworks, are revised in light of the community's lack of familiarity with management protocols and theory-based conservation strategies. At present the community's lack of fluency in English and their low competencies in Western skills limits the power they can exert over the management of their resources.

- Traditional ecological knowledge surrounding plant resource extraction and use needs to be incorporated into conservation and management policies and should be regarded integral to the decision-making process. To foster this convergence of perspectives requires applied work as well as improved collaboration between traditional knowledge holders and scientists across a variety of fields.
    - It is suggested that the ethnobotanical findings of this study be used as a benchmark for monitoring and evaluation efforts and should inform further studies on sustainable harvesting levels.

- SANParks and the State are advised to accentuate, to the JMB, the access rights and resource use rights of the community, particularly focusing on access and use within the various zones within the KTP. The community then needs to be duly informed.

- The JMB are advised to regularly update and brief the community on matters relating to their access and use, with mechanisms put in place that will better inform the broader community. Also called for is the effective communication of the rights, roles and responsibilities of representatives and an explanation of how the system works due to differences in perspectives (i.e., differences in Western and traditional paradigms regarding natural resource use).
    - A review of the current permit system is necessary. Presently access and the use of natural resources are externally imposed and the community should essentially dictate their own levels of resource use.

- A feedback meeting, with the JMB and community members, which considers ethical boundaries pertaining to anonymity, is recommended to illustrate the isolation and fragmentation of individuals and groups in the knowledge networks.

  - The JMB need to be informed about present and potential hubs and clusters (this should be visually illustrated, obscuring identity but displaying age, gender, location etc) in order to encourage network weaving.
  - Current structures in place need to be investigated to enhance the network weaving process (e.g. women's groups, craft making circles).

- The State and SANParks are urged to put in place mediation and negotiation bodies to overcome fractions within the community and to bridge communication gaps between various groups.

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Appendix 1

The ≠Khomani Bushmen land claim settlement

In addition to the six farms, the ≠Khomani Bushmen were awarded the following:

- Ownership of 25 000 ha on the southern boundary of the KTP where they are relatively free, within the limits of a 'contract park agreement', to perform cultural practices, collect bush foods, hunt, and conduct ecotourism activities. Inclusive therein are walking and overnight trails and 4x4 routes with the ≠Khomani agreeing that no permanent residence will be permitted (this contractual park falls within the Park and is managed by the Joint Management Board, JMB).

- Priority commercial use of the area falling between their designated area (the contractual park) and the Auob River, known as the *V* Zone. Here, over and above all cultural practices, the ≠Khomani are entitled to formulate and carry out ecotourism projects, in partnership with SANParks.

- Symbolic and cultural use of 400 000 ha, roughly one half, of the South African portion of the KTP occurring in the southern section thereof (between the Auob and Nossob Rivers), stretching north to a jagged boundary between Mata-Mata and Nossob and referred to as the *S* Zone. In effect, this right implies that the ≠Khomani are able to make use of that entire area for traditional and ancestral use, except for commercial activities. Both young and old can venture deep into the Park and experience the Kalahari as it was and live a more traditional lifestyle, as they once did.

- Commercial opportunities, jointly owned between the ≠Khomani and SANParks, a Community Nature Park, shared by the ≠Khomani and their rural neighbours – the Mier, who had put in a conflicting land claim at the last minute– as well as an International Heritage Site listing have all been agreed upon in principle.

Map: Katharina Dierkes

Appendix 2

Classification of Khoisan peoples by languages

(Barnard 2007)

The Bushmen form part of a larger assemblage of ethnic groups that have been referred to as the 'Khoisan' peoples since the 1920's. The term was introduced by the Europeans, initially to classify individuals of a supposed physical type but is now usually employed as a cultural or linguistic description. The Bushmen are the most geographically dispersed and linguistically diverse groups in comparison to the other Khoisan groups.

The term Khoisan comprises two words; Khoi and San. Linguistically, Khoi or Khoe refers to those who use the word in their own languages to denote 'person'. It includes the sheep and cattle-herding KhoeKhoe or 'People of People', who were once labeled 'Hottentots' although this term is regarded as offensive and is no longer used. The expression Khoe may also comprise the hunter-gatherers who speak languages related to KhoeKhoe, such as the Central Bushmen or Khoe Bushmen.

The name San means Bushmen, hunter-gatherers or foragers in some of the KhoeKhoe dialects but not in any Bushmen or San language. It carries negative connotations; since foragers were generally considered low-status people (e.g. accusations of thievery were leveled at cattle-less San, or more accurately *saan,* in Cape KhoeKhoe, or *sān,* in Nama). Thus those KhoeKhoe who lived by scavenging and robbing their wealthier kinfolk were referred to as San.

In the present thesis, although it is accepted that there cannot be a correct term since both San and Bushmen carry positive and negative connotations, the latter term is used simply because the subject of the thesis, the ≠Khomani, have requested it.

The basic classification of Khoisan peoples by language

(Barnard 2007):

Khoe-speaking peoples

- **KhoeKhoe or 'Hottentot' cattle and sheep herders** (Cape KhoeKhoe, Korana, Nama, Damara; who live in Namibia and western parts of South Africa)

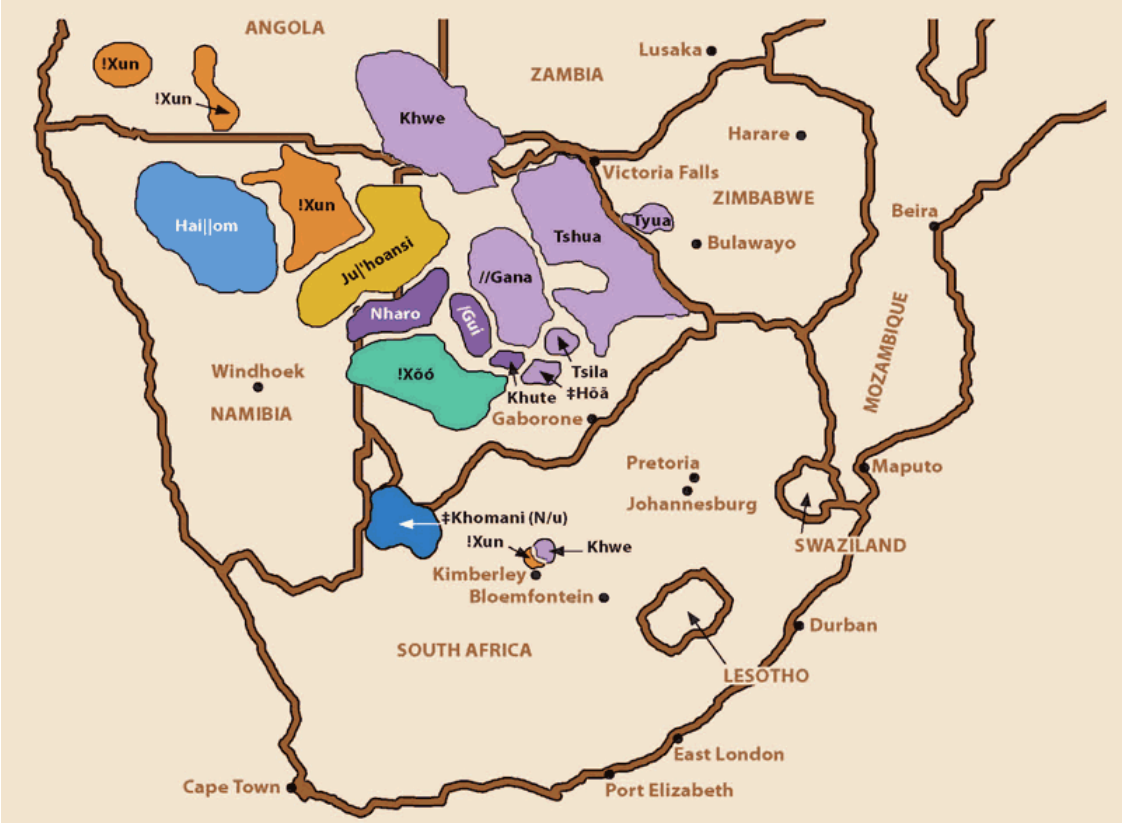
- **KhoeKhoe-speaking Bushmen or San** (Hai//om who live in northern Namibia)

- **Central Bushmen or San** (Nharo or Naro, G/wi, G//ana, Bugakhoe, Kxoe; a diversity of groups who live mainly in central Botswana and the Okavango swamp)

Non-khoe-speaking Bushmen or San

- **Northern Bushmen or San, also known as !Kung** (!Xũ and Ju/'hoansi who live in north-western Botswana, north-eastern Namibia and southern Angola)

- **Southern Bushmen or Southern San** (/Xam, ǂKhomani, !Xoõ; a diversity of who once inhabited much of southern Africa but today include mainly groups in southern Botswana)



Basic classification of Khoisan peoples by language

A note on orthography

(Barnard 1992)

Clicks are consonant sounds produced by allowing air to pass into the mouth, rather than out of it. They are combined with other consonants to form clusters. Clicks occur only in the Khoisan languages, two languages of East Africa (Hadza and Sandwe) and some southern Bantu languages (Nguni, Zulu, Xhosa, Ndebele).

Attempts have been made to put the click symbols into written form. W.H.I. Bleek recorded 28 different systems that had been invented by 1858 (Bleek 1858). He selected the system created by Richard Lepsius in 1854 (Lepsius 1863[1854]). Adopted in 1856 by the Rhenish Mission Society (RMS), this system has remained in general use since that time. The Lepsius-RMS-Bleek system or the Standard Khoisan system has five basic clicks:

□	Bilabial	A bilabial stop or affricate. Produced by releasing air between the lips, often as in a kiss. Found only in !Xo and Southern Bushmen languages
/	Dental	A dental or alveolar affricate, also described as a fricative. Made by a sucking motion with the tip of the tongue on the teeth. Found in all Khoisan languages.
≠	Alveolar	An alveolar stop, produced by pulling the blade of the tongue sharply away from the alveolar ridge, immediately behind the teeth. Found in all the Khoisan languages.
//	Lateral	A lateral affricate, also described as a fricative. Made by placing the tip of the tongue on the roof of the mouth and releasing air on the one side of the mouth between the side of the tongue and the cheek. Found in all Khoisan languages.
!	Palatal	Sometimes called cerebral or retroflex. An alveopalatal or palatal stop, produced by pulling the tip of the tongue sharply away from the front of the hard palate. Found in all Khoisan languages.

Appendix 3

The Bushmen-*Hoodia* case

The story of *Hoodia* has been told many times (Geingos and Ngakaeaja 2002, Stephenson 2003, Wynberg 2004) and involves the Bushmen, the oldest human inhabitants of Africa and an intriguing plant that attempts to solve the Western world's affliction of obesity (Wynberg et al. 2009). The use of *Hoodia* by the Bushmen was perhaps first recorded by the botanist Francis Masson, who visited the Cape from 1772 to 1774 and 1786 to 1796 (Wynberg and Chennells 2009). He recorded finding '*Stapelia gordoni*', now *H. gordonii* and mentioned that the stems of *Trichocaulon piliferum* were eaten by the 'Hottentots'[1] (Masson 1796). Rudolf Marloth wrote:

"This is the real ghaap[2] of the natives, who use it as a substitute for food and water. The sweet sap reminds one of liquorice and, when on one occasion thirst compelled me to follow the example of my Hottentot guide, it saved further suffering and removed the pangs of hunger so efficiently that I could not eat anything for a day after having reached the camp" (Marloth 1932)

Khoisan groups seemingly used *Hoodia* for millennia, although the manner in which they did so is unclear. Some reported the Bushmen as using it for hunting to give 'strength' (Steyn 1984). It was used as food and a drink substitute and appetite suppressant including other uses such as to improve virility, to treat or cure hangovers and as a treatment for asthma, haemorrhoids, high blood pressure, pulmonary tuberculoises, stomach pains, flu and eye pain (Watt and Breyer-Brandwijk 1962, Khoisis 1983, van Wyk and Gericke 2000, Hargreaves and Turner 2002, van Wyk et al. 2009).

The documentation of Hoodia as a food and water substitute by Marloth (1932) as well as by White and Sloane (1937) led the Council for Scientific and Industrial Research (CSIR), a South African research institution, to include it for investigation in a 1963 project on edible wild plants. In 1986, the CSIR identified the relevant molecular structures of *Hoodia* species with the aid of high-field nuclear magnetic resonance spectroscopy equipment (CSIR 2001, Wynberg and Chennells et al. 2009). Then in 1995 a patent application was filed by the CSIR for the use of the active components responsible for appetite suppression (South African Patent No. 983170). In 1998 a licensing agreement was signed

[1] The "Hottentots" or KhoiKhoi were herders related to the Bushmen, but the distinction was not recognised in the colonial botanical accounts, where all groups were grouped as "Hottentots", including the Bushmen.
[2] A vernacular name for *Hoodia* and *Trichocaulon* species.

between the CSIR and Phytopharm, a British company, to further develop and commercialise the product (Phytopharm 1997). This granted the company exclusive international licence to manufacture and market *Hoodia* products and to further exploit any other parts of the CSIR's intellectual property rights pertaining to *Hoodia*. In the same year, a licence and royalty agreement with Pfizer was signed to further develop the product. Phytopharm then granted exclusive global licence to the consumer giant Unilever plc in 2004 for *H. gordonii* extracts (Wynberg and Chennells 2009).

Up until 2001, such agreements for the development and commercialisation of *Hoodia* proceeded without acknowledgement to the Bushmen (Vermeylen 2009). Biowatch South Africa, a local non-governmental organisation (NGO), assisted by an international NGO, Action Aid, alerted the foreign media in June 2001 (Barnett 2001). Although news about the CSIR-Phytopharm agreement and the patent surrounding *Hoodia* had been made public, the international exposure catalysed action (Wynberg and Chennells 2009). The lack of prior consent on behalf of the CSIR meant that the Bushmen gained the moral high ground which considerably strengthened their bargaining power. The Bushmen where, however, faced with difficult ethical considerations since the sharing of knowledge is a culture-defining feature of communities and fundamental to their way of life while traditional knowledge of plants, as such, is viewed as being collectively owned, and cannot be owned individually (Vermeylen 2009). Also, they were faced with legal argument that the product itself was not a new invention. They opted for a share of the royalties emphasising that their traditional knowledge surrounding *Hoodia*, as well as other plants and their uses, is the collective intellectual property of the Bushmen and it should not be morally justifiable for any individual to own (Chennells et al. 2009).

Appendix 4

Ethnobotanical Survey Questionnaire

Number:
Date:

Demographic information

Name:					Gender:			M/F
Age:					Marrital status:			
Schooling:					Income:			
Primary					*Employed (full-time*			
Highschool					*Empolyed (part-time)*			
Tertiary					*Gov. Grants*			
					Unemployed			
					Self-employed			
Farm:					Town:			
Andriesvale					*Ashkam*			
Erin					*Welkom*			
Miershoop pan					*Rietfontein*			
Scotty's ford								
Uitkoms								
Witdraai								
"24"								
"26"								
How many persons in household					Language			
Adults								
Gender								
Agem								
Children								
Gender								
Age								

Plant use:

1. I use indigenous plants:

0	1	2	3	4
Never	Yearly	Monthly	Weekly	Daily

2. I harvest indigenous plants myself:

0	1	2	3	4
Never	Yearly	Monthly	Weekly	Daily

3. I grow indigenous plants myself:

0	1	2	3	4
Never	Yearly	Monthly	Weekly	Daily

4. What plants do you use?
   -
   -
   -

5. Of those plants that you do NOT harvest yourself, where go you get them from?

6. Approximately what proportion of plants that you use do you harvest or grow yourself?

7. Where does most plant collection occur?

in your vicinity/farm		in the ≠Khomani contract park		another farm	
in the *S* zone		other.....			

8. a) When do plant collections occur?

b) What is harvested each month/season?

plant	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

9. What factors determine when harvesting occurs?

10. How does harvesting occur?

➢

a)

Destructive		Non-destructive	

b) Part used?

Root	Stem	Leaf	Flower	Fruit	Seed	Bulb/tuber

c) Uses *(can be more than one use per plant)*

food	water	medicine	ritual/cultural/ spiritual	domestic/ construction	crafts	other

(replicated for each plant used)

11. Of all the plants I use, most are predominantly used for?

12. What are your most widely used plants? By volume? By regularity?

Scarcity/Availability:

13. I can always access the plants I wish to use:

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

14. The most widely used plants are easy to find:

a)

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

b) If not, why not?

15. Can any other plant(s) be substituted when above plants are not available?

a)

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

b) If so, which ones?

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

16. Specific plants have become harder to find since I've lived here:

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

17. I have to walk further for certain plants:

a)

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

b) If so, which ones?

-
-
-

18. I have not had to stop performing certain practices due to scarcity/unavailability:

0	1	2	3	4
Strongly disagree	Disagree	Unsure	Agree	Strongly agree

19. a)Can plants be stored? If so, for how long and in which condition are they stored?
    b)If not, why?

20. Do you know of plants inside the KTP that you would like to harvest, but to which access is currently problematic?

Yes		No	

21. Do you know of specific locations of these plants? If yes, where are they located?

Desirable plant use:

22. Are there certain plants you need, but that aren't available/you have no access to?

    a) If so, what are these plants?

    b) And where are they found?

Historical plant use:

23. How long have you been using plants?

24. How or from whom has your knowledge of these plants been obtained?

Appendix 5

Social Network Survey Questionnaire

Section 1. Demographic Questions

Name: _____

Number: _____ Date: _____

1. What is your gender?

Male ☐ Female ☐

2. What is your birth year?

☐

3. Where do you live?

Andriesvale	☐	Witdraai	☐	Reitfontein	☐
Erin	☐	Farm "24"	☐	Twee Rivieren	☐
Miershoop Pan	☐	Farm "26"/ Sonderwater	☐	Other	☐
Scotty's Ford	☐	Uitkoms	☐	_____	☐
Welkom	☐	Askham	☐	_____	☐

4. Which particular clan/tribe do you consider yourself in?

≠Khomani	☐	Mixed ethnicity	☐		
Bushman/San	☐	Don't know	☐		
Khoi	☐	Decline to answer	☐		
!Kung and Khwe	☐	Other	☐		
!Xu and !Xo	☐		☐	_____	☐
Nama/Griqua	☐		☐	_____	☐

5. Which of the following best describes your occupation?

Builder	☐	SASI employee	☐		
Craft maker/seller	☐	Tour/park guide	☐		
Farmer	☐	SANParks employee	☐		
Farm worker	☐	Tracker	☐		
Housewife/househusband	☐	Unemployed	☐		
Medicine man	☐	Other	☐	_____	☐

6. How long have you been living on this farm/in this town?

< 1 year	☐	5 – 10 years	☐
1 – 5 years	☐	> 10 years	☐

6.a) Where did you live before moving to this farm/town?

_____

Section 2. Attribute Questions

7. In what way do you use plants? Please indicate the primary manner.

Medicine man/woman	☐	Distributor/Trader	☐
General user	☐	Crafts	☐
Non-user	☐	Other _____	☐

8. Do you have the knowledge needed to use wild plants forever and never have them go extinct?

All the knowledge necessary	☐
Most of the knowledge necessary	☐
Some of the knowledge necessary	☐
None of the knowledge necessary	☐

9. Which do you consider your MAJOR barrier to plant collection and/or use?

_____

_____

_____

9a). If 'people', who?

Name	Relation	Location

10. Which ONE from the list below is most needed for you to conserve wild plants?

Money	☐	Access to more land	☐	All of the above	☐
Time	☐	Awareness	☐	Combination of the above	☐
Knowledge	☐	Interest	☐	Other _____	☐

Section 3. Network Questions

11. Do you collect your own plants?
Yes ☐ No ☐

If no, from whom do you get your plants from?

_____
_____
_____

12. From whom did you obtain your knowledge of wild plants and their use?

Name	Relation	Location	Your age when you obtained this knowledge?

13. With who do you exchange information with which is useful for you to carry out your use and/or collection of plant?
Name the person(s) below
(E.g. told you about harvesting practices, good harvesting spots, timing, seasons, beliefs etc)

Name	Relation	Location	How often?	What topics do you discuss?

14. With whom do you discuss important matters pertaining to your use of plants?

Name	Relation	Location	How often?	What topics do you discuss?

15. With whom from the community do you work with when it comes to plant use?

Name	Relation	Location

16. On whom do you depend to carry out your harvesting of plants?
(E.g. do you need transport from someone, a blessing, support, and permission etc in order to carry out your harvesting?)

Name	Relation	Location	How often?	What do you depend on them for?

17. Who, in your opinion has contributed the most i.t.o providing access to natural resources?

18. Who, in your opinion has contributed the most i.t.o knowledge transfer?

19. If you noticed changes in the natural environment which might prove negative to Bushman culture, who would you discuss this with?

20. Who do you go to when seeking assistance to support your efforts to use plants and to share your knowledge?

21. Who do you go to when seeking assistance to share your knowledge?

Name		**Questions:**				
		17	18	19	20	21
Traditional Leaders:	Dawid Kruiper					
	Petrus 'Vallie' Vaalbooi					
	John Kruiper					
Council of Elders:	Regopstaan Kruiper					
	Ouma //Tuna					
	Elsie Vaalbooi					
	Ouma Seekooi					
	Gert Swartz					
	'Agarop'					
Legal/Human Rights:	Roger Chennells					
	Cait Andrews					
Area Leaders:						
Witdraai and Erin:	Barbara Raats					
	Jan Pietersen 'Oupa Jan'					
Scotty's Ford:	Katrina Kooper					
	Frik Bok					
Uitkoms and Miershoop:	Willem Vaalbooi					
	Johanna Visser					
Andriesvale:	Jan v d Westerhuizen					
Project Leaders:						
Sisen Craft:	Andrew Vaalbooi					
Women's League:	Magdalena Steenkamp					
Committee Leaders:						
Small Livestock:	Andries Steenkamp					
Youth League:	Dirk Pienaar					
Park Committee:	Jan Pietersen 'Oupa Jan'					
	Jan v d Westerhuizen					
Park Committee - Welkom	David Kariseb					
Park Committee - Upington	Willemina Montsinger					
Khomani San Technical Advisors:	David Grossman					
	Phillipa Holden					
SANParks:	Nico v d Walt					
	Henriette Ferriera					
	Dupil Erasmus					
	Christine du Plessis					
!Xaus lodge operators:	Pieter Retief					
Social Services:	Advocate Oktober					
Land Affairs:	Peter Mokomele					
South Africa San Institute (SASI)	Fonnie Brou					
	Finkie v d Westerhuizen					
	Grace Humphreys					
Other* _____						
_____						
_____						
_____						

*Please list the names and organisations of any additional people not in the above list

Appendix 6

Table 7 Average degree measures and individual degree measures for the entire knowledge networks (Individual hubs in italics)

Map	Figure 3				Figure 5				Figure 6			
Network	**knowledge acquisition**				**knowledge generation**				**knowledge diffusion**			
		N	**Mean**	**Std dev**		**N**	**Mean**	**Std dev**		**N**	**Mean**	**Std dev**
Degree												
Out		66	1.89	0.98		63	1.73	0.93682		64	1.89	0.99
In		87	1.44	1.52		60	1.82	2.19005		64	1.89	2.41
Individual measures	**node**	**out**	**node**	**in**	**node**	**out**	**node**	**in**	**node**	**out**	**node**	**in**
	A109	***6***	*A36*	***12***	*A177*	***5***	*A36*	***15***	*A36*	***5***	*A36*	***17***
	A12	***4***	*A185*	***9***	*A36*	***4***	*A102*	***8***	*A71*	***4***	*A68*	***8***
	A88	***4***	A15	**3**	A03	3	*A68*	***6***	*A202*	***4***	*A109*	***8***
	A141	***4***	A68	**3**	A14	3	*A97*	***5***	*A222*	***4***	*A81*	***5***
	A03	**3**	A102	**3**	A50	3	*A52*	***4***	A03	3	*A116*	***5***
	A36	**3**	A171	**3**	A73	3	*A88*	***4***	A35	3	*A82*	***4***
	A40	**3**	A186	**3**	A80	3	A50	3	A37	3	A88	3
	A71	**3**	A48	**2**	A110	3	A116	3	A40	3	A102	3
	A86	**3**	A81	**2**	A112	3	A223	3	A68	3	A203	3
	A95	**3**	A116	**2**	A124	3	A06	2	A80	3	A06	2
	A97	**3**	A140	**2**	A137	3	A78	2	A82	3	A13	2
	A137	**3**	A150	**2**	A145	3	A81	2	A95	3	A34	2
	A169	**3**	A159	**2**	A169	3	A82	2	A116	3	A71	2
	A10	**2**	A169	**2**	A202	3	A169	2	A124	3	A73	2
	A18	**2**	A214	**2**	A12	2	A203	2	A169	3	A110	2
	A21	**2**	A222	**2**	A35	2	A211	2	A177	3	A123	2
	A37	**2**	A04	**1**	A71	2	A02	1	A220	3	A140	2
	A42	**2**	A06	**1**	A78	2	A04	1	A12	2	A169	2
	A61	**2**	A07	**1**	A82	2	A16	1	A57	2	A194	2
	A68	**2**	A09	**1**	A88	2	A19	1	A73	2	A02	1
	A73	**2**	A13	**1**	A95	2	A32	1	A78	2	A04	1
	A78	**2**	A14	**1**	A109	2	A34	1	A86	2	A07	1
	A82	**2**	A17	**1**	A116	2	A40	1	A88	2	A14	1
	A110	**2**	A20	**1**	A135	2	A44	1	A97	2	A21	1

A111	2	A23	1	A136	2	A69	1	A102	2	A24	1
A112	2	A39	1	A151	2	A71	1	A109	2	A29	1
A114	2	A45	1	A167	2	A80	1	A110	2	A44	1
A115	2	A47	1	A205	2	A91	1	A111	2	A52	1
A124	2	A54	1	A220	2	A93	1	A135	2	A58	1
A129	2	A59	1	A10	1	A100	1	A137	2	A61	1
A135	2	A61	1	A18	1	A105	1	A141	2	A66	1
A136	2	A63	1	A37	1	A106	1	A156	2	A77	1
A140	2	A65	1	A40	1	A107	1	A159	2	A78	1
A167	2	A70	1	A42	1	A109	1	A167	2	A80	1
A177	2	A71	1	A43	1	A110	1	A181	2	A85	1
A180	2	A73	1	A56	1	A111	1	A10	1	A86	1
A181	2	A75	1	A61	1	A115	1	A14	1	A91	1
A202	2	A76	1	A68	1	A117	1	A18	1	A93	1
A210	2	A82	1	A72	1	A119	1	A42	1	A97	1
A220	2	A87	1	A81	1	A123	1	A43	1	A100	1
A43	1	A90	1	A83	1	A125	1	A46	1	A106	1
A46	1	A92	1	A86	1	A129	1	A50	1	A107	1
A50	1	A94	1	A93	1	A131	1	A56	1	A111	1
A56	1	A96	1	A97	1	A132	1	A61	1	A113	1
A57	1	A98	1	A100	1	A134	1	A72	1	A119	1
A79	1	A99	1	A102	1	A137	1	A81	1	A124	1
A80	1	A101	1	A107	1	A141	1	A112	1	A125	1
A81	1	A103	1	A114	1	A142	1	A114	1	A131	1
A83	1	A104	1	A119	1	A150	1	A115	1	A132	1
A100	1	A107	1	A120	1	A152	1	A119	1	A136	1
A102	1	A109	1	A129	1	A156	1	A120	1	A137	1
A107	1	A113	1	A140	1	A172	1	A129	1	A141	1
A120	1	A118	1	A144	1	A173	1	A136	1	A149	1
A144	1	A122	1	A150	1	A174	1	A144	1	A150	1
A145	1	A125	1	A154	1	A178	1	A145	1	A152	1
A150	1	A126	1	A155	1	A181	1	A150	1	A159	1
A151	1	A127	1	A156	1	A190	1	A151	1	A172	1
A156	1	A128	1	A159	1	A196	1	A154	1	A174	1
A159	1	A130	1	A160	1	A215	1	A155	1	A198	1
A160	1	A133	1	A180	1	A220	1	A160	1	A211	1
A166	1	A138	1	A181	1			A180	1	A215	1
A189	1	A143	1	A189	1			A189	1	A216	1

A198	1	A146	1	A223	1	A198	1
A205	1	A147	1			A223	1
A222	1	A148	1				
A223	1	A152	1				
		A158	1				
		A165	1				
		A168	1				
		A170	1				
		A176	1				
		A181	1				
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		A217	1				
		A218	1				
		A219	1				
		A221	1				

A217	1		
A220	1		