ANCESTRAL PHARMACOPOEIAS: A PALEOETHNOBOTANICAL ASSESSMENT OF PLANT USE IN THE WESTERN FREE STATE, SOUTH AFRICA

by

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ABSTRACT

Excavations of Early Later Stone Age sites at Erfkroon in the Western Free State, South Africa, yielded several partial grinding stones, possibly indicating an increase in the reliance on plant resources and signifying the economic, technological, and social shift from the Middle Stone Age to Later Stone Age. From October to December of 2011, I carried out an ethnobotanical study of economically important native plants used by modern Setswana and Basotho inhabitants of the Western Free State, South Africa. I interviewed traditional healers and plant sellers in the vicinity of Erfkroon at Ikgomotseng, Bloemfontein, near the former Basotho homeland at Phutaditjhaba and the Basotho Cultural Village. Extant plant knowledge in this region is overwhelmingly Basotho in origin and my investigation of the plants addressed in this study provide one of the only studies on modern plant use in the Free State and may help decode the composition of prehistoric human diets and plant usage patterns in Southern Africa and how they relate to Stone Age subsistence strategies.

CHAPTER I

INTRODUCTION

The goal of this exploration of modern plant use in the western Free State grassveld is to extrapolate possible Early Later Stone Age (Early LSA) patterns of subsistence and plant use. In 2009 and 2010 while digging the Early LSA occupation at Erfkroon several partial grinding stones were unearthed. These grinding stones highlight the technological transition that took place at the beginning of the LSA, a shift that is poorly documented in Southern Africa. This era plays an essential role in understanding the last major technological transition in the region. Bousman and Brink (in prep) hypothesize that this transition is characterized by a shift from more structured subsistence, technology, and mobility strategies to more flexible suite of strategies (foraging). Strong evidence for this transition is found in a comparison of the lithics associated with the Middle Stone Age (MSA) and the Early LSA. During the MSA, stone tools were meticulously crafted into specific tool shapes with very precise activities in mind. These tools would have been associated with a reliable meat-based subsistence. In contrast, Early LSA stone tools were made quickly with very general applications in mind. The implication is that Early LSA peoples were working smarter, not harder, as the efficiently made (though visually less attractive) tools could be used for a variety of tasks. These tools would facilitate the implementation of a more varied subsistence characterized by greater use of plant resources and a marked reduction in reliance upon hunting strategies. In the context of the Early LSA research at Erfkroon, grinding stones

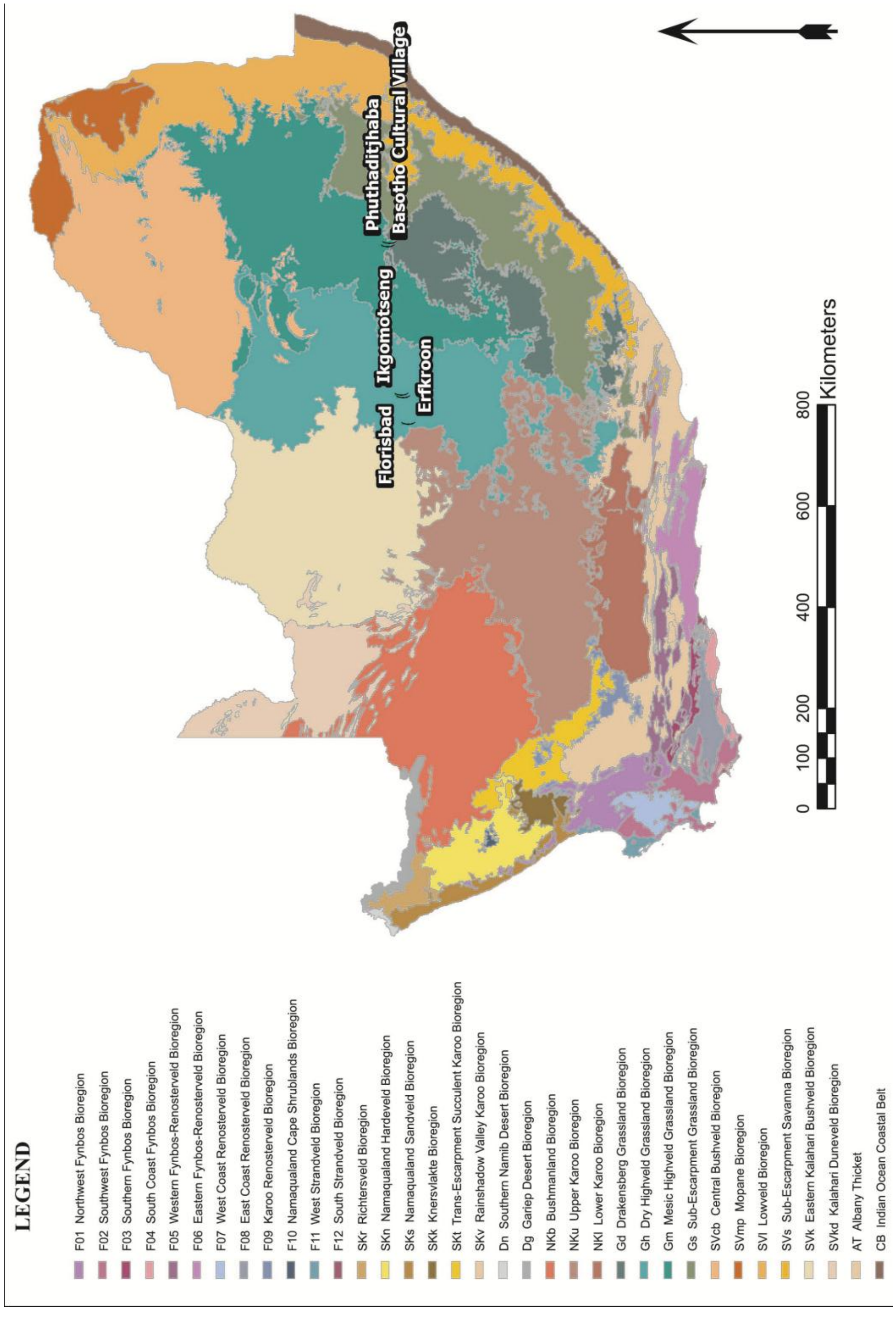

Figure 1. Bioregion map of the ethnobotanical study area localities.

indicate an increase in the reliance on plant resources, which in turn, may signify the shift from MSA to LSA economy, technology and society.

The discovery of *in situ* plant remains would provide the most direct subsistence evidence for the MSA to LSA transition. However, plant remains at Erfkroon have not been preserved. Faced with the same dilemma in the Karoo, Youngblood (2003, 2004) undertook an effort to identify the plants used by indigenous farm laborers to establish the modern economic botanical baseline. From these data she extrapolated prehistoric hunter-gatherer patterns of plant exploitation. I used a similar ethnoarchaeological approach for my research in the grassveld (Figure 1), in the Western Free State at the township of Ikgomotseng, the Florisbad Quaternary Research Facility, and the Erfkroon site; and in the Eastern Free State at Phutaditjhaba and the Basotho Cultural Village in Golden Gate Highlands National Park. I interviewed local people with indigenous plant knowledge residing in the Free State. Setswana people comprise the dominant non-white ethnic group in this region and have been there since the mid to late 19th century. Unfortunately, very little is known about their current use of plants and this knowledge base exists below the cash economy of the modern South African State. My ethnobotanical interviews from the Free State serve to reveal this otherwise obscured plant knowledge. Traditional healers, called *sangoma*s, have the most comprehensive local botanical knowledge, but this tradition does not have a local origin. The basis of botanical knowledge comes from the Basotho *muthi* (herbal medicine) tradition of Lesotho, though practitioners come from practically every ethnic group.

There is anecdotal evidence that the Basotho likely inherited this knowledge from the Khoesan and/or the Khoekhoe who predated them in this region. Since few (if any)

Khoesan remain in the Free State or Lesotho and Khoekhoe informants are similarly scarce, this research focused on the botanical knowledge of *sangoma*s and *muthi* plant sellers from the Western Free State, near Erfkroon, as well as from the Eastern Free State, in the Basotho region of the Drakensberg Mountains. Low expectations of extant botanical knowledge led me to record all the plant knowledge with which I was provided, but the focal point of my research was plants and edible and/or medicinal plants that are routinely ground and native to either of these regions. Extant botanical knowledge notwithstanding, the record of plants of these types originating from the Eastern Free State is significant to this research since the paleoclimate of Erfkroon during the early part of the LSA was similar to that of the modern Drakensberg.

For this study I pursued questions pertaining to botany, culture, and climate that fieldwork conducted for the Erfkroon Project in the western Free State did not (or could not) reveal, alone. Pursuing research regarding the annual rainfall cycle and gathered modern and paleoenvironmental climate data on the Free State led to the formation of several compelling questions about the environment. Did previous habitats exist that no longer survive? How does grazing, fire, and rainfall impact availability of plant foods. Conducting background research on modern and prehistoric indigenous peoples, including modern and extinct hunter-gatherers and foragers, and their technological and subsistence patterns illuminated still more questions. What types of human interaction increase or decrease plant productivity? Have illness/deaths occurred? Which plants are consumed only during dire living conditions? What percentage of the local diet comprises wild plant foods? How does plant use vary between cultural groups?

The most arresting observation to come out of this research was that nearly every medicinal plant in use today is prepared with a grinding stone, or its modern counterpart. Conversely, my systematic combing of the archaeobotanical record revealed regrettably little direct evidence of medicinal plants. I propose that the presence of grinding stones found in the archaeological context, such as those found in the Early LSA levels at Erfkroon, may serve as a proxy for medicinal knowledge. The subsistence role of edible plants has traditionally superceded medicinal applications in archaeological analyses of Stone Age hunter-gatherers, and even foragers. Medicinal plants were not necessarirly being ground more often than edible plants nor is it argued that that they were more important than edibles. Rather, this study promotes the assertion that medicinal applications are a significant component of modern and Stone Age subsitence. The link between ground stone processing and medicinal plant use has the potential to open up a fruitful new avenue of research.

This thesis is divided into seven Chapters. **Chapter II** presents the environmental and cultural geographic context of the study. The environmental setting is defined and descriptions of current and past climate and vegetation are compared in order to establish the efficacy of the assumption that Stone Age and modern inhabitants of the Free State would have had environmental access to some of the same plants. The study region is established and contextualized through the exploration of the modern and archaeological plants discussed, and their relation to the people that use(d) them. Current biomes of the study area identified and subdivided into bioregions and specific vegetation units. The paleoclimate and corresponding plant communities of the study area, from the Pleistocene to the present are detailed chronologically, with respect to the environmental mechanics and indicators of transition. This chapter is meant to establish the overall efficacy of the project's focus and methodology.

In **Chapter III**, the ethnographic basis of the study is established and described. The modern indigenous plant use economy associated with the descendants of Bantu agriculturalists, especially the *muthi* culture, is juxtaposed against ethnohistoric evidence of hunter-gatherer (Khoesan) and herder (Khoekhoe) plant use. Ethnobotanical practices of the Khoesan, Khoekhoe, and traditional healers of the Free State are described with special reference to medicinal and edible plants that are processed with a grinding stone. Other ritualistic, utilitarian, and recreational uses are discussed, as well. **Chapter IV** presents a narrative of the research methods developed for my ethnobotanical study of plants use in the Free State, South Africa. This includes a detailed description of interviews with traditional healers and *muthi* sellers. In **Chapter V**, I present the results of the study. This includes all of the plants encountered during *muthi* interviews and botanical hikes that have been identified. I report on the themes of use in each collection. In **Chapter VI**, the methods of Paleoethnobotanical analysis that have been used at archaeobotanical sites across South Africa are described. A chronology of sites with plant remains is presented, including charcoal, seed, macrobotanical, residue, and phytolith studies that have provided evidence for plant use. These findings are reviewed in relation to the thesis of this research: that grinding stones act as proxies for medicinal knowledge when medicinal archaeobotanical remains are absent or seemingly underrepresented. In **Chapter VII**, I summarize and synthesize the results of this study by comparing the plants identified through fieldwork with the archaeobotanical evidence from MSA and LSA sites across South Africa. The implications for the role of archaeological grinding stones as indicators of medicinal knowledge are discussed in terms of potential intra-site spatial patterning and future Stone Age subsistence research.

CHAPTER II

BACKGROUND

In order to connect the plants used today to Stone Age plant use, it is necessary to establish and contrast the environmental conditions in which modern and ancient peoples lived. In this chapter, descriptions of current and past climate and vegetation are compared in order to validate the assumption that Stone Age and modern inhabitants of the Free State would have had environmental access to the same plants. To meet this end, first, the study region (Figure 1) is established by the origin of the archaeological and ethnobotanical plants mentioned in this paper as well as the peoples that used them. Second, the biomes that exist within the study area in the modern era are identified and subdivided into bioregions and corresponding vegetation units. A biome is defined here, after Low and Robelo (1998), as a broad ecological spatial unit representing major life zones of large natural area, and defined mainly by vegetation structure and climate, as well as by major large-scale disturbance factors (such as fire). A subunit of a biome, a bioregion is a composite spatial terrestrial unit defined on the basis of similar biotic species, physical features and processes at the regional scale (Mucina and Rutherford, 2006). Next, the paleoclimate and paleovegetation of the study area during the Middle and Later Stone Ages are detailed geographically, based on biome (**Figure 3**), and chronologically, based on correspondence to Marine Isotope Stages (**Table 1**). Climatic shifts are explained using paleoclimatological evidence from a broad range of analyses including seeds, charcoal, pollen, phytoliths, ice and marine sediment cores, and occasional fauna. The chapter closes with a discussion of the efficacy of the study in light of the paleoenvironmental evidence provided.

Defining the Study Environment

The study concerns botanical traditions practiced by healers from nearly every ethnic group living in the Free State, but originating from the Basotho peoples of Lesotho and the Eastern Free State. It is popularly believed that the Basotho traditions are based on botanical knowledge acquired from the Khoesan inhabitants encountered by the earliest Bantu settlers of the Drakensberg region during the Later Stone Age. The botanical specimens that form the focal point of this study are those known to practitioners of the Basotho botanical tradition. These include species endemic to the Western Free State, the Eastern Free State, and Lesotho. An essential question is what is the likelihood that these plants were environmentally accessible to the local Stone Age inhabitants?

Biomes and the Modern Environment

The vegetation of the study area is associated with grassland in Lesotho, the Eastern Free State, and the Central Free State; savannah in the far Western Free State; and Nama-Karoo in the far southwestern Free State. Mucina and Rutherford (2006) divide biomes into meaningful bioregions and vegetation units.

Grasslands (colloq: grassveld) are dominated by a single layer of grasses. Geophytes are abundant and trees are restricted to a few localized habitats. Grass dominance is maintained through grazing, fire, and frost. The density of the grass layer depends on rainfall and the degree of grazing. Two categories of grass plants, distinguished by carbon fixation pathways, exist: sour grasses and sweet grasses (Low and Robelo 1998). Sour grasses employ C_3 fixation, whereby carbon dioxide is fixed from the air using the Calvin cycle with the inefficient loss (photorespiration) of up to half of the carbon that has been fixed at the expense of light energy, thus undoing the work of photosynthesis. Sour grasses, such as *Sporobolus pyramidalis* Beauv., have higher fiber content and withdraw nutrients from their leaves to underground storage organs during winter. This results in a low nitrogen-to-carbon ratio, which makes them indigestible to stock. Sour grasses dominate high altitude-high rainfall grasslands with less fertile acidic soils, known as Sourveld. *Ziziphus mucronata* (buffalo thorn) and *Acacia nigrescens* (knob thorn) trees are frequently associated with Sourveld landscapes in Southern Africa.

Sweet grasses, believed to have evolved more recently, employ C_4 fixation, an elaboration of the C_3 carbon fixation (Mucina and Rutherford 2006). C_4 fixation involves a two-stage process were CO2 is fixed in thin-walled mesophyll cells to form a 4-carbon intermediate, typically malate (malic acid), which is actively pumped across the cell membrane into a thick-walled bundle sheath cell where it is split into CO2 and a 3-carbon compound. The resulting CO2 then enters the Calvin cycle, bypassing the detractive effects of photorespiration, an advantage in hot, dry conditions. Sweet grasses have relatively low fiber content and conserve nutrients in their leaves through the winter making them palatable to stock year round. They occur in low altitude-low rainfall grasslands with rich alkaline soils, known as Sweetveld. Sweetveld is the most common type of South African grassland, and it supports a number of species especially from the subfamily *Panicoideae*. The tribe *Andropogoneae* of *Panicoideae* (e.g. *Heteropogon* *contortus* (L.) Roem. and Schult.) dominates the temperate cool sweetveld of South Africa. The dense low-lying Sweetveld is often accompanied by *Acacia karoo* (sweet thorn acacia) trees.

In the study area (Figure 1), the grassland bioregions include the Drakensberg Grassland, with 6 subunits, and the Mesic Highland Grassland, with nine subunits. The Drakensberg Grassland is associated with the Great Escarpment of the Drakensberg region, which extends from the southern border of the Eastern Free State through central and western Lesotho. This bioregion is one of the highest elevations in Southern Africa and experiences a high level of precipitation, including snow. Diverse heath vegetation, including several highly endemic species dominates the steep slopes, including *Helichrysum palustre* and *Aloe polyphylla* (**Figure 2**). The <u>Northern Drakensberg Highland Grassland</u> subunit has mean annual precipitation of 1017 mm and mean annual temperature of 13.4°C (*Protea caffra, P. roupelliae, Setaria sphacelata, Themeda trandra,* and *Agrostis lachnantha*). The <u>Drakensberg Amathole Afromontane Fynbos</u> has mean annual precipitation of 1167 mm and mean annual temperature of 12.2°C, with characteristic seasonal extremes (*Passerina, Cliffortia, Erica, Euryops, Helichrysum, Macowania, Protea, Widdringtonia,* and *Ischryrolepsis*). The <u>uKhahlamba Basalt Grassland</u> has mean annual precipitation of 1234 mm and mean annual temperature of 11.6°C with hot summers (greater than 50 °C) and frost common during winter (*Bromus speciosus*, *Pentaschistus tysoniana, Cymbopogon nardus, Festuca caprina*, *Rendlia altera, Themeda triandra, Agapanthus, Merwilla, Helichrysum, Erica,* and *Euryops*). The <u>Lesotho Highland Basalt Grassland</u> has mean annual precipitation that varies from 575 mm at high the highest elevations to 928 mm along the eastern edge. Mean annual

Figure 2. ***Aloe polyphylla*****, photographed near the Basotho Cultural Village, in Golden Gate Highlands National Park.** ***A. polyphylla*** **is highly endemic to the Drakensberg grassland bioregion and used extensively in local** ***muthi*****.**

precipitation is 707 mm and mean annual temperature is 9.6 °C with frost common during the winter and at high elevations during the summer (*Passerina Montana*, *Chrysocoma ciliata*, *Pentzia cooperi, Festuca caprina, Kniphofia caulescens,* and *Mermuellera macowanii*). Western Lesotho Basalt Shrubland has warm summers and dry winters with mean annual precipitation of 731 mm and mean annual temperature of 12.1°C. (*Leucosoidea sericea, Buddleja loricata, Chrysocoma ciliate, Felicia muricata,* and *Digitaria eriantha*). Drakensberg Afroalpine Heathland mean annual precipitation of 737 mm and mean annual temperature of 14°C. This is just above freezing Temperature fluctuates significantly, irrespective of altitude and frost is present around half the year, even in summer (*Helichrysum trilineatum, H. sessiloides, Mermuellera disticha, M. drakensbergensis*, and *Chrysocoma ciliata*).

The Mesic Highland grassland occurs in the eastern Highveld running north to south through the Free State and western Lesotho. It is a biome with heavy precipitation and highly endemic sourveld vegetation, including herbs, geophytes, and andropogonoid grasses. Shrubs are sparse, but concentrated on outcroppings of mostly volcanic rock. The Zastron Moist Grassland subunit has mean annual precipitation of 615 mm and mean annual temperature of 14°C with high thermic continentality and a mix of sweet and sour grasses (*A. ferox, Aristida congesta, Cymbopogon pospischilii,* and *Themeda triandra*). The Sunqu Montane Shrubland has mean annual precipitation of 687 mm and mean annual temperature of 13.1°C, with a cool-temperate thermic pattern (*Rhus erosa, Olea europea, Diospyros austro-africana, Kiggeleria africana, Leucosidea sericea,* and *Rhamnus prinoides*). Eastern Free State Clay Grassland has a mean annual precipitation of 630 mm and mean annual temperature of 14.4°C, with some of the coldest winter temperatures of the Highveld (*Eragrotus curvula, Themeda triandra, Cymbopogon pospischilii, Eragrostis plana, Setaria sphacelata, Elionurus muticus,* and *Aristida congesta*). Eastern Free State Sandy Grassland has a mean annual precipitation of 700 mm and mean annual temperature of 13.6°C. The continental climate marked by frequent thunderstorms from November to March, great differences in average temperature from summer to winter, and frequent frosts (*Eragrostis curvula*, *Tristachya leucothrix, Themeda triandra, E. capensis, E. racemosa, Cymbopogon popischilii, Elionurus muticus, Eragrostsis plana*, *Aristida junciformis*, *Helichrysum, Vernonia*, and *Berkheya*). Basotho Montane Shrubland has mean annual precipitation between 635-1400 mm, primarily from convectional summer storms, and mean annual temperature of 13.7 °C. Frost is rare (*Rhus erosa*, *Olea europaea* subsp. *africana, Euclea crispa* subsp. *crispa, Buddleja* *salviifolia, Leucosidea sericea, Rhus burchellii, Rhamnus prinoides, Scutia myrtina*, and *Gymnopentzia buxifolia*). Frankfort Highveld Grassland has mean annual precipitation of 638 mm and a mean annual temperature ranging from 14-15°C, with a high degree of thermic continentality due to deep inland locality (*Eragrostis curvula*, *E. capensis*, *E. plana*, *E. racemosa*, *Themeda triandra, Cymbopogon pospischilii, Elionurus muticus* and *Aristada junciformis*). Northern Free State Shrubland has mean annual precipitation of 627 mm and mean annual temperature of 14.4°C with convectional rains and around 40 days of frost (*Rhamnus prinoides, Leucosidea sericea, Buddleja salviifolia*, *Rhus dentata, Euclea crispa* subsp. *crispa, Diospyros lyciodes*, and *Kiggelaria africana*). Soweto Highveld Grassland has mean annual precipitation of 662 and mean annual temperature of 14.8°C with large thermic diurnal differences (*Themeda triandra, Elionurus muticus, Eragrostis racemosa, Heteropogon contortus,* and *Tristachya leucothrix*). Rand Highveld Grassland has mean annual precipitation of 662 with highly seasonal summer rains and very dry winters. Mean annual temperature is 14.8°C with a greater incidence of frost in the west than in the east (*Themada, Eragrostis, Heteropogon*, *Rhus, Elionurus*, *Asteraceae* herbs, *Protea caffra* subsp. *caffra, P. welwitschii*, *Acacia caffra*, and *Celtis africana*).

Savannah is the most widespread biome in Africa and comprises some 32.8% of South Africa. It consists of a grassy ground layer and a distinct overstory of woody plants, with distinctions based on vegetation height and/or density. Shrubveld has an upper woody layer that is close to the ground, woodland refers to savannah with a dense upper woody layer of vegetation, and savannah with intermediate woody plant heights are known as bushveld. The distinctive features of this biome include frequent fires, a high level of grazing, and a lack of sufficient summer rainfall; all preventing the upper layer from dominating. C_4 grasses dominate regions with hot growing seasons and C_3 grasses dominate winter rainfall regions.

Savannah bioregions occurring in the study area include the Central Bushveld and the Eastern Kalahari Bushveld. The Central Bushveld is found in sparse concentrations in the northern Free State. This concentration (subunit) is known as the Gold Reef Montane Bushveld and has mean annual precipitation of 666 mm and mean annual temperature of 16.4°C with very dry frosty winters (*Acacia caffra, Canthium gilfillanii, Ehretia rigida,* and *Athrixia elata*). It is an undulating landscape consisting of diverse rocky *Acacia* woodlands with a grass-dominated sub layer.

Eastern Kalahari Bushveld is found along the ridges and hills east of the confluence of the Vaal and Orange rivers, and relatively close to the Western Free State fieldwork area in this study. The summer and fall rainfall and dry winters produce thornveld vegetation comprised of spindly trees in sheltered sites, such as *Celtis africana* and *Acacia tortilis*, evergreen shrubs, grasses, and bulbous and annual herbaceous plants. Eastern Kalahari Bushveld has three vegetational subunits. The Kimberley Thornveld subunit has mean annual precipitation of 408 mm and mean annual temperature of 17.2°C. Rainfall is concentrated to summer and autumn and frosts are frequent during the winter (*Acacia erioloba, A. tortilis, A. karoo, Boscia albitrunca, Tarchonanthus camphoratus,* and *A. mellifera*). Vaalbos Rocky Shrubland has mean annual precipitation of 331 mm and mean annual temperature of 17.1°C. Rainfall is concentrated to summer and autumn and lowland frost is common (*Tarchonanthus camphoratus, Olea europaea* subsp. *africana, Euclea crispa, Diospyros lycioides, Rhus burchellii, Buddleja saligna, R.*

lancea, Celtis africana, *Ziziphus mucronata*, *and Acacia tortilis*). Schmidtsdrif Thornveld has mean annual precipitation of 373 mm and mean annual temperature of 17.7°C with summer-autumn rainfall and dry frosty winters (*Acacia mellifera, A. tortillis*).

The Nama-Karoo is the second largest biome and appears on the central plateau of western South Africa. Deciduous dwarf C_3 shrubland and C_4 grasses, summer rains (100-520 mm mean annual precipitation), and poorly developed lime rich soils are distinguishing features of this biome. Fires are rare due to low vegetation density and tree growth is limited to drainages and rocky outcroppings. The ecotonal and climatically unstable nature of the region is linked to a relatively high diversity of plant forms with a low level of floristic diversity (Cowling *et al.* 1994): annuals, geophytes, C_3 and C_4 grasses, succulents, chamaephytes, and trees.

Nama-Karoo occurs in the study area as the Upper Karoo bioregion of the Western Free State. It is the largest and highest altitude bioregion of the biome, with a northern boundary in the vicinity of Douglas and Petrusburg extending south toward the Great Escarpment and west to the Northern Cape border. The Northern Upper Karoo is the subunit that occurs in the Free State, with 275 mm mean annual precipitation and mean annual temperature of 16.5°C with peak rainfall in autumn (*Acacia mellifera* subsp. *Detinens, Boscia albitrunca*, *Lyceium cinereum*, *L. horridum*, *Chrysocoma ciliata,* and *Hertia palens*).

Reconstructing the Paleoclimate

In this section, data are presented to provide a chronology that helps to detail paleoclimatic changes in South Africa and place the cultural events from the Middle

Stone age to the Later Stone Age into this an integrated time frame. Dating conventions and the dates of the chronozones, or segments of time bounded by significant events, that are applicable to the study are defined in **Table 1**. The culture chronology of the Middle Stone Age to the Later Stone age is briefly described and summarized in **Table 2**. All dates are reported as calibrated years BP and correlated to Marine Isotope Stage (MIS) boundaries from Martinson *et al.* (1987). Marine isotope stages are alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples. The data derived from pollen and foraminifera (plankton) remains in drilled marine sediment cores, sapropels (dark organic-rich sediments), and other proxy historic climate data. Originally developed from the work of Cesare Emiliani in the 1950s, the MIS timescale is used in archaeology to express dating in the Quaternary period (the last 2.6 million years), and is especially applied to paleoclimatological data. The MIS timescale is the standard correlation for Quaternary climate records. The MIS chronology is compared to the Greenland Ice Core Chronology for the period of overlap. The Greenland Ice Core Chronology, known as GICC05, provides a high-resolution time scale for the second half of the Late Pleistocene (Anderson *et al.* 2006; Walker *et al.* 2006, Svensson *et al.* 2008).

The base of the **Middle Pleistocene** is most clearly marked by the shift from reversed to normal magnetic polarity at the Matuyama–Brunhes boundary, dated to about 780,000 to 790,000 cal. B.P. (Martinson *et al.* 1987; Shackleton *et al.* 1990; Hou *et al.* 2000). The Middle Pleistocene corresponds to MIS19 to 5e. The Middle to Late Pleistocene boundary is the beginning of the last interglacial, at approximately 126,000 cal. B.P.

Table 1. Chronozones correlated to Marine Isotope and Greenland Ice Core Stages. Adopted from Martinson *et al.* 1987 and Svensson *et al.* 2008.

MIS Number	Begin-End Date (B.P.)	Greenland Ice Core Stages	Begin-End Date (cal. BP)	Chronozone
1	0-12,050	?	0-11,650	Holocene
2	12,050-24,110	GS-1	11,650-12,845	Younger Dryas
		GI-1	12,845-14,460	
		GS-2	14,460-24,850	LGM
3	24,110-58,960	GI-16 to GI-3	58,280-24,850	Late Pleistocene
4	58,960-73,910	?		
5a	73,910-84,130			
5b	84,130-94,060			
5c	94,060-105,080			
5d	105,080-118,690			
5e	118,690-129,840			
6	129,840-189,610			Middle Pleistocene
7	189,610-244,180			
8	244,180-303,000			

The beginning of the **Late Pleistocene** is defined by the base of the Eemian interglacial phase before the final glacial episode of the Pleistocene 129,800 cal. B.P. years ago. The end of the age is defined as 11,650 calendar years before AD 2000 (Walker *et al*. 2008). The Late Pleistocene corresponds to MIS5e to MIS2 and represents the final stage of the Pleistocene epoch and is followed by the Holocene epoch (MIS1). Much of the Late Pleistocene age was dominated by glaciation and many megafauna species became extinct during but especially toward the end of the epoch, a trend that continued into the Holocene. Humans spread to every continent except Antarctica as non-modern human species died out.

The **Last/late Glacial Maximum** (LGM) was a period in the Earth's climate history when the ice sheets were at their maximum extension, at about 21,000 cal. B.P. (Potts *et al.* 2013). The LGM corresponds to MIS2. Ice sheets covered much of North America, northern Europe and Asia, affecting climates worldwide by initiating drought, desertification, and a dramatic drop in sea levels and temperatures. In Africa and the Middle East, many smaller mountain glaciers formed as sandy deserts expanded.

The **Younger Dryas** stadial was a geologically brief period of cold climatic conditions and drought, which occurred between approximately 12,800 and 11,500 cal. B.P.

A stadial is a period of lower temperatures during an interglacial, which separates the glacial periods of an ice age. MIS2 is a stadial while MIS3 is an interstadial. The Younger Dryas is believed to have been caused by the rapid melting of the North American ice sheets and the surge of fresh water into the North Atlantic. The Younger Dryas saw a rapid return to glacial conditions in the higher latitudes of the Northern Hemisphere between 12,800 and 11,500 B.P., a sharp contrast to the warming of the preceding interstadial deglaciation. The transitions likely occurred over a period of a decade or faster. Thermally fractionated nitrogen and argon isotope data from Greenland ice core GISP2 indicate that the summit of Greenland was approximately 15 °C colder during the Younger Dryas than today (Alley 1993).

The **Holocene epoch** followed the Pleistocene epoch at 11,650 calendar years B.P. (Walker *et al.* 2009) and corresponds with the entirety of MIS1. The transition from the last glacial to the Holocene was marked by the Huelmo/Mascardi Cold Reversal, a cooling event in South America between 11,400 and 10,200 cal. B.P. (Hajdas 2003), 550 years before the Younger Dryas. The warm temperatures (hypisthermal) were fully established in the Northern Hemishere by 7,000 cal. B.P. and lasted until about 6257 cal. B.P., moving into the Neoglacial. This period was similar to the modern climate, but with a slight warming at the Medieval Warm Period (Mann *et al.* 2009) lasting from 1000 to 600 cal. B.P., and a slight cooling during the Little Ice Age, from the 13th or 14th century to the mid-nineteenth century (Keigwin 1996).

Culture Chronology. The Middle Stone Age (MSA) lasted from 280,000 B.P. to 50-25,000 years ago and corresponds to MIS8 to MIS3 (**Table 2**). MSA inhabitants created the first art and symbolic culture, as well as arrows and hide working tools hafted with a unique gluing technique. Lithic technology included Levallois prepared cores (Shea 2011), blades, and composite microliths (Brown *et al.* 2012). MSA technocomplexes include pre-Still Bay, Still Bay, Howiesons Poort, and post-Howiesons Poort.

The **Pre-Still Bay** lithic industry is the earliest of the MSA. Levallois cores, unifacial points, and large blades and flakes are the most distinctive markers of the assemblage. The **Still Bay** (SB) lithic industry is an MSA stone tool manufacturing style named for the Stillbaai Site where it was first described (Goodwin 1927) Dated to between 71,900 and 71,000 B.P. (Jacobs *et al.* 2008), SB corresponds to MIS4. The SB style of lithic manufacture is distinctive for its association with bifacial points. The **Howiesons Poort** (HP) lithic industry was named for Howieson’s Poort Shelter near Grahamstown (Stapleton and Hewitt 1927; Goodwin and van Riet Lowe 1929). The HP lasted about 5,000 years, from 65,800 to 59,500 BP (Jacobs *et al.* 2008), and corresponds to end of MIS4. HP culture is distinctive for having both modern and pre-modern

Table 2. Culture chronology for Southern Africa correlated to MIS stages.

MIS/Begin Date	Chronozone	Cultural Period	Industry/ Culture	Begin cal. BP
MIS 1 11,650	Holocene	Later Stone Age	Smithfield Wilton Oakhurst	860 7800
MIS 2 24,110	Late Pleistocene		Oakhurst Robberg	13,800
MIS 3 58,960			Robberg Early LSA	26,150 48,350
MIS 4 73,910		Middle Stone Age	Post HP MSA Howieson's Poort Still Bay Pre-Still Bay MSA	59,500 65,800 71,000
MIS 5 129,840			Pre-Still Bay MSA	280,000
MIS 6 189,610	Middle Pleistocene			
MIS 7 244,180				
MIS 8 303,000				

characteristics. Tools seem to foreshadow the characteristics of Upper Paleolithic industries introduced 25,000 years later. These include lithics made of fine grained stone, composite tools and hunting weapons made by hafting microliths with a compound resin of ochre and plant gum (Wadley *et al.* 2009), and possible evidence for the use of traps (Clark and Plug 2008). The **Post-Howiesons Poort** is a late MSA lithic industry dating to between 22,000 and 60,000 cal. B.P. (Volman 1984). The key features of the assemblage are hollow based points and an increased diversity of point types. Small blades and backed HP lithics are exceedingly rare.

The **Early Later Stone Age** (ELSA) marks the transition from the Middle Stone Age to the Later Stone Age (LSA). Deacon and Deacon (1999) define the LSA as a culture-stratigraphic unit including assemblages dated within the last 20,000 years, though more recent dating (Villa *et al.* 2012) put the start of the ELSA at around 50,000 B.P., corresponding to MIS3. Distinctive artifacts include hafted microlithic tools, bored stones used as digging-stick weights, bows and arrows, polished bone tools (e.g. awls, linkshafts, and arrowheads), fishing equipment, beads of shell and ostrich eggshell, and engraved decoration on bone and wood items. The Early LSA, Robberg, Oakhurst, Wilton and Smithfield comprise the technocomplexes of the LSA.

The **Robberg Industry** was the last Pleistocene technological expression of the LSA and dates to 22,000/21,000 to 12,000 B.P. (Deacon and Deacon 1999; Bousman 2005, Mitchell 1988, J. Deacon 1978, 1984). The lithic assemblages are distinct for their abundant bladelets, rare microlithic backed tools, and unifacial scrapers (Deacon 1984; Mitchell 1988, 2002; Wadley 1993, 1996). This industry corresponds to MIS2.

The **Oakhurst Complex** occurs between 12,000–8000 cal. BP in most of Southern Africa and corresponds to the end of MIS2 and the early portion of MIS1 (Deacon 1984; Deacon and Deacon 1999; Mitchell 1997, 2002; Sampson 1974; Wadley 1993; Bousman 2005). The lithic assemblage is distinctive for the presence of large scraping tools, but no microliths (Deacon 1978, 1984, Mitchell, 2002; Sampson 1974). Several regional variants exist including Lockshoek in the Eastern Karoo near Blydefontein (Sampson 1974; Bousman 2005), Kuruman industry in the Northwest Cape (Humphreys and Thackery 1983) and Coastal Oakhurst (aka Albany; Deacon 1976). The assemblages of the latter two variants contain abundant bone tools, possibly used as projectile tips (H. Deacon 1976; J. Deacon 1984; Mitchell 1997; Wadley 1989).

The Holocene follows the last glacial period and, in South Africa, includes the later part of the Oakhurst Complex described above, Wilton and Smithfield technocomplexes. The **Wilton industry** was named for the two rock shelters in the Albany district of the Eastern Cape where it was first identified (Hewitt 1921). The term is used to describe middle and late Holocene microlithic assemblages spanning 7000 to 1000 BP (Bousman 2005; Deacon 1976; Deacon and Deacon 1999; Hall 1990; Mitchell 1993, 2002; Opperman 1987; Sampson 1967, 1970, 1974; Wadley 1997). Wilton corresponds to MIS1. Sampson (1970, 1974), divided the Wilton into Coastal and Interior complexes. He further divided the Interior Wilton into Early, Classic, Developed, and Ceramic phases, based on his research in the Orange River Scheme area. The **Smithfield Industry**, associated with historic Khoesan (Bollong and Sampson 1996; Bollong et al. 1993; Sampson 1967, 1970, 1974) is best documented in the Karoo, dates to the last 1000 years and corresponds to MIS1. The lithic assemblage includes large end scrapers, bone points, and few microliths (Goodwin and van Riet Lowe 1929; Sampson 1974). Khoe ceramics and stone circular corrals demonstrate a dense occupation south of Blydefontein in the southern Zeekoe Valley (Sampson 1988, 2010; Sampson and Vogel 1995, 1996).

Inland Proxy Paleoclimate Studies. In an effort to define the paleoenvironmental transitions that have occurred in the vicinity of the study area, this section presents a chronological description of these changes since MIS3. These transitions are defined by climate studies from continental pollen sites (**Figure 2**) that provide valuable proxy information about the fluctuations in the region. The discussion is organized by marine isotope stage (**Table 1**) and subdivided by evidence from inland sites located within the biomes associated with the study area (**Figure 1**): bushveld, grassveld, and Nama Karoo. The pollen sites discussed are summarized in **Table 3**.

MIS3. The pollen sequence from Tswaing crater (Partridge *et al.* 1997) and the δ13C stalagmite record from Lobatse Cave (Holmgren *et al.* 1995) suggest that by 50,000 cal. B.P. summers were moist and cool and, in general, atmospheric CO2 concentrations were low during the Late Pleistocene. At Equus Cave, in the southern Kalahari, depleted δ13C values, relatively high Stoebe and fynbos pollen values at 48,000 cal. B.P. were followed by enriched δ13C values, and lower Stoebe and fynbos values at 44,000 cal. B.P. respectively. Tswaing seems to represent dry Kalahari Thornveld vegetation (Scott 1999a,b) and the Lobatse Cave shows enriched δ13C values over this interval, possibly the result of isotopic fractionation affecting the calcite precipitation under evaporative conditions. However, if evaporative conditions and the decline of C3 plants were present, it is not possible to know which had the strongest effect on the isotope record in Lobatse Cave. Both factors might have been strong during this period when the inter-tropical convergence zone (ITCZ), summer insolation, and possibly the circum-polar vortex (Tyson 1999) appeared to have been in transition. The ITCZ in Africa affects seasonal precipitation patterns across that continent. Low atmospheric CO2 concentrations likely

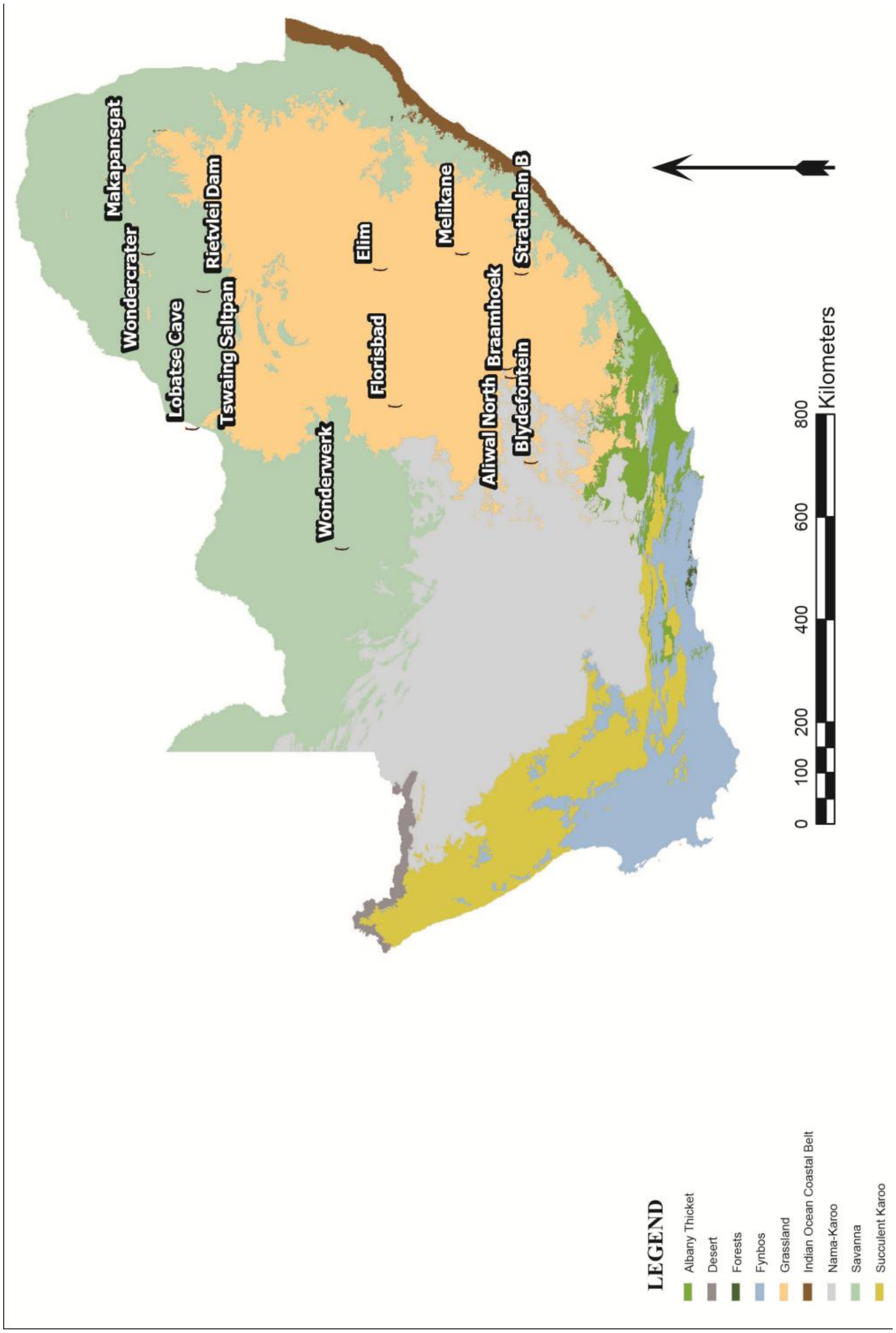

Figure 3. Biome map of the pollen sites significant to the study area.

reduced the C3 plants in the region, but δ13C values might have been partly cancelled out during stronger evaporation phases.

In 2013, Truc *et al.* applied a series of botanical climatological transfer functions based on a combination of modern climate and plant distribution data from southern Africa to the Wonderkrater fossil pollen sequence, located in the grassland biome. They derived quantitative estimates for temperatures during the cold and warm quarters and precipitation during the wet and dry quarters. A species-selection method based on Bayesian statistics provided focused selection of likely plant species from what are otherwise taxonomically broad pollen-types. Precipitation at Wonderkrater, in the savannah, climaxed at about 37,000 cal. B.P. (Truc *et al.* 2013). These results are based more clearly on the relationship between modern plant distributions and individual climatic variables. High lake levels in the Nama-Karoo and Kalahari after 32,000 B.P. suggest moist and mild conditions during this period.

Grass phytoliths from Tswaing, in the savannah, dating between 29,500 and 8,000 cal. B.P., suggest that C3 grasses increased in the region during this cool phase (Scott, 2002), with a notable shift at 27,000 cal. B.P. δ13C in grazer tooth enamel from Equus Cave indicate C4 grass vegetation during the Late Pleistocene, but at 27,000 cal. B.P., C3 grasses regain prominence (Lee-Thorp and Talma, 2000). This shift corresponds with depleted δ13C values at Lobatse Cave.

Moderately cool sub-humid conditions are indicated at two sites around the end of MIS 3 (26,000 to 24,000 B.P.) as indicated by the pollen from Wonderkrater in the current subtropical savanna and Elim at Clarens in the high-lying grassland of the Free

State. The combined pattern from these two sites suggests varying but moist conditions including a moderately dry episode 25,000 cal. B.P. with wetness returning towards 24,000 cal. B.P. The Clarens pollen site at Elim seems to suggest moderate temperature conditions 26,000 to 24,000 cal. B.P. in view of lower fynbos and Stoebe-type pollen.

MIS2. Pollen results corresponding to MIS2 (24,000 to 12,000 cal. B.P.) indicate that the coldest phases during the "glacial" period in South Africa were between 24,000 and 23,000 cal. B.P. and 22,400 and 17,500 B.P. in the eastern Free State high altitude grassland, Wonderkrater, Wonderwerk, Cave and Equus Cave. In the grassland, precipitation at Wonderkrater increased following the Younger Dryas (Truc *et al.* 2013). Temperatures during both the warm and cold seasons were 6 ± 2 °C colder during the LGM and Younger Dryas (MIS2). Rainy season precipitation during the Last Glacial Maximum was about 50% of mid-Holocene levels. The Clarens grassland pollen site at Elim seems to suggest cold and moist conditions 24,000 to 23,000 cal. B.P., becoming warm and dry around 22,000 cal. B.P. (Scott 1989).

The records indicate a slight warming between 20,000 and 19,000 cal. B.P. There were widespread increases in moisture during the coldest phases at Wonderwerk Cave, Equus Cave and Wonderkrater. The oldest pollen spectra in the grassland comes from Aliwal North and suggests generally moist conditions from 16,600 to 11,500 cal. B.P (Coetzee 1967) including more swampy conditions in the early phase and some brief interruptions of slightly drier events. The dry woodland pollen from Wonderwerk Cave and Equus Cave pollen records suggest lower temperatures before 17,000 cal. B.P and a

Table 3. Continental pollen sites significant to the study area. Relates the site region (Rutherford and Westfall 1986) to bioregion (Mucina and Rutherford 2006) as discussed in the Modern Environment section. Adapted from Scott *et al.* 2012.

<table>
<tr><th>Pollen Site</th><th>Deposit Type</th><th>PCA Set</th><th>Biome</th><th>Region (Rutherford and Westfall 1986)</th><th>Bioregion (Mucina and Rutherford 2006)</th></tr>
<tr><td>Rietvlei Dam</td><td>Swamp</td><td rowspan="3">1</td><td rowspan="5">Savannah</td><td rowspan="3">Sub-humid woodland</td><td>Mixed Dry and Mesic Highveld Grassland (Borders Central Bushveld)</td></tr>
<tr><td>Tswaing Crater</td><td>Lake</td><td rowspan="2">Central Bushveld</td></tr>
<tr><td>Wonderkrater</td><td>Spring</td></tr>
<tr><td>Wonderwerk Cave</td><td>Cave stalactite</td><td rowspan="2">2</td><td rowspan="2">Dry Woodland</td><td rowspan="2">Eastern Kalahari Bushveld</td></tr>
<tr><td>Equus Cave</td><td>Cave coprolite</td></tr>
<tr><td>Braamhoek</td><td>Swamp</td><td rowspan="2">3</td><td rowspan="5">Grassland</td><td rowspan="2">Upland Grassland</td><td rowspan="2">Mesic Highveld Grassland</td></tr>
<tr><td>Elim at Clarens</td><td>Swamp and Spring</td></tr>
<tr><td>Blydefontein</td><td>Swamp, Hyrax dung, and Cave</td><td rowspan="5">4</td><td rowspan="5">Grassland/ Karoo</td><td rowspan="3">Dry Highveld Grassland</td></tr>
<tr><td>Aliwal North</td><td rowspan="4">Spring</td></tr>
<tr><td>Florisbad</td></tr>
<tr><td>Badsfontein</td><td rowspan="2">Nama Karoo</td><td rowspan="2">Upper Karoo</td></tr>
<tr><td>Deelpan</td></tr>
</table>

general warming trend after this with strongly oscillating moisture conditions between 23,500 and 11,000 cal. B.P. The last glacial period (post 20,000 cal. B.P) for the Sub-humid woodland recorded at Wonderkrater suggest a 1000 meter lowering of the vegetation belt (Scott 1982a).

The fossil pollen record from the Wonderkrater spring mound (Théry-Parisot *et al.* 2013) in northeastern South Africa has contributed substantially to our understanding of past vegetation change since the Last Glacial Maximum, 21,000 years ago (MIS2). The isotope records of Wonderkrater, Makapansgat and Cango Caves place the coldest conditions at 17,000 years B.P. (MIS2). Increasing temperatures are indicated in both the Makapansgat and Wonderkrater pollen records at 13,000 cal. B.P (MIS2). A hiatus from 12,700 (MIS2) to 10,200 (MIS1) cal. B.P. is found in the Makapansgat speleothem record, while the Wonderkrater sequence indicates a return to slightly cooler, drier conditions with *Chenopodinaceae* and *Amaranthaceae*. At 10,200 cal. B.P. (MIS1), the stalagmite and pollen records suggest increasingly dry conditions.

MIS2/MIS1 Transition. As temperatures increased between 15,000 and 7000 cal. B.P., at the MIS2 to MIS1 transition, most sites show dry to moist fluctuations, which are not necessarily parallel to each other. Wonderwerk cave became drier between 13,000 and 11,500 cal. B.P., the YD interval. In contrast, at Aliwal North on the boundary of the grassland and Karoo regions in the central eastern part of the sub-continent, the trend seems less marked. The upland grassland pollen data from Braamhoek (Norström *et al.* 2009) shows a slight temperature increased slightly after 13,000 cal. B.P. peaking around 9000 cal. B.P. with low temperatures during the intervening periods (13,100 and 10,100 cal. B.P.). Later there seems to be a period of slow drying during the mid to late

Holocene. Moisture fluctuations at Wonderkrater and Aliwal North include a slight increase between 12,000 and 11,000 cal. B.P.

MIS1. Radiocarbon dates from Colwinton Rock Shelter (Tusenius 1989) in the grassland biome indicate a warm and dry environment dominated by grass cover at the beginning of the Holocene. The Wonderkrater data suggest sub-humid conditions with an apparent dry episode lasting from 12,500 to 11,500 cal. B.P. Following relatively moist conditions 11,500 to 10,500 cal. B.P., coinciding with the beginning of MIS 1. Despite opposing trends at some sites, dryness is well established by 10,500 cal. B.P. at Wonderkrater, Wonderwerk and Equus Cave while a wet phase occurred at Braamhoek at 10,000 cal. B.P. Drier conditions at Wonderkrater are suggested between 10,000 to 8000 cal. B.P.

The early Holocene is poorly covered in the Grassland and Nama Karoo but seems to indicate dry conditions at Blydefontein 11800 to 7000 cal. B.P., after which it became wetter. Drying is suggested at Florisbad until 8000 cal. B.P. after which there is a slight increase in moisture 7000 cal. B.P. After 8000 cal. B.P. there are signs of increasing moisture throughout the region. Conditions appear to be relatively more humid between 8000 and 7000 cal. B.P. in the dry woodland eastern savanna at Wonderkrater and Tswaing. Relatively constant humidity is suggested for the rest of the Holocene in the dry savanna. A general increase in temperatures is suggested at 15,000 cal. B.P. for the sub-humid woodland with highest temperatures indicated in the early to middle Holocene at different sites but there is marked, not necessarily co-varying, changes between them. Equus Cave data suggest only a slight but gradual temperature decline from 8000 cal. B.P. onwards. The late Holocene was wetter and cooler with an increase in shrubs.

The Wonderkrater pollen core indicates an 8000 year B.P. warming and the 7200 cal. B.P. cooling (Scott 1989; Thackeray 1994; Scott and Thackeray 1987). The mid-Holocene hyperthermal at Wonderkrater was approximately 1°C warmer than modern conditions. At 8500 cal. B.P., the higher $\delta^{13}C$ values at Makapansgat and increase in grass pollen at Wonderkrater correspond to a sudden increase in grasses. These data suggest open savanna, Kalahari trees, shrubs and dry grassland. Warmer temperatures occurred at 9500 to 6000 cal. B.P. This trend does not follow the curve from Makapansgat closely, although relatively high temperatures for the period are also indicated. Cooling is apparent in the Wonderkrater spring sequence after 6000 cal. B.P. and temperatures reach their lowest values by 3000 cal. B.P., corresponding to the isotope records of Makapansgat. Moderate dryness is also indicated at Wonderkrater during this period.

The warm conditions of the middle Holocene were replaced by cooler temperatures towards the Late Holocene from 6000 cal. B.P. until 1500 cal. B.P. Overall this time period was moist but variable with a gradual decline in wetness in summer rain regions. Compared to the general trend of increased moisture after 8000 cal. B.P., Blydefontein experienced increased humidity 6400 cal. B.P. In the Karoo grassland at Florisbad, a marked drying is obvious between 6000 and 5000 cal. B.P. (Scott and Nyakale 2002) and this is paralleled by conditions at Braamhoek (Norström *et al.* 2009). In the center of the sub-continent, apparent see-saw anomalies 6500 to 2000 cal. B.P., occur between Florisbad and Deelpan in the grassland area, and Blydefontein in the Karoo region to the south.

Temperatures seem to show a slight general decrease after 6000 cal. B.P. at Wonderkrater and Tswaing Crater until 2000 cal. B.P. Around 5000 cal. B.P., Blydefontein and Badsfontein springs indicate much drier conditions than at Florisbad. In the middle and later Holocene, widespread organic paleosols in the region suggest that conditions favored the development of swamps. At Blydefontein, moist conditions alternated with drier episodes, leading to more karroid vegetation. Widespread dry events are recorded at sites throughout the sub-continent at 4000 cal. B.P. and 2000 cal. B.P. Deelpan (Nama Karoo) and Florisbad (Grassland) overlap except at 2000 cal. B.P. where Deelpan was drier. Both Deelpan and Blydefontein indicate a drying trend in the last 400 years. Moisture conditions seem to stay moderately humid in the modern Sub-humid Woodland until 3000 to 3500 cal. B.P. when different sites indicate slightly lower moisture levels until about 1500 to 2000 cal. B.P. after which moisture levels increase.

Tree ring and pollen studies and stable isotopes in stalagmites indicate a period of medieval warming from AD 600 to 1200 with a cool dry event associated with the Little Ice Age between AD 1500 and 1800 (Holmgren *et al.* 2003). These fluctuating conditions may not be evident in the Sibudu seed data because the plants adapted to the mild climate along the KwaZulu-Natal coast are unlikely to react to changes in temperature of a few degrees and rainfall changes are less dire in the vicinity of a river, such as the Tongati. Changes in vegetation in the Sibudu Cave area were likely represented by an increase or decrease of grass vs. tree cover and are reflected in the relative abundances within species rather than in the types of species.

Paleoenvironmental Chronology of the Free State Localities. The previous sections of this chapter presented background information about the past and present climate and vegetation states in the biomes of the study area. This section characterizes the modern regional environment setting and the paleoenvironmental chronology of the study area localities in the Eastern and Western Free State. These include the township of Ikgomotseng and the archaeological sites of Florisbad and Erfkroon in the Western Free State and the town of Phutaditjhaba and the Basotho Cultural Village in the Eastern Free State. Modern environmental data are reported for the Western Free State and Eastern Free State bioregions (Mucina and Rutherford 2006) followed by a localized chronological reconstruction.

The Western Free State localities of Florisbad, Ikgomotseng, and Erfkroon are situated on the Mesic Highland grassland bioregion (Mucina and Rutherford 2006). The paleoenvironmental reconstruction of Florisbad (Bamford and Henderson 2003, Scott and Rossouw 2005, Scott *et al.* 2012) discussed here is meant to also represent the other study area localities in the Western Free State, including Ikgomotseng and Erfkroon, due to their close proximity. The bioregion, discussed previously, is dominated by C4 grasses that thrive on summer and spring rains during the growing season (Vogel *et al.* 1978). Woody species growth is limited by regular frosts and fire, except for *Acacia karoo* along drainages and *Rhus* spp., *Olea africana*, and *Buddleia saligna* on dolerite hills (Acocks 1988).

Florisbad is a fossil-bearing and archaeologically rich spring mound approximately 42 km north of Bloemfontein, situated on the edge of a large playa, known as Soutpan. The spring mound consists of distinctive layers of sands, silts, and organics that have yielded a 7 meter interval of fossil pollen (Van Zinderen Bakker 1957). The vegetation of Florisbad is dominated by *Themeda triandra*, with *Cymbopogon plurinodis* as the tallest (though uncommon) grass (Acocks 1988), and exotic trees including *Prosopis juliè ora*, *Pinus*, and *Eucalyptus* species. Halophytic plants and weeds, often associated with sites disturbed by salt exploitation, such as *Salsola glaberescens,* are found in the nearby pan. This vegetation changes to a *Diplachne fusca* grassveld during periods when the pan is moist.

The significance of the geological, paleontological, and paleoenvironmental setting relating to the sediment sequence has been revised recently (Coetzee and Brink 2003; Scott and Rossouw 2005; Scott *et al.* 2012; and Scott *et al.* 2013). Florisbad is the type locality of the Florisian Land Mammal Age (Hendey 1974) and the fossil fauna at the site largely represents a number of open grassland grazers that reflect a highly productive grassland ecosystem during the late Quaternary (Brink 1987, 1988). The Florisian grasslands are the thought to be the immediate precursors of the modern Grassland Biome (O'Connor and Bredenkamp 1997), though extinction of several contemporary grazer species at the end of the Pleistocene (Hendey 1974; Klein 1980; Brink and Lee Thorp 1992) indicate that their productivity differed significantly from the present-day vegetation. The presence of lechwe and hippopotamus remains indicate that the grassland was wetter than today, with large bodies of water in the vicinity. Remains of *Antidorcas bondi*, an extinct springbok known to be a specialized grazer, were identified in the spring collection and the MSA Horizon at Florisbad. In order for this species to have survived, young shoots must have been available all year, which would suggest a milder frost regime.

In addition to its unique evidence of Pleistocene human activity and fauna, the Florisbad spring site also provides pollen data indicating long-term vegetation and climate change during the upper Pleistocene and Holocene. Indeed, the Florisbad sequence of 300,000 years (Grün *et al.* 1996) is considered the longest terrestrial pollen record yet discovered in southern Africa. It is longer than both the 200,000-year Tswaing Crater sequence and the 50,000-year Wonderkrater spring deposit (Scott 1999). Unfortunately, the available pollen spectra cannot directly related to faunal and archaeological finds of the MSA because they represent different sequences. Except for the Holocene pollen sequence (Scott and Nyakale 2002), it has not been possible to assign precise ages to Van Zinderen Bakker's (1989) pollen zones. As a result, the Florisbad sequence cannot be compared to other pollen records like the Tswaing Crater (Scott 1999) or Wonderkrater (Scott 1982b). Furthermore, some Florisbad zones contain pollen samples with no equivalents in the Tswaing Crater sequence (Grün *et al.* 1996) Oxygen Isotope Stage 5a (present at Tswaing) may correspond to one of the sub-zones in Florisbad Pollen Zone III, but the pollen sequences at the respective sites do not match up (Scott 1999). Scott and Rossouw (2005) have indicated the importance of dating the palynological sequence (in order to link the MSA paleoenvironment to the faunal and archaeological record), locating the position of the Middle Stone Age living-floor in the pollen sequence of the site, phytolith analysis of both pollen and non-pollen bearing layers of the sequence, in addition to pilot studies of diatom and isotope content.

The Early Holocene at Florisbad was very dry and pollen did not preserve well. Perhaps the most significant revelation of these data is that summer rains appear to have been significant at Florisbad at an earlier stage in the mid-Holocene than at Blydefontein

(Scott *et al.* 2005, 2012; Scott and Nyakale 2002). Around 6500 cal. B.P., conditions were warm and relatively dry with high local evaporation (Butzer 1984a; 1984b; Visser and Joubert 1991). The environment shifted from arid to more mesic grassy conditions due to summer rain between 6300 cal. B.P. and 4400 cal. B.P. Arboreal pollen did not increase during this period despite higher rainfall (Scott and Roussouw 2005) suggesting that frost remained severe at Florisbad. Between 5500 and 4500 cal. B.P., karroid shrubs and *Asteraceae* increased indicating drier conditions in the region (Scott and Roussouw 2005). *Asteraceae* also increased at Kathu Pan at 4400 cal. B.P. (Beaumont *et al.* 1984) and at Blydefontein in the Karoo between 4700 cal. B.P. 5000 cal. B.P. (Nyakale 1999, Scott *et al.* 2005), suggesting a general trend during the early part of the late Holocene. Fluctuations at Florisbad continued until 2100-1700 cal. B.P. when dry summer conditions set in. Vegetation was dominated by sedges and other semi-aquatics, but had no trees.

Evidence for the environment of the Free State during the Early Later Stone Age is found in the charcoal assemblage from Rose Cottage. Vegetation regimes coinciding with the Late Pleistocene and Holocene are represented. The Holocene levels contain charcoal from scrub thicket and woodland taxa including *Celtis africana*, *Leucosidea sericea, Olea africana, Myrsine africana*, *Rhus* spp., *Rhamnus prinoides, Euclea crispa, Diospyros austroafricana, Maytenus heterophylla, Grewia occidentalis* and *Buddleja salviifolia* (Wadley *et al.* 1992). Scrub thicket was almost absent by 12,500 cal. B.P. as the local grassland contained heathland elements. Alpine grassland may have expanded from the Drakensberg and Maluti mountains to lower altitudes during the Last Glacial when a temperature depression in the order of 4 to 6 degrees C occurred in southern Africa (Deacon *et al.* 1983; Vogel 1983; Deacon and Lancaster 1988; Scott 1989).

The results of the charcoal analysis do correspond well with results from pollen and charcoal studies conducted in the north-eastern Cape, Lesotho and the eastern Orange Free State. Both heathland species and C3 grasses expanded their boundaries in these areas during the LGM. The pollen record from *B* suggests the presence of heathland and C3 grasses at least as far south-east as Maclear during the LGM (Opperman and Heydenrych 1990). In Melikane Shelter, eastern Lesotho, the Carbon-13 content of collagen from *Equus* teeth from Late Pleistocene and Late Holocene levels shows a high percentage of C3 between 20,000 and 42,000 cal. B.P. (Vogel 1983). In the Clarens area, pollen spectra from Elim show maximum heathland development, and therefore the coolest and driest conditions, at about 19,000 cal. B.P. (Scott 1989). Thereafter, in the warm, dry conditions of the Holocene, grassland replaced heathland as the dominant vegetation type (Scott 1989). Charcoal studies from Colwinton and Ravenscraig rock shelters suggest that similar environmental changes were operating in the north-eastern Cape in the Holocene (Tusenius 1989).

CHAPTER III

CULTURAL HISTORY OF PLANT USE IN SOUTHERN AFRICA

The modern indigenous plant use economy includes food, *muthi*, and utilitarian applications, but no large-scale regional studies have been carried out in the Free State. Ethnobotanical data collection has been a passive byproduct of botanical studies or early 20th century ethnographic studies that have been largely overlooked by archaeologists. Local indigenous plant food usage has declined dramatically in the post-Apartheid era. The spread of farming throughout the interior has reduced both the prevalence of ethnobotanically significant indigenous plants on the landscape and their role in local subsistence. Local plant diets have shifted steadily toward grocery stores and urban markets stocked with non-local produce. Even when *muthi* and edible plants are known to grow in the Free State, these plants are sourced from wetter regions with a network of well-established commercial farms and a vigorous *muthi* industry. The scope of this research is concerned with medicinal and/or edible plants and ground stone processing, traditional applications that would have been of primary importance in the MSA-LSA and continue to be an essential component of modern indigenous life.

A definitive ancestry linking the herbal practices of the Southern Bantu agriculturalists to hunter-gatherers has never been substantiated, though evidence of selective borrowing of these traditions has been recognized (Hammond-Tooke 1998). The unearthing of ethnographic accounts of Khoekhoe herder plant use in the Western Free State (Englebrecht 1934) has revealed use consistent with Bantu and Khoesan use patterns, though a clear ethnobotanical lineage is still unclear. This chapter presents select linguistic, historical, and ethnographic examples of the use of plants by the Khoesan hunter-gatherers, Khoekhoe herders, and Southern Bantu agriculturalists of South Africa.

The Ethnobotany of Hunter-Gatherers

There are three categories of healers in the Khoesan tradition: diviners, herbalists and poison/snake doctors. Each of these healers a unique curative approach. Diviners, known as !*gai aup* (! denotes the palato-alveolar click), treat serious ailments. Still many be encountered in remote regions of the Kalahari, and very often they are female. Herbalists treat minor and chronic ailments and are still referred to with the honorific *bossiedokter* in certain parts of the cape. A *bossiedokter* is a highly skilled and experienced doctor who uses herbs or small bushes (bossies) to heal. Poison or snake doctors specialize in the treatment of snakebites, one of the major threats to human life, especially in regions populated with Cape cobra (*Naja nivea*) and the puff adder (*Bitis arietans*). Traditionally snake doctors would ingest small daily doses of snake poison to build up their immunity and perhaps to symbolically gain power over the snake (B.-E. van Wyck 2008). Snake bite treatment involved scarification of the wound and the application of specific plants in the form of poultices or orally as infusions or decoctions (Laidler 1928). *Leonotis leonurus* (L.) R.Br. (wild *dagga*) was sometimes crushed with the snake head and applied to the bite.

In Khoesan culture there are strong beliefs regarding the gendered use of plants (especially aromatic plants). The use of a “female plant” by a man may result in impotence or sterility. This is especially the case for leaf powders, known as *buchu*, which are mixed with fat and used as ointments (B.-E. van Wyk 2008). Plants, especially *buchu* plants, were often used employed in traditional Khoesan massage and aromatherapy. Indeed, the Khoe referred to the *San* or *Sanqua* (*Sonqua*) as the “men or people (*qua*) who anointed their bodies with bushes (*son*, *san*)”, because of their habit of massaging with powdered aromatic bushes mixed with sheep fat (Smith 1966). The name *Son* (plural *San*) originates with one of the preferred aromatherapy plants, *Pteronia onobromoides* DC, which was powdered into *buchu* and carried in a container made from a tortoise shell. *Sonqua* translates to “bossieman”, from which *boesman* and bushman were derived. Small shrubs, *bossies*, are very prominent in the culture, idiom and language of the Karoo and Renosterveld regions, where this plant form dominates the vegetation (B.-E. van Wyck 2008).

Another Khoesan remedy is the use of medicinal snuffs for the treatment of a wide variety of ailments. Dried and powdered plants parts, often leaves or roots, are ground into a fine powder. A small amount is administered into each nostril as the patient quickly inhales. The treatment is meant to induce sneezing. The basis of the treatment is that sneezing is thought to expel an illness (Laidler 1928; Archer 1990). The root of *Gomphocarpus cancellatus* (Burm.f.) Bruyns is prepared in this way and administered for the treatment of influenza (Archer 1990).

Psychoactive Plants for Trance and Ritual. Mitchell and Hudson (2004) have compiled ethnographic, archaeological, and ethnohistoric evidence that psychoactive plants may sometimes be employed by modern Kalahari healers and have been used in the past by more southerly hunter-gatherers. Hunter-gatherers are known to have intimate and comprehensive local plant knowledge and medicinal applications feature prominently in their practice. However, Liengme's (1983) survey of ethnobotanical research in South Africa showed that the majority of studies of indigenous plant-use have focused on medicinal plants (16 %) and food plants (20 %), with only a few (7 %) relating to the category 'Magic, ritual and customs' (Dold and Cocks 1999; Sobiecki 2008). The Kalahari Bushmen of southern Africa pursue altered states of consciousness in order to cure the sick and engage in out of body experiences (Katz 1982; Lee 1979, 2003; Marshall 1999). The Bushman rock art tradition is, primarily, a record of the experiences of shamans engaging in these altered states. There is a compelling correlation between modern Kalahari Bushmen, more southerly 19th century Bushman, and rock art depictions of shamanic activities (Lewis-Williams 1998, 2003; Lewis-Williams and Dowson 1999; Lewis-Williams and Loubser 1986).

Winkelman and Dobkin de Rios (1989) studied fifteen species of medicinal plant used by the Ju/'hoãnsi, as reported by Lee (1979). Five were found to contain psychoactive substances, two contained toxic or fatal substances, six were closely related to plants with either type of substance, while only one was found to be non-toxic and non-psychotic. Katz (1982) provided a detailed analysis of *Ferraria glutinosa*, included in Lee's list, as it is used in the trance dance practice of the Ju/'hoãn (!Kung) from the Dobe region of northwestern Botswana. In the past the plant was used to teach initiates how to handle the trance experience. While the practice had ended before his 1960's fieldwork, one of his informants confirmed that the plant's root (mixed with other ingredients) was still used to make a communal drink that can induce a trance state. *F.*

glutinosa is not known to contain psychoactive phytochemicals, but *F. welwitschii* is toxic to rabbits. The family, *Iridaceae*, to which of these plants belong is known to include plants with narcotic effects. Marshall (1999) reported that the Ju/'hoãn of northeastern Namibia mix *F. glutinosa* roots with urine and other medicines in the healer's tortoiseshell medicine container to make a special *buchu*. The bitter brew is drunk in order to induce a healing trance. The root of an unidentified Ju/'hoãn plant called *gwa* was cooked and eaten/drunk by women in order to help initiates achieve a trance state during the Drum Dance.

Firsthand accounts from Kalahari Bushman healers reinforce the findings of the ethnographers. This teaching medicine was termed *Mokgonastole*, meaning "I can do anything and I can heal anyone", by the student of the healer Mataope Saboabue (Keeney 1999). The medicine is taken immediately before dancing. *Terminalia sericea* and *Acacia giraffae*, known in the Kalahari as *zau* and */ana*, are examples of plants imbued with a supernatural potency independent of their pharmacological properties. This phenomenon leads Mitchell and Hudson (2004) to call for further ethnobotanical and ethnopharmacological research into which plants contain psychoactive substances and how these substances affect the user.

Since virtually no Bushman communities survive south of the Kalahari, ethnohistoric accounts from the 19th century are used to establish psychoactive plant use south of the Limpopo and Gariep rivers. The testimony of a Bushman informant, named Qing, was collected during Joseph Orpen's 1873-1874 travels in the highlands of Lesotho (Lewis-Williams 2003). Qing was able to elucidate the meaning of several rock paintings and recount the myths related to, /Kaggen, the creator deity, thereby illuminating the link between shamanism and rock art. Through the stories recounted by Qing, a "charm medicine" containing snake powder called *canna* is linked to shamanistic death and rebirth. Mitchell and Hudson (2004) present ethnohistoric evidence that *canna* is a psychoactive plant (probably *Sceletium anatomicum* or *S. tortuosum*), used by Khoe-Khoe herders and Bushmen at least as early as the 19th century. Death, in Bushman myth, has been established (Lee-Williams 1981 and Katz 1982) as a metaphor for the experience of entering trance. Similarly, snakes shedding skin is linked to death and rebirth. *Sceletium* plants were reportedly consumed with *Cannabis* or it's indigenous substitute *Leonitus leonuris*, according to some 18th and 19th century accounts, and *Cannibis* is used by Dobe Ju/'hoãnsi to facilitate entry into trance (Katz 1982).

The scant published archives of Bleek and Lloyd, compiled through their work with /Xam informants from the Northern Cape, refer to a possible psychoactive plant known as ʃo-/õa (Bleek 1956). These effects were reported in baboons, which are anthropomorphized in /Xam belief, and linked to the shamanistic themes of teaching and dying. The long root, habitat, and ethnography suggest that it is *Pancratium tenuifolium*, which contains several hallucinogenic alkaloids. The varied application (used in medicinal tattoos, as a hunting charm, a wound treatment) of the plant in male dominated activities associated with subsistence and wellbeing, establish ʃo-/õa as a vital component of /Xam society, without being eaten.

These ethnographic and ethnohistoric data on native psychoactive plants compiled by Mitchell and Hudson (2004) suggest that psychoactive plants were probably used to access altered states of consciousness more commonly than has previously been accepted in academic circles. Furthermore, this evidence supports the idea that a plant does not need to be edible in order to be a vital component of hunter-gatherer society.

Hunting Poisons and Adhesives. A reversable bone tipped arrow with a rounded end and a pointed end was stored with the poisoned pointed end turned into the arrow shaft. The "loaded" point would be reversed for shooting. An alternate design involved the poisoned point being stored within the hollow reed comprising the linkshaft.

Khoesan dart poisons contained a variety of ingredients including extracts of *Acokanthera venata, Haemanthus toxicarius (Amaryllis disticha), Euphorbia* sp.; venom of puff adders (*Bitis arietans*) and cobras (*Naia haje*); the poison of the *Cladocera nigro-oronata* beetle and the trapdoor spider; and arsenic based "rock poison" (Routledge 1930). Ingredient selection was regional, with Namib and Northwest Bushmen using botanical poisons, Southern Bushmen combing faunal and botanical ingredients, and Kalahari Bushmen relying mostly on the grub or chrysalis of *Cladocera*. In the latter case, *Cladocera* would have been powdered and mixed in a tortoise shell with the juice of citrullus caffer (spiked cucumber) or *Zizyphus mucrononata*, which has a non-poisonous fixative effect. Historical accounts of Bushmen in the Namib and the Western Cape (Routledge 1930), describe the poisoning of game as a hunting technique. A spring was fenced off, forcing game to drink from a manmade waterhole tainted with the poisonous exudates of Euphorbia braches sunk below the surface.

Wooden Hunting Tools. Spears and throwing sticks, or "knob kirris", were hunting tools made from wood. Throwing sticks, usually made of *Acacia*, were used for digging, to knock down small bird and mammal prey, and occasionally for defense. Metal tipped composite spears, likely adopted from a Bantu design, were fashioned from local wood (Englebrecht 1934).

The Ethnobotany of Herders

In the 1920's Englebrecht initiated an ethnographic study of the Khoekhoe inhabitants of the Western Free State. The Khoekhoe of the Free State were historically referred to as the Korana, "Hottentot" herders who migrated into South Africa as early as the 5th century from Botswana (Boonzaier *et al.* 1996). A pastoral offshoot of Khoesan hunter-gatherers, the Khoekhoe were known to raise sheep, goats, and cattle at the time of European contact in the 16th century. In 1928, Englebrecht published a linguistic study derived from ethnographic encounters with Khoekhoe informants residing in the Winburg area. During his decade of research, Englebrecht expanded the study to include ethnohistoric information gathered from informants in Bultfontein, Hoopstad, Hertzogville, Bloemhof, Kimberley, Boshof, Windsorton, Barkly West (**Figure 4**). His accounts include edible, ritual, medicinal, and recreational use of plants by historic Khoekhoe inhabitants of the Western Free State.

The ground edible bulbs, roots, corms, and rhizomes (known as *uintjies* in Afrikaans) harvested from the veld played an important role in the Khoekhoe diet, which was otherwise comprised of meat, milk, butter, and occasionally fish and eggs. Englebrecht noted that while these geophytes had historically been the staple of the Khoekhoe diet, only children were known to harvest them at the time of his research.

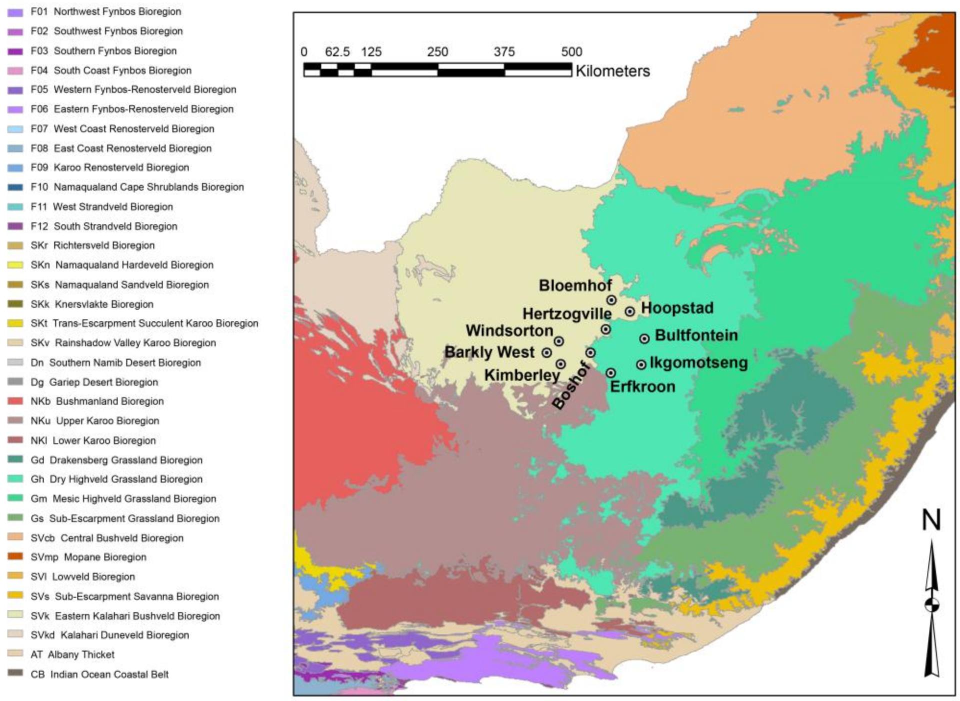

Figure 4. Map depicting the locations of Englebrecht's Khoekhoe informants and historic Khoekhoe localities to the current Western Free State study area localities. Adopted from Mucina and Rutherford (2006).

Traditionally, women would harvest the geophytes from nearby fields using digging sticks, roast them over a fire, and serve them peeled into bite-sized pieces. Leftover geophytes were also broken apart, dried and stored for the winter when they would beground into a powder and reconstituted into porridge with milk. Leaves of some geophytes were also cooked in milk to get rid of a natural bitter taste. Geophytes were rarely eaten raw, though a sweet variety known as *//ama-!lamareb*, (*porselein* in Afrikaans) was eaten raw with salt.

Wild fruits and berries were eaten raw when ripe and dried, ground and cooked in milk. The ripe fruit of the fig-like *muxununu* (*moxonono* in Bloemhof) tree was eaten raw. The raisin like berry, *≠xau,* was crushed, dried and reconstituted with fresh or soured milk. The berries of *Ziziphus mucronata* were crushed, salted, and pressed into cakes. The berries of *Rhus lancea* (*!xareb*) and the *taaibos* were also prepared as a milk-based porridge. The sweet berries of *Boscia albitrunca* (*!honeb*) were crushed in fresh milk or dried and preserved to later be eaten with tree gum (*!lamareb*). A coffee-like beverage was made from the dried and roasted beans of the *Elephantorrhiza elephantina* (*loa-≠?ab*); pits of *Acacia karoo* (*≠xon-//xu:b*), *Diospyros lycioides*, and *Acacia erioloba* (*!lganab*); and the crushed, dried, and roasted roots of *B. albitrunca*. The bitter brew resulting from *A. karoo* and certain other unidentified plants was often diluted with milk.

Honey beer (*≠goas or ≠goa-! xaris*), could be made from many different roots, such as bi :bib and lha:b, but never were they mixed together. The roots were skinned, chopped, ground, dried, and ground again. Lukewarm water was added to the mash, allowed to sit for a half day, drained, and the process repeated twice more with lukewarm, and then cold water. Honey and lukewarm water was used for the final brew, which was covered with skins and left to sit in the sun. Englebrecht's informants reported that the Nama possessed roots and bulbs which that produced a more alcoholic brew. As a result, the Khoikhoi could demand as much as a sheep or a goat for a very small quantity of these plants. The "honey" (*≠h//i-danis*) used to make beer was either bee honey or a gum, such as that which is exuded from *Salix mucronata* following heavy rains. The sweet gum was collected in containers left under the trees and used alone or mixed with bee honey to make beer.

As in the Khoesan healing tradition, the tortoise shell container used for *buchu* was important part of Khoikhoi plant use. The tortoise shell was glued together with a resin derived from the dried and pounded interior of the *Boophone disticha* bulb mixed with animal fat. The *buchu* powder was made of the dried and ground parts of various plants including the root bark of the *D. lycioides* (*≠harib), Z. mucronata (≠xarob),* or *taaibos* (*≠loub, !geib, ≠laieb,* or *≠?aeb);* the pith of the *Rhus lancea*; roots of the "common *mimosa"*, a bush called *≠nabeb* with yellow flowers growing two feet tall, a rush-like aquatic plant *(!hareb);* a lichen used to make *stone buchu* (alternately roasted and prepared like coffee), the leaves of bitter bush ((d) */gumma)*, a rare and highly prized plant resembling a pineapple known as *//xonabeb;* and the flowers of *!-urub*. *Buchu* plants were readily kept on hand and the dosage was based on the desired odor level. Odor was equated with potency and *buchu* was applied to the body with a piece of jackal or sheep skin or by hand.

Ritualistic plant use was often difficult to distinguish from utilitarian use. The *mimosa* branches piled over graves deterred dogs and were also believed to discourage sorcerers (*//xaixakwa)* from harvesting human bones that could be ground with herbs for use in occult curses. Englebrecht distinguished sorcerers, who did harm through poisons, from witchdoctors (*!gaixab*), who provided antidotes. Both were knowledgeable herbalists. The witchdoctor's antidotes were plant medicines either taken internally, rubbed into the body, put into incisions in the skin. Women were generally believed to have stronger medicine than men. When sorcery was suspected, a female witchdoctor would administer incisions to vicims or as vaccinations prior to the curse. The healer also advised people to touch a special piece of wood to the tongue to prevent poisoning or to induce vomiting when poisoning was suspected. Herbs were also used ritualistically to cure or prevent stock illness. Herbs and roots were mixed with the kidney fat and stomach contents of a sheep or goat and boiled in water. The mixture was sprinkled on all of the stock. The second part of the ritual involved filling a horn with a mixture of charcoal made from medicinal roots, kidney fat and stomach contents of a sheep or goat. A small pebble was smeared with the mixture and buried right in the center of the cattle kraal. Stock were further treated with the medicinal smoke produced by placing a hot coal in the medicine horn. The medicine was also smeared on six pegs made from *Salix mucronata* (*lkxloub)* or *Z. mucronata* (*≠xarob)* and driven into the ground in and around the hut and at the entrance to the cattle kraal. Each family member was given incisions treated with the medicine. Some medicine was burned in the family fire, which burned constantly. The doctor was frequently paid in cattle.

Plants were also used in cosmetics and initiation ceremonies. A mixture, !gu-kx?unubis, was prepared from the roasted root bark of *Z. mucronata* or *Rhus lancea* (*!xareb)* and ground with ochre. The mixture was painted onto the skin or applied as a powder. *Senna italica* roots (*du:-heib*) were burnt to charcoal and mixed with milk for use in male initiation ceremonies. This medicinal milk was drunk by the initiate "to purify him of everything that was childish (Engelbrecht 1934: 158)". Furthermore, a heated axe was dipped into it and used to make incisions on the initiate's abdomen. A bitter succulent and *otterboom (//xurub)* was mixed into the meat hunted by the initiate and prepared by a male elder for the initiation feast. The smoke of burning *stone buchu* was used in the female initiation ceremony.

Recreational applications included plants used as raw materials for games and musical instruments. A game known as */gibigu* involved the use of *Gomphocarpus fruticosus* seedpods or the juicy leaves of *hurubeb* (probably a succulent, growing flat on the ground) placed in a pile. The competitors surrounded the pile wielding thorns. Pods or leaves were speared with the thorn using the right hand and collected with the left hand. The competitor that collected the most from the pile declared the winner.

All of the musical instruments described by Engelbrecht were made of wood, but rarely was the type of wood identified. A musical bow played by the women, known as *kha:s,* was drawn over an overturned wooden vessel, which acted as resonator. Another bowed instrument, the *!gabus,* had a shorter stick and thinner bowstrings than that of the *kha:s.* The *goras* was a stringed instrument fashioned from a straight stick that could imitate the sound of any bird. The strings were often suspended from the body of the instrument with a matchstick-sized piece of wood acting as a bridge, though some informants indicated that these additions were only necessary if the maker was an amateur. The strings of the instrument were fixed in placed either by pegs holding them in holes, by wrapping them around the end of stick instrument body and attached to a tuneable peg, by stringing them through a hole and wrapping around a notch or knotting them in place, by attaching them to a bit of sinew attached to the instrument body.
The *!guises* were a class of multi-stringed instruments that resembled the banjo. One such

instrument, the *ramkie,* was made by stretching a young goatskin over a shallow thin wooden vessel and stitching it in place. A long flat stick comprised the neck of the ramkie, complete with tuning peg holes on the far end and a bridge that accommodated strings made from goat intestines. Reed flutes came in different sizes and shapes and nomenclature was not standardized between groups.

The Ethnobotany of Bantu Healers

The practice of traditional medicine in South Africa is relatively common. There are as many as 200,000 traditional healers in South Africa providing certain forms of treatment to 80 percent of the black population (Kale 1995). Whether treatment is administered by an individual, a family member or by a traditional healer, people are drawn to traditional healing for economic and personal reasons (Peltzer 2009; King 2012). Some of the benefits include improving one's personal wellbeing or spiritual state (Cocks and Møller 2002; Ross 2008) and reduced cost (Liverpool *et al.* 2004), although communities with subsidized health clinics, healers can be the more expensive alternative. King (2012) observed that many patients visit with a *sangoma* only after going to the clinic or hospital, indicating a desire for a spiritual approach, rather than an epidemiological one. Individual health decisions are based on, and mediated by divergent perceptions of wellness and disease that do not necessarily align with public health initiatives.

There is a growing body of ethnobotanical literature from across South Africa reporting on the knowledge of traditional healers (Bhat and Jacobs 1995) used as primary healthcare (Dlisani and Bhat 2009) and the significant contribution of medicinal plant collection to the household economy and livelihood protection (Twine *et al.* 2003;

Makhado *et al.* 2009). The southern African trade in traditional medicine transcends the assumed rural-local paradigm, and is a vast transnational industry based on an interurban network of herb collectors and sellers, traditional healers, and patients. Medicinal plants collection is impacted by changing patterns of land cover, which in turn, are impacting the ability of collectors to locate plants. Additionally, communal areas in rural South Africa, which remain vital locations for the collection of a number of natural resources for livelihood production, exist at the intersection between overlapping and sometimes conflicting rules shaping access (King 2005, 2011).

South Africa has an array of traditional healers, including *inyangas*, and *umthandazis, and sangomas* (King 2012). *Inyangas* and *sangoma*s are both skilled herbalists, but *sangoma*s have the additional abilty to commune with ancestral spirits. S*angomas* frequently pursue additional training in order to fine tune their practice, and are perceived by many as being more powerful. *Umthandazis* are faith healers often affiliated African Christian churches that incorporate bible study and prayer sessions into their treatments.

Southern Bantu Muthi. Health and misfortune are believed to stem from ancestral wrath, witchcraft or ritual pollution (Hammond-Tooke 1998). Diviners identify the cause of the malady and prescribe appropriate action in the form of plant medicines and perform rituals. Southern Bantu diviners, known as *amagqirha* (Xhosa) or *izangoma* (Zulu) are called to their profession by their ancestors. The process of becoming a diviner, *ukuthwasa* (verb), is undertaken by a person in the state of *intwaso* (noun) (Hirst 1990), a troubled condition (*inkathazo*) involving an array of illnesses, dreams, and psychiatric disturbances (Callaway 1868). The initiate is cured of the *intwaso* condition using special plant-based "medicines of the home" (Hammond-Tooke 1998: 12), dieting with *ubulawu*, and training with a practicing healer in techniques of divination and curing. The term *ubulawu* may refer to the roots, stems, leaves or bark of certain plants used in *muthi*. In the Xhosa tradition, ubulawu plants are classified according to the locality in which they grow (i.e. *ubulawu* of the river) (Hirst 1990).

Sobiecki (2008) undertook a study of plants used in divination in southern Africa and their psychoactive effects. Fieldwork was primarily conducted in Gauteng in the Witwatersrand urban area, but also in the Free State and KwaZulu-Natal, consisted of interviews with male and female diviners and indigenous healers (including herbalists), *muthi* traders, and customers. Xhosa, Zulu, and Sotho participants contributed to the study. The combination of various plant species used in *ubulawu* mixtures can enhance the power of individual plants. These mixtures are used to heal the body by removing impurities, as charms, and to induce psychoactive effects. Low dosages taken on an empty stomach induce profound and lucid dream experiences connected with the spirits and sacred animals (Hirst 1990). Other psychoactive effects include improved memory and enhanced mental faculties (Laydevant 1932), and the ability to induce visions (Hoernlé 1937).

The following species have known psychoactive effects (Sobiecki 2008). *Myosotis afropalustris C.H. Wright* as the primary ingredient produces elation and stimulation. Sotho diviners use it to treat hysteria and to develop the memory of trainee indigenous healers (Watt and Breyer-Brandwijk 1962). The fresh or dried flowers of

Figure 5. The poisonous bulb, *Boophone disticha*, as photographed near the Basotho Cultural Village, in the Drakensberg Grassland. *B. disticha* is both archaeobotanically and ethnobotanically significant to the current study.

Nymphaea nouchali Burm.f. have empathogenic effects. *Boophone disticha* is a hallucinogen that can yield 'impure' and arbitrary visions (**Figure 5**). In Basotho male initiation ritual, *B. disticha* is used to imbue the initiates with the qualities of their ancestors (Laydevant 1932). *Silene undulata* Aiton and *Chamaecrista mimosoides (L.)* Greene are both used to induce dreams, 'true visions', which elicit intuitive powers that normally arise only while sleeping. In addition, *C. mimosoides* is a *bonisele* plant, of the Zulu initiation tradition, used to elicit divinatory powers and induce dreams of the ancestral spirits. A mixture of *Hippobromus pauciflorus (L.f.)* Radlk., *Dianthus mooiens*is F.N. Williams, and *H. integrifolius* is used Johannesburg diviners to communicate with the ancestors. The combination of *Rubia petiolaris* DC. with *Silene*, *Hippobromus* and *Dianthus* species produces complementary psychoactive effects, such as visions (Broster 1981). *Casearia gladiiformis* Mast. (Junod 1962) may also induce visions. *Vangueriopsis lanciflora* (Hiern) Robyns and *Canthium sp*. are the active ingredients in leaf medicines used for *ihamba (spirit)* exorcism rituals among the Ndembu of Zambia, which allow the diviner the ability to see spirits (Turner 1992).

Growing ethnobotanical data support the prominent role of psychoactive plant use. *Ubulawu* is considered to be one of the most powerful preparations used by Zulu diviners (Hulme 1954). Indeed *ubulawu* preparations play a vital role physical, spiritual and psychological healing in southern African healing traditions.

Discussion

While there are indeed many common themes in the ethnobotany of hunter-gatherers, herders, and agriculturalists, medicinal plant use and ground stone processing stand out most prominently. Medicinal use is both the most common and the most varied use type among all of the groups. Healers from all of the traditions grind plants for their curses and antidotes. Khoesan snake doctors produced poultices from *L. leonurus*, *buchu* powders have been used by all of the groups, and Bantu *umbalawu* plants are frequently ground, especially when used in *buchu.* It is important to note that modern ethnographies do not consistently or explicitly mention the grinding requirement associated with culturally significant plants. Rather, grinding is implied by the use of terms such as decoction, poultice, powder, paste, mash, and crush. It was my experience that grinding was so ubiquitous with medicinal plant use among my informants that they initially found its declaration to be superfluous. Ground psychoactive plants blend the distinction between medicinal and ritualistic plant use. Examples include *F. glutinosa*, taken to induce ritual trance states (Mitchell and Hudson 2004), and psychoactive *ubalawu*, which has been shown to improve memory (Sobiecki 2008). Hunter-gatherers and herders have used medicinal tattoos made from *buchu* plants. Plants used in Bantu cosmetics and Khoesan hunting adhesives are all ground. Grinding is not universally required for edible plants, though milk porridges, coffee-like beverages, and beer (that did require grinding) featured prominently in Khoekhoe foodways. The link between grinding and plant medicines suggests that grinding stones in the archaeological record could indicate medicinal plant knowledge. This assertion is supported by the findings of study detailed in the following chapters.

CHAPTER IV

ETHNOBOTANICAL RESEARCH METHODS

During the 2010 field season in the Free State I located local Setswana individuals knowledgeable about the identification and use of local veld plants. During this exploratory research I interviewed two female *sangomas*, traditional healers, from the township of Ikgomotseng, north of Bloemfontein and 5 km from Florisbad. During the first meeting they laid out all of the plants they had in stock in the surgery, or *ndomba*, where they carry out their consultations and dispense remedies. I photographed the plant samples along with the grinding stone the practitioners use to process them. With the help of a translator, I asked the *sangoma* a standardized set of questions, about each individual plant, recording our conversation on my laptop while simultaneously taking handwritten notes. My translator assisted in spelling Setswana plant names and even took his own notes, which proved to be invaluable.

I developed the following questions for the informants about the use of local medicinal plants: Who can collect plants? Where do specific plants grow (landforms)? How far must collectors go to find these plants? How are these plants identified and harvested? How often are they harvested? Are any tools needed for harvesting or can they be harvested by hand? What time of year are they available and/or preferred? How frequently are the usable portions of the plant regenerated? What kind of processing is required to make them palatable or useable? What plants must be processed using grinding stones? What portion of the plant is used/eaten? If a plant is not eaten or applied medicinally, how is it used? How predictable is its availability? How frequent is indigenous plant use? What are the most common uses? What species (varieties?) are the most preferred by locals? How are plants selected?

During the interview, it became apparent that it was more appropriate to ask certain questions about plants in general, rather than about each individual plant. This was done when the informant produced duplicate responses for the same question with regard to several different plants.

On our second meeting, I accompanied the women on foot to the veld just west of the township to collect plants. We walked for several hours and collected 11 plant specimens with the help of a large pickaxe. My translator collected the plants in bags and labeled each with its Sotho or Setswana name. I photographed the plants as they came out of the ground and recorded GPS coordinates of their precise location. These coordinates were used to delineate harvest areas and associated landforms, allowing me to create detailed maps of the collection areas.

While I intended for this first fieldwork to be my only fieldwork, it became clear that a return trip was necessary. The limitation of conducting a plant study during the latter half of the South African winter was that most of the veld plants had died back into a dormant state and had not yet regenerated. This fact, coupled with rigid time constraints, meant that I was only able to collect a few species and then only medicinal varieties. Additionally, I was unable to compile any data on food species, which are vital to the understanding of veld subsistence strategies. Information concerning plant food use has the potential to provide the strongest argument for the shift to an increase in the use of plant resources and a subsequent shift in subsistence patterns, because food use (a basic necessity for survival) provides a more compelling motivation for subsistence change than medicine or material use of plants.

2011 Sangoma Interviews and Field Work

Remediating the gaps and limitations of the 2010 field investigations meant that I would have to return to South Africa in November and December of 2011, during the South African spring. This trip would allow me to undertake a literature study and complete further field research during the growing season.

Prior to my departure I compiled a list of economically important plants and recorded their ethnobotanical applications and habitats in South Africa to determine the distribution of those native to the Free State. These maps served to narrow down my focus. These genera, sorted by plant type (geophytes, hemicryptophytes, etc.), have become the focal point of my research. In addition to the interview questions designed for the 2010 interviews (which focused on individual plants), additional questions were formulated for my 2011 interviews toward the distinction of plant types with regard to how they are processed and used.

I flew to South Africa in late October 2011 and rented a car upon my arrival in Johannesburg. For the duration of my fieldwork I stayed at the Florisbad Quaternary Research Facility located 45 kilometers northwest of Bloemfontein. Residing at the facility put me in close proximity to several important research localities: Ikgomotseng township, the towns of Soutpan and Dealesville, and several small settlements and farms in the area.

During the 2010 field season, time was divided between excavations at Erfkroon and my own ethnobotanical investigations in and around Ikgomotseng, the nearest township. The 2011 trip was focused exclusively on the application of the ethnobotanical methodology I devised for my previous work at Ikgomotseng to interviews with a broader sample of Free State plant specialists. Considering the difficulty of finding adults who were willing to discuss plant use, I hoped that the youth population would provide invaluable information as children are less inhibited about their traditional knowledge. Many adults are reluctant to admit that they utilize plants as food or medicine because this kind of subsistence does not interface well with more desirable impressions of modernity and elevated socio-economic status in the New South Africa. A retired museum employee known for his plant knowledge, a prospective informant whom I pursued in 2010, declined to participate likely because of this. Ironically, on the ground, the youth approach failed to develop, while the *sangoma* approach I had all but abandoned finally began to bear out.

Upon my arrival to Florisbad, I managed to make contact with a *sangoma*, new to Ikgomotseng, but from the area. One of the employees of the museum, Isaac Thapo, arranged a meeting with this new *sangoma*, *N*, a woman of Sotho and Shangaan descent who completed her training as a traditional healer in the early 1990's. Not only was she willing to talk with me but her daughter, *B*, was quite willing to act as translator. During our first meeting I explained my project and how her participation would contribute to its completion. She seemed agreeable to the proposition but invited me to join her in her *ndomba* to pray to the ancestors for a blessed partnership (**Figure 6**). When she agreed to the terms I asked *N* and *B* to each sign a document of informed consent. In exchange for her participation I agreed to help her find out how to acquire an official government certificate allowing her to legally collect wild plants from the veld. Wild plant collection

Figure 6. *N* in her *ndomba* praying to the ancestors prior to our first interview.

is regulated quite rigorously in a governmental attempt to curtail the rampant over harvest of indigenous plants. Unfortunately, the regulation is infrequently enforced and overharvesting continues largely unabated. I also agreed to write her a letter of recommendation explaining her contribution to the project.

Ndomba Consultations. After these preliminary introductions, we began our first semi-structured interview. I encouraged *N* to set the tone and pace of our consultations. All interviews carried out at the *ndomba* were recorded on a digital voice recorder. *N* would pull jars and paper bundles of plants and plant mixtures down from her shelves, one by one, allowing me to ask questions and take pictures. My initial approach was to direct my questions to *B* and have her translate for her mother, but after *N* made a teasing comment directed towards me in Setswana, *B* told me, “She can understand you! You can ask her!” It became quite clear that *N* understood English well but was not comfortable speaking to me in English, so from that point on *B* only translated her mother’s responses to my questions unless a clarification was needed. Once our pattern of enquiry became routine, *N* and *B* began to anticipate my questions and presented each specimen without prompting. This anticipation became a repetitive feature of subsequent informant interviews. *B* also prepared a photographic “bucket brigade” of specimens in order to streamline the process. She even offered to take photographs while I was taking notes or to check my spelling while I was taking pictures.

Florisbad Botanical Hike. We began to alternate our interviews with botanical excursions. We would meet in the *ndomba* for an interview until we exhausted all of the resources there, so the next meeting would be a field trip of some kind. Our first field trip was an exploration of the veld plants growing on the Florisbad property (**Figure 7**).

Figure 7. Searching for local *muthi* plants in the marsh near Florisbad.

The spring rains were several weeks late, at this point, and the Free State was experiencing an extended drought. The undeveloped veld near Florisbad was a desirable site for plant hunting because the spring-fed pools at the facility were being drained into the marsh while maintenance and renovations were being carried out following damage from the previous year caused by a rare tornado. This flooding contributed to the lushest landscape in the vicinity. If economically important native species were to be found anywhere in the Free State, it would be here. We walked for several hours and identified seventeen medicinal and/or edible plants. In spite of the flooding, plants still appeared to be scarce. We agreed to hold off on further veld hikes until environmental conditions improved.

Bloemfontein Muthi Shops. In the interim, we planned a trip to the Bloemfontein Central Business District in order to visit the *muthi* shops (**Figure 8**) where she buys the plants used in her practice. I collected *N* and *B* from Ikgomotseng and we drove into the Central Business District (CBD), which functions as the city center for the non-white population of Bloemfontein. Though easily the busiest part of town, whites are exceedingly rare and many vendors were surprised by my presence. After introductions by *N* and B, all of the vendors were willing to work with us.

The walls of the first *muthi* shop were lined with metal shelves painted with the names of the plants, contained in bins separated by shelf dividers. *N* made our introductions and *B* translated my request to ask questions about the origin and use of the plants they had in stock. Unfortunately the clerk (and co-owner) of the shop could not furnish me with any of this information except in a few cases. I was welcome to photograph freely but no one on staff knew where specific plants came from. Plants were purchased from a variety of sources across southern Africa, including Lesotho, Swaziland, and KwaZulu-Natal, and the clerk did not keep record of these transactions. He had no knowledge of traditional plant usage other than what is required to furnish *sangoma*s with the plants they need. While I photographed the shelves, *N* followed me around the shop and volunteered any information she had about the plants on display, occasionally recognizing plants from the collection back at the *ndomba* or those that we encountered on the veld. The limitations of the *muthi* seller's knowledge about plant origins and usage, encouraged me to shift my focus to recording and photographing all of the *muthi* plants in the Central Business District. We visited four more shops and stalls staffed by a handful of sellers with valuable information to contribute. An Afrikaans man working in a shop that sold *muthi*, personal hygiene products, furniture, and hardware spoke at length with us about the veld plants whose uses he knew from growing up in the Free State and the Northern Cape. When we left the CBD, I had photographed several hundred plants, however *N* was only able to identify the plants she used regularly or if the *muthi* seller provided its Sesotho name.

Figure 8. Bloemfontein *muthi* shop in the Central Business District.

A few days later, still waiting for rain, we met at *N* and *B*'s house in Ikgomotseng to attempt to take an accounting of the plants we had encountered at the *muthi* shops. *N* called over two other healers from the township and the three of them put their heads together to decipher the linguistic origin of the names. It turned out that the male healer (*A*), a close friend of *N*, was familiar with Zulu, Xhosa, Swazi, Afrikaans, and Basotho plants names. He was even able to translate these names into Sesotho. This translation was vital to my research as my primary identification source was a dictionary of Basotho plant and animal names (Moffett 2010). During this meeting, the sangomas explained that the Basotho *muthi* tradition, originating from Lesotho, was the basis of the form of traditional healing practiced in this region. However, plants used in the local *muthi* were sourced from all over southern Africa: Swaziland, Botswana, KwaZulu-Natal, and Lesotho. In the case that a *sangoma* does not know the foreign name he/she must be able to identify the plant by sight. This scenario seemed to be standard, so *muthi* sellers showed no eagerness to standardize plant names and, in the case of street corner *muthi* stalls, plants were usually not labeled at all. In addition to identifying Basotho names, *A* was also able to describe the indication for most plants and the portion of the plant used in the medicine. The gathering of healers proved to be quite productive. Working together, they were able to pool their collective plant knowledge and remind one another of details.

Erfkroon Botanical Hike. Our final field trip, a plant search at Erfkroon, took place a day before my departure from the Free State. *B* was unavailable to accompany us for translation so *N* invited *A*, a now proven translator, to come along. It still had not rained enough to substantially boost plant growth so we followed the riverbank and sought out areas of the densest vegetation. Our search produced twenty-three different plants, photographed and described. We then returned to the *ndomba* where she said a prayer and made an offering to the ancestors. An unfortunate loss of the original field notes meant that plants were identified using a few pictures that had been fortuitously duplicated and separated from the lost files. Though, with no local name to use as reference and the prevalence of geophytes without recognizable reproductive parts, identifications were limited to only two plants (Figure 10).

Eastern Free State Field Work. The last week of field work was spent in the Eastern Free State near Qwaqwa, the Apartheid-era Basotho *bantustan* (homeland) in order to seek more informants, visit the Basotho Cultural Village in Golden Gate Park, and to meet with correspondences. Tom Ashofa, ethnobotanist and head of the botany department at the University of the Free State, QwaQwa campus put me in contact with a student who would accompany me to the Phutaditjhaba market to track down *muthi* sellers and assist with translations. We were not optimistic that any *muthi* sellers would be willing to participate, as this had been Ashofa's experience. Fortunately, this expectation did not hold up.

Figure 9. A *muthi* seller displays his recent harvest in the Phutaditjhaba market.

We pursued three *muthi* sellers and two were eager to contribute to the study. The first seller was an elderly man who was quite knowledgeable about *muthi* and had been collecting plants from the nearby grassland valleys for most of his life (**Figure 9**). The second seller was in his mid-twenties and his knowledge was derived from growing up the son of a traditional healer. In both cases the sellers allowed me to photograph their wares as they detailed the use of each plant.

Basotho Cultural Village. At the Basotho Cultural Village, the following day, I followed the traditional healer in residence on a hike, taking pictures and notes along the way. Spring was late in the Drakensberg, as well as the grassveld. Fewer plants were available than had been expected, but it was helpful to see live examples of plants only previously encountered in dried form at the *muthi* markets. We did encounter a large number of aloes, including a magnificent A. polyphylla (**Figure 2**) during the hike, which I would not have been able to see in the Western Free State.

Discussion

Before any formal analysis of the data was undertaken, it became clear in the field that medicinal plants were almost universally ground. *N*'s well-worn array of modern and traditional grinding implements is a testament to this discovery. From my earliest interviews, I made clear my interest in ground stone processing while recording all of the specimens presented to me. Remarkably few plants in the *ndomba*, at the *muthi* markets, or from the veld were excluded from this category. These cursory ethnobotanical observations further promote the assertion that grinding stones are proxies for medicinal plant use in the archaeological context.

CHAPTER V

ETHNOBOTANICAL RESULTS

This chapter contains the results of ethnobotanical observations from the Free State culled from interviews with local people with indigenous plant knowledge. The interviews were employed in order to reveal the state of plant knowledge in a generally understudied region. The results are organized chronologically based upon the method used to generate them. The prominence of grinding becomes quite clear and their constant association with muthi lends further support to the link between Stone Age ground stone artifacts and medicinal plant use.

Over the course of two field seasons in 2010 and 2011, I interviewed and followed 4 *sangoma*s from Ikgomotseng, a township in the western Free State about 7km from the Florisbad Quaternary Research Facility, where I was based during my research. My first ethnobotanical interviews in August 2010 served as a pilot study for my planned research trip the following year. The successes and failures of this initial study helped me to determine the scope of the plant knowledge of the local traditional healers and how best to glean the information that would help me to address my archaeobotanical questions regarding plant use in the Early Later Stone Age. In November of 2011, I commenced my study at Ikgomotseng, having been introduced to a *sangoma*, referred to as N, who was new to the area, but was held already held in high regard in the community as an herbalist (*inyanga*). I conducted several formal and informal interviews in her home, whereby she explained the *muthi* properties and applications of every plant in her *ndomba* and her garden. We searched for and documented the *muthi* plants in the wetland and undeveloped veld adjacent to the Florisbad Quaternary Research facility. When it became clear that the plants we sought locally would not be visible until the spring rains arrived, *N* accompanied me to the *muthi* shops in the CBD in Bloemfontein. We organized a meeting at *N*'s home with two local *sangoma*s who helped translate the names of the plants we recorded from the *muthi* shops into English, Basotho, and/or Afrikaans. A young second generation male *sangoma*, was particularly knowledgeable about local botanical nomenclature. In the final stage of my field data collection, this male *sangoma* joined us in an excursion to Erfkroon, where we continued our search for wild *muthi* plants.

In the following section I will present the ethnobotanical data I collected during August of 2010 and November and December of 2011 through interviews and field excursions with the traditional healers from Ikgomotseng and the Basotho Cultural Village as well as *muthi* sellers from Phutaditjhaba. Of primary importance are those plants that could have at one time played a significant role in local subsistence and those that involve ground stone processing in their use.

The Ndomba

Twenty-five plants comprising the botanical component of N's *muthi* pharmacy were recorded during this initial interview (**Table 4**). The informant provided names for individual plants and/or medicinal concoctions primarily in Basotho, though English, Setswana, and Xhosa names were used occasionally. *Allium sativum (Alliaceae*), a non-native garlic, was called *konofolo*, a name the *sangoma* identified as Afrikaans, though this claim was not substantiated in the literature. Scientific names were identified in 13 of the specimens using botanical identification techniques and/or ethnobotanical sources. Plant families represented include *Asteraceae, Asphodelaceae*, *Alliaceae, Campanulaceae, Poaceae, Crassulaceae, Fabaceae, Myricaceae*, *Phytolaccaceae* and *Amaranthaceae.* The underground portion of plants, such as roots, bulbs, and tubers were most commonly used. The informants and the translator did not apply the names of these portions in the scientifically defined sense. *Bohloko ba dinoha, moliana wa labese, makgorometsa,* and *simpampane* are used whole, while only the leaves of *lekgala (Xanthorrhoeaceae)* and *moroho* are used.

The informant did not explicitly identify any food plants, though *Sorghum sp.* is edible and the majority of the plants listed are administered as oral medicines. *Bulbine narcissifolia* (*Asphodelaceae*), *Scabiosa columbaria (Dipsacaceae,* non-native*),* and *Guilleminea densa (Amaranthaceae)* are boiled and administered as tea. *Matunga, bohloko ba dinoha,* and *simpampane* are also prepared as tea. Other medicinal plants, *Dicoma anomala (Asteraceae)* and roots of *Monnamotsho (Ebenaceae or Myricaceae)* and *Pohotsehla/kokwana (Asclepiadaceae or Phytolaccaceae)* are powdered and eaten. *Wahlenbergia sp. (Campanulaceae)* and *Lotononis eriantha (Fabaceae)* are chewed whole and prescribed as a charm to protect the innocent in court cases. Nine plants were associated with ground stone processing, having been ground, mashed, or shredded. The rootstock was ground in all but two cases: an aloe (*Xanthorrhoeaceae*), whereby the leaves are pounded and mixed with water to induce appetite; and *bohloko ba dinoha* (Basotho), whereby the entire plant is dried, ground, and prepared as a tea prescribed to "clean the womb". Several medicines are concoctions combining more than one plant or

Table 4. Plants and botanical medicines from N's *ndomba* at Ikgomotseng in the Western Free State.

Local Name	Name Origin	Possible Scientific Name (Family)	Portion Used	Processing	Indication	Concoction	Taken as Tea	Ground Stone Processing	Taken Orally
"Large aloe"	English	*Aloe ferox (Xanthorrhoeaceae)*			Reduces the chances of former prisoners returning to jail.				Yes
Bohloko ba dinoha	Basotho		Whole	Coarsely ground	Tea to cleanse the womb.		Yes	Yes	Yes
Ditemetwane	Basotho				Treats swollen tonsils.				Yes
Hlwenya	Basotho	*Dicoma anomala (Asteraceae)*	Root	Dried and ground	Fine powder induces apetite.			Yes	Yes
Kgomoyabadisa or *kgomoyabashemane*	Basotho	*Bulbine narcissifolia (Asphodelaceae)*	Bulb	Dried and boiled	Combined with *matunga* for kidney complaints.	Yes	Yes		Yes
Konofolo	Afrikans*	*Allium sativum (Alliaceae)*			Combined with "small garlic" to treat stomachache in children and the elderly when vomiting occurs.	Yes			Yes
Lehaba	Basotho		Tuber	Ground	Treats a painful swollen stomache.			Yes	Yes
Lekgala	Basotho	*Aloe ecklonis (Xanthorrhoeaceae) Aloe maculata Aloe striatula var. caesia*	Leaves	Mashed	Mixed with water to induce apetite.			Yes	Yes
Linaka	Basotho			Ground	Combined with several other plants to reduce pain and swelling in sprains and joints.	Yes		Yes	Yes
Makgorometsa	Basotho		Whole	Dried and ground	Induces labor in pregnant women that are overdue.			Yes	Yes
Manolo	Basotho	*Wahlenbergia sp. (Campanulaceae)*	Root	Chewed whole	Justice for innocent party in court case.			Yes	Yes
Matunga	Xhosa		Bulb	Dried and boiled	Combined with *kgomoyabadisa* for kidney complaints.	Yes	Yes		Yes
Mochani	Setswana		Tree root		Treats diarrhea.				Yes
Mofoko or *mofoka*	Basotho	*Sorghum sp. (Poaceae)*	Root	Dried and ground	Banish evil spirits.			Yes	Yes
Mokgatollo	Basotho	*Crassula natans (Crassulaceae) Berkheya montana (Asteraceae) Berkheya multijuga Berkheya onopordifolia*	Root	Ground	Boiled with *poosehla* and *salepe* as an enema preparation.	Yes		Yes	
Moliana wa labese	Basotho		Whole	Coarsely ground	Flushes breast milk out of a child's system when weening.			Yes	Yes
Molomo monate	Basotho	*Lotononis eriantha (Fabaceae)*	Root	Chewed whole	Justice for innocent party in court case.				Yes
Monnamotsho	Basotho	*Euclea coriacea (Ebenaceae) Morella serrata (Myricaceae)*	Root	Dried and ground	Powder swallowed for diarrhea.			Yes	Yes
Moroho	Basotho		Leaves	Dried and shredded	Menstrual cramp prevenative taken a week before onset of menses.			Yes	Yes
Pohotsehla or kokwana	Basotho	*Pachycarpus rigidus (Asclepiadaceae) Phytolacca heptandra (Phytolaccaceae)*	Root	Dried and ground	A fine powder for diarrhea.			Yes	Yes
Salepe	Basotho	*Hermannia geniculata (Malvaceae) Unidentified plant*	Root	Shredded	Boiled with *mohatollo* and *poosehl*a as an enema preparation.	Yes		Yes	
Selumi/selomi	Basotho	*Scabiosa columbaria (Dipsacaceae)*	Root	Dried	Boiled for tea to treat menstrual pains.		Yes		Yes
Simpampane	Basotho		Whole	Ground and boiled.	Tea treats a painful swollen stomache.		Yes		Yes
Tantanyane	Basotho	*Guilleminea densa (Amaranthaceae)*	Root	Boiled	Combined with mokgatollo to reduces greeness of veins in infants.	Yes	Yes		Yes

that combine plants with other non-plant ingredients (e.g. ostrich eggshell). Plants used in concotions that require ground stone processing are taken orally and as enemas. Ground plants administered as enemas include the *mokgatollo* root (*Crassulaceae* or *Asteraceae*) and the *salepe* root (possibly *Malvaceae)*. *Linaka* (Basotho) is a botanical concoction that is ground and taken as teas to reduce swelling. Other plants used in orally administered concoctions, though not ground, include *Bulbine narcissifolia* (*Asphodelaceae*), *Guilleminea densa* (*Amaranthaceae*), non-native *Allium sativum (Alliaceae*), and the *matunga* bulb (Xhosa*).*

Florisbad

Over the course of a morning hike, fifteen medicinal and edible plants were encountered. (**Table 5**) and identified by their Basotho name. Contact with the live plants in the field significantly increased the identification capabilities. Six plants were identified to the species level and three plants were identified to the genus level by cross-referencing ethnobotanical information furnished by the informant with botanical photographs taken in the field. Plant families represented in the sample include *Asteraceae, Asphodelaceae, Cyperaceae, Fabaceae, Malvaceae, Rhamnaceae, and Mesembryanthemaceae*. Sap, roots, fruit, bulbs and leaves comprise the usable portions of the plants. In contrast to the *ndomba muthi* collection, most of the plants encountered at Florisbad are eaten and many were identified as food plants. *Acacia karoo* exudes a sap that is eaten like honey and the seeds of the unidentified *Acacia* were coated in a sweet candy-like gum. Species with edible fruit include *Cyperus usitatus* (Cyperaceae), *Zizyphus mucronata* (*Rhamnaceae*), and *mochani* (Basotho). The leaves of *Chenopodium*

Table 5. Edible, medicinal, and magical plants encountered in grassland marshes at Florisbad. Local names are in Basotho unless otherwise noted.

Local Name	Scientific Name	Portion Used	Processing	Indication	Ground Stone Processing	Taken Orally	Edible	Native
Bareku	*Acacia karoo (Fabaceae)*	Sap		Food; Eaten like honey.			Yes	Yes
Disutu	*Acacia sp. (Fabaceae)*	Fruit		Food; Seed pod aten like candy.			Yes	Yes
Kgomoyabadisa	*Bulbine narcissifolia (Asphodelaceae)*	Root	Boiled	Kidneys complaints;		Yes	Yes	Yes
Mabona (Basotho) or rooistorom (Afrikaans)	*Delosperma hirtum (Mesembryanthemaceae) Delospermala lavisiae*	Root		Tooth decay				Yes
Mochani		Fruit		Berries as food.			Yes	No
		Green roots	Boiled and mashed	Diarrhea	Yes	Yes	Yes	
Mofuku		Bulb	Mashed	Mixed with water and splash around living area with cowtail or broom to deter evil.	Yes			
Moithimulo		Leaves	Ground	Powder snorted in order to induce sneezing for headache relief.	Yes			
		Root	Mashed	Sexually transmitted diseases.	Yes			
Mokgalo (Basotho), wag-n-bitjie (Afrikaans)	*Zizyphus mucronata (Rhamnaceae)*	Fruit	Cooked	Food; Eaten raw or cooked with meat.			Yes	Yes
Monakaladi	*Cyperus usitatus (Cyperaceae)*	Fruit		Food			Yes	Yes
Selepe	*Hermannia geniculata (Malvaceae)*			Charm for protection.				Yes
Seruwe	*Chenopodium album (Chenopodiaceae)*	Leaves		Food; Eaten like spinach.			Yes	No
Shweshwe	*Gazania krebsiana subsp. serrulata (Asteraceae)*	Leaves		Luck in court cases.				Yes

album (Chenopodiaceae) are eaten like spinach. Relatively few plants are administered as oral medicines. The green roots of *mochani* are boiled, mashed, and indicated for the treatment of diarrhea. *Bulbine narcissifolia* (*Asphodelaceae*) is taken as a tea to treat kidney problems.

Unfortunately none of the plants potentially associated with ground stone processing, *mochani, mofuku,* and *moithimulo,* were scientifically identified. Root plants are mashed and or ground. The leaves of *moithimulo* are dried, ground and snorted for the treatment of headache. Endemic status was established for all plants identified scientifically. *Chenopodium album (Chenopodiaceae)*, likely introduced from Europe, was the only non-native plant definitively identified.

Phutaditjaba Muthi

A visit to all of the Phutaditjhaba *muthi* shops resulted in the largest data collection yet recorded during the study, combined with the presence of knowledgeable informants (**Table 6**). Fifty-two plants were photographed and recorded. However, since the specimens were dried and often altered to the point of floristic ambiguity, identification was problematic. Much of this problem was mediated by the presence of very knowledgeable informants (*muthi* sellers and plant collectors) coupled with Moffet's (2010) dictionary of Basotho plant and animal names. Informants provided the Basotho names for individual plants.

Whole plants were most commonly employed, rather than just a portion of the plant, though some of the informants did not furnish this information. Informants identified the useable portion of *legwegwe, podisa, moferifiri (Onagraceae, Solanaceae,* or *Asteraceae)*, and *shweshwe (Asteraceae)* as the "top". This refers to the above ground portion of the plant. The bark of *monnamotsho* (*Ebenaceae* or *Myricaceae*) is ground for a diabetes treatment. The thorns of *mogalolo* are used as a protective "lightning rod". *Tsebe ya pela (Eriospermaceae* or *Asteraceae)* is heated to release a medicinal sap. Twenty-one plants were identified to the species level, sixteen were not botanically identifiable, and

Table 6. *Muthi* plants from Phutaditjhaba

Local Name	Scientific name	Portion Used	Processi	Indication	Groun	Eaten	Food	Tea
Bosisi		Whole plant	Ground	Luck	Yes			
Chachanae		Whole plant	Ground	Wedding luck	Yes			
Delinina			Ground	Mix with tea to regain lost love.	Yes	Yes		Yes
Dilgopa		Tuber	Ground	Food	Yes	Yes	Yes	
Eiye	*Alium cepa (Alliaceae)*	Whole plant		Banish evil spirits.				
Hlwenya	*Dicoma anomala (Asteracea)*	Whole plant						
Kgampupu	*Eucomis bicolor (Hyacinthaceae), Eucomis autumnalis, Eucomis autumnalis subsp. Clavata, Eucomis regia, Orinthogalum shawii, Schizocarpus nervosus*		Ground	Banish evil spirits.	Yes			
Kgaratsa/lotsana/lotsane/modi/modikgaratsa/modiletsane/modilotsane	*Hypoxis hemerocallidea (Hypoxidaceae)*	Roots	Ground	High blood pressure	Yes	Yes		
Kgwara/kgwaara	*Geranium caffrum (Geraniaceae)*	Roots		Upset stomach		Yes		
Khehla	*Aristea woodii (Iridaceae), Gladiolus cruentus, Gladiolus dalenii subsp. dalenii, Gladiolus ecklonii, Gladiolus longicollis, Gladiolus longicollis subsp. Platypetalus Gladiolus maculatus, Gladiolus montanus, Gladiolus ochroleucus, Gladiolus papilio,Gladiolus sp., Watsonia lepida*		Ground	Mixed with vaseline and applied to face as a cosmetic.	Yes			
Legwegwe		"Top"	Ground	Stomach rash	Yes			
Lemanamana	*Achryanthes aspera (Amaranthaceae), Aleranthaceae pungens, Aristada congesta subsp. congesta (Pooaceaea)*	Whole plant	Ground	Reunite people	Yes			
Lephelephele	*Plectranthus ciliatus (Lamiaceae)*			Rituals				
Leptjetlane	*Ledebouria cooperi (Hyacinthaceae), Schizocarphus nervosus, Chironia palustris (Gentianaceae)*							
Lераratau	*Asparagus microraphis (Asparagaceae), Asparagus sp., Asparagus stellatus*	Roots	Ground	Added to *lelodi* mixture for the enhancement of female fertility.	Yes	Yes		
Leshoma	*Boophone disticha (Amaryllidaceae)*	Whole plant		Prevent lightning strikes.				
Lesire/lesira	*Senecia macrospermus (Asteraceae)*	Whole plant	Dried and ground	Establish innocence	Yes			
Lesoko/lesoku	*Alepidea amatymbica (Apiaceae)*	Whole plant						
Looka		Whole plant	Burned and ground	Banish evil spirits.				
Mabone/rooistorom	*Delosperma hirtum (Mesembryanthemaceae), Delospermala lavisiae, Galium capense subs. Capense (Rubiaceae), Galium wittbergense*		Ground	Rituals	Yes			
Marakalla/marakalle	*Thesium angulosum (Sanatalaceae), Thesium costatum var. costatum, Thesium racemosum, Thesium sp.*	Whole plant		Rituals				
Mliloritshwa		Whole plant		Luck				
Mmusapelo/musapelo	*Indigofera sp. (Fabaceae), Lessertia depressa, Lessertia glabricaulis, Lessertia perennans, Othonna natalensis (Asteraceae), Sutherlandia frutescens (Fabaceae), Trifolium africanum var. africanum*			Irregular heartbeat		Yes		
Moferifiri	*Epilobium hirsutum (Onagraceae), Lycium horridum (Solanaceae), Lycioum tenue, Senecio asperulus (Asteraceae)*	"Top"	Ground	Cause someone to lose their job.	Yes			
Mogalalo		Thorns		Lightening rod for house or head.				

Table 6. *Muthi* plants from Phutaditjhaba. Continued.

Local Name	Scientific name	Portion Used	Processing	Indication	Ground	Eaten	Food	Tea
Mogogathwane		Roots		Food		Yes	Yes	
Monamotso	*Euclea coriacea (Ebenaceae), Morella serrata (Myricaceae)*	Roots	Ground and boiled	Immune boost	Yes	Yes		Yes
		Bark	Ground	Cleanse blood for treatment of diabetes.	Yes	Yes		
Monyesa			Ground	Sprinkle around affected area to banish evil spirits.	Yes			
Morotwana phookwana/ Morotwanaphookwana	*Orinthogalum gracillimum (Hyacinthaceae), Orinthogalum marlothii, Orinthogalum shawii, Orinthogalum viride*			Cleanse blood for treatment of diabetes.		Yes		
				Food		Yes	Yes	
Motlhabakolobe		Leaves		Used to make traditional mats.				
Motrombolo			Ground	Headache	Yes			
Motsosa	*Hypoxis villosa (Hypoxidaceae), Orinthogalum maximum (Hyacinthaceae), Orinthogalum setsosum,* Unidentified generic aphrodisiac	Roots	Ground and boiled	Treatment of HIV.	Yes	Yes		Yes
Motsubo		Leaves	Smoked	Headache				
			Dried and Smoked	Headache				
		Roots	Dried and ground	Snorted for the treatment of headache.	Yes			
Mpepa		Whole plant	Burned	Incense				
Phateyangaka	*Chenopodium sp. (Chenopodiaceaea), Helichrysum caespititium (Asteraceae), Hermannia depressa (Sterculiaceae)*	Whole plant		Flu		Yes		
Phela	*Othonna natalensis (Asteraceae)*			Food		Yes	Yes	
Podisa		"Top"	Ground	Neutralize bad medicine.	Yes	Yes		
Pohotsehla/kokwana	*Xysmalobium undulatum (Apocynaceae)*		Ground		Yes			
Qobo	*Gunnera purpensa (Gunneraceae)*			Cleanse blood for treatment of diabetes.		Yes		
Seboka	*Schizocarpus nervosus (Hyacithaceae)*	Whole plant		Cleanses the stomach.		Yes		
Sehalahala sa matlaka	*Eriocephalus punctulatus (Asteraceae)*	Whole plant		High blood pressure		Yes		
Sehlapetso/sehlapetsu	*Mimulus gracilis (Scrophulariaceae)*	Whole plant		Proscribed for pregnant women.		Yes		
Sehlehle	*Euphorbia clavarioides var. clavarioides (Euphorbiaceae)*			Rituals				
Sehloko	*Andropogon schirensis (Poaceae), Elyonurus muticus, Euphorbia clavarioides var. clavarioides (Euphorbiaceae), Euphorbia inaequilatera*		Ground	Rituals	Yes			
Sepatlapatla	*Sisymbrium thellungii (Brassicaceae)*	Leaves		Food; eaten like spinach.		Yes	Yes	
Seruwe	*Eragrostis sp. (Poaceae)*	Roots		Reunite people				
Sesepa sa dinoha	*Kedrostis capensis (Cucurbitaceaea)*	Fruit	Dried and ground	Treatment of colic.	Yes	Yes		
				Deter snakes and body				

Table 6. ***Muthi*** **plants from Phutaditjhaba.** Continued.

Local Name	Scientific name	Portion	Processing	Indication	Ground	Eaten	Food	Tea
Setinemollo/ setimamollo	*Kylinga erecta (Cyperaceae), Pentanesia prunelloides (Rubiaceae)*		Ground	Reduce foot swelling.	Yes	Yes		
Sewete mputswe	*Schizoglossum atropupureum (Apocynaeceae)*			Food		Yes	Yes	
				Headache				
				Luck in court cases.				
Shweshwe	*Gazania krebsiana (Asteraceae), Gazania krebsiana subsp. serrulata, Gazania linearis var. linearis, Hirpicium armerioides*	"Top"		Eaten to make poisoner forget to poison.		Yes		
Sutha		Whole plant	Burned	Banish evil spirits.				
Tsebe ya pela	*Eriospermum ornithogaloides (Eriospermaceae), Gerbera piloselloides (Asteraceae)*		Heated to produce sap.					
Tsilatsila	*Acrotome inflata (Lamiaceae)*		Ground	Soak in bath for luck in court cases.	Yes			

fifteen were narrowed down to a list of possible species and families. Plant families represented in the sample include: *Alliaceae, Amaranthaceae, Amaryllidaceae, Apiaceae, Apocynaceae, Asparagaceae, Asteraceae, Brassicaceae, Chenopodiaceae, Cucurbitaceae, Ebenaceae, Eriospermaceae, Euphorbiaceae, Fabaceae, Geraniaceae, Gunneraceae,Hypoxidaceae, Hyacinthaceae, Iridaceae, Lamiaceae, Mesembryanthemaceae, Myricaceae, Onagraceae, Poaceae, Rubiaceae, Santalaceae, Scrophulariaceae, Solanaceae,* and *Sterculiaceae.*

A large subset of the sample was edible, with a limited number of food plants, as would be expected for a *muthi* shop. The leaves of *Sisymbrium thellungii* (*Brassicaceae*) are prepared like spinach. *Othonna natalensis* (*Asteraceae*), *Schizoglossum atropupureum (Apocynaeceae),* and *Morotwana phookwana* (an indeterminate genus of *Hyacinthaceae*) are also food plants. *Kedrostis capensis (Cucurbitaceaea), Hypoxis hemerocallidea (Hypoxidaceae), Geranium caffrum (Geraniaceae), Schizocarpus nervosus (Hyacithaceae), Eriocephalus punctulatus (Asteraceae), Mimulus gracilis (Scrophulariaceae*), and *Gunnera purpensa (Gunneraceae)* were identified as orally administered medicines. *Monamotso (Ebenaceae or Myricaceae), motsosa (Hyacinthaceae* or *Hypoxidaceae*), and *delinina* (unknown) prepared as medicinal tea. Most of the edible medicinal plants are ground. *Dilgopa*, an unknown tuberous plant was the sole ground food plant. Twenty-five of the plants required grinding,

Supernatural and ritualistic plant use was featured much more in the Phutaditjhaba sample than in the Western Free State sample. Supernatural applications involve maximizing luck using *Schizoglossum atropupureum (Apocynaeceae)*, protecting oneself from violence *muthi* using *Boophone disticha (Amaryllidaceae),* and using *muthi* to target rivals with *shweshwe (Asteraceae)*. General ritual plants included *Marakalla (Sanatalaceae), Mabone (Mesembryanthemaceae or Rubiaceae), Sehloko (Poaceae or Euphorbiaceae), Plectranthus ciliatus (Lamiaceae)*, and *Euphorbia clavarioides* var. *clavarioides (Euphorbiaceae)*. This category of use was poorly described, though significant in number.

Drakensberg Herbal Trail

Twenty-one plants were encountered during a hike in the hills above the Basotho Cultural Village just inside Golden Gate Park (**Table 7**). The informant provided names in English and Basotho. Family level botanical identifications were available for all but four plants: *skila, letjwetlane, amira*, and *(t)lemel akjomo*. *Cotyledon sp.* was identified as an aloe by the informant, with no Basotho name, but was graphically classified as a member of *Crassulaceae*. *Kgapumpu (Hyacinthaceae) and Mabelebele (Anacardiaceae* or *Santalaceae)* were delimited to a few species each. Families represented include *Cyperaceae, Hypoxidaceae, Asteraceae, Convulvulaceae,*

Crassulacea, Hyacinthaceae, Santalaceae, Anacardiaceae, Rosaceae, Poaceae, and *Xanthorrhoeaceae.* Aloes *(Xanthorrhoeaceae)* featured prominently in the sample, followed by members of *Asteraceae* and *Convulvulacea*. The bark, gum, and leaves of *Scleria dregeana (Cyperaceae)* are chewed interchangeably for the treatment of sore throat. Especially due to the prominence of the Aloes, leaves were the most commonly utilized portion of the plants, though roots and whole plants were also important.
The underground portion of plants, such as roots, bulbs, and tubers were most commonly used. The informants and the translator did not apply the names of these portions in the scientifically defined sense. *Bohloko ba dinoha, moliana wa labese, makgorometsa,* and *simpampane* are used whole, while only the leaves of *lekgala (Xanthorrhoeaceae)* and *moroho* are used.

The informant did not explicitly identify any food plants, though *Sorghum sp.* is edible and the majority of the plants listed are administered as oral medicines. *Bulbine narcissifolia* (*Asphodelaceae*), *Scabiosa columbaria (Dipsacaceae,* non-native*),* and *Guilleminea densa (Amaranthaceae)* are boiled and administered as tea. *Matunga*, *bohloko ba dinoha,* and *simpampane* are also prepared as tea. Other medicinal plants, *Dicoma anomala (Asteraceae)* and roots of *Monnamotsho (Ebenaceae or Myricaceae)* and *Pohotsehla/kokwana (Asclepiadaceae or Phytolaccaceae)* are powdered and eaten. *Wahlenbergia sp. (Campanulaceae)* and *Lotononis eriantha (Fabaceae)* are chewed whole and prescribed as a charm to protect the innocent in court cases.

Table 7. *Muthi* Plants from the Basotho Cultural Village herbal trail.

Local Name	Scientific name	Portion Used	Processing	Indication	Food	Edib	Tea
Motswetswe	*Scleria dregeana (Cyperaceae)*	Bark, gum, leaves		Chewed for sore throat.		Yes	
Mabelebele	*Searsia dentata (Anacardiaceae) Tesium burkei (Santalaceae)*	Berries		Travel food	Yes	Yes	
"Aloe"	*Cotyledon sp. (Crassulaceae)*	Leaf jelly	Scraped	Jelly removed from skin and put into inflamed ear for infection.			
"Large Aloe"	*Aloe ferox (Xanthorrhoeaceae)*	Leaf jelly	Scraped	Jelly removed from skin and applied to skin inflammation.			
Lekgala le lenyenyane/lekgalana/ lekgalana la badimo/ ntehiseng/sereledi/ sereledile	*Aloe aristata (Xanthorrhoeaceae)*	Leaf jelly	Scraped	Jelly removed from skin and applied to inflamed eye.			
Lekgala kharatsa	*Aloe polyphylla (Xanthorrhoeaceae)*	Leaf jelly	Scrape jelly from skin	Jelly removed from skin and applied to skin inflammation.			
Skila		Leaves	Burned	Deter mosquitos			
		Leaves		Bath soak to treat skin problems.			
Tjhetjhe	*Leucosidae sericea (Rosaceae)*	Leaves	Boiled	High blood pressure.			Yes
Wormwood	*Artemesia afra (Asteraceae)*	Leaves	Boiled	Used as a nasal plug to treat Influenza.			
Sehalahalasamatlaka	*Eriocephalus punctulatus (Asteraceae)*	Leaves	Boiled	Blood purification			Yes
Amira		Roots	Boiled	Encourage deep sleep and decrease power.			Yes
Kgapumpu	*Eucomis bicolor (Hyacinthaceae) Eucomis autumnalis Eucomis autumnalis subsp. Clavata Eucomis regia Orinthogalum shawii Schizocarpus nervosus*	Roots		Reduce inflammation, diabetes treatment, and to increase fertility.			Yes
Mathokgo	*Ipomea oblongata (Conulvulaceae)*	Roots	Boiled	Increase power		Yes	Yes
(T)lemel akjomo		Roots		Support immune system.		Yes	Yes
		Stalk	Burned	Deter mosquitos			
Kgaratsa/lotsana/lotsane/ modi/modikgaratsa/modiletsane/ modilotsane	*Hypoxis hemerocallidea (Hypoxidaceae)*	Whole Plant		Kidney problems		Yes	Yes
Letjwetlane		Whole Plant	Boiled	Laxative for stomach ache in toddlers.		Yes	Yes
Sephomolo	*Athrixia phylicoides (Asteraceae)*	Whole Plant	Boiled	Increase strength		Yes	Yes
Maime	*Ipomea crassipes (Convulvulaceae)*	Whole Plant	Chopped	Banish evil spirits and protect from lightening.			
Mofiti/mofethe	*Eragrostis planiculmis (Poaceae)*	Woody branches	Boiled	Banish evil spirits.			Yes

Erfkroon

The final field hike to Erfkroon was less productive than the other excursions, as only two plants were identified (**Table 8**), *Gomphocarpus fruticosu*s (*Apocynaceae*) and *Senna italica* (*Fabaceae*). Both are edible medicinal types that can be ground, though neither is a food plant. The dried and powdered leaves of *G. fruticosas* are used as a snuff for headaches and tuberculosis. The roots of the same plant are also dried and powdered for a tea purported to ease the stomach pain and body aches. *S. italica* has both internal and external procriptions for multiple indications.

Table 8. Plants identified from Erfkroon from the final day of field work.

Local Name	Scientific name	Portion Used	Processing	Indication	Ground	Edible
Lebegana/lereke-la-ntja	*Gomphocarpus fruticosus (Apocynaceae)*	Leaves	Dried and powdered	Snuff for headaches and tuberculosis	Yes	
		Roots	Dried and powdered, boiled in water	Stomach pain and body aches	Yes	Yes
Swartstorm/wilde ertjie	*Senna italica* (Fabaceae)	Roots		Influenza, liver and gall bladder problems, a purgative for gastrointestinal complaints, dysmenorrhoea and uterine pain, eye drops, wound dressing,	Yes	Yes

CHAPTER VI

ARCHAEOBOTANICAL REMAINS FROM STONE AGE SITES IN SOUTHERN AFRICA

This section presents a summary of key Middle Stone Age and Later Stone Age paleoethnobotanical and paleoecological studies carried out at archaeological sites across southern Africa. Archaeological macrobotanical plant remains are scarce in Stone Age contexts from the South African interior and virtually absent at Erfkroon. Establishing the paleoethnobotanical baseline of the region helped to inform the design of my analysis of modern plant use, and contributed to an effort to establish the modern ethnobotanical baseline. The most common types of archaeobotanical analyses (macrobotanical remains such as leaves, seeds, and charcoal) first are described as there is a great deal more context for these studies than the less common types (pollen and phytoliths). The following sections are organized chronologically from the earliest archaeological plant remains from Sibudu Cave to the recent sites in the Drakensberg with plant based paints and plant depictions. The broader implications of these findings on the study of the change in subsistence from the MSA to LSA also are presented where appropriate. Biome maps are provided with the locations of MSA sites **(Figure 10)** and LSA sites **(Figure 11)** discussed in the chapter. Two tables were created for this review of existing archaeobonatical literature. **Table 9** contains a list of the identified archaeobotanical remains from the MSA and **Table 10** contains that of the LSA.

Macrobotanical Remains

Macrobotanical remains comprise the most recognizable category of recovered plant remains. These include the seeds, nuts, roots, and other portions of the plant that are visible to the naked eye. Macrobotanical remains, while rare, may provide examples of exactly how the plant was used even if its precise identity is not certain. More detailed dicussions follow below for seeds and charcoal analysis.

Seed Studies

Seeds are particularly useful because in many cases they can be identified to species level. Other portions, such as wood and microbotanical remains, such as pollen and phytoliths, can rarely be identified beyond genus. The uncertainty as to how the seeds found their way into the archaeological context limits the interpretations of seed studies. Seeds may be transported from another location by humans or other seed-collecting fauna through active dispersal or via passive dispersal. Passive dispersal (unintentional) is not uncommon, so species identification can help determine the likelihood that human interaction was a factor and whether the seeds played a significant role in their subsistence. In seed studies, as in all archaeological studies, it is crucial to identify sample bias and the agents of accumulation and redistribution and determine how they affect site interpretations. Reiterating Wagner (1988), Scott (2005) notes that while sampling bias cannot be completely avoided, it can be controlled in order to maintain consistency, potentially allowing assemblages with the same bias to be compared freely. Understanding the agents of accumulation (how seeds got to the site) and redistribution (how seeds moved within the site), combined with an inductive approach, can help investigators determine the whether or not the seeds present at sites such as Sibudu Cave are the result of human utilization. Rather than assuming that seeds found in context with cultural occupations imply human accumulation and use, investigators must consider seed taphonomy. Was the seed deposited fluvially during a rainstorm by slopewash? Is it a favorite fruit of a bird, rodent or primate that may have left it behind? Could it have been blown in by the wind? What are the possibilities for the mixing of depositional layers at the site?

Wadley (1984) and Scott (2005) suggest that excavations of uninhabited caves and rock shelters could be used as controls for interpreting deposits in inhabited shelters. In seed studies, this comparison would help archaeologists determine which seeds resulted from human activity, which seeds blew in on the wind, which seeds were deposited by animals, and which seeds were deposited during a flood.

Archaeological Charcoal

The study of archaeological charcoal, also known as anthracology, is possible due to the fact that the characteristic features needed to identify wood to the genus and/or species level can survive the process of burning (Salisbury and Jane 1940). In the intervening years, this analysis has become ubiquitous in archaeology, worldwide.

The analysis of South African charcoals can be traced to the foresight of Hillary Deacon, who, beginning in the 1970s, promoted interdisciplinary scientific crosstraining in archaeology. Deacon believed that the insights gained from archaeology and biogeography have the potential to make significant contributions to one another. Archaeologists' access to and understanding of ancient botanical remains could contribute to the development of biogeographical models. Also, the documentation, identification, and dating of flora and fauna from archaeological contexts could help illuminate changes in climate. With this intent in mind, Deacon (1979) formulated his research method for Boomplaas Cave. These excavations (Deacon *et al.* 1983) formed the pilot for this method, with Anton Scholtz's (1986) completing the charcoal analysis for his Master's thesis. Tusenius (1986) followed with an unsuccessful analysis of the charcoal from Klasies River mouth, but she was able to obtain good charcoal samples from LSA sites in the Drakensberg (Tusenius 1989). Environmental charcoal studies expanded throughout the region during the 1980s and 1990s: Tusenius (1989) in the Eastern Cape; Prior (1983) and Prior and Price-Williams (1985) in Swaziland; Dowson (1988) at Jubilee Shelter in the Magaliesburg north of Pretoria; February (1992a) at Elands Bay Cave in the Western Cape; Wadley *et al.* (1992) at Rose Cottage Shelter and Esterhuysen (1992) at Liliehoek shelter, both in the Free State; Esterhuysen and Mitchell (1996) in Lesotho. February (1992b) and Shackleton and Prins (1992, 1993) carried out method studies that helped to fine-tune these anthracological investigations.

The deposition of archaeological charcoals is the result of both human activities and natural processes. Wood may be burned in a hearth during a cooking event, but the resulting charcoal may then be washed into secondary contexts by flooding events or wind. Charcoals may also form from naturally occurring fires. The archaeologist must study the taphonomy of archaeological charcoals very carefully in order to make informed decisions about how the charcoals may contribute to their studies. For instance, natural charcoals can be used for radiocarbon dating and vegetation studies while charcoals found in distinctive hearth features may shed light on fuelwood selection. Also, a method of xylem analysis termed ecologically diagnostic xylem analysis (EXDA) can reveal microscopic changes in wood structure. EXDA is a computer based method for analyzing a wide array of functionally significant anatomical variables from thin sections of wood, was developed by Anton Scholtz (1986) during his work at Boomplaas.

Both kinds of analyses are crucial to the interpretation of archaeological sites. While this paper is primarily concerned with evidence of human use, it should be noted that most researchers are more comfortable using charcoals for vegetation studies than for discussions of fuelwood selection. As in the case of seed analysis, this is primarily due to the complexity of sorting out the agents of accumulation and redistribution but this need not discourage researchers from asking questions about human activity. Esterhueysen (1996) eloquently defined this point: "Archaeological charcoal is first and foremost an artifact of human activity and as such represents a culturally selected sample; i.e., that portion of the woody environment once collected for social, cooking, heating and/or medicinal purposes. The woody remains do however provide information about past environment." Théry-Parisot *et al.* (2010) reiterate this preeminence, suggesting that because paleoclimatic vegetation studies rely on both cultural and natural formation processes, the human relationship to charcoals in archaeological sites (anthracological reconstruction) should be established first. In the studies of archaeological charcoals from the South African MSA presented here, fuelwood selection is always treated as a small component of a broader vegetation study.

According to Marston (2009), one way to sort out the human role in charcoal deposition is to explore how and why people may have selected specific woody taxa for particular purposes. He designed experiments to test a set of models derived from the field of human behavioral ecology that predicted that people forage for wood resources by taking into account the relative usefulness, abundance, and handling time related to procuring different wood types. The results of the study showed that, at the Anatolian site of Gordion in modern day Turkey, these factors did not hold equal weight, as was the expectation. However, the study did effectively illustrate the benefits of separating the models' component variables and testing them individually. Marston found that he could establish the degree to which wood was selected and what selection criteria may have been used. Perhaps most importantly, the study revealed that selection criterion at a site related to the constraints of the activity rather than the currency of the activity.

A final problem with the charcoal vegetation studies in South Africa is the assumption that the charcoal assemblage of a site represents all or most of the species found at the site's surrounding environment and that the frequency of archaeological species mirrors the actual density in the surrounding vegetation during the periods in question. Shackleton and Prins (1993) identified numerous cultural and environmental factors that detract from this assumption: active selection for, or avoidance of, particular species and size classes for fuelwood purposes, differential preservation of charcoals from different species, sampling problems during excavation, the potential non-uniform deposition of charcoal throughout the period of consideration, fuelwood collection from vegetation areas that are not the same as that of the site, and the variable charcoal yield of different species. These revelations further underscore the need for greater emphasis on the role of humans in the deposition of charcoals.

Botantical Residues

Over the last few decades, the analysis of plant residues on stone tools and other artifacts has become a vital component to investigations of human activity at Stone Age sites throughout South Africa. Deacon (1993) expounded on the importance of archaeological plant remains, in general, at sites such as Scott's Cave, Klasies River, and Amanzi Springs; and residue analysis in particular. He noted that, in keeping with the overall preeminence of all types of faunal analyses, "the study of plant residues from archaeological contexts in southern Africa has not drawn the same attention (Deacon 1993; 86)." However, technological limitations coupled with the reality of economic constraints restricted researchers' ability to undertake such complex chemical studies at that time, but colleagues certainly took heed.

Time and technological advances have allowed for the emergence of a variety of microscopic techniques including the analysis of starch grains, phytoliths, chemical residue analysis and Micro-PIXE. At the forefront of these investigations are Lyn Wadley and Marlize Lombard at Sibudu Cave, Bonnie Williamson at Rose Cottage and Sibudu Cave, and Geeske Langjans at Sterkfontein and Sibudu Cave. Over the last decade, these researchers have scoured both archaeological and experimental lithic assemblages for residues and developed experiments to test the efficacy of their methodologies. The differentiation of faunal and botanical residues has been explored extensively.

In 2002, Wadley, Lombard, and Williamson collaborated on the development of a series of blind tests designed to test the efficacy of residue analysis methods (Wadley *et al.* 2004). The first goal of the study was to test the identification and interpretation skills of the stone tool residue analyst. How accurate and specific are their routine analyses? Secondly, the authors wanted to test the agents of residue preservation. What key factors explain why residues are found on some tools but not on others? Twenty-eight stone flakes (replicas of the MSA lithic assemblage at Sibudu Cave) were knapped and sterilized for use in various plant and animal processing activities. One set was sealed in a plastic bag and given to an analyst to test her recognition of residues and activities. Another was buried in a compost pile for a month and then exposed to open air for a period of three days after being unearthed and analyzed for the effects of acidic, organic-rich deposits on plant and animal residues. The tests revealed that the blind analyst (Lombard) scored quite high in her recognition of residues and tool use (88%) and that animal residues are more sensitive to certain burial conditions than are plant remains. The study also helped to identify aspects of residue analysis that must be explored and improved upon. How can analysts be sure that certain residues are not due to leaching from the surrounding sedimentary matrix resulting in misleading results? How do depositional conditions and forms of diagenesis affect the recognition of residues? Why didn't residues from animal sources preserve as well? Finally, how do different soils, waters, and contexts affect preservation and recognition of residues?

Wadley and Lombard (2007) carried out four more blind tests on an assemblage of fifty-three manufactured stone tools. In addition to being utilized for plant and animal processing activities, as in previous studies, some tools were also hafted before use. This was intended to identify whether hafting leaves behind any kind of recognizable traces and whether these activities can be distinguished from other forms of routine use.

In addition to replicating fine-tuned versions of the first two blind tests, subsequent tests explored a new set of questions and produced some provocative insights. The third test revealed that rock type affected the analysts' ability to recognize and interpret residues. The fourth test produced the highest scores for the analyst who analyzed a set of tools for characteristics of various replicated activities (Wadley *et al.* 2004). These studies have contributed immensely to residue studies, encouraging researchers to plan carefully their research design in order to mitigate recognition and preservation issues. With insights from these studies, Wadley, Lombard, and Williamson set the standards for their subsequent and numerous investigations of lithic residues from Sibudu Cave.

Phytolith Analysis

Opal phytoliths are the resilient, microscopic silica accumulations absorbed by plants through groundwater. They form in many plant tissues during the plant's lifetime. The silica deposits solidify as facsimiles of the plant cells. The phytoliths are released into sediments through burning or microbial degradation of plant. These bodies are indicative of the plant and plant part from which it originates. Phytoliths remain even when the rest of the plant has decayed, thereby preserving the signature of past vegetation. They are good indicators of fossil ash deposits, especially in cases where the plant ash has been changed through diagenesis and the original structures of fireplaces and ash dumps are no longer discernable (Schiegl *et al.* 1996).

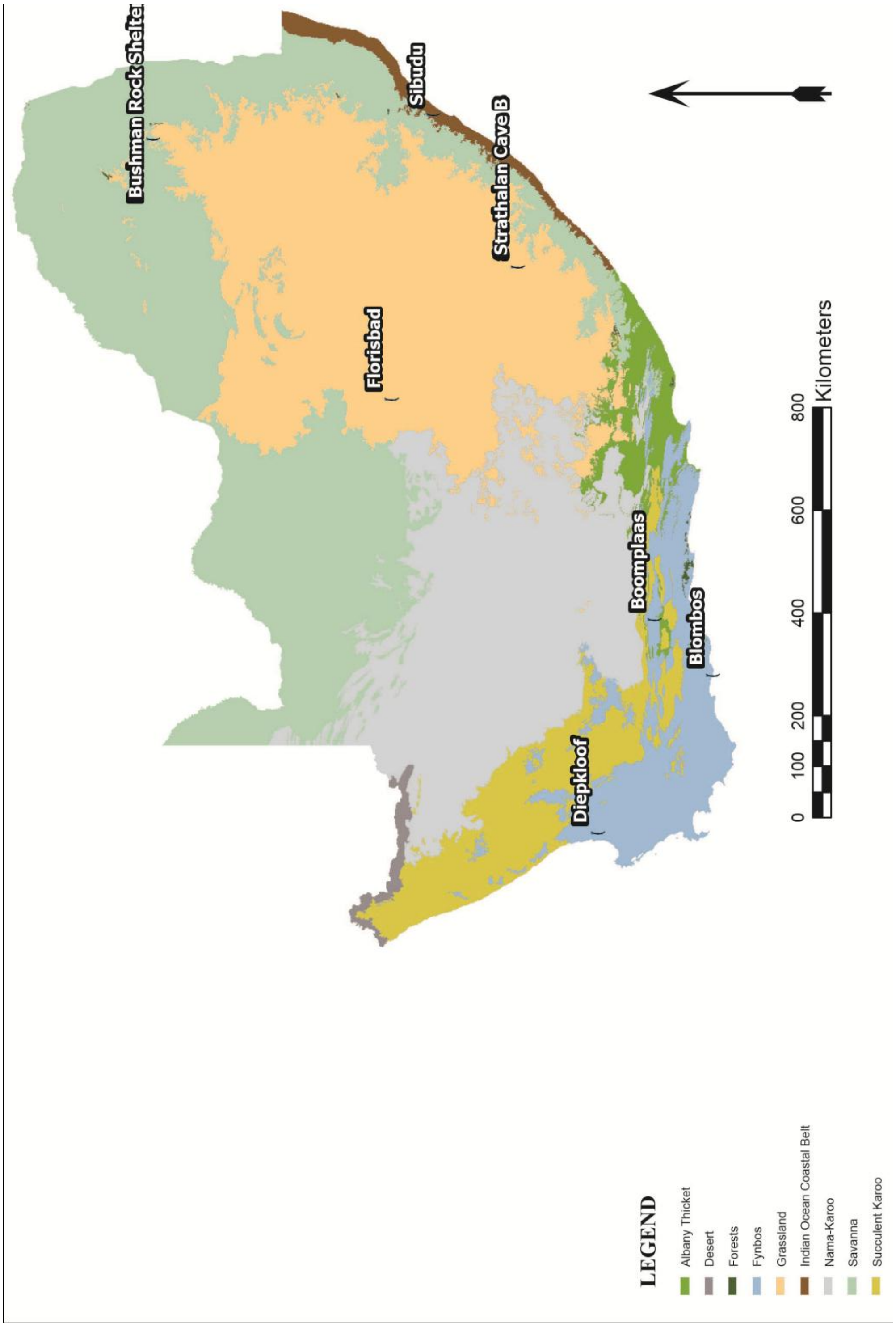

Figure 10. Biome map of MSA archaeobotanical sites. Adopted from Mucina and Rutherford (2006).

Middle Stone Age Macrobotanical Remains

Florisbad. Excavations at Florisbad **(Figure 10)** in 1952 yielded several pieces of wood **(Table 9)** from one of the spring eyes and associated with Middle Stone Age (MSA) artifacts (Bamford and Henderson 2003). One of these pieces was preserved and identified as part of an ancient throwing stick with what appear to be cut marks towards the tip. The piece is composed of non-local *Rutaceae* wood, *Zanthoxylum chalybeum* (Engl.) (kundanyoka knobwood), which occurs naturally in Zimbabwe and farther north (Mucina and Rutherford 2006) The presence of this taxon so far south implies that there was a southern shift of the vegetation zones in relation to the disputed age of the piece, 125,000 or 259,000 years ago (Bamford and Henderson 2003).

The pollen sample that corresponds to the date of the piece indicate cooler and/or moister conditions with high fluctuations in dominant grasses coupled with a decline in grasses as species fluctuated gradually. Neither typical savanna woodland pollen associated with bushveld or tropical species pollen that might indicate frost-free conditions are found in the sequence. The vegetation was open grassland or karroid shrubland throughout most of its history.

Sibudu Cave. The earliest confirmed plant remains **(Table 9)** in southern Africa are bedding plants found at Sibudu Cave **(Figure 10)** in the context of the cave floor that date to between 77,000 and 73,000 B.P. (Wadley *et al.* 2011) and correspond to the pre-Still Bay (MIS4). Sibudu Cave is a west-south-west-facing sandstone and shale overhang located above the Tongati River in northern KwaZulu-Natal that was initially discovered and subsequently excavated but not published by Aron Mazel of the Natal Museum in

1983. This preliminary excavation, a small (one meter deep) test trench, revealed a rich Iron Age deposit layered over a rich Middle Stone Age occupation. Several innovations in the MSA are seen in archaeological sequence at Sibudu, initially explored in a large-scale excavation at Sibudu that uncovered a wealth of rare small elliptical bifaces and hollow-based points, bone tools (Blackwell *et al*. 2008), seeds (Wadley 2004; Sievers 2006), bedding plants (Wadley *et al*. 2011, Sievers and Muyasa 2011, Sievers 2006) and archaeological charcoal. Post-excavation analysis of the lithic assemblage revealed organic polishes composed of plant resins and plant, animal, and ochre residues.

At least 15 occupation horizons from Sibudu (Wadley *et al*. 2011), extending for at least 1 meter and up to 3 meters across the excavated area, incorporate compacted layers of finely laminated, herbaceous material, including stems and leaves, capped by laminated, articulated phytoliths (*Poaceae*). Occupation debris found within plant layers imply that the bedding was refurbished regularly and most bedding appeared to have been burned. Accidental burning may have occurred on occasion, but repeated carbonization throughout the sequence suggests that burning was employed in order to eliminate pests and garbage, a form of site maintenance reported in the ethnographic literature (Cameron 1990). The bedding layers appear compressed (suggestive of repeated trampling) and were probably used as a surface for working and sleeping. Taxon identification of the often tangled, broken and incomplete bedding plants was problematic, but a *Cladium* sp. culm was recognized. In addition, some culm fragments have been identified as monocotyledons, such as sedges, rushes, and grasses.

Table 9. Identified archaeobotanical remains from the South African Middle Stone Age.

Family	Taxa	Florisbad	Sibudu Cave			Strathalan Cave B	Boomplaas Cave	Diepkloof Rock Shelter	Bushman Rock Shelter	Total
		Bamford and Henderson 2003	Wadley 2004	Sievers 2006	Bruch et al 2012	Opperman and Heydenrych 1990	Scholtz 1986	Cartwright 2013	Plug 1981	
Achariaceae	*Kiggelaria africana*							Fuelwood		2
	Xylotheca sp.			Seeds						
Anacardiaceae	*Harpephyllum caffrum*		Seeds	Seeds						15
	Heeria argentea							Fuelwood		
	Protorhus longifolia		Seeds	Seeds						
	Rhus sp.			Seeds						
	Sclerocarya birrea		Seeds							
	Sclerocarya caffra								Seeds	
	Searsia dissecta							Fuelwood		
	Searsia glauca							Fuelwood		
	Searsia incise							Fuelwood		
	Searsia laevigata							Fuelwood		
	Searsia lucida							Fuelwood		
	Searsia tomentosa							Fuelwood		
	Searsia undulate							Fuelwood		
Apocynaceae	*Ancylobothrys capensis*								Seeds	1
Araliaceae	*Cussonia sp.*			Seeds						2
	Cussonia spicata		Seeds							
Arecaceae	*Phoenix reclinata*		Seeds							1
Asparagaceae	*Asparagus sp.*		Seeds	Seeds						2
Asteraceae	*Euryops speciosissimus*							Fuelwood		1
	Brachylaena sp.				Fuelwood					
Boraginaceae	*Cordia cf. caffra*			Seeds						3
	Cordia ovalis								Seeds	
	Ehretia rigida			Seeds						
Burseraceae	*Commiphora harveyi*			Seeds						2
	Commiphora sp.			Seeds						
Buxaceae	*Buxus sp.*				Fuelwood					1
Cannabaceae	*Celtis africana*		Seeds	Seeds				Fuelwood	Seeds	18
	Celtis mildbraedii		Seeds	Seeds						
	Trema orientalis			Seeds						
	Cassine peragua subsp. Affinis							Fuelwood		
	Cassine schinoides							Fuelwood		
	Cassine sp.								Seeds	
	Celastraceae			Seeds						
	Gymnosporia buxifolia							Fuelwood		
	Maytenus cf. ehretia								Seeds	
	Maytenus oleoides							Fuelwood		
	Citrullus lanatus								Seeds	
	Cucurbitaceae			Seeds					Seeds	
	Lagenaria sp.			Seeds						
Cunoniaceae	*Cunonia capensis*							Fuelwood		1
Cupressaceae	*Widdringtonia cedarbergensis*							Fuelwood		1
Cyperaceae	*Cladium mariscus (L.) Pohl subsp. jamaicense (Crantz) Kük*			Seeds						1
	Cyperaceae			Seeds						
	Cyperus longus var. longus							Fuelwood		
	Cyperus longus var. tenuiflorus							Fuelwood		
	Cyperus sphaerospermus							Fuelwood		
	Cyperus thunbergii.							Fuelwood		
Ebenaceae	*Diospyros austro-africana*							Fuelwood		11
	Diospyros glabra							Fuelwood		
	Diospyros lycioides							Fuelwood		
	Diospyros sp.			Seeds						
	Euclea acutifolia							Fuelwood		
	Euclea racemosa subsp. racemosa							Fuelwood		
	Euclea sp.		Seeds	Seeds						
	Euclea tomentosa							Fuelwood		
	Erica sp.				Fuelwood		Fuelwood			
Erythroxylaceae	*Erythroxylum emarginatum*		Seeds	Seeds						2

Table 9. Identified archaeobotanical remains from the South African Middle Stone Age. Continued.

Family	Taxa	Florisbad	Sibudu Cave			Strathalan Cave B	Boomplaas Cave	Diepkloof Rock Shelter	Bushman Rock Shelter	Total
		Bamford and Henderson 2003	Wadley 2004	Sievers 2006	Bruch et al 2012	Opperman and Heydenrych 1990	Scholtz 1986	Cartwright 2013	Plug 1981	
Euphorbiaceae	*Croton sylvaticus*			Seeds						4
	Ricinus communis			Seeds						
	Sapium sp.				Fuelwood					
	Spirostachys sp.				Fuelwood					
Fabaceae	*Acacia karroo*						Fuelwood			5
	Acacia sp.			Seeds	Fuelwood					
	Aspalathus hirta subsp. hirta							Fuelwood		
	Aspalathus linearis							Fuelwood		
Hyacinthaceae	*Vepris lanceolata*			Seeds						1
Icacinaceae	*Apodytes dimidiata*		Seeds	Seeds						2
Iridaceae	*Tritonia freezia*			Seeds		Fuelwood				4
	Watsonia sp.					Fuelwood				
Lamiaceae	*Clerodendrum glabrum*			Seeds						1
Lauraceae	*Cryptocarya latifolia*		Seeds	Seeds						3
	Cryptocarya liebertiana								Seeds	
Loganiaceae	*Strychnos sp.*								Seeds	1
Malvaceae	*Grewia occidentalis*		Seeds							2
	Grewia sp.			Seeds						
Moraceae	*Ficus burtt-davyi*							Fuelwood		4
	Ficus cordata subsp. cordata							Fuelwood		
	Ficus ilicina							Fuelwood		
	Ficus sur							Fuelwood		
Myrsinaceae	*Myrsine africana*							Fuelwood		4
	Rapanea melanophloeos			Seeds	Fuelwood			Fuelwood		
Myrtaceae	*Metrosideros angustifolia*							Fuelwood		1
Ochnaceae	*Ochna pulchra/arborea*		Seeds							1
Oleaceae	*Olea africana*						Fuelwood			3
	Olea europaea subsp. africana							Fuelwood		
	Olea sp.						Fuelwood			
Penaeaceae	*Olinia ventosa*							Fuelwood		1
Phyllanthaceae	*Antidesma venosum*			Seeds						2
	Bridelia micrantha			Seeds						
Poaceae	*Poaceae*			Seeds						2
	Zea mays								Seeds	
Podocarpaceae	*Podocarpus elongatus*							Adhesive		4
	Podocarpus falcatus			Seeds					Seeds	
	Podocarpus sp.				Fuelwood					
Proteaceae	*Leucadendron glaberrimum*							Fuelwood		10
	Leucadendron nitidum							Fuelwood		
	Leucadendron procerum							Fuelwood		
	Leucadendron pubescens							Fuelwood		
	Leucospermum arenarium							Fuelwood		
	Leucospermum calligerum							Fuelwood		
	Leucospermum rodolentum							Fuelwood		
	Protea glabra							Fuelwood		
	Protea laurifolia							Fuelwood		
	Protea nitida							Fuelwood		
	Protea repens							Fuelwood		
Restionaceae	*Ximenia caffra*								Seeds	1
Rhamnacaea	*Phylica rigidifolia*							Fuelwood		4
	Ziziphus mucronata		Seeds	Seeds					Seeds	
Rosaceae	*Cliffortia ruscifolia*							Fuelwood		2
	Leucosidea sericea				Fuelwood					

Table 9. Identified archaeobotanical remains from the South African Middle Stone Age. Continued.

Family	Taxa	Florisbad	Sibudu Cave			Strathalan Cave B	Boomplaas Cave	Diepkloof Rock Shelter	Bushman Rock Shelter	Total
		Bamford and Henderson 2003	Wadley 2004	Sievers 2006	Bruch et al 2012	Opperman and Heydenrych 1990	Scholtz 1986	Cartwright 2013	Plug 1981	
Rubiaceae	*Canthium inerme*		Seeds	Seeds						9
	Canthium sp.			Seeds						
	Lagynias lasiantha		Seeds							
	Pavetta spp.			Seeds						
	Psychotria capensis			Seeds						
	Psydrax sp.			Seeds						
	Rubiaceae			Seeds						
	Vangueria infausta								Seeds	
Rutaceae	*Calodendrum capense*			Seeds						3
	Ptaeroxylon obliquum				Fuelwood					
	Zanthoxylum chalybeum	Macro								
Sapindaceae	*Allophylus* sp.		Seeds							4
	Dodonaea viscosa var. angustifolia							Fuelwood		
	Dodonea sp.						Fuelwood			
	Pappea capensis			Seeds						
Sapotaceae	*Chrysophyllum viridifolium*			Seeds						4
	Englerophytum magalismontanum								Seeds	
	Sideroxylon inerme		Seeds	Seeds						
Scrophulariaceae	*Buddleia salvifolia*					Fuelwood				1
Strelitziaceae	*Strelitzia sp.*			Seeds						1
Thymelaeaceae	*Passerina truncate*							Fuelwood		1
Typhaceae	*Typha capensis*							Fuelwood		1
Verbenaceae	*Lantana cf. rugosa*			Seeds						1
Vitaceae	*Cyphostemma sp.*			Seeds						3
	Rhoicissus digitata			Seeds						
	Rhoicissus rhomboidea		Seeds							
Xanthorrhoeaceae	*Aloe* sp.					Macro				1
Zamiaceae	*Encephalartos sp.*								Seeds	1

More than 600 fruits of *Cyperaceae* (sedges) and *Juncaceae* (rushes) were discovered (Sievers 2006). Most other fruits are *Cladium mariscus* subsp. *jamaicense* (L.) Pohl (Crantz) Kük, accompanied by *Scleria natalensis*, *S. melanomphala Kunth, and Juncus* sp. Sedges and rushes are normally plants of wet habitats and would not occur naturally in a rock shelter, but riverine clay found in the layers support the argument that clay-caked plants were collected by people from the river valley and brought back to the shelter. In fact, several clay fragments bear monocotyledonous leaf or stem impressions.

The oldest bedding, constructed around 77,000 years ago, during the pre-Still Bay, includes an unburned layer of white, fossil dicotyledonous leaves overlying a layer of monocotyledonous leaves and stems and well preserved articulated monocotyledonous phytoliths (Wadley 2012). The pre-Still Bay, recently describe by Porraz *et al.* (2013)

and Conard and Wadley (2012), at Sibudu is characterized by the dominance of hornfels and dolerite as raw materials and flakes being the most common type of debitage. Additionally, retouched forms, blades, and points, also occurs frequently. Both soft and hard hammer percussion is observed along with Levallois reduction. This assemblage is referred to as being part of the newly termed Sibudan Sequence (Porraz *et al.* 2013)

The preserved leaves are exclusively *Cryptocarya woodii* Engl. and since woody plants grew near Sibudu during the MSA (Sievers 2006; Allott 2006), it is improbable that the leaves of only one taxon would accumulate without the aid of human activity. *Cryptocarya* species are used as traditional medicines and the crushed leaves of *C. woodii* contain traces of chemicals, a-pyrones, cryptofolione, and goniothalamin, with insecticidal and larvicidal properties against insects, like mosquitos (Drewes *et al.* 1995). Wadley *et al.* (2001) argue that the early use of herbal medicines may have awarded selective advantages to humans, and the use of such plants implies a new dimension to the behavior of early humans at this time. At 73,000 B.P., all bedding at Sibudu is burned and evidence of *C. woodii* use disappears.

The most intensive occupation occurred post-Howiesons Poort as the rate of anthropogenic sedimentation increased, with 37 clearly distinguishable layers present. layers. Blades and bladelets were being produced by hard hammer direct percussion (Villa *et al.* 2005). Heavy reduction of flakes seemed to result in the intensive use of raw material. Discoidal and Levallois flaking were being employed in order to produce pointed or oval-shaped flakes. However, the majority of the cores were further reduced via core rotation and rejuvenation. Bipolar flaking of quartz cobbles was a further element of this diverse repertoire (Cochrane 2003).

During the post-Still Bay period, individual bedding layers increased along with the appearance of swept ashes from hearths, a practice absent before 58,000 B.P. and recorded historically in the Kalahari (Marshall 1976). In addition, there is an increase in the density of stone tools at the same time: 4462 unbroken flakes per m^3 were found in sediments dating to 58,000 versus 2244 flakes per m^3 in the 70,000-year-old layers. Intensification may be attributed to longer visits, more visits, or larger group size, all of which would also necessitate more regular site maintenance.

Blombos Cave. The site of Blombos Cave **(Figure 10)**, excavated from 1992 to 1999, by Henshilwood, contributes valuable data to discussions of behavioral modernity. Blombos Cave is located some 100 meter from the Indian Ocean and 300km east of Cape Town. It is situated in an ancient wave-cut cliff formed in calcified sediments of the Bredasdorp Group. Organic materials in the form of bedding plants **(Table 9)** are found in the MSA context with a Still Bay lithic assemblage. The chronological location of Still Bay type bifacial points within the southern Cape MSA places the Still Bay before the Howiesons Poort dated at 65000 to 70,000 cal. B.P. (Miller *et al.* 1999). Before the Blombos excavations Still Bay assemblages were rarely found *in situ* and were poorly recorded, but now Blombos shows Still Bay within the MSA culture sequence. The Still Bay bedding plant assemblage was found in the context of the BBC Layer, roughly contemporaneous to Klasies River and Die Kelders Cave. Several basin-shaped hearths are composed of a compressed matrix of carbonized sand mixed with carbonized humified and/or burnt plant material possibly used for bedding or fuel. Taxonomic identification of plant remains has not been yet possible. At Blombos, robust densities of flaked stone, ochre, marine resources and faunal remains along with unprecedented organics have allowed for unique insights into human subsistence behavior and paleoenvironmental reconstruction at Blombos (Henshilwood 2007).

Strathalan Cave B. The site of Strathalan Cave B in the Eastern Cape **(Figure 10)** was the first to produce detailed evidence for the utilization of plant resources during the MSA based on macrobotanical remains (**Table 9**; Opperman and Heydenrych 1990; Opperman 1996). Previously, MSA subsistence behavior was understood on the basis of faunal and molluscan evidence from early sites predating 25,000 cal. B.P. (Klein 1976, 1977; Singer and Wymer 1982, Deacon 1978) Situated in the foothills of the Drakensberg Range, the Strathalan site consists of three adjacent west-facing caves. Cave B is associated with an MSA habitation contained within an occupational layer preserved beneath an uneven cover of sterile sand. These exceptionally dry conditions allowed for the preservation of macrobotanical remains, including grass, twigs, wood fragments, charcoal, and more rarely, corm scales and corm bases (Opperman and Heydenrych 1990).

It was nearly impossible make species identifications with regard to grasses because only leaf sheaths and culms were preserved. Leaf blades were needed in order to make species designations. However, radiocarbon analysis did reveal that the grasses were C_3 species, indicating cold weather adaptation (Vogel *et al.* 1978). Plant food remains, radiocarbon dated to between 20,000 and 25,000 25,000 cal. B.P., consisted of corm scales and corm bases of *Watsonia* sp., a corm tunic of *Tritonia-Freezia* (both *Iridaceae*), *Buddleia salviifolia* (*Scrophulariaceae*) and *Aloe* sp. (*Asphodelaceae*).

In 1990, Opperman and Heydenrych presented the results of a spatial analysis of the cave based on the arrangement of food processing and sleeping areas. Three distinct patches of red ash, each surrounded by a circle of white ash were identified as hearths based on plant food remains, bone fragments, and a density of lithic artifacts. Bedding areas were designated by dense concentrations of plant materials (mostly grasses, of which many had been harvested with roots and stems intact) arranged in a semi-circle around the perimeter of the cave.

In this spatial analysis, the researchers suggest a correlation between the necessity of fire management in the propagation of geophytes during the LSA at sites such as Klasies River (Deacon 1989) and the density of geophytes at Strathalan. Additionally, the arrangement of activity centers mirrors that of the LSA site of Melkhoutboom (Deacon 1976) and sites in the south-western Cape dating to the last 2,000 years (Liengme 1987). Opperman and Heydenrych (1990) present the argument that Middle and Later Stone Age peoples did not differ greatly in their utilization of plant food resources and organization of living spaces. Modern human behavior appears to have already been well established during this late MSA occupation.

The diminutive size of the living space at Strathalan Cave B factored prominently in the questions addressed in Opperman's 1996 study. Mentioned previously, Cave B is the only cave with an MSA occupation at Strathalan. It is the smallest cave (10.22 square meters) and access is complicated by an entrance that is four meters up a sheer cliff face. To understand why MSA inhabitants would choose this site over two other potentially more suitable living spaces, Opperman (1996) built fires in each cave and took temperature readings. The low roof height and small overall living area made Cave B the best heat reflector of the three caves. This might have been attractive to people seeking a winter camp. Employing Hassan's (1981) population-based index for hunter-gatherer survival, Opperman argues that the projected population of Strathalan Cave B at any given time (8-12 inhabitants maximum) would not have supported long-term survival. His model assumes that the sporadic inhabitants of Strathalan Cave B cooperated with nearby support groups in hunts of large migratory game, found in the faunal assemblage.

Watsonia sp. was found in the earlier MSA context, as it had in the previous excavation, but Opperman noted that the quantity was much lower than at Melkhoutboom (Deacon 1976) or in the 2500 year old horizon at Strathalan Cave A (Opperman 1996). These data provided early evidence that environment factors may have spurred an increase in plant utilization during the LSA. This increase in plant food remains may indicate a meaningful subsistence shift.

Middle Stone Age Charcoal Analysis

Boomplaas Cave. During excavations of the deeply stratified deposit, episodic human occupation horizons were identified by lenses of ash and burnt or carbonized organic matter divided by culturally sterile small mammal deposits, spanning the last 80,000 years. Scholtz employed a method of xylem analysis termed ecologically diagnostic xylem analysis (EXDA). Charcoal **(Table 9)** was recovered either during excavation or through water flotation of recovered sediments (in upper levels where charcoals increased in abundance). Relative charcoal abundance also informed the sampling method. In the upper layers two pieces of charcoal were randomly selected from each hearth feature. In the lower levels where charcoals were sparser, ten well-preserved pieces were selected from each hearth. Occasionally all the charcoal from a given feature was analyzed. In an effort to avoid size biases, analysis was carried out on transverse sections. These sections were then photographed and images were compared to a reference collection in order to facilitate the identification of morphological types. Charcoal pieces (1,039 total) were analyzed and sorted by two separate researchers, in order maintain a level of objectivity.

The BLA member (65,500 cal. B.P.) contained a large quantity of unidentified charcoals, originating from a series of elongated charcoal-filled features outside the normal size range of simple circular hearths, were interpreted as an impressive collection effort probably undertaken in order to cure or dry meat. High density of lumps of charcoal from depressions giving low draught conditions is suggestive of a fire for drying or smoking. The charcoal beds may have related to drying meat strips to preserve them, but bone is scarce in direct association with the features.

Preceding the discussion of the interpretation of the Boomplaas charcoals, Scholtz (1986) noted that considerable environmental change might occur without being reflected in firewood collections. On the other hand, changes in exploitation patterns, relating to human activity, could be completely responsible for changes in the composition of firewood collections. While these assemblages are subject to the interplay of both human and environmental factors, human behavior provides the most meaningful evidence for both archaeological and paleoclimatic interpretations.

Acacia karoo, Erica sp., and *Olea/Dodonata* sp. are well represented in the late BLD samples (MSA) and in the present vegetation. A heavy carpet of plant material was deposited on the floor of the living area during occupation and hearths built on this surface carbonized the remains, compressing the deposit and collapsing the original stratigraphy.

Sibudu Cave. The MSA charcoals **(Table 9)** came from eight assemblages excavated in 2003 and correlated with Howiesons Poort and Post-Howiesons Poort lithic assemblages dating (via OSL) to 62000 B.P. to 33000 B. P. (Wadley and Jacobs 2004). The highest densities of charcoals were taken from the post-HP sequence: late post-HP (60-55,000 B. P.), middle post-HP (55 to 50,000 B. P.), and late post-HP (35,000 B. P.). Wood charcoal and other burned botanical remains (seeds, grass, corms and thorns) preserved well at Sibudu Cave. Even in layers where charcoals were sparse, preservation of internal structures was good enough to allow for specimen identification to the level of family or charcoal type.

Applying a new quantitative GIS-based Coexistence Approach (CA_{GIS}) to fossil plant material, Bruch *et al.* (2012) quantified paleoclimate and vegetation parameters at Sibudu. After the determination of the requirements concerning climate and openness of habitat for as many taxa of the fossil flora as possible, CA_{GIS} involves the utilization of the program ClimStat to calculate the climatic range in which the maximum number of taxa can coexist independently for each parameter considered. Those coexistence intervals provide a quantitative description of the environmental situation under which the given fossil flora lived. Because much of the material is anthropogenically introduced in the archaeological context, the effects of natural changes in the local vegetation and behavioural changes of the people that inhabited the shelter can be difficult to differentiate. CA_{GIS} can be applied to these assemblages in order to directly quantify paleoclimate and vegetation parameters at an archaeological site.

Three OSL dates from Sibudu established the Howiesons Poort at 57,118 B.P., 57,664 B.P., and 59,472 B.P.(Jacobs *et al.* 2008), which corresponds to MIS4. HP winters were slightly colder and drier than present, summer temperatures and precipitation were similar to today, and vegetation density might have been lower than today. Post-HP winters (MIS3) were drier and colder than the HP or modern conditions. Summer temperatures were consistent, though summer precipitation and vegetation over all decreased to a level below that of the HP or today. The late MSA (MIS3) was significantly warmer, especially during winter, summer precipitation increased, and vegetation became more dense, but still similar to the modern anthropogenically altered landscape.

The agents of charcoal preservation were analyzed taphonomically. The variability in temperature, duration of exposure to fire and the amount of oxygen present determine whether a fragment is burnt completely or charred. Fractures, glassy appearance, and fused anatomical structures are symptomatic of exposure to high temperatures. Variation in charcoal density may also be due to less wood being burned during the early MSA occupation. Preservation may also vary amongst different wood types. These factors tempered and guided Allot's (2005) cultural and environmental interpretations.

Evidence for the existence and variability of culturally influenced wood selection was explored through a comparison of HP and Post-HP charcoals. The charcoal assemblage from the HP occupations do not contain good fuelwoods. Pre-60,000 B.P.

layers within the Howiesons Poort occupations are dominated by evergreen forest taxa, including *Podocarpus* spp., *Buxus* sp., *Brachylaena* sp., *Sapium/Spirostachys* and *Ptaeroxylon obliquum*. *Kirkia* sp. suggests that a warm, woodland savanna habitat grew beyond the forest vegetation. At 60,000 B.P. there are taxa from evergreen, riverine forest communities, including *Erica* spp., *Leucosidea sericea* and *Rapanea melanophloeos*. By 50,000 B.P., fewer evergreen forest components and more bushveld taxa, which are common in northern, drier regions of South Africa, are present, along with more *Acacia* spp. and other *Fabaceae* taxa, and fewer *Erica* spp. This may result from environmental change, a change in wood selection, charcoal fragmentation, or sampling bias. At 37,000 B.P., there are modern KwaZulu-Natal type evergreen and deciduous taxa accompanied by *Kirkia* sp., evidence for a dry habitat. The unidentified taxa may indicate a vegetation for which there is currently no reference material.

Modern preferred fuelwood taxa, *Acacia* spp. and *Erica* spp. were routinely collected by 60,000 B. P, contrasting starkly to the pre 60,000 B.P. HP layers that are dominated by *Podocarpus* spp. During the post-HP occupations, the fuelwoods present in that charcoal assemblage reflect a steady trend toward the use of better fuelwoods that would have allowed for longer burning fires. The HP inhabitants of Sibudu at this time were not building fewer fires due to a poor understanding of fuelwood selection (Allot 2005) since MSA inhabitants throughout the MSA expressed an awareness of the importance of raw material sourcing in the production of lithics. It is unlikely that this awareness did not extend to fuelwood sourcing. This pattern may be a result of changes in the local vegetation, sample bias or simply a different approach to wood collection and use between the HP and 60,000 B.P. occupations (Allot 2005).

Diepkloof. Diepkloof Rock Shelter is located near the Atlantic coast of the Western Cape about 180 km north of Cape Town **(Figure 10)**. It is situated 120 m above the southern bank of the Verlorenvlei River and is part of the dominant large isolated outcrop of quartzitic sandstone (Parkington *et al.* 2013). Identifications of wood charcoal fragments **(Table 9)** from Diepkloof have been associated with LSA and upper MSA sequences. The new chronological a new chronology based on optically stimulated luminescence dates has been recently published by Texier *et al.* (2013) and corresponds to MIS4. Still Bay (SB) at Diepkloof dates to 109 ±10 ka (OSL) and is significantly earlier than at Blombos or Sibudu (Jacobs *et al.* 2008, 2012).

Charcoal present at any site could be the result of anthropogenic, taphonomic, and incidental factors. It is possible that fuelwood collected by people could account for a high proportion of charcoal excavated and retrieved and, as such, different charcoal taxa may have been selectively selected and should never be proportionally interpreted as exact reflections of the local environment. It is possible that different fuelwood could have been selected from considerable distances away from the archaeological site. Another viewpoint exists whereby charcoal-rich sediments accumulated over a very long time period, suggesting climate change accounts for most of the differences in vegetation. The latter argument is argument is based on the popular view that hunter-gatherers mainly acquired resources within a few hours (about 10 km) walk from their base.

The identification of wood charcoal from pre-Still Bay, Still Bay and Howiesons Poort assemblages at Diepkloof Rock Shelter (Cartwright 2013) using scanning electron microscopy. The earliest phases are associated with pre-Still Bay and the charcoal shows a predominance of Afromontane forest taxa, some riverine woodland species, mesic thicket and proteoid fynbos vegetation. These taxa include *Cunonia capensis Olinia ventosa, Rapanea melanophloeos, Leucadendron nitidum, Gymnosporia buxifolia Ficus sur, Ficus burtt-davyi, Salix mucronata, Widdringtonia cedarbergensis, Celtis africana, Podocarpus elongates, Cassine peragua* subsp. *affinis, Dodonaea viscosa* var. *angustifolia, Heeria argentea, Olea europaea* subsp. *africana, Leucadendron pubescens, Leucospermum arenarium, Protea glabra, Protea repens* and *Protea nitida.*

The Still Bay shift corresponds towards an increase in thicket taxa. Proteid fynbos species diversify and evidence for plant use emerges from the local wetlands of the Verlorenvlei. The taxa include *Ficus sur, Ficus burtt-davyi, Salix mucronata, Widdringtonia cedarbergensis, Celtis africana, Podocarpus elongates, Cassine peragua* subsp. *affinis, Dodonaea viscosa* var. *angustifolia, Heeria argentea, Olea europaea* subsp. *africana, Leucadendron pubescens, Leucospermum arenarium, Protea glabra, Protea repens* and *Protea nitida, Kiggelaria africana, Myrsine africana, Maytenus oleoides, Diospyros austro-africana, Diospyros lycioides, Diospyros glabra, Searsia undulate, Searsia lucida, Searsia dissecta, Searsia incise, Protea laurifolia, Aspalathus linearis, Passerina truncate, Phylica rigidifolia, Searsia glauca,* and *Typha capensis*

During the Howiesons Poort contexts, the charcoal shows some Afromontane forest persisting, but the overwhelming change is towards greater species diversity. Woody taxa become increasingly more representative of thicket and shrubland, wetland plant use increases, and some of the fynbos and thicket species are transition toward vegetational communities which inhabit well-drained soils, rocky or dry locations at the present day. HP taxa include *Celtis africana, Podocarpus elongates, Cassine peragua* subsp. *affinis, Dodonaea viscosa* var. *angustifolia, Heeria argentea, Olea europaea* subsp. *africana, Leucadendron pubescens, Leucospermum arenarium, Protea glabra, Protea repens* and *Protea nitida, Kiggelaria africana, Myrsine africana, Maytenus oleoides, Diospyros austro-africana, Diospyros lycioides, Diospyros glabra, Searsia undulate, Searsia lucida, Searsia dissecta, Searsia incise, Protea laurifolia, Aspalathus linearis, Passerina truncate, Phylica rigidifolia, Searsia glauca, Typha capensis, Ficus cordata* subsp. *cordata, Ficus ilicina, Searsia laevigata, Searsia tomentosa, Metrosideros angustifolia,, Cassine schinoides, Leucadendron glaberrimum, Leucadendron procerum, Leucospermum calligerum, Leucospermum rodolentum, Aspalathus hirta* subsp. *hirta, Euclea acutifolia, Euclea tomentosa, Cliffortia ruscifolia, Euclea racemosa* subsp. *racemosa, Euryops speciosissimus, Cyperus longus* var. *longus, C. longus* var. *tenuiflorus, Cyperus sphaerospermus,* and *Cyperus thunbergii.*

The range of taxa in pre-Still Bay, Still Bay, and Howiesons Poort contexts and the diversity of their preferred habitats (modeled on present-day recorded distributions) must be considered in terms of the extent to which people might have collected these diverse woody resources from a mosaic of vegetational communities, some local, some far away (Cartwright 2013).

Middle Stone Age Seeds

Sibudu Cave. This section will present paleovegetational evidence from seed studies **(Table 9)** at Sibudu Cave with proxy data from sites throughout the interior of southern Africa. Wadley (2004) first identified and analyzed the MSA seeds from Sibudu dating between 61,500 and 26,000 years ago (MIS4 to MIS3). Drawing support from charcoal (Allott 2004) and phytolith analyses (Schiegl *et al.* 2004) from Sibudu, a detailed vegetation study revealed that on some occasions in the past the Sibudu area had less forest and more savanna than today. Using low-power microscopy the following species were identified: *Celtis africana, Celtis mildbraedii, Euclea* sp., *Sideroxylon inerme, Ziziphus mucronata, Phoenix reclinata, Cryptocarya latifolia, Erythroxylum emarginatum, Sclerocarya birrea, Harpephyllum caffrum, Protorhus longifolia, Apodytes dimidiate, Allophylus* sp., *Rhoicissus rhomboidea, Grewia occidentalis, Ochna pulchra/arborea, Cussonia spicata, Lagynias lasiantha,* and *Centhium inerme* (Wadley 2004).

A subsequent study (Sievers 2006), showed that carbonized seeds, nuts and the stones of fruits are present in Middle Stone Age layers at Sibudu Cave from more than ~60,000 B.P. to about ~37,000 B.P. In spite of the preservation of at least 66 taxa, the lack of comparative material allowed for the identification of only 35 taxa to family, genus or species. These taxa consist of sedges, grass and woody climbers, shrubs and trees associated with evergreen forest, forest margins and riverine vegetation occurring near Sibudu. The sedges are associated with wet habitats and were likely harvested by people from the nearby Tongati River throughout the MSA sequence. The widespread distribution and adaptations of many of the woody plants make for inconclusive evidence of vegetation change during the MSA occupations. Frequency distributions of evergreen and deciduous taxa compared through time, with evergreen woody taxa predominating at about 60,000 B.P. (a time of gradual warming, followed by a marked increase in deciduous taxa. This may be an indication of a greater deciduous element in the forest or of more open vegetation near Sibudu Cave around 50,000 B.P. ago than was previously the case.

In 2005, Christine Scott published an analysis of the numerous seeds found and identified during excavation of the Iron Age deposit at Sibudu. This research constituted the first detailed archaeobotanical study of seeds in South Africa and sough to reconstruct the vegetation around Sibudu over the last millennium. About 100 different taxa were present, but only about 70 could be reliably identified to family, genus or species level. Trees, shrubs and climbers were more common than grasses, herbs and forest undergrowth species. Taxa include the following: *Harpephyllum caffrum,(*wild plum), *Sclerocarya birrea* (marula), *Vanguerieae* (the medlars), *Commiphora* spp. (corkwoods). *Croton sylvaticus* (forest croton), *Ziziphus mucronata* (buffalo thorn), *Celtis* spp. (stinkwoods), *Celtis mildbraedii* (red-fruit white stinkwood) and *Ricinus communis* (castor beans—non-native). All of the indigenous taxa identified still occur in the Sibudu Cave area or in nearby habitats. A statistical comparison of the plants from the upper layers at the cave supported the assessment that they came from the same population and suggests that there has not been any change in the composition of the vegetation within foraging distance of the cave over the last 1000 years.

While a large number of seeds was recovered from Sibudu, only the presence of sedge nutlets (Sievers 2006; 2012) contributes to the interpretation of possible human behavior. Other seeds were limited to vegetation studies. The plants in question, *Schoenplectus* sp.*, Scleria* sp.*,* and *Albildgaardia ovata* may provide evidence for human harvesting of sedges for weaving, matting, or bedding. This is supported by Schiegl and Conard's (2006) study of the phytoliths sediments occurring outside hearth features at

Sibudu. High percentages of phytoliths suggest the possible degradation of fresh plant material, but if agents other than humans deposited the sedge nutlets in the shelter it is unlikely that they would be immature (unpalatable) or whole (uneaten), as is the case throughout the MSA sequence at Sibudu. The nutlets are harvested for the starchy kernel within the hard outer layer and as such, birds and micromammals (Glenny 2006) are unlikely to have deposited such a volume of whole nutlets into the shelter, either in droppings or for food storage (Taylor 1998). Since human agency is the most likely explanation, the Sibudu Cave seed assemblage thus provides the first evidence of the possible use of sedges in MSA contexts in southern Africa.

The interpretive limitations associated with the seed assemblage at Sibudu cave has more to do with the problematic nature of cave and rock shelter sites than any inherent problem with seed analysis. Depositional mixing is a serious problem that affects all sorts of artifacts and ecofacts in cave and rock shelter contexts (Bousman 2005). Lithic analysts are able to transcend the mixing problem because stone tool types have been so well attributed to specific reduction strategies and corresponding ages. There is no reason why a similar bypass cannot be applied to seed analysis. Combining seed identifications with Scott's guidelines for the identification of bias and the agents of accumulation and redistribution would allow researchers to create categories of seeds (according to physical condition and species) that are candidates for human utilization. Furthermore, a comparative study of the rate of depositional mixing of seed remains in cave versus open-air archaeological sites would be an invaluable contribution to this area of archaeological analysis.

Bushman Rock Shelter. Excavated in 1965, the site of Bushman Rock Shelter **(Figure 10)** represented the earliest discovery of plant seed remains **(Table 9)** clearly associated with an MSA occupation. The shelter, 51.81 meters wide and 21.34 meters deep, is located on a south facing dolomite ridge in Mpumalanga Province, formerly the Eastern Transvaal. Grid excavations (Louw 1969) unearthed a succession of occupations (Iron Age, LSA, and MSA), all of which contained charred seed remains (Plug 1981). Little or no occupation seems to have taken place after 9000 B.P. In the years preceding Deacon's (1972, 1993) inspirational call for the expansion of botanical investigations in southern African Stone Age archaeology, researchers were limited significantly in their ability to address questions regarding changes in hunter-gatherer subsistence strategies. Bushman Rock Shelter, with a continuity of seed remains in both the MSA and LSA occupations at the site, presents a unique opportunity to explore changing subsistence patterns within a single site, as well as provide a proxy comparison to other seed-bearing sites. Specifically, the Bushman Rock Shelter seeds have the potential to contribute to the understanding of changes in plant-based subsistence (versus other food sources) over time.

The seeds were identified in Plug's (1981) revisitiation of the site, but these data did not figure prominently in her interpretations. Plug (1981) and Louw (1969) were very conservative in their seed analyses. Louw highlighted the existence of ethnobotanically significant marula seeds in the LSA context, while Plug limited her interpretations to conclusive evidence for climatic change since that period, because the species present in the sample were consistent with modern plant communities in the area (Dorst and Dandelot 1972; Palmer and Pitman 1972; Acocks 1975). Identified seeds include

Landolphia capensis, Citrullus lanatus, cf. Sphedamnoa, Zea mays, Cucurbitaceae, Encephalartos sp., *Podocarpus falcatus, Celtis africana, Ximenia caffra, Cryptocarya liebertiana, Sclerocarya caffra, Maytenus cf. ehretia, Cassine* sp., *Ziziphus mucronata, Bequaertiodendron magaliesmontanum, Strychnos* sp., *Cordia ovalis,* and *Vangueria infausta* (Plug 1981). Seeds were dated to between 10,774 and 11082 B.P. and 8703 B.P. The possibility that seeds were not deposited by humans, but by non-human inhabitants of the cave may have contributed to the conservative nature of the interpretation (Wadley 2004; Scott 2005). In the end, the results of the excavations at Bushman Rock Shelter were perceived as being more enigmatic than conclusive.

Middle Stone Age Phytolith Analysis

Sibudu Cave. At Sibudu, phytolith analysis was employed as a way of understanding the sedimentological processes (Schiegl and Conard 2006). The MSA at this site is associated with numerous hearth palimpsests, though there has been some uncertainty about the identification of hearths and ash deposits (Schiegl *et al.* 2004). Phytoliths are small opaline bodies that are formed in many plant tissues during the plant's lifetime. The phytoliths are released into sediments through burning or microbial degradation of plant. Phytoliths are good indicators of fossil ash deposits, especially in cases where the plant ash has been changed through diagenesis and the original structures of fireplaces and ash dumps are no longer discernable (Albert *et al.* 2000, 2003; Schiegl *et al.* 1996). The MSA phytoliths at Sibudu date to between 62,094 and 36,000 B.P. and correspond to MIS3.

Polarized light microscopy (PLM) was used to classify and count phytoliths from twenty sediment samples and a reference collection was created through burning native grasses and wood. These reference ashes were also viewed using PLM and compared to the archaeological phytoliths to aid in identification. The phytoliths identified in the archaeological hearth sediments were characteristic of wood types commonly used as fuelwood-species. Additionally, the morphological state of many of the phytoliths was consistent with intensive heating. Schiegle *et al.* (2004) suggest that the hearths contained either long-burning fires or were reused frequently.

The results of the phytolith study are an invaluable contribution to the exploration of MSA human fire-making activities, a topic initially addressed in Allot's charcoal study. Schiegl *et al.* (2004) appear to have considered many of the taphonomic problems related to charcoals that were identified by charcoal analysts (Allot 2005, Scholtz 1986, Shackleton and Prins 2010, Théry-Parisot *et al.* 2010, Tusenius 1986, 1989, and Marston 2009) and tried to alleviate or a least try to control for them in their study.

At Sibudu only one sample, taken from the lining of a possibly decomposed hearth, contained a high opal component associated with a minor amount of apatite that may indicate a phytolith-rich residue. This could also be grass ash, which can consist mostly of opal and very few other ash minerals. High phytolith abundances are a good indicator of combustion of plant matter. The most plausible explanation of the frequency of sediments with high phytolith contents in the MSA layers is the burning of high amounts of plant matter through which such numbers of phytoliths can be accumulated. This is supported by the large number of visible hearth remains and ash deposits, though a certain portion of the phytoliths was released to the sediments through microbial degradation of fresh plant matter. Humans could have brought in fresh plant material for bedding or construction to the site. The identification of large frequencies of seeds from sedges, which may have been used in the shelter for bedding or sleeping mats, may provide a clue to the phytolith content of the sediments (Sievers 2006). The introduction of phytoliths through wind is a minor factor because modern sediments have low phytolith concentrations and the site is largely unprotected from strong winds (Schiegl and Conard 2006).

Middle Stone Age Residue Analysis

Sibudu Cave. After a decade of experience with fine-tuned residue analyses, discussed at the beginning of this chapter, Wadley linked the manufacture of compound hafting adhesives to complex cognition (2009, 2010). This revelation was built upon the findings of numerous residue studies based on the analysis of MSA stone tools from Sibudu Cave (Lombard 2004, 2005, 2007, 2008; Williamson 2004; Wadley 2005,). A study of the distribution of botanical and faunal residues from the post-Howiesons Poort assemblage, 50,000-60,000 B.P., at Sibudu Cave revealed distinctive patterns indicating that MSA points had been hafted on spears (Lombard 2004). Twenty-four lithic points were analyzed and a pattern emerged whereby faunal residues seemed to be clustered on the distal portions of the tools (the tips) while botanical residues where found to cluster around the proximal and medial portions of the tools. This distribution pattern was found to be universal throughout the assemblage but the proportion of faunal residues was much lower than that of the botanical residues, a proportion anticipated in Wadley’s first blind tests (Wadley *et al.* 2004, Williamson 2004). Statistical analyses, including chi-square tests, were performed in order to determine that the distribution patterns were neither skewed nor coincidental. The chi-square tests supported the assertion that the distribution data were robust and reliable.

Lombard (2005) followed with a study of MSA points from and fragments from Sibudu, employing a multi-analytical approach to determine whether the tools had been hafted onto spears and used for hunting. Faunal, botanical, and ochre residues were recognized on the tools and chi-square tests were again used to establish the validity of the data. An experiment was designed to test the results of macrofracture results on local raw materials that were utilized by MSA inhabitants of Sibudu cave. The sample was comprised of 50 bifacial and unifacial points and point fragments from the post-Howiesons Poort material, OSL dated to between about 51,800 and 61,500 years ago. The specimens were cleaned, packed separately, and then handled as little as possible. The analytical basis of the methodology was based on the spatial breakdown and interpretation of the distribution patterns of the macroscopic and microscopic use traces on the points.

Two further blind tests were designed in order to address issues regarding the accurate visual identification of modern and ancient residues, as well as the potential of organic material to survive a variety of post-depositional conditions. Twenty-eight stone flakes, made of local hornfels, dolerite, chert, and opaline, were smeared with blood and plant exudates (by a second party without the awareness of the author). The goal was to differentiate the signatures of the botanical residues (general plant tissue, plant fibers, starchy residue, starch grains, epidermal cell tissue, woody residue, and resin/exudate) from one another as well as from the faunal residues (general animal tissue, muscle tissue, collagen, animal fat/marrow, bone, blood, hair). Usually a suite of features rather than a single indicator was used in order to determine the botanical or faunal origin of a residue. Tool residues were compared to the replicated residue catalogue (Williamson, unpublished document) before identifications were fully substantiated. The treated flakes were then allowed to dry and the process was repeated in a duplicate experiment on a new set of flakes. In order to replicate archaeological soil conditions, the flakes were buried in dry organic compost, exposed to the environment, and watered (Wadley et al. 2004a).

Several lines of evidence were used to identify support the hypothesis that hafted hand-delivered thrusting and/or throwing spears were used for hunting by the Post-HP MSA peoples living at Sibudu Cave 50,000-60,000 years ago. First, vegetal residues occurring mostly on proximal and medial surfaces, indicates that fibrous plant material was probably used as binding material for hafting. Second, concentrations of epidermal cell tissue medial lateral edges and the proximal edges suggest the contact of these portions with bark-rich material. Third, the distribution of woody residue mostly present on the proximal and medial portions of the tools, while resin and exudates are concentrated on proximal and medial portions, may indicate the use of resin as a fixative. Next, the discovery of ochre on the points and point fragments. Lombard interpreted this as a consequence of ochre being associated with the hafting process, which is strengthened by the fact that these residues are concentrated on the proximal and medial portions, where the macrofracture and use-wear analyses marked the hafting locations. Ochre may have been used a binding material to be mixed with botanical resins in the hafting of spears during the MSA at Sibudu Cave. In a subsequent study of hafted Howieson's Poort tools from Sibudu Cave and Umhlatuzana Rock Shelter, Lombard (2007) found a pattern of concentration of ochre and resin residues on the backed portions of points in conjunction with variation in distribution patterns for all the documented organic residues, with the majority of animal residues concentrated on the blade (sharp, cutting) portions of the segments and plant residues concentrated on the backed portions of the segments.

Plant twine was probably the preferred binding material to attach the points to wooden hafts. The crafting of spear hafts also represents a woodworking specialization that is unprecedented for the MSA in southern Africa. The use of composite tools, hafting, and the production of bone and ivory tools with techniques conceived for these materials are considered by some (Klein 2000; McBrearty and Brooks 2000) to be important features characterizing modern human behavior.

If MSA points were indeed hafted on shafts, next logical step from a research perspective would be to determine how this was done. In 2009, Wadley reported on the results of a replication study of MSA adhesives. In this study she argued that red ochre served not only as a dying agent, but also as crucial component of hafting adhesives. Indeed, the process of making these adhesives involved a complex set of steps, indicating that MSA peoples were capable of complex sequential and abstract thought. The execution of hafting activities required that plant resins used in the adhesive be made less acidic, through the addition of ochre, and dehydrated to achieve the necessary level of stickiness. According to the Barnard *et al.* (2007) model of mental architecture, whereby abstract meanings and sophisticated organization of action sequences determine decisionmaking. Compound adhesive manufacture involved executive steps that are not possible without mental abilities such as the ability to think in abstract terms, successful mental rotation, capacity for multilevel operations (Wadley *et al.* 2009).

In 2010, Wadley published an article that further explored the link between hafting, adhesive manufacture, and modern human cognition. She introduced the idea that mental rotation, an ability associated with modern human advanced working-memory, is required to place the segments in various positions to create novel weapons and tools. Middle Stone Age peoples had to be able to plan ahead and think and do several things at the same time, a capability known as cognitive fluidity (Wadley 2010).

The fact that by the Middle Stone Age these complex techniques were already established indicates that the cognitive capabilities of MSA people were at the same level or at least approaching the level of modern humans. This revelation was an alternative to the more traditional (though highly contentious) cognitive indicator: symbolism. Wadley's argument bypasses the requirement that MSA peoples express symbolic behavior in order to be behaviorally modern. Instead, modernity is expressed in MSA peoples' ability to exhibit cognitively modern capabilities including multi-tasking and mental rotation. In the context of the current study, the presence of adhesive residues in the Middle Stone Age at Sibudu represents the earliest evidence of ground stone processing. Both the ochre and the plants used to make the adhesive needed to be finely ground.

Diepkloof. The excavation at Diepkloof Rock Shelter has revealed several lithic artifacts with a black residue (**Table 9**) distributed over their surface, associated with the

Howiesons Poort. This suggests a close relationship between the appearance of hafting adhesive and the appearance of blades and geometric backed tools (Cherrie-Duhaut *et al.* 2013) Preliminary use-wear analysis supports the hypothesis that hafted tools were mostly integrated within daily domestic activities (Igreja and Porraz 2013). Compared to Sibudu, where ochre additive is documented, the hafting technology at Diepkloof introduces another level of variability within the HP tradition and suggests the existence of regional expressions and adaptations.

The analysis of a thick black residue found on a Late HP quartz flake revealed, for the first time in a MSA context, the nature of a compound adhesive. It was possible to reconstruct a model of the multilevel operations, including ground stone processing, and interactions involved in the hafting process. *Podocarpus elongates* (Yellowwood), collected in the form of a resin that was naturally dried or heated at a low temperature and possibly mixed with fragmented bone and quartz grains. The identified charcoals of wood taxon have also been identified in the Diepkloof archaeological record (Cartwright 2013), so it is possible that *Podocarpaceae* tar was collected and used, in the same way as the well-known pitch (*Pinaceae*) and birch bark tar. Heating modifies the molecular composition, but the aromatic structures detected in tar, the marker for the presence of pitch, are not found in the Diepkloof assemblage. The adhesives from Diepkloof represent the second earliest bit of evidence for ground stone processing.

Later Stone Age Macrobotanical Evidence

Border Cave. A bundle of organic material (**Table 9**), 4 cm wide, was recovered from 1BS Lower B-C (MIS2) at Border Cave (**Figure 11**) and dates to between 41,167 and 39,194 B.P. (Villa *et al.* 2012). Vegetal fibers found imbedded in deep grooves around the bundle underwent microscopic analysis. The fibers and grooves are the remains of twine used to bind the bundle when the contents were still malleable. Gas chromatography identified the substance contained within the bundle as beeswax with the addition of a protein-based material, such as egg, and triterpenoids derived from *Euphorbia tirucalli* resin (Pencil cactus). Unlike the organic residues used as adhesives at Sibudu Cave, some triterpenoids can be used medicinally (*Euphorbia ingens*-Candelabra tree) or highly concentrated and used as poisons (*E. tirucalli*). Poison is derived from the latex and seeds of *E. tirucalli* and is used as an insecticide or to kill fish while *E. ingens* is also used medicinally (Villa *et al.* 2012). The lump of vegetal poison from is Border Cave is ealiest known example of the use of beeswax and the third earliest example of ground stone processing.

The Later Stone Age digging stick found in the 1WA layer from Border Cave is the oldest known artifact of its kind from a Southern African archaeological context. It has been radiocarbon dated to 49,000 cal. B. P. and corresponds to MIS3. Two of the 14 well-preserved wood fragments recovered from this layer looked similar and were about the same thickness, suggesting that they were pieces of the same tool. The wood is *Flueggea virosa (Roxb. ex Willd.) Voigt* subsp. *virosa* (White-berry Bush), a shrub or small tree that grows in deciduous woodland, forest margins, or on rocky outcrops and is widely used throughout Africa for making arrow shafts and other tools. The longer fragment shows evidence of a bevel modification created by rounding and crushing on the working end that is consistent with Khoesan and LSA digging sticks. Though the digging stick is small in diameter (1.6 cm) for a Khoesan or LSA specimen, it was discovered along with a bored stone from 1BL Lower L Layer with a correspondingly small perforation (1.5 cm), thought to be a digging stick weight.

Four pieces of a thin wooden stick missing its middle section were recovered from layer 1BS Lower B-C (24,000 cal. B.P.) and identified as a poison applicator. The fragments do not refit, but the wood (*F. virosa*) is the same as the digging stick. A dark orange residue was found on the end of one of the pieces and lighter traces were found on the body of this piece as well. Using gas chromatography, lipid material (monocarboxylic and dicarboxylic acids) and even- and odd-chain-length hydrocarbons were identified as being a major component of the residue. This suggests that the material, probably cuticular wax, was heated. Also present was ricinoleic acid, one of the most dangerous natural poisons, which originates from mature castor beans *(Ricinus communis L.)*, a native species.

The poison applicator was constructed by removing the bark from a branch and then making perpendicular incisions along its entire length. Villa *et al.* (2012) suggest that it may be a repurposed broken arrow shaft. This utilization would be consistent with the design of implements used by the Kalahari Khoesan to carry and apply poison to arrow points whereby the notches serve to hold poison paste and wax in place. It is as of yet unknown whether poison residue exists on the end of the stick, vital support for this argument. This artifact dates to 24,000 cal. B.P. and corresponds to the MIS2 to MIS transition (Villa *et al*. 2012).

Analysis of the macrobotanical specimens from Border Cave support the argument that by 44,000 years ago, the inhabitants of the site were already utilizing several of the complex technical and symbolic items associated with LSA and historical Khoesan material culture. Interpretations of the organic remains from Border Cave relied on unambiguous parallels to the habits of living or historically known hunter–gatherers. Villa *et al.* (2012) note that the organic artifacts from the upper layers of Border Cave may represent the oldest substantiated instance of modern culture. These results are significant because the lithic assemblage alone would indicate a gradual evolution toward the Early LSA starting after 56 ka (Villa *et al.* 2012). However, the exceptionally early and abrupt appearance of implements usually associated with LSA and Khoesan material culture underscore an apparent discrepancy in rates of cultural change. D'Errico *et al.* (2012) suggest that the characteristics of modern behavior may be more meaningful when documented at a regional scale. The notched poison applicator dating to 24,000 years ago represents the earliest known secure evidence of the use of poison for hunting purposes and the fourth earliest representation of ground stone processing in in the South African record. Kalahari Khoesan poison their arrows with beetle larvae, snake venom, and plant extracts (Villa et al. 2012), which are not available in the tropical KwaZulu-Natal environment. The poisons identified at Border Cave may represent a regional adaptation to exploit and process local toxic substances.

Melkhoutboom. Melkhoutboom (**Figure 11**), an inland cave in the Eastern Cape, offers a unique opportunity to document systematic plant foods collection (**Table 10**) in the Wilton occupation. Holocene layers dating back to 6000 years that show complete preservation of vegetable material. Well-preserved edible plant remains in the long Wilton Sequence at Melkhoutboom represent a relatively small number of species, dominated by *Watsonia* and *Hypoxis*, in spite of the overall density of local flora (Deacon1972). Corm scales and bases of *Watsonia (Iridaceae)* and leaf sheaths of *Hypoxis* are the most abundant food residues found in the Melkhoutboom sequence and they litter the central domestic space. There are also discarded knotted bunches of the leaves of bulbar plants that give insights into gathering practices (Deacon 1993). Holocene hunter-gatherers from the Eastern Cape relied on geophytes as a stable carbohydrate source supplemented by small bovids as the main source of protein at Melkhoutboom. Roasted whole or ground and cooked into cakes (Deacon 1984), Watsonia, Morea spp., Hypoxis argentea, and Freezia corymbosa were abundant year round though harvested primarily in the spring due to the unpalatability of older winter corms (Hall 1990). Intensified exploitation of non-seasonal food resources is more evident post 4000 B.P. probably due plants that give insights into gathering practices (Deacon 1993). Holocene hunter-gatherers from the Eastern Cape relied on geophytes as a stable carbohydrate source supplemented by small bovids as the main source of protein at Melkhoutboom. Roasted whole or ground and cooked into cakes (Deacon 1984), Watsonia, Morea spp., Hypoxis argentea, and Freezia corymbosa were abundant year round though harvested primarily in the spring due to the unpalatability of older winter corms (Hall 1990). Intensified exploitation of non-seasonal food resources is more evident post 4000 B.P. probably due to the pattern of reduced, more stationary home ranges. Grass lined, stone capped pits contained *Pappea cappensis* seeds, which was

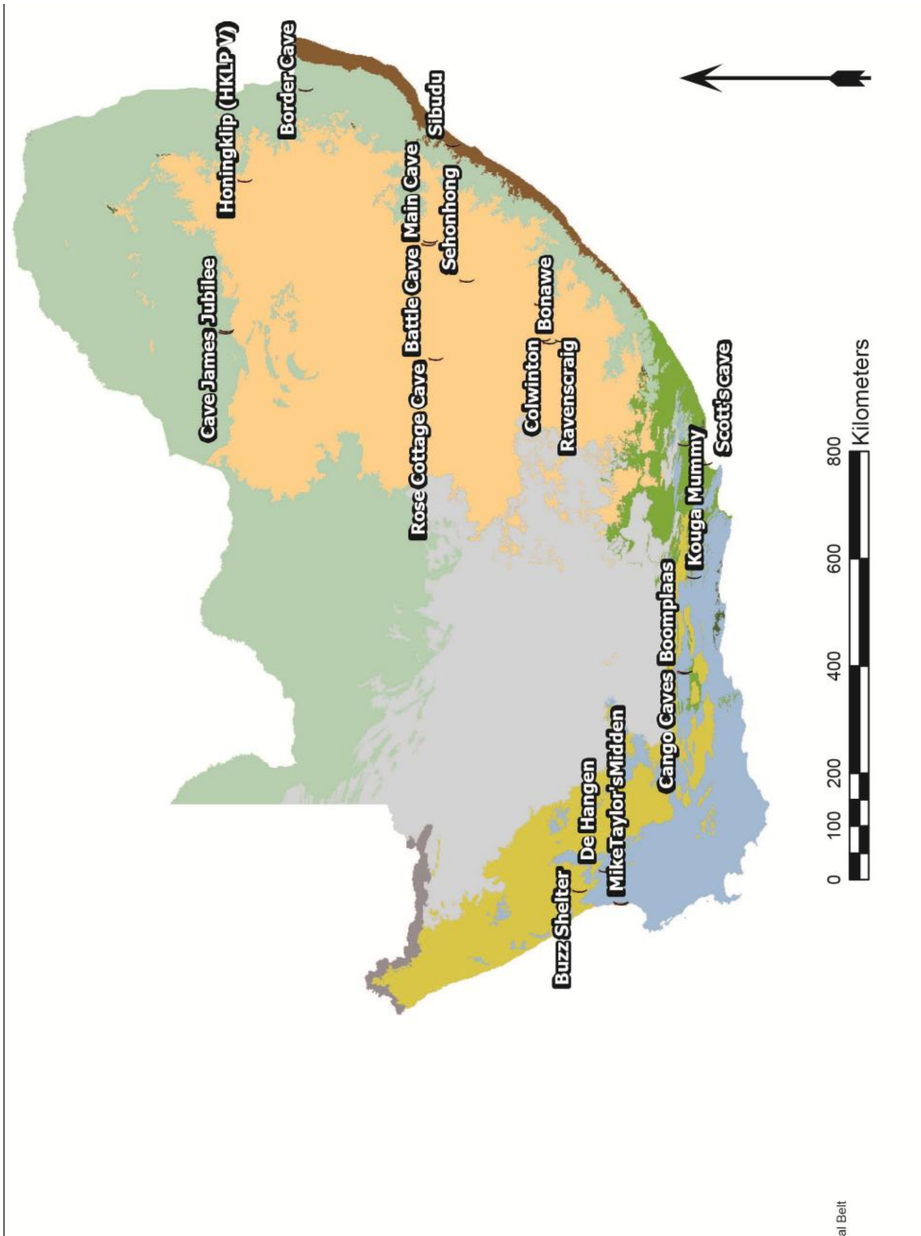

Figure 11. Biome map of LSA archaeobotanical sites. Adopted from Mucina and Rutherford (2006).

often used to make oil for cosmetics (Deacon 1976, Hall 1990), and whose fruits are edible (Fox and Norwood-Young 1982).

Cango Caves. The Cango Caves (**Figure 11**), a popular tourist attraction in the southern Cape known for their spectacular stalagmite formations, were first explored archaeologically by Goodwin in 1925. Cutting an excavation unit in the main cave revealed hearths, artifacts and faunal remains associated with spasmodic human occupation during the Middle and Later Stone Ages (Goodwin 1930). Plant food remains and bedding mats were found in the context of the Later Stone Age occupation **(Table 10**). In conjunction with the excavations of Boomplaas beginning in the mid 1970's, a survey of the archaeological potential of the Cango Caves was undertaken (Deacon 1978) exposing a section of Goodwin's excavation (1930) with an in situ hearth at the top of the sequence. Wood fragments were found below the hearth (1 m. below the surface) and dated to between 7900 and 7500 cal. BP. (Deacon and Vogel 1977). An excavation intended to accommodate an electric cable unearthed corms of *Hypoxis villosa*, also found at Boomplaas, and matting identified as *Cyperus textilis*. Moffett and Deacon (1977) identified *H. villosa* as an important edible plant food throughout the valley.

Boomplaas. Excavations at Boomplaas Cave (**Figure 11**) were undertaken to study the quaternary environments and human adaptations in the Southern Cape (Deacon 1979). The site is situated on a limestone cliff 60 meters above the in the Cango Valley floor with the archaeological deposits originating from a deep fissure. It is roughly 4 km from the Cango Caves in the foothills of the Swartberg mountain range. Excavations in the 1970's (beginning in 1974) uncovered archaeological sequences measuring up to 5 meters in thickness with occupations dating from the Upper Pleistocene through the Holocene, and spanning 80k years. Boomplaas is a significant Southern Cape site, occupied twice during the Later Stone Age, around 6,400 cal. B.P. and again around 2,000 cal. B.P. (BLD Member). Macrobotanicals (**Table 10**) were recovered from underground storage pits radiocarbon dated to the latter BLD member. During an occupation devoid of pottery or faunal evidence of domestic stock and associated with the BLD member, 45 pits (200-400 mm wide) were used to store the mid-summer harvest of *Pappea capensis* fruit. The collection of fruits was not as important outside of the Holocene at Boomplaas and other sites in the region (Deacon 1976).

Ethnographic and pharmacological arguments (Watt and Breyer-Brandwijk 1962) suggest that the inhabitants were using the fruits as a source of a bitter-tasting vegetable oil used in cosmetics, storing them in a grass layer sandwiched between layers of papery leaves from the poisonous bulb, *Boophone disticha* (**Figure 5**). Most of the pits no longer contained the fruits they were likely intended for, but many were still lined with the leaves as a natural wrapping material to repel insects. Edible *in situ* plant remains were scarce, consisting of two potato-like corms of *Hypoxis villosa* and one of *Watsonia sp.* found in (otherwise empty) pit debris. Both are quite common at sites dating to this period, in fact, the same fruits and linings are recorded at Melkhoutboom (Deacon 1976). During the floristic survey, potential food plants were very limited in the vicinity (Moffett and Deacon 1977). These finds, coupled with faunal evidence of hunting (Klein 1978), suggest that Boomplaas was used for repeated short-term occupation as suggested

Table 10. Identified archaeobotanical remains from the South African Later Stone Age.

Family	Taxa	Border Cave	Melkhoutboom Cave	Cango Caves	Boomplaas Cave	Strathalan Cave A	Sehonghong Rock Shelter	HKLP V Cave	De Hangen Cave	Boomplaas Cave	Rose Cottage Cave	Ravenscraig Rock Shelter	Bonawe Rock Shelter	Colwinton Rock Shelter	Mike Taylor's Midden	Tortoise Cave	Spring Cave	Buzz Rock Shelter	Scott's Cave	Kouga Mummy	Jubilee Shelter	Cave James	Total
		d'Errico et al 2012	Deacon 1972	Deacon and Vogel 1977	Deacon 1979		Mitchell 1995	Korsman and Plugg 1994	Parkington and Poggenpoel 1971	Deacon 1979	Esterhueysen 1996	Tusenius 1986	Tusenius 1986	Tusenius 1986	February 1992	February 1992	February 1992	Parkington and Poggenpoel 1971	Wells 1965	Binneman 1999	Wadley 1996	Wadley 1996	
Achariaceae	*Kiggelaria africana*							Macro															1
Aizoaceae	*Carpobrotus edulis*								stems														5
	Ruschia sp.								Macro						Fuelwood	Fuelwood	Fuelwood						
Amaranthaceae	*Amaranthus paniculatus*																		Macro				1
Amaryllidaceae	*Boophone disticha*				Fuelwood					Leaves as Food pit liner								Pest deterrent		Preservative			4
Anacardiaceae	*Ozoroa paniculosa*																					Seeds	11
	Rhus lancea																					Seeds	
	Rhus sp.						Macro		Macro		Fuelwood	Fuelwood	Fuelwood	Fuelwood							Seeds		
	Sclerocarya birrea							Macro													Seeds		
Apocynaceae	*Ancylobothrys capensis*																					Seeds	1
Araliaceae	*Cussonia sp.*							Macro															1
Asparagaceae	*Asparagus sp.*								twigs														1
Asteraceae	*Arctotis sp.*								Inflorescences														8
	Helichrysum expansum								Macro														
	Helichrysum sp.								Macro					Fuelwood									
	Metalasia sp.								Macro														
	Euryops sp.											Fuelwood		Fuelwood									
Burseraceae	*Conophytum sp.*								Inflorescences														
Cannabaceae	*Celtis africana*										Fuelwood		Fuelwood									Seeds	7
	Maytenus sp.										Fuelwood		Fuelwood										
	Pterocelastrus															Fuelwood	Fuelwood						
Combretaceae	*Combretum sp.*							Macro															13
Cyperaceae	*Cyperus or Mariscus*								Grass stems														
	Cyperus Sp. cf. Sphearopermus Schrad.																		Macro				
	Cyperus textilis			Food															Macro				
	Cyperus usitatus																		Macro				
	Ficinia sp.								Macro														
Dennstaedtiaceae	*Pteridium aquilinum*								Macro														1
Dioscoreaceae	*Dioscorea elephantipes*								Grass stems														1
Ebenaceae	*Diospyros lycioides*							Macro													Seeds	Seeds	16
	Diospyros sp.										Fuelwood								Macro				
	Diospyros/Euclea															Fuelwood	Fuelwood						
	Euclea linearis								Macro														
	Euclea sp.						Macro						Fuelwood								Seeds	Seeds	
	Euclea tomentosa								Macro														
	Erica sp.						Macro				Fuelwood		Fuelwood										
Euphorbiaceae	*Euphorbia tirucalli*	Poisonous resin																					6
	Flueggea virosa Roxb. ex Willd. Voight subsp. virosa	Digging stick and poison applicator																					
	Hyaenanche globosa								Macro														
	Manihot sp.							Macro															
	Ricinus communis	Poison							Macro														

Table 10. Identified archaeobotanical remains from the South African Later Stone Age. Continued.

Family	Taxa	Border Cave	Melkhoutboom Cave	Cango Caves	Boomplaas Cave	Strathalan Cave A	Sehonghong Rock Shelter	HKLP V Cave	De Hangen Cave	Boomplaas Cave	Rose Cottage Cave	Ravenscraig Rock Shelter	Bonawe Rock Shelter	Colwinton Rock Shelter	Mike Taylor's Midden	Tortoise Cave	Spring Cave	Buzz Rock Shelter	Scott's Cave	Kouga Mummy	Jubilee Shelter	Cave James	Total
		d'Errico et al 2012	Deacon 1972	Deacon and Vogel 1977	Deacon 1979		Mitchell 1995	Korsman and Plugg 1994	Parkington and Poggenpoel 1971	Deacon 1979	Esterhueysen 1996	Tusenius 1986	Tusenius 1986	Tusenius 1986	February 1992	February 1992	February 1992	Parkington and Poggenpoel 1971	Wells 1965	Binneman 1999	Wadley 1996	Wadley 1996	
Fabaceae	*Acacia karroo*				Fuelwood					Fuelwood													6
	Acacia sp.												Fuelwood						Macro				
	Medicago denticulata																		Macro				
	Schotia afra var. afra																		Macro				
Geraniaceae	*Pelargonium spp.*								Macro														1
Hyacinthaceae	*Ledebouria sp.*								Macro														3
	Velthaemia sp.								Macro														
	Vepris undulata																		Macro				
Hypoxidaceae	*Hypoxis sp.*		Food																				4
	Hypoxis villosa			Food	Food					Food													
Iridaceae	*Babiana sp.*								Seeds and corms											geophyte bundle			18
	Freesia sp.																			geophyte bundles			
	Homeria sp.								Macro														
	Iridaceae																	x					
	Moraea sp.								Macro														
	Watsonia sp.		X		Food	Food			Macro	Food									Macro				
Juncaceae	*Juncus capensis*								Macro														1
Loganiaceae	*Strychnos pungensa*																				Seeds		1
	Grewia sp.																				Seeds	Seeds	2
Meliaceae	*Ekebergia capensis*							Macro															1
Mesembryanthemae	*Mesembryanthemae*								Macro														1
Moraceae	*Ficus sp.*							Macro															1
Oleaceae	*Olea africana*								Macro	Fuelwood													5
	Olea sp.				Fuelwood			Macro					Fuelwood										
Paceae	*Pennesetumm Macrourum*								Macro														1
Poaceae	*Ehrharta calycina*								Macro														3
	Phragmites australis																	x					
	Secale cereale								Macro														
Podocarpaceae	*Podocarpus elongatus*	Adhesive resin																					1
Polygonaceae	*Emex australis Steinh.*																		Macro				1
Prioniaceae	*Prionium serratum*																		Macro				1
Proteaceae	*Brabeiums stellatifolium*								fruit casing														5
	Leucadendron sp .								Macro														
	Protea sp.								Macro		Fuelwood		Fuelwood										
Restionaceae	*Cannamois sp.*								Rush Seeds														3
	Ischyrolepis setiger (Kunth) H.P.Linder								Macro														
	Ximenia sp.																					Seeds	
Rhamnacaea	*Rhamnus sp.*												Fuelwood										3
	Ziziphus mucronata																				Seeds	Seeds	
Rosaceae	*Cliffortia illicifolia L.*																		Macro				8
	Cliffotia sp.										Fuelwood	Fuelwood	Fuelwood	Fuelwood									
	Leucosidea sericea										Fuelwood	Fuelwood	Fuelwood										

Table 10. Identified archaeobotanical remains from the South African Later Stone Age. Continued.

Family	Taxa	Border Cave	Melkhoutboom Cave	Cango Caves	Boomplaas Cave	Strathalan Cave A	Sehonghong Rock Shelter	HKLP V Cave	De Hangen Cave	Boomplaas Cave	Rose Cottage Cave	Ravenscraig Rock Shelter	Bonawe Rock Shelter	Colwinton Rock Shelter	Mike Taylor's Midden	Tortoise Cave	Spring Cave	Buzz Rock Shelter	Scott's Cave	Kouga Mummy	Jubilee Shelter	Cave James	Total
		d'Errico et al 2012	Deacon 1972	Deacon and Vogel 1977	Deacon 1979		Mitchell 1995	Korsman and Plugg 1994	Parkington and Poggenpoel 1971	Deacon 1979	Esterhueysen 1996	Tusenius 1986	Tusenius 1986	Tusenius 1986	February 1992	February 1992	February 1992	Parkington and Poggenpoel 1971	Wells 1965	Binneman 1999	Wadley 1996	Wadley 1996	
Rubiaceae	*Canthium inerme*							Macro															
	Tapiphyllum parvifolium																				Seeds	Seeds	5
	Vangueria infausta																				Seeds	Seeds	
Rutaceae	*Clausena anisata*												Fuelwood										
	Diosma hirsuta								Fruit and leaves														8
Sapindaceae	*Dodonea sp.*				Fuelwood																		
	Pappea capensis		Cosmetic		Cosmetic			Macro		Macro												Seeds	
Sapotaceae	*Englerophytum k. krause*																				Seeds	Seeds	3
	Mimusops sp.																				Seeds		
Scrophulariaceae	*Buddleia salvifolia*										Fuelwood		Fuelwood										2
Solanaceae	*Lycium sp.*								Macro						Fuelwood		Fuelwood						3
Thymelaeaceae	*Passerina montana*										Fuelwood												
	Passerina sp.											Fuelwood		Fuelwood									
Vitaceae	*Rhoicissus digitata*							Macro															5
	Rhoicissus sp.																					Seeds	
Willdenovia striata	*Willdenovia striata*								Macro														1
Xanthorrhoeaceae	*Aloe* sp.																		Macro				1
Zygophyllaceae	*Zygophyllum sp.*														Fuelwood	Fuelwood							2

by the low density of artifact debris and inconsistent supply of plant food. Inhabitants probably visited the cave seasonally following the harvest of *P. capensis* fruits and other plants and animals. The cosmetics derived from B. disticha involve the use of ground stone process and represent the sixthth earliest occurrence in the South African record.

Strathalan Cave A. Watsonia bulbs (**Table 10**), some of which showed evidence of having been chewed or with stems tied together, were discovered at Strathalan Cave A **(Figure 11)** along with digging sticks likely used to harvest them (Opperman 1999). These plant foods were found in context with dossies, klipspringer, and grey roebuck. The presence of grazers suggest that subsistence had broadened by 3000 cal. B.P. in conjunction with patterns of reduced seasonal movement (Klein 2002).

Sehonghong Shelter. The site of Sehonghong Rock Shelter (**Figure 11**) it important because it is one of the few sites in southern Africa that contains an uninterrupted sequence of MSA and LSA assemblages. The site is helpful in the dating of the transition between the MSA and the LSA, though only the LSA occupation is discussed due to the presence of plant remains from that period. Sehonghong is the only known site in Lesotho at which any plant remains (**Table 10**) have survived from the MSA. MSA materials from the site span a period of 50,000 years, from 70,000 to 20,000 cal. B.P., a period that was marked by increasingly cool temperatures as well as by lowered faunal and botanical diversity. Sehonghong is even more remarkable considering that many sites in southern Africa, including Klasies River Mouth Cave, were abandoned at around 70,000 cal. BP as the climate worsened. The deteriorating climate in the years leading up to the Last Glacial Maximum may have encouraged hominids to become more efficient and more productive in their tool making, tool use, and subsistence activities. The site was reused over many thousands of years, although it was never occupied on a permanent basis. Sehonghong may have been exploited seasonally as environmental conditions worsened, and the site was possibly part of a network of sites visited by groups that supplement their resource supply. Information from the original excavation suggested that macrobotanical preservation at Sehonghong, while good, was largely restricted to the Holocene horizons (Carter 1978; Carter *et al.* 1988), although an 'organic mass' (**Table 10**) was noted beneath a rock in a pit dated to 11,000 cal. BP (Carter 1971).

Several grindstones, dated to 10,300 cal. B.P., were found and given the good quality preservation of plant remains in this layer, together these lines of evidence may be significant in building up a picture of terminal Pleistocene plant food exploitation at the site. These are the earliest known grinding stones associated with plant remains in the South African record and and the fifth earliest representation of ground stone processing. Analysis of any remaining organic residues on grindstone surfaces is needed, however, the only direct evidence for grindstone use is the presence of heavy red ochre-staining on one upper and one lower grindstone from RBL/CLBRF and on one of the two lower grindstones. Of the forty-seven artifacts from Layers RF and RBL/CLBRF, dating to 11,000 cal. B.P. (MIS2), all but four of them are partly covered by a thin, glossy black film that appears to be the remains of mastic. The location of the mastic is most consistent with bladelets having been hafted in series, such as is the case with a knife. The Rockfall layer at Sehonghong (5000 to 1000 cal. B.P.) consists of a major rock fall within and below which is a black, organic-rich loam with excellent macrobotanical preservation. Detailed observations during excavation indicate that at least three rock fall events, possibly occurring in fairly rapid succession, are present, since plant remains and artifacts are interstratified with the rocks. The macrobotanical remains include carbonized and uncarbonised grasses, seeds and fragments of twigs, wood and leaves. Identifications obtained so far include seeds of *Rhus* sp. and *cf. Euclea* sp. as well as woody tissues of *Erica sp*. (Mitchell 1995), suggesting that the plants were collected as food, fuel and bedding.

Honingklip Caves. The excavation of two LSA cave sites, HKLP I and HKLP V, at Honingklip farm was undertaken by H. F. Sentker between 1962 and 1975. The analysis of the excavated remains was undertaken by Korsman (1990) for her master's thesis and published by Korsman and Plug 1994. Relying on artifacts and old field notes and documentation, the study focused on insights into the Holocene occupation of the eastern Transvaal. Only the site of HKLP V (**Figure 11**) produced macrobotanical remains (**Table 10**), so it is the only of the two that will be discussed in further detail.

HKLP V is a small rock shelter formed by large fallen boulders with a steep southern terrace facing HKLP I (the neighboring site that lacks plant remains). There are traces of small rock paintings in bad condition on two boulders supporting the roof of the shelter. Charcoal fragments from the hearth context constrained the occupation to the last 300 years (cal. B.P.). Fragments from the main excavation were insufficient for dating purposes but the cultural assemblage is typologically similar to the dated gravel layer at HKLP I. Roughly regarded as contemporary, both are dated to around 4500 cal. B. P.

Twelve species were identified in the macrobotanical analysis (Korsman and Plug 1994) and possible uses were inferred and organized into categories including domestic, food procurement (digging stick wood), medicinal, food source, and magical properties. The domestic species were *Combretum* sp., *Rhoicissus digitata*, *Pappea capensis, Ficus* sp., and *Olea sp*. Taxa used in food procurement, such as those used for digging stick wood, include *Combretum* sp., *Ficus* sp., and *Olea* sp. Medicinal taxa include *Combretum* sp., *Canthium inerme, Rhoicissus digitata, Cussonia* sp., *Ficus* sp., *Olea* sp., and *Sclerocarya birrea.* The species with magical properties are *Combretum* sp., *Rhoicissus digitata, Ficus* sp., and *Diospyros lycioides.* These medicinal and magical plants are the earliest archaeological representation of their kind. All of the identified taxa were indicated as food sources with the exception of *Ekebergia capensis* and *Kiggelaria africana*. Unfortunately, Korsman and Plug (1994) did not provide the basis for these uses, though it can be assumed that they were sourced from existing archaeological and ethnobotanical literature. A single taxonomically unknown piece of wood was recovered from a shallow context and identified as a peg used to stretch skins during the drying process.

De Hangen. De Hangen (**Figure 11**) is a north facing sandstone cave located at an altitude of 580 meters and 18 km south of the Doom River and 8 km south east of the Olifants River. Excavations at De Hangen (Parkington and Poggenpoel 1971) unearthed a significant amount of macrobotanical remains (**Table 10**), including seeds, corms and bulbs that were analyzed and related to prehistoric diets during the LSA. Two radiocarbon dates place the macrobotanical assemblage at around 1700 cal. BP. and the last 300 years (cal. B. P.). Much of these remains are believed to be food debris since plants do not grow in this main cave chamber and herbivorous animals are unlikely to remove their plant foods to the cave. Non-food explanations for the remains could have been that they were introduced on animal coats, as firewood, as components of tool manufacture, or inside bundles of grass bedding. The identified plants include *Ehrharta calycina, Pennesetum macrourum, Juncus capensis, Cyperus or Mariscus, Cyperus textilis, Ischyrolepis setiger (Kunth) H.P.Linder, Willdenovia striata, Cannamois* sp., *Ficinia* sp., *Helichrysum expansum, Helichrysum* sp., *Diosma hirsuta Berg, Protea* sp., *Leucadendron* sp., *Dioscorea elephantipes, Euclea tomentosa, Euclea linearis, Olea africana, Rhus* sp., *Ricinus communis, Secale cereale, Hyaenanche globosa, Pelargonium spp., Ledebouria* sp., *Brabeium stellatifolium, Carpobrotus edulis, Ghaukum Moraea* sp., *Homeria* sp., *Babiana* sp., *Watsonia* sp., *Velthaemia* sp., *Passerina or Struthiola (Thymeliaceae), Pteridium aquilinum, Lycium* sp., *Asparagus* sp., *Arctotis* sp., *Metalasia* sp., *Conophytum* sp., *and Ruschia* sp..

The identified macrobotanical remains at De Hangen are associated with food, bedding, string, arrow shafts, arrow poison, containers made of leaves, digging sticks, medicines, cosmetics, and fuelwood. Fruits and rootstocks comprised most of the edible plants. The drupes and berries of shrubs and trees, such as from *Euclea*, *Rhus*, *Leucadendron*, *Olea*, and genera of *Restionaceae* (*Restio, Willdenovia, Cannamois, Ficinia*), were collected and eaten and perhaps ground and made into cakes that could be roasted over coals and stored for times of food shortage (Schapera 1933). Rootstocks (corm bases, bulb cases and tuber cases) are very common in the deposits, especially the grass layer and were likely harvested from the veld with the aid of the digging-stick.

Bedding plants were most commonly grasses including: Ehrharta and Pennesetum, a species of Juncus, the genus Helichrysum, and a member of the *Cyperaceae*, Cyperus or Mariscus. Many seeds, leaves, twigs, corms and bulbs were found within the bedding layer and are believed to have been accidentally included in the bedding bundles when they were brought to the cave or were eaten as food that later became integrated into the bedding material. The flowering season for these plants is October to December, suggesting that they could not have been harvested with their flowers much later than December.

Excavated string was made from *Cyperus textilis* and a genus of *Thymeliaceae (Passerina* or *Struthiola)*. The former was also used in the manufacture of mats or trays. Short lengths of a reed shaft have been implicated as arrow shafts and tentatively identified as *Phragmites communes*. The seeds of the poisonous *gifboom* tree/shrub (*Toxicodendron capense/Hyaenanche globosa*) were used as a source of arrow poison. Various members of the family *Liliaceae* have large underground bulbs coated with bulbar leaves. The leaves of one of this family (possibly *Velthaemia*) were found wrapped around some black mussel shells at De Hangen. Clearly the large bulbar leaves were used to parcel up supplies of various commodities to facilitate their transportation. Other plant resources remain as yet unidentified. Thus the woods used in the making of digging-sticks may prove to be *Rhus* or *Tamarix* and the fragments of painted wood may be *Cotyledon* or one of the aloes, but these are only preliminary guesses. Similarly the identity of seeds used as beads has not yet been revealed. One interesting element in the list of plant remains is *Diosma hirsuta*, a *buchu* plant discussed in Chapter 3. This was used as a deodorant by mixing with grease or fat and then applying it to the body. Large amounts of wood and seeds from the *Proteaceae* were unearthed and were likely used as firewood (Parkington and Poggenpoel 1971)

Later Stone Age Charcoal Analysis

Boomplaas. The analysis of charcoals (**Table 10**) from Boomplaas Cave (**Figure 11**), dated to between 9,000 and 17,000 cal. B.P. (MIS1), was employed in order to shine a light on the formation of the modern habitat in the Cango Valley. Moffett and Deacon (1977) carried out a vegetation study of the habitats surrounding the site. They completed a floristic study of each of the Cango valley vegetation types and made a collection of all plants that were either in flower or in fruit. Plants presenting reproductive structures are much easier to identify to the species level than those without reproductive structures. These specimens were identified and an ethnographic study of modern plant use by elderly inhabitants of the area. The GWA/HCA Member deposits, associated with the Robberg are roughly contemporaneous with the last glacial maximum (17,500 years ago) when environmental conditions were cold (five degrees Celsius cooler than today) and similarly as dry as the Karoo. The charcoals indicate that small shrubs dominated fuelwood selection, suggesting that woodland had disappeared from the valley.

The EXDA analysis of the LSA charcoals from Boomplaas suggest that *Acacia karoo* was the major fuelwood species during the Holocene. Burnt organic material was discovered with hearths in a carbonized loam layer (CL Member); the product of intensive occupation, associated with the Robberg, radiocarbon dated to between 14,500 and 12,000 years ago. Climates were cooler than today, with charcoals from the *Olea/Dodonaea* group (olive trees) superceding *A. karroo* as the dominant type. The BRL member dated to 9000 to 11,000 cal. B.P. was rich in floral, faunal, and lithic artifacts, and contained charcoals that helped to identify a relatively dry environment spanning several occupations.

Rose Cottage. In 1992, Wadley *et al.* conducted a preliminary study of charcoals (**Table 10**) from Rose Cottage Cave (**Figure 11**) that originated from deposits dating to roughly 68,000 cal. B.P. to 31,100 cal. B.P. This analysis revealed that the vegetation at Rose Cottage Cave reflected the climate change that marked the beginning of the Holocene. Vegetation shifted from *Protea* and heathland species that dominated the later Pleistocene vegetation to the 'scrub thicket' associated with Holocene vegetation.

Following up on the discovery of such marked climatic sensitivity, Esterhueysen (1996) analyzed a larger charcoal sample (1276 pieces) from layers dating to between 12,700 and 5000 cal. B.P., and sixteen taxa were identified. The terminal Pleistocene layers show a great deal of species diversity: *Cliffortia spp*., *Protea spp.*, *Leucosidea sericea Rhus spp.*, *Celtis africana*, *Maytenus* sp., *Passerina montana* and *Diospyros sp*., *Buddleia spp.*, and *Olea africana*. The most prominent taxa throughout Pleistocene and the Holocene, *Cliffortia spp.*, *Leucosidea sericea*, *Olea africana* and *Protea spp.* are highly favored by the Basotho as 'good burners' (Guillarmod 1971). *Rhus spp*. is known experimentally to produce an excellent charcoal (Archer 1990).

While fuelwood species did not vary greatly from the Pleistocene to the Holocene, the dominant vegetation did change. The larger charcoal sample revealed a greater number of plants than the initial study, which allowed for this paleoclimatic reconstruction based on plant adaptations. Taxa adapted to cooler alpine macchia-type climates dominated the landscape at around 12,900 to 12,500 cal. BP., including

Cliffortia and *Erica*, *Protea spp*., *Leucosidea sericea* and *Rhamnus prinoides*. Warmer conditions during the Holocene led these taxa to decline as woodland taxa, including *Celtis africana*, *Rhus spp.*, *Maytenus sp*., *Diospyros sp*., *Olea africana*, and *Buddleia spp*. The LSA charcoal assemblage from Rose Cottage is biased towards choice fuel, but the shift in taxa through time suggest that selectivity is bound by availability (Esterhueysen 1996).

Later Stone Age Fuelwood Selection at Eastern Cape Cave Sites. The examination of archaeological charcoals by Tusenius (1984, 1986, 1989) from Eastern cape cave sites excavated by Opperman (1987), was initiated in order to provide comparative information regarding the scale and direction of environment changes during the Holocene above and below the Drakensberg Escarpment. This discussion will address only the implications for fuelwood selection, rather than the paleoenvironmental reconstruction. The cave sites included in this study are Ravenscraig and Colwinton, which are above the escarpment, and Bonawe, which is below the escarpment. The earliest dated charcoals were found at Ravenscraig, followed by Bonawe, and Colwinton and are discussed in this order.

Ravenscraig rock shelter (**Figure 11**) is located along a sandstone krans (shear rock face) on the western side of the Sterkspruitkloof at 1850 m. above sea level. The oldest charcoal remains date to 10,200 cal. B.P. (Tusenius 1984). The identifiable charcoals (**Table 10**) were *Leucosidea* sp., *Cliffortia* sp., *Rhus* sp., *Passerina* sp., and *Euryops* sp. (Tusenius 1984). The assemblage is dominated by *Leucosidea sericea* when the relative frequencies of *Euryops* are lower (Tusenius 1986), for example, prior to 10,000 BP and after 3000 BP. as at Colwinton (Tusenius 1989).

Identified charcoals (**Table 10**) from Bonawe rock shelter (**Figure 11**) dating to between 9000 and 8500 cal. BP. or after, include *Celtis Africana, Acacia* sp., *Leucosidea sericea, Cliffortia* sp., *Rhus* sp., *Rhamnus* sp. *Erica* sp., *Olea* sp., two different species of *Protea*, and an unknown legume. Additionally, other charcoals were provisionally identified as *Clausena anisata, Maytenus/Pteroelustrus* sp., *Euclea/Diospyros* sp., and *Buddleia* sp. (Tusenius 1986). The relatively even distribution of *Euclea/Diospyros, Acacia*, *Maytenus/Pteroelustrus, Rhus* and *Olea* prior to between 2500 and 2000 cal. B.P. suggest a preference for the most nearest available species. The selection of *Olea* and *Rhus* at between 9000 and 8500 cal. BP. (Tusenius 1986) probably indicates that there was a small range of woody taxa available given the contrast of low diversity in the early Holocene and the high diversity in the late Holocene.

Colwinton Rock shelter (**Figure 11**), 1830 meters above sea level, lies on the eastern side of the Langkloof, a 160 km long valley in South Africa, lying between Herold and Humansdorp. Identified charcoals (**Table 10**) include *Euryops* sp., *Helichrysum* sp. *Passerina* sp., *Cliffortia* sp., and *Rhus* sp. The most significant trend at Colwinton concerns the relative frequencies of *Euryops*. There is a high frequency from 7300 to 7000 cal. BP, the earliest dated charcoals at the site, whereas there is almost none dated to the last 2000 years. In these latter layers that *Cliffortia* accounts for over 50% of the specimens (Tusenius 1989). The distribution of fuelwood species throughout the deposit is fairly even, suggesting that inhabitants were collecting a random sample of the surrounding vegetation rather than relying on a single species. The early to mid-Holocene charcoal at Colwinton indicates that the winters were harsh since small shrubs, such as Euryops, was the best fuelwood available (Tusenius 1986), when Leucosidea sericea, a superior fuelwood not present in the botanical assemblage from this period, would have been preferred.

Southwestern Cape Fuelwood Charcoals. The comparison of charcoals (**Table 10**) from three Elands Bay sites (**Figure 11**; February 1992) focused on the interpretation of environmental conditions and fuelwood selection strategies. The sites discussed here include Spring Cave, Tortoise Cave and a midden excavated by Mike Taylor (MTM), Charcoals were identified by comparisons with modern specimens harvested from the vicinity of the sites and radiocarbon dated to between 4200 and 460 c14 cal. BP. Most importantly, the modern environmental taxa compliment the charcoal assemblage from all of the sites.

The identifiable taxa from all three sites are represented at Spring Cave and include *Ruschia* sp., *Pterocelastrus,* sp., *Lycium* sp., *Zygophyllum* sp., *Rhus* sp., *and Dios/Euclea sp.* The woody species growing in the vicinity of MTM and Spring Cave are dominated by *Rhus* sp., *Zygophyllum morgsana, Ruschia frutescens, Ruschia maxima* and *Euclea racemosa.* The dominant woody species growing in the vicinity of Tortoise cave are *Diospyrol glabra. Zygophyllum morgsana* and *Rhus* sp. Identifiable macrobotanical taxa from Tortoise cave include *Ruschia* sp., *Pterocelastrus,* sp., *Zygophyllum* sp., *Rhus* sp., *and Dios/Euclea* sp. The oldest charcoal sample, dating to 4200 cal. BP. (February 1992), comes from this site and is associated with a high percentage of *Ruschia* compared with the other sites. Identifiable taxa from Spring Cave include *Ruschia* sp., *Pterocelastrus,* sp., *Lycium* sp., *Zygophyllum* sp., *Rhus* sp., *and Dios/Euclea* sp. Identifiable taxa from MTM include *Ruschia* sp., *Lycium* sp., *Zygophyllum* sp., *Rhus* sp., *and Dios/Euclea* sp.

The narrow selection (bias) of fuelwood taxa is indicative of human collection at all of the sites. Ruschia sp. is the preferred fuelwood throughout the region but it was only consistently used at Tortoise cave. The assemblage at Tortoise Cave doesn't appear to be subject to the same climatic constraints as the coastal sites, MTM and Spring Cave (February 1992).

Later Sone Age Macrobotanical Remains

Namaqualand. Recent excavations at two stratified LSA sites (Orton *et al.* 2011), with MSA artifacts on their talus slopes on the Knerrvlakte, a region of a hilly terrain covered with quartz gravel in Namaqualand in the north-west corner of the Western Cape Province in southern Namaqualand, have produce significant macrobotanical remains (**Table 10**). The sites included in the study are the adjacent Reception and Buzz shelters (**Figure 11**). Both sites have MSA artifacts eroding out of their talus slopes, but only the LSA deposits are intact. The detailed macrobotanical analysis of both sites is still in progress, so only the preliminary observations are presented here. The sites are 43 km inland from the coast on a farm situated on the Varsche River. The shelters are cut out of coarse-grained, quartz-rich limestone cliffs, cut by the river. Dating and identification of the macrobotancial artifacts is still at an early stage. Dates and taxonomic determination are provided here in their current state of availability. The chronological presentation of the sites in this section is also based on these limited dates.

Buzz Rock Shelter is a south facing rockshelter situated in a small side valley on the north bank of the Varsche River. It is 270 meters north of Reception Shelter. LSA material littered the drip-line region and the floor inside was covered with modern sheep or goat dung, though the talus showed evidence of MSA artifacts.

Three pieces of string or rope and three fragments of knotted netting were dated to between 5400 and 500 cal. BP. The string undoubtedly from the same original piece and made from three strands braided together. The netting was constructed from a thinner string made from two strands twisted together suggesting that the fragments of string and netting found at the site might have been used for carrying plant foods (Deacon 1976) such as the small and bulbs in abundance at Buzz Shelter. Several cut sections of the reed *Phragmites australis* were also found. A small, hard, slightly sticky resinous lump, probably mastic, was found in Layer 5 indicating that is was older than 5400 and 500 cal. BP.

Much of the macrobotanical remains from the site are undated. Wood shavings shavings and at least three pieces of worked wood were found in the undated upper two layers. They are found in context with stone adzes thought to have been woodworking tools suggesting active woodworking at the site. Also undated were fragments of poisonous *Boophone disticha* bulbs which may have been placed above pits in order to ward off animals that could have dug out the pits to get to the stored foods. A folded wad of *Boophone* had to have been folded while still fresh and green; the leaves would otherwise crack. Worked and unworked examples of the aquatic plants *Phragmites australis* and *Cyperus textilis* were present at Buzz Shelter, despite the lack of marshland along the Varsche River. These were dominated by more of the short cut lengths that resembled arrow shafts similar to those found by Deacon (1976) at Melkhoutboom.

Reception Rock Shelter is at southwestern end of a limestone outcrop near the top of the cliff line on the south bank of the Varsche River. All of the macrobotanical remains were found between the oldest LSA dates at Level 15a, (800 to 600 cal. BP) and the youngest dates at Level 1 (700 to 300 cal. BP.). Two wood shavings associated with woodworking were found in Level 3. Five macrobotanical artifacts associated with the main bedding unit date to Layer 5. but only two have been described in any detail and none have been taxonomically identified. One is a wooden peg used either for stretching skins or for hanging items on the cave walls (Parkington and Poggenpoel 1971; H. Deacon 1976). Two pieces of string, both tied in loops, seem to be made of grass but with fibres of different thicknesses. No braiding occurs—the fibers simply run parallel to one another.

The detailed study of the macrobotanical remains from Buzz and Reception shelters is still underway, however Orton *et al.* (2011) have noted that similar species, including edibles, are present at both sites. The bedding deposits composed of dense grass include at least two species. Members of *Iridacea*, which are associated with the genera *Moraea* and *Ferraria* were found throughout the Holocene layers. Both are common throughout Namaqualand (Le Roux 2005) and the spring to late summer harvest of these plants may be indicative of the seasonal occupation of the shelter.

Scott's Cave. Scott's Cave (**Figure 11**) is an LSA site located in the Gamtoos valley excavated in 1963 by H. J. and Janette Deacon. The removal of collapsed roof blocks exposed bedding heaps overlying a matrix of soil and plant remains (**Table 10**), stone, wood and bone implements, string, leather, shell, pottery and bone fragments. The homogenous, single occupation of Scotts Cave was dated to between 1300 and 800 cal. BP and 500 and 200 cal. BP. (Deacon 1967). The goal of the analysis of the plant remains (Wells 1965) was to determine the likelihood that plant deposits from Eastern Cape cave sites contained useful botanical and archaeological information.

This early macrobotanical study sought to develop a methodology for the excavation, taxanomic identification, and possible ethnobotanical utilization of the remains. The morphological components were sorted by fragment type and identified as *Cyperus textilis*, *Cyperus usitatus*, *Cyperus* sp. *cf. Sphaerospermus Schrad., Schotia afra* var. *afra*, *Amarantus paniculatus*, *Cliffortia illicifolia*, *Dioscorea* sp., *Watsonia* sp., *Medicago polymorpha*, *Aloe* sp., *Acacia karroo, Emex australis, Prionium serratum,* and *Vepris undulata*. *Cyperus textilis* was used to make mats and string. *Schotia afra* var. *afra* seeds, *Cyperus usitatus* bulbs, *Amarantus paniculatus* leaves, and *Freesia* or *Tritonia* corms were probably used in some way, though *Schotia afra* var. *afra* and *Cyperus usitatus* may have also been eaten.

This analysis of macrobotanical remains allowed archeologists to expand their understanding of LSA beyond the evidence from lithic analyisis. Wells argued that the composition of the macrobotanical assemblage provides circumstantial evidence of the use of digging instruments for harvesting bulbs and sharp cutting instruments to produce curled wood shavings. Additionally, many of the plants were identified in the modern vegetation, on the slopes around the cave, while the presence of water-loving plants might be indicative of the stream that may have shaped the cave. The flowering and fruiting schedule of the remains suggest that the occupation of the cave occurred in the growing season, between August and April, though seeds, corms and bulbs could also have been collected between May and July indicating a winter occupation.

Kouga Mummy. A Khoesan mummy found in a cave in the Kouga/Baviaanskloof area of the Eastern Cape (**Figure 11**) provide a significant instance of symbolic plant use in the context of ritualized burial. Binneman (1999) discovered the burial while excavating a stone slab decorated with Khoesan paintings. The slab represented the first recording of a painted stone used for marking a prehistoric grave found during controlled excavations. Beneath the slab were two layers of sticks and branches, followed by a layer of *Boophone disticha* leaves (**Table 10**). The overlying branches from the grave were radiocarbon dated to between 1900 and 1700 cal. BP. The entire body, lying in flex 0.8 m. deep, was covered in a thick layer of the leaves, which likely accounted for the well-preserved skin tissue. Bundles of geophytes, *Babiana spp.* or *Freesia spp*., placed with the body, indicate an August or early September burial, when the plants would have been in season.

The psychoactive value of *B. disticha* is well-documented (Winkelman and Dobkin de Rios 1989; Mitchell and Hudson 2004) and discussed in more detail in the ethnobotany chapter of this work. In Khoesan ethnomedicine *B. disticha* symbolizes eternal life (B.-E. van Wyck 2008), a powerful association in the context of an intentional mummification. Together with the painted slab, these archaeobotanical remains exemplify a rare instance of a Cape burial with fully intact symbolic components.

Magaliesberg Seeds From The Later Stone Age

The analysis of seeds from the Later Stone Age occupation at Jubilee Shelter was compared to an equivalent seed assemblage from Cave James, also located in the Magaliesberg region of the North West Province, in order to examine the archaeological evidence for contact between hunter–gatherers and agropastoralists during the mid to late Holocene and more recent occupations. Seasonal indicators, including seeds (**Table 10)**, suggest that Jubilee and Cave James (**Figure 11**) were used differently. Autumn/winter fruits are represented in the Jubilee mid-Holocene levels, while spring/summer fruits are found in Cave James. The Jubilee mid-Holocene assemblage was probably an autumn/winter aggregation camp, while James was a spring/ summer dispersal phase camp (Wadley 1987, 1989, 1996).

Jubilee Shelter. Jubilee Shelter is on the northern slopes of the Magaliesberg in a bushveld environment. The site dates to between 7700 to 6900 cal. BP. and 3600 to 2900 cal. BP. Edible underground plants seeds identified from the site include *Vangueria infausta*, *Englerophytum K. Krause*, *Rhus* sp., *Diospyros lyciodes, Grewia* sp. (summer and winter spp.), *Tapiphyllum parvifolium, Euclea* sp.*, Ziziphus mucronata, Sclerocarya birrea, Mimusops* sp.*,* and *Strychnos pungensa.* These plants are associated with mid to late Holocene occupation dated between 6400 to 3100 cal. B.P. and less than 1200 cal. B.P. The seed evidence from Jubilee Shelter indicates winter occupation by foraging groups, especially since winter plant resources are quite numerous in the bushveld (Wadley 1984; 1996).

Plant remains in all but the latest pottery levels are from winter fruits. In the pre-pottery levels dating between 7400 and 3200 cal. B.P (Wadley 1984), remains of the autumn/winter marula fruit (*Sclerocarya birrea)* continue in these levels but a few seeds of spring/summer fruits are included. During the Late Iron Age contact period, after 680 A.D. (in the undated levels), the plant food collection pattern shifted from heavy reliance on marula and other autumn/winter fruits to steady utilization of summer fruits. The implication is that shelter occupants changed their former seasonal mobility in order to remain in the area for longer periods. These changes at Jubilee Shelter suggest increased dependence of the hunter–gatherers on the Iron Age village of Braedersdorp, which caused their causing their aggregation and dispersal patterns to be disturbed.

Cave James. Cave James, a few kilometers away, is a hilltop site surrounded by sour grassland. Cave James has occupations dating from 7000 to 4200 cal. BP. (Wadley 1996). Edible underground plant seed identified at the site include *Ancylobothrys capensis, Vangueria infausta*, *Ximenia* sp.*, Englerophytum K. Krause, Diospyros lyciodes, Grewia* sp.*, Tapiphyllum parvifolium, Rhus lancea, Euclea* sp.*, Celtis africana, Ozoroa paniculosa, Rhoicissus* sp.*, Pappea capensis,* and *Ziziphus mucronata.* Autumn/winter fruits are represented in the Jubilee mid-Holocene levels, whereas spring/summer-bearing fruits are present in Cave James. Thus the Jubilee mid-Holocene assemblage was probably an autumn/winter aggregation camp, while James was a spring/summer dispersal phase camp.

Wadley (1996) explained the different behavior at the two sites using the Khoesan model of aggregation and dispersal. Assimilation of Khoesan by agropastoralists was and still is common. Aggregation was an opportunity for information about the condition of the veld and the abundance of resources to be exchanged between people subsisting in different ways. In addition, those who married or worked outside of their original social scheme were able to gather with their relations for activities such as, group hunting, socializing, tool preparation, gift exchange, marriage brokering, and ritual (Lee 1979, Silberbauer 1981).

Botanical Pigments and Plant Depictions in Historic Rock Art

Plant signatures have been identified in pigments from undated historic Khoesan rock arts sites (**Figure 11**) located in the Drakensberg region. Pigment samples were collected from sandstone caves in the Clarens Formation at the Main Cave site at Giants Castle Nature Reserve and Battle Cave site at Injisuthi Nature Reserve in the uKhahlamba-Drakensberg Park (Arocena *et al.* 2008). The mineral composition and micromorphology of the pigment was determined using X-ray diffraction and scanning electron microscopy. X-ray diffraction is one of the primary techniques used by mineralogists and solid state chemists to examine the physico-chemical make-up of unknown solids. The procedure involves the scattering of X-rays on contact with matter, thus changing the radiation intensity, which is then used to study the sample's atomic structure. The samples from this study were exposed either *in situ* or powder diffraction. *In situ* diffraction pattern was collected by directing the X-ray radiation to any mineral of interest in an intact sample through a laser focusing system. In powder diffraction, the mineral was extracted from the sample, ground, and randomly mounted on a glass slide using mineral oil for X-ray diffraction. Mineral identifications were made by the comparison of the resulting XRD (X-ray diffraction) patterns with the JCPDF Powder Diffraction Database 2 using EVATM software.

A scanning electron microscope was used to scan the samples with a focused beam of electrons that interact with atoms in the sample, producing various signals that contain information about surface topography and composition. The resulting images recorded the *in situ* chemical composition of the pigment, estimated using EDAX-4 software that corrects energy spectrum based on atomic number, absorption, and fluorescence factors.

Whewellite, likely from plant sap, was found in all of the samples regardless of color, along with gypsum, alumino-silicates, and quartz. Whewellite is a mineral, hydrated calcium oxalate ($CaC_2O_4 \cdot H_2O$), whose organic content it is thought to have an indirect biological origin. The presence of whewellite in pigments from other Khoesan rock art (Escott *et al.* 2006), in the Kimberly region in Australia (Ford *et al.* 1994), Argentina (Wainright et al., 2002), and the United States (Edwards *et al.* 1998) is attributed to biological activities leading to the deterioration of the pigments, such as fungus. In this study, both globular whewellite from plant sap (such as *aloe vera*) and needle-shaped whewellite from fungal hyphae (associated with pigment deterioration) are present.

The uniform distribution of globular habit crystals in the pigment suggest that *Aloe ferox*, common in the vicinity of the caves, was and purposely added to the pigment as binder or extender. Also, the random orientation of the crystals further indicates that the mineral was uniformly mixed as the pigment ingredients were stirred. Dried aloe sap had strong Raman absorption, corresponding to calcium oxalate stretching vibration, which correlates well with the whewellite identification (Edwards *et al.* 1997). *A. ferox* sap may have also been selected for its whitening properties as calcium oxalate prevents the oxidation of organic matter. Araceno *et al.* (2008) argue that if the whewellite had a fungal origin, the paintings would be in a far worse state and would be found in more localized needle habits. Indeed, these concentrations are found growing locally in cracks developed in the pigment and can be differentiated.

Depictions of plants in rock art are exceedingly rare, though *Aloe ferox* and *Aloe broomii* are depicted in historic San rock paintings (Reynolds 1950), with human figures holding the plants. The yellow leaf juice of both these species contains anthraquinone glycosides, which have purgative effect. The dried latex of *A. ferox* (known as Cape Aloes) has a long history of use, having been exported to Europe since 1761 (Robertson 1979). The rock paintings, dated to 1935 indicate that *Aloe ferox* and *Aloe broomii* were important when there were still semi-nomadic Khoesan inhabiting the area.

Discussion

While the archaeological record reveals very little direct evidence of medicinal plants, ground stone processing is represented early and often. The earliest evidence of ground stone processing is provided by the MSA adhesive residues at Sibudu cave, followed by those found on stone tools from Dieplkloof Rock Shelter. Ground stone processing is not encountered again until the LSA occupation of Border Cave. The earliest beeswax artifact, a bundle of arrow poison, is also the first non-adhesive example of grinding. The Digging stick recovered from this same occupation provides evidence of geophyte harvest, a major component of medicinal plant use. A poison applicator associated with a later occupation, is further indication of the grinding tradition. Corms of *Pappea* *capensis* from Boomplaas would have been crushed in order to extract the oils needed to make the cosmetic they were used for. The first grindstones associated with plant remains are found in the LSA layers at Sehonghong and the first definitive medicinal plants are found HKLP V. Ground stone processing is implicated in the discovery at De Hagen of arrow poison, *buchu* plants, and edible plants known to be mashed into cakes. An indeterminate mastic was found at Buzz rock shelter and likely represents a hunting adhesive. The pigments used in the rock art at the Clarens formation and at the Giant's Castle Nature Preserve were undoubtedly ground, even the non-vegetal ingredients. Together these sites outline the continuity of the practice of ground stone processing since the MSA, punctuated by the occasional appearance of medicinal, edible, and utilitarian plants, which increase in occurrence during the LSA. Preservation bias may explain why none of the archaeobotanical evidence of ground stone processing was specifically associated with medicinal or edible plants. Analysis of plant residues on grinding stones would provide the best evidence for medicinal and edible plant use.

CHAPTER VII

DISCUSSION AND CONCLUSION

The period between 40,000 and 20,000 years ago, the transition from the Middle Stone Age to the Later Stone Age, is poorly understood. Archaeologists question the timing of the transition and disagree about its markers. In an effort to define the transition it is necessary to explore what it is that distinguishes the MSA from the LSA. Archaeologists research the various ways that humans might have changed biologically or socially and how the environment would have affected technology and subsistence. A much more complicated task is to determine our early human ancestors' intentions and what progress may have meant to them, in light of the difficulty of survival.

The emergence of modern human cognition is key to understanding the transition. By 80,000 years ago, populations in South Africa and across the continent harnessed common technological innovations considered by many to be the earliest manifestations of modern human behavior. Ochre was being used as red pigment for utilitarian and artistic activities (Wadley *et al.* 2009; Watts 2010; Henshilwood et. al. 2011), including abstract designs on ostrich eggshell and engravings on pieces of ochre and ostrich eggshell (Henshilwood *et al.* 2009; Texier *et al.* 2010). Pigment was also used to paint marine shell at both coastal and inland sites (d'Errico et al. 2009) and used as personal adornments. Organic and mineral ingredients were used in hafting resins that required a great deal of organization and forethought (Wadley *et al.* 2009). Both of these applications imply the use of ground stone processing. Vital techniques of the LSA included the construction of projectile points and domestic tools out of bone (d'Errico *et al.* 2012), pressure flaking that allowed for refined lithic projectile points (Mourre *et al.* 2010), and the creation of backed lithic tools, which facilitate the production if composite tools (Lombard 2011, McBrearty and Brooks 2000).

The LSA was a culture-stratigraphic unit associated with the last 50,000-40,000 years of human artifacts and defined by a unique assemblage: hafted microlithic tools, bored stones (used as digging stick weights, bows and arrows, polished bone tools, fishing tools, shell beads and ostrich eggshell beads, and wood and bone engravings. The Robberg industry, dated to between 22,000 B.P. and 17,000 cal. B.P. (Villa *et al.* 2012), was the earliest technological expression of the early LSA. The Border Cave Early LSA assemblages are the earliest known occurrence of the LSA in South Africa (Villa *et al.* 2012) The process of change began after 56,000 cal. B.P. and included the decline and abandonment of the complex reduction sequences of the MSA, a tendency toward simplification of stone artifact production, emphasis on microlithic elements, disappearance of stone spear points in favor of the adoption of bow and bone arrows, and the use of arrow poisons.

In the Western Free State, the site of Erfkroon, with its robust Early LSA component, provides further clues to the subsistence patterns that defined the transition. Several partial grinding stones unearthed during excavations highlight the reality of changing subsistence during this period. Bousman and Brink (in prep) hypothesize that the Early LSA involved a shift from more structured subsistence, technology, and mobility strategies to a generally more flexible suite of strategies. Rather than continuing the complex lithic traditions of the MSA, stone tool manufacturing at Erfkroon, as with other

Early LSA sites across southern Africa, underwent a drastic simplification in favor of expedient tools that could do the same job. The appearance of these first grinding stones are further evidence of flexibility with regard to subsistence. Humans at this time were moving away from complex hunting schemes that required a lithic specialization toward foraging strategies that required a new toolkit. In order to know what this new subsistence may have involved it is helpful to explore how modern people use the same tools.

The goal of this exploration of modern plant use was to explore the relationship that modern indigenous people have with the material most commonly associated with ground stone use: medicinal plants. The discovery of plant remains *in situ* would provide the most direct subsistence evidence for the MSA to LSA transition, but since plant remains at Erfkroon have not been preserved, I adopted an ethnoarchaeological approach for my research. My ethnobotanical interviews with traditional healers focused on native plants that are ground or just have a similarly important role in subsistence. Low expectations of extant botanical knowledge led me to record all the information I could get my hands on, resulting the collection of a great deal of proxy information that had never been encountered before.

The occurrence and use of food plants was much more common than had been expected and ground stone processing was ubiquitous with medicinal plants use. The comparison of the plants from the current ethnobotanical study with the archaeobotanical remains from South African Stone Age sites reveals some noteworthy continuity. Many of the plant families and species identified in the Southern African MSA and/or LSA

Table 11. Comparison of archaeobotanical and ethnobotanical plant families of the study.

Family	MSA	LSA	Current Study
Achariaceae	x	x	
Aizoaceae		x	
Amaranthaceae		x	
Amaryllidaceae		x	x
Anacardiaceae	x	x	x
Apocynaceae	x	x	x
Araliaceae	x	x	
Arecaceae	x		
Asparagaceae	x	x	
Asteraceae	x	x	
Boraginaceae	x		
Burseraceae	x	x	
Buxaceae	x		
Cannabaceae	x	x	
Combretaceae		x	
Cunoniaceae	x		
Cupressaceae	x		
Cyperaceae	x	x	x
Dennstaedtiaceae		x	
Dioscoreaceae		x	
Ebenaceae	x	x	x
Erythroxylaceae	x		
Euphorbiaceae	x	x	x
Fabaceae	x	x	
Geraniaceae		x	x
Hyacinthaceae	x	x	x
Hypoxidaceae		x	x
Icacinaceae	x		
Iridaceae	x	x	
Juncaceae		x	
Lamiaceae	x		x
Lauraceae	x		
Loganiaceae	x	x	
Malvaceae	x		x
Meliaceae		x	
Mesembryanthemae		x	x
Moraceae	x	x	
Myrsinaceae	x		
Myrtaceae	x		
Ochnaceae	x		
Oleaceae		x	
Paceae		x	
Penaeaceae	x		
Phyllanthaceae	x		
Poaceae	x	x	x
Podocarpaceae	x	x	
Polygonaceae		x	
Prioniaceae		x	
Proteaceae	x	x	
Restionaceae	x	x	
Rhamnacaea	x	x	x
Rosaceae	x	x	x
Rubiaceae	x	x	x
Rutaceae	x	x	
Salicaceae			
Sapindaceae	x	x	
Sapotaceae	x	x	
Scrophulariaceae	x	x	x
Solanaceae		x	x
Strelitziaceae	x		
Thymelaeaceae	x	x	
Typhaceae	x		
Verbenaceae	x		
Vitaceae	x	x	
Xanthorrhoeaceae	x	x	x
Zamiaceae	x		
Zygophyllaceae		x	

context are still in use today (**Table 11**). Plant families encountered in both the MSA and LSA context as well as in the current ethnobotanical study include *Anacardiaceae,* *Apocynaceae, Cyperaceae, Ebenaceae, Euphorbiaceae, Hyacinthaceae, Poaceae, Rhamnacaea, Rosaceae, Rubiaceae, Scrophulariaceae, and Xanthorrhoeaceae.* These include: *Acacia* sp. *Boophone disticha, Cyperus* sp., *Alepidea* sp., *Aloe ferox, Celtis africana, Artemesia afra, Asparagus* sp., *Combretum* sp., *Cyphostemma* sp., *Ekebergia capensis, Grewia occidentalis, Hypoxis villosa, Ledebouria* sp., *Olea europaea* subsp. *africana, Pappea capensis, Pelargonium spp., Podocarpus falcatus , Rapanea melanophloeos, and Ziziphus mucronata.*

Perhaps the most provocative result was the revelation that the preeminence of medicinal applications in modern plant use is almost universally linked with ground stone processing. Traditional healers still process their medicines with a grinding stones that is morphologically similar to the Stone Age equivalent. The use of ground stone technology has been linked to a potential subsistence shift, though food processing need not have been the motivation for its manifestation during the Early Later Stone Age. Physical and spiritual health concerns feature prominently in the behaviors of modern humans, so why assume that subsistence strategies in the past were not similarly motivated?

It is important to note that this argument does not void the importance of edible plants; rather it broadens the scope of future subsistence-based plant studies. When faced with archaeobotanical ambiguity such as that at Erfkroon, the potential role of medicinal plants should be given equal consideration as edible plants at a given site, when ground stone processing is a factor. Medicinal plants require grinding to a greater degree than edible plants. The edible portions of many plants may be eaten without any processing at all, while a high percentage medicinals must be ground in order to be used. It is possible that a greater amount of time was spent grinding edible plants on a daily basis among groups that relied on non-raw plant foods than on grinding medicinal plants, but the potential variety of plants that require grinding is greater among the medicinal species. The prevalence of indigenous pharmacopeias in a medically modern South Africa is a testament to the stamina of folk medicine. The fact that individuals return to the *ndomba* even after receiving modern biomedical treatment is further evidence of the complexity of perceived wellness.

The implications of these findings are exciting for future research prospects. Since edibility is no longer the supreme requirement of an important subsistence plant, researchers are encouraged to delve into the patterns of medicinal and ritualistic plant use. Such sophisticated use has not generally been associated with MSA peoples and the simplification of the Early LSA toolkit does not otherwise suggest that these later inhabitants were capable of complex processing. It is vital that intrasite spatial patterning is explored in order to determine whether such processing was a constant feature of Stone Age subsistence once it emerged or if its use was determined by environmental variables. Social factors may also have played a role in its continued practice. Regional differences, based on the in depth of analysis of archaeobotanical sites bearing medicinal plants, will be vital to distinguishing the markers of these variables. The rate and quality of archaeobotanical research is vastly improving by way of the pioneering efforts of researchers working to refine complex botanical identification techniques. This research is supported by recent technological advances in every kind of archaeobotanical analysis. With respect to defining the proxy relationship between ground processing and medicinal plants in the archaeological record, it is important that the stones are examined through phytolith and residue studies for medicinal plant signatures.

In general, archaeobotanical research must be expanded so as to increase the quality and size of the South African assemblage, especially in archaeologically underepresented areas such as the Free State. Ethnobotanical research is similarly sparse in this region, relative to the coastal regions of the country, so much more remains to be learned about historic and modern botanical traditions. Certainly, the recent discovery of Engelbrecht's ethnobotanical accounts of the Khoekhoe inhabitants of the Western Free State is quite encouraging since many of the archaeologists and botanists I have encountered through this research have assumed that this kind of early research in the Free State was lost, if it ever indeed existed. Abandoning such unconstructive regional assumptions helps to shrink sample bias, thereby increasing the analytical value of our hypotheses.

APPENDIX I

Table 12. A list of vernacular names for culturally significant plants endemic to the Free State. Species are included on the basis that they are either edible (as food or medicine) or prepared using ground stone processing.

Species	Family	Plant Type	English	Afrikaans	Sotho	Shona	Venda	Tswana	Zulu	Khoi	Xhosa	Origin
Acacia erioloba	Fabaceae	Tree	Camel thorn	*Kameeldoring*	*Mogotlho*							
Acacia karoo	Fabaceae	Tree	Sweet thorn	*Soetdoring*	*Mookana*				*Umunga*			
Acacia mellifera* subsp. *Detinens	Fabaceae	Tree	Black thorn	*Swarthaak*	*Mongangatau*							
Acacia tortilis* subsp. *Heteracantha	Fabaceae	Tree	Umbrella thorn	*Haak-en-steek*	*Mosu*				*Umsasane*			
Agapanthus africanus	Agapanthaceae	Herbaceous	Blue lily	*Bloulelie*	*Leta-le-phofu*				*Ubani*		*Isicakathi*	
Alepidea amatymbica	Apiaceae	Herbaceous perennial	Alepidea	*Kalmoes*	*Lesoko*				*Ikhathazo*		*Iqwili*	
Aloe ferox	Asphodelaceae	Succulent	Bitter aloe	*Bitteraalwynn*	*Umhlaba*				*Umhlaba*		*Umhlaba*	
Arcopus echinatus	Apiaceae	Herbaceous		*Sieketroos, Kaapse platdoring*								Khoesan
Artemesia afra	Asteraceae	Perennial shrub	African wormwood	*Als, alsam, wildeals*	*Lengana*			*Lengana*				
Aster bakeranus	Asteraceae	Herbaceous perennial			*Phoa*				*Udlutshana*		*Unozixekana*	
Athryxia phylicoides	Asteraceae	Aromatic shrub	Zulu tea, bush tea, bushman's tea	*Boesmanstee*	*Sephomolo*				*Ishanelo, ishayelo*		*Icholocholo*	
Boophone disticha	Amaryllidaceae	Bulb	Bushman poison bulb	*Gifbol*	*Leshoma*	*Muwandwe*		*Leshoma*	*incotha*		*Incwadi*	Khoesan
Boscia albitrunca	Capparaceae	Tree	Shepherd tree	*Witgat*	*Mhlopi*				*UmVithi*			
Bowiea volubilis	Asparagaceae	Bulb	Climbing potato	*Knolklimop*					*Iqibisila, gifisila*		*Umagaqana*	
Buddleja saligna	Loganiaceae	Tree	False Olive	*Witolien*					*Icqeba-elimhlope*			
Buddleja salviifolia	Loganiaceae	Tree	Sagewood	*Saliehout*	*Molalatau*				*Isohane*			
Bulbine frutescens	Asphodelaceae	Shrub	Burn jelly plant	*Rankkopiva, balsemkopiva*					*Ibhucu, ithethe elimpofu*			
Bulbine natalensis	Asphodelaceae			*Rooiwortel*					*ibhucu*			
Cassinopsis ilicifolia	Icacinaceae	Tree	Lemon Thorn	*Lomoentjiedoring*	*Ishilokozane*							
Celtis africana	Ulmaceae	Tree	White stinkwood	*Wistinkhout*	*Molutu*				*Ndwandwazane*			
Combretum erythrophyllum	Combretaceae	Tree	River bush-willow	*Vaderlandswilg*	*Modibo*				*Umbondwe*			
Conyza scabrida	Asteraceae	Shrub		*Bakbos, oondbos*	*Isavu*						*Isavu*	
Cotyledon orbiculata	Crassulaceae	Succulent	Pig's ears	*Plakkie*	*Seredile*			*Seredile*			*Imphewula*	
Crinum macawanii	Amaryllidaceae	Geophyte							*Umduze*			Zulu
Deinbollia oblongifolia	Sapindaceae	Tree	Dune soapberry	*Duineseepbessie*	*Iqinisamasimu*							
Dichrostachys cinerea subsp. Africana	Fabaceae	Tree	Sickle bush	*Sekelbos*	*Moretse*				*Ugagane*			
Dombeya rotundifolia	Malvaceae	Tree	Wild pear	*Dikbas*	*Mohlabaphala*		*Mulanga*	*Motubane*	*Inhlizya enkulu*			
Ehretia rigida	Boraginaceae	Tree	Puzzle bush	*Deurmekaabos*	*Morobe*				*Umhele*			
Ekebergia capensis	Meliaceae	Tree	Cape ash	*Essenhout*	*Mididibidi*				*Umnayamathi*			
Elephantorrhiza elephantina	Fabaceae	Herbaceous	Elandsbean	*elandsboontjie*	*Mositsane*	*Mupangara*			*Intolwane*		*Intolwane*	
Eucomis autumnalis	Asparagaceae	Bulb	Pineapple flower	*Wilde pynapple*					*Umathunga*			
Ficus abutilifolia	Moraceae	Tree	Large-leaved rock fig	*Grootblaarotsvy*	*Mphaya*				*Inkokhokho*			
Gnidia kraussiana	Thymelaceae	Shrublet	Yellow heads	*Harige giffbossie*					*Isidikili, imfuzane, umsilawengwe*			
Gomphocarpus fruticosus	Apocynaceae	Shrublet	Milkweed	*Melkbos, tontelbos*	*Modimolo, lebengana, lereke-la-ntja*				*Umsinga-lwesalukazi*			
Grewia flava	Tiliaceae	Tree	Brandy-bush	*Wilderosyntjie*	*Mothetlewa*				*Unhlwampunzi*			
Grewia monticola	Tiliaceae	Tree	Silver raisin	*Vaalrosyntjie*					*Umlalampunzi*			
Grewia occidentalis* var. *occidentalis	Tiliaceae	Tree	Cross-berry	*Kruisbossie*	*Motshwarabadikana*				*Ilanayathi*			
Gunnera purpensa	Haloragaceae	perennial herb	River pumpkin	*Rivierpampoen, wilderamenas*	*Qobo*		*Rambola-vhadzimu*		*Ugobho*		*Iphuzilomlambo*	
Helichrysum nudifolium	Asteraceae	perennial herb	Everlastings	*Hottentotsteebossi, kooigoed*					*Icholocholo, imphepo, isidwaba-somkhovu*		*Isicwe, indlebe zebhokwe, undleni*	
Helichrysum odoratissimum	Asteraceae	perennial herb	Everlastings	*Kooigoed*					*Imphepho*		*Imphepho*	
Heteromorpha arborscens	Apiaceae	Woody shrub	Parsley tree	*Ildepetersielie*	*Mkatlala*				*Umbangandla*		*Umbangandla*	
Hypoxis heterocallidea	Hypoxidaceae	Tuberous perennial	Star flower or African potato		*Moli-kharatsa*				*Inkomfe*			
Ilex mitis var. mitis	Aquifoliaceae	Perennial herb	Cape holly	*Without*	*Monamane*				*Iphuphuma*			
Leonotis leonurus	Lamiaceae	Shrub	Wild dagga	*Wilde dagga*	*Lebake*	*Umhlahlampetu*			*Umunyane*		*Umfincafincane*	
Melianthus comosus	Melianthaceae	Shrub		*Kruidjie-roer-my-nie*					*Ibonya*			
Mentha longifolia	Lamiaceae	Perennial herb	Wild mint	*Ballerja, kruisement*	*Koena-ya-thaba*				*Ufuthane lomhlange*		*Inixina*	
Merwilla plumbea	Asparagaceae	Flowering bulb		*Blouberglelia, blouslangkop*					*Inguduza*			
Mundulea sericea	Fabaceae	Tree	Cork bush	*Kurkbos*	*Mosetla-tlou*				*Umhlalantethe*			
Myrothamnus flabellifolius	Myrothamnaceae	Woody shrub	Resurrection plant	*Bergboegoe*					*Uvukwabafile*			
Myrsine melanophloes	Primulaceae	Tree	Cape beech	*Kaapse boekenhout*					*isiqalaba-selathi, umaphipha*		*Isiqwane-sehlati, isiqalaba-selathi*	
Olea europea* subsp. *Africana	Oleaceae	Tree	Wild olive	*Olienhout*	*Mohlware, motholoari*				*Umnqumo, umquma*		*Umquma*	
Pappea capensis	Sapindaceae	Tree	Jacket Plum	*Doppruim*	*Mongatane*				*Umqhoqwane*			
Pelagonium luridum	Geraniaceae	Herbaceous perennial	Wild geranium						*Ishaqua, uvendle*	*Rabassam, rabas, rooirbas*		
Pelargonium sidoides	Geraniaceae	Herbaceous perennial		*Rabassam, rabas, rooirbas*	*Khoaara e nyenyane*					*Rabassam, rabas, rooirbas*	*Iyeza lezikhali, ikhubalo, icwayiba*	
Pellaea calomelanos	Adiantaceae	Fern	Hard fern		*Lehrometso*				*Inkomankomo*			
Pentanisia prunelloides	Rubiaceae	Herbaceous perennial	Wild verbena	*Sooibrandbossie*								

Table 12. A list of vernacular names for culturally significant plants endemic to the Free State. Continued.

Species	Family	Plant Type	English	Afrikaans	Sotho	Shona	Venda	Tswana	Zulu	Khoi	Xhosa	Origin
Pittosporum viridiflorum	Pittosporaceae	Tree	Cheesewood	*Kasuur*	*Kgalagangwe*				*Unfusamvu*			
Plumbago auriculata	Plumbaginaceae	Shrub or scrambler		*Syselbos*					*Utshilitshili*		*Umabophe*	
Podocarpus falcatus	Podocarpaceae	Tree	Outeniqua yellowood	*Outenikwageelhout*	*Mogobagoba*				*Umsonti*			
Rapanea melanophloeos	Mysinaceae	Tree	Cape beech	*Kaaps boekenhout*	*Mogono*				*Isicalabi*			
Rhamnus prinoides	Rhamnaceae	Tree	Dogwood	*Blinkbaar*	*Mofifi*				*Umnyenye*			
Rhoicissus tridentata	Vitaceae	Shrubby creeper	Wild grape	*Bobbejaantou*					*Isinwazi*			
Rhus lancea	Anacardiaceae	Tree	Karee	*Karee*	*Mokalabata*							
Rhus leptodictya	Anacardiaceae	Tree	Mountain karee	*Bergkaree*	*Mohlwehlwe*							
Salix mucronata	Salicaceae	Shrub or tree	Wild willow	*Wilde wilger, rivierwilger*								
Scabiosa columbaria	Caprifoliaceae	Herbaceous perennial	Wild scabious	*Bitterwortel*					*Ibheka*		*Makgha*	
Scadoxus puniceus	Amaryllidaceae	Bulb	Red paintbrush	*Rooikwas*					*Umphompo*			
Senecio serratuloides	Asteraceae	Herbaceous perennial	Two day plant						*Insukumbili, ibohlololo*			
Senna italica	Fabaceae	Perennial	Wild senna	*Swartstorm, wilde ertjie*								
Sutherlandia frutescens	Fabaceae	Shrub	Cancer bush	*Kankerbos*	*Musa-pelo, musa-pelo-oa-noka, motlepelo*			*Phetola*	*Insiswa, unwele*		*Insiswa, unwele*	
Tarchonanthus camphoratus	Asteraceae	Tree	Camphor bush	*Kanferbos*	*Sefalha*				*Igqeba-elimhlophe*			
Teucrium trifidium	Lamiaceae	subshrub		*Paddaklou, katjiedrieblaar*								
Thesium hystrix	Santalaceae	Shrublet		*Kleinswartstorm*								Griqua and Tswana
Typha capensis	Typhaceae	Reed-like perennial	bulrush	*papkuil*					*Ibhuma*			
Valeriana capensis	Caprifoliaceae	Herbaceous perennial	Cape valerian	*wildebalderjan*								
Vangueria infausta* subsp. *Infausta	Rubiaceae	Tree	Wild medlar	*Wildemispel*	*Mmilo*				*Unviyo*			
Withania somnifera	Solanaceae	Perennial shrublet	Winter cherry	*geneesblaarbossie*	*Bofepha*				*Ubuvimbha*		*Ubuvuma*	
Xysmalobium undulatum	Apocynaceae	Herbaceous perennial	Uzara						*Ishongwe*			
Zantedeschia aethiopica	Araceae	Evergreen herb	Arum lily	*Aronskelk, varklelie, varkblom*	*Mothebe*				*Intebe*		*Inyiba*	
Zanthoxylum capense	Rutaceae	Tree	Small knobwood	*Kleinknophout*	*Monokwane*				*Umnungumabele*			
Ziziphus mucronata	Rhamnaceae	Tree	Buffalo-thorn	*Blinkblaar-wag-'n-bietjie*	*Mokgalo*			*Mokgalo*	*Umphafa, umlahnkosi*		*Umphafa*	
Eragrostis chloromelas	Poaceae	Grass	Curly leaf	*Kruulblaar*	*Moseeka, moseka, seritsane, seritswana, tlanyane, tsane*							
Miscanthus capensis	Poaceae	Grass	Dabagrass, East-coast broomgrass	*Ooskus-ruigtegras, ruigtegras*	*Lesene, mothala*							
Pennisetum thunbergii	Poaceae	Grass	Thunberg's Pennisetum									
Hemarthria altissima	Poaceae	Grass	Swamp couch									
Imperata cylindrica	Poaceae	Grass	Cottonwool grass									

APPENDIX II

Table 13. Free State endemic species and their ethnobotanical application and processing requirement. Species are the same as those listed in Table 12. in Appendix I.

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Acacia erioloba	Fabaceae	Tree	Dry Woodland along riverbeds where underground water is present and on sandy loams and deep Kalahari sand.	Y			Confection	Gum	Eaten	Y							1
							Coffee substitute	Seed	Roasted	Y	Y			Y			1
						Y	Rope	Bark	Stripped and pounded.		Y						1
					Y		Headaches	Bark	Burnt and powdered.	Y	Y		Y				1
							Discharging and infected ears.	Pods	Dried and powdered.		Y				Y		1
Acacia karoo	Fabaceae	Tree	Diverse, most common in wooded grassland and margins of marshy areas.	Y			Coffee substitute	Seed	Burned and ground.	Y	Y		Y				1, 2, 3, 4
							Confection	Gum	Eaten as *Gomme du Cap* (Cape Gum).	Y							
					Y		Colic	Roots	Crushed and mixed into baby food.	Y	Y						
							Stomach ache	Roots	Ground and used in infusion	Y	Y						
							Colds, Conjunctivitis, hemorrage	Bark, leaves and gum.	Decoction	Y	Y	Y					
Acacia mellifera* subsp. *Detinens	Fabaceae	Tree	Dry thornveld, wooded grassland and woodland, brackish soils and Kalahari sand.	Y			Confection	Gum	Eaten	Y							1
Acacia tortilis* subsp. *Heteracantha	Fabaceae	Tree	Deciduous woodland, thornveld, bushveld.	Y			Confection	Gum	Eaten	Y							1
Agapanthus africanus	Agapanthaceae	Herbaceous			Y		Anti-natal and post-natal medicine, newborn medicine	Rhizomes and roots.	Decoction	Y	Y	Y					2
Alepidea amatymbica	Apiaceae	Herbaceous perennial	Grasslands		Y		Colds, chest complaints, asthma, influenza, abdominal cramps.	Rhizomes and roots.	Taken as a decoction, chewed, or dried and inhaled as snuff.	Y	Y	Y	Y		Y		2, 3, 5, 6, 10, 11
Aloe ferox	Asphodelaceae	Succulent			Y		Laxative	Juice	Dried into resin (aloe lump or Cape aloes)	Y	Y				Y		2, 3, 12
							Laxative, arthritis, hypertension, eczema, conjunctivitis, stress.	Roots and leaves.	Boiled for tea.	Y		Y					
Arcopus echinatus	Apiaceae	Herbaceous	Cape fynbos region		Y		Venereal disease, diuretic, demulcent, purgative, bladder ailments, skin irritations, epilepsy.	Roots	Decoction	Y	Y	Y					2, 3, 13, 14
Artemesia afra	Asteraceae	Perennial shrub			Y		Colds, coughs, influenza, fever, appetite, colic, headache, earache, malaria, and intestinal worms.	Roots	Decoction	Y	Y	Y					2, 3, 5, 9
Aster bakeranus	Asteraceae	Herbaceous perennial	Grasslands		Y		Induce sneezing, cleanse nostrils, purgative, emitic, snake bite, venereal disease, stomach complaints, enema for parasites.	Roots	Dried and powered (snuff) or dried powdered and mixed with water as decoction.	Y	Y	Y			Y		2, 3, 5
Athryxia phylicoides	Asteraceae	Aromatic shrub			Y		Purgative, cough, and excessive menstual bleeding.	Leafy twigs and roots.	Decoctions	Y	Y	Y					2, 3, 4, 7, 8
				Y			Humans	Twigs and leaves.	Tea substitute	Y		Y					
Boophone disticha	Amaryllidaceae	Bulb	Open grassland		Y		Headaches, abdominal pain, weakness, sedative, induce hallucinations, and eye conditions.	Bulb scales	Decoction as enema.	Y	Y	Y				Y	2, 3, 5, 14, 15, 16
Boscia albitrunca	Capparaceae	Tree	Dry open woodland.	Y			Humans	Roots	Dried and beaten into a porridge.		Y				Y		1
								Young flower buds.	Eaten, similar to capers.	Y							1
								Fruit	Edible but taste is disagreeable.	Y							
Bowiea volubilis	Asparagaceae	Bulb			Y		Sore eyes	Bulb and bulb scales.	Decoction as lotion.		Y	Y				Y	2, 3, 5
Buddleja saligna	Loganiaceae	Tree	Dry deciduous woodland along drainage lines.		Y		Purgative to induce vomiting.	Roots	Scraped		Y						1
Buddleja salviifolia	Loganiaceae	Tree	Forest margins, rocky outcrops, and along drainage lines	Y			Tea	Fresh or dried leaves.	Boiled	Y		Y					1

Table 13. Free State endemic species and their ethnobotanical application. Continued.

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Bulbine frutescens	Asphodelaceae	Shrub			Y		Wounds, burns, herpes, rashes, itches, ringworm, and cracked lips.	Fresh leaves.	Leaf gel ground into poultice and applied warm.		Y						2, 3, 7
Bulbine natalensis	Asphodelaceae				Y		Blood purification.	Whole plant.	Decoction	Y	Y	Y					2, 3, 7,
Cassinopsis ilicifolia	Icacinaceae	Tree	Montane forests, forest margins, in densely wooded kloofs and along streams.	Y			Humans	Fruit	Eaten	Y							1
Celtis africana	Ulmaceae	Tree	High rainfall areas in forests and along streams, low rainfall areas in woodland/wood grassland, on termite mounds or on rock outcrops.	Y			Humans	Fruit	Eaten	Y							1
Combretum erythrophyllum	Combretaceae	Tree	Along rivers and streams.		Y		Antibiotic	Gum	Dried, powdered, applied to sores.		Y				Y		1
Conyza scabrida	Asteraceae	Shrub			Y		Women's ailments and pain relief.	Twigs and leaves.	Poultice		Y						2, 3, 5
							Coughs, cold, fever	Twigs and leaves.	Snuff		Y				Y		
Cotyledon orbiculata	Crassulaceae	Succulent			Y		Boils, earache, and inflammation.	Leaves	Poultice		Y					Y	2, 3, 17
Crinum macawanii	Amaryllidaceae	Geophyte			Y		Scrofula, micturition, rheumatic fever, blood cleansing, kidney and bladder disease, glandular swelling, fever, and skin problems.	Bulbs and leaves.	Mixed with other ingredients.		Y						2, 3, 4
						Y	Arrow poison	Bulbs and leaves.	Mixed with other ingredients.		Y	Y					
Deinbollia oblongifolia	Sapindaceae	Tree	Coastal, maily in dune bush, woodland and along streams in thick bush.	Y			Humans	Leaves and fruit.	Leaves eaten like spinach. Fruit eaten whole when ripe.	Y							1
Dichrostachys cinerea subsp. Africana	Fabaceae	Tree	Low and high altitude woodlands, forest margins, scrub, and grassland. All soils.		Y		Skin Conditions	Bark	Powdered		Y						1
Dombeya rotundifolia	Malvaceae	Tree			Y		Labor induction, chest complaints	Bark	Decoction	Y	Y	Y					2, 3
							?	Root	Powdered and burned or inhaled.		Y		Y		Y		
Ehretia rigida	Boraginaceae	Tree	All habitats except aquatic.	Y			Humans	Fruit	Eaten	Y							1
Ekebergia capensis	Meliaceae	Tree			Y		Vermifuge	Leaves	Decoction	Y	Y	Y					2, 3
							Abcesses, boils and acne.	Bark	Powdered and used infusion. Sometimes fixed with flour. Applied topically to skin complaints.		Y				Y		
Elephantorrhiza elephantina	Fabaceae	Herbaceous	Grassland		Y		Skin complaints	Root	Grated and steeped.	Y	Y	Y				Y	2, 3
Eucomis autumnalis	Asparagaceae	Bulb			Y		Backache, post-op and fracture recovery, urinary disease, stomache ache, fevers, colic, flatulence, hangovers, syphilis, labor induction.	Bulb	Decoction as enema		Y	Y					2, 3, 4
Ficus abutilifolia	Moraceae	Tree	Rocky hills, ridges, and cliffs.	Y			Humans	Fruit	Eaten raw or dried.	Y					Y		1
Gnidia kraussiana	Thymelaceae	Shrublet	Grassland		Y		Ease childbirth	Rootstock and roots.	Decoction		Y	Y				Y	2, 3, 4
Gomphocarpus fruticosus	Apocynaceae	Shrublet			Y		Headache, tuberculosis, emitic.	Leave and sometimes roots.	Ground and used as snuff.		Y				Y		2, 3, 4, 5, 16, 19
							Stomache ache, body ache, diuretic, purgative, emitic.		Decoction	Y	Y	Y					
Grewia flava	Tiliaceae	Tree	Open deciduous woodland and Kalahari veld on sandy soils.	Y			Humans	Fruit	Beer, brandy, mampoer, eaten whole, dried and ground into a porridge.	Y	Y				Y		1

Table 13. Free State endemic species and their ethnobotanical application. Continued

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Grewia monticola	Tiliaceae	Tree	Open deciduous woodland, fringes of riverine bush, rocky hill slopes.	Y			Humans	Fruit	Eaten	Y							1
							Tea	Leaves	Boiled	Y		Y					1
Grewia occidentalis var. occidentalis	Tiliaceae	Tree	Wide variety of habitats including arid karoo, coastal dune bush, and evergreen montane forest.	Y			Humans	Fruit	Dried and boiled or fresh. Fermented into beer.	Y		Y			Y		1
Gunnera purpensa	Haloragaceae	perennial herb	Moist habitats		Y		Induce or augment labor, antenatal medication, expulsion of the placenta, stomach trouble, rhuematic fever, swellings, menstrual pain, and stomach bleeding, wound dressing.	Rhizomes	Decoction is eaten or applied externally.	Y	Y	Y					2, 3, 4, 7, 18
Helichrysum nudifolium	Asteraceae	perennial herb			Y		Coughs and colds	Leaves	Tea	Y		Y					2, 3, 4, 20
Helichrysum odoratissimum	Asteraceae	perennial herb			Y		Coughs and colds	Leaves	Tea	Y		Y					2, 7
Heteromorpha arborscens	Apiaceae	Woody shrub			Y		Tuberculosis, abdominal pains, colic, nervous and mental disorders, fever, shortness of breath, asthma, coughs, dysentary, infertility, weakness and intestinal worms, blood/stomach/kidney purification.	Leaves and roots.	Decoctions	Y	Y	Y					
Hypoxis heterocallidea	Hypoxidaceae	Tuberous perennial	Grasslands		Y		Weakness in children	Corm	Decoction as tonic	Y	Y	Y					2, 3, 4
					Y		Prostate problems, testicular tumors, prostate hypertrophy, and urinary tract infections.	Stems and leaves.	Mixed with other herbs	Y	Y						
Ilex mitis var. mitis	Aquifoliaceae	Perennial herb	Evergreen woodland and forests, mostly shaded, with roots in water.	Y			Humans	Fruit	Eaten	Y							1
Leonotis leonurus	Lamiaceae	Shrub			Y		Boils, eczema, skin diseaes, itching, muscular cramps, coughs, colds, influenza, bronchitis, high blodd pressure, headaches.	Leaves, stems and roots.	Internal and external decoction.	Y	Y	Y					2, 3, 4, 16
Melianthus comosus	Melianthaceae	Shrub			Y		Septic wounds, sores, bruises, bachache, rheumatic joints, snakebite, ringworm.	Leaves	Poultice and decoction		Y	Y				Y	2, 3, 16
Mentha longifolia	Lamiaceae	Perennial herb	Wet places.	Y			Tea	Leaves	Boiled for tea.			Y			Y		2, 3, 16, 5, 4
					Y		Coughs, colds, asthma, headaches, fever, indigestion, flatulence, hysteria, painful menstuation, delayed pregnancy, diaphoretic, antispasmodic, wound treatment, swollen glands.	Leaves	Decoction, tea, crushed whole and inserted into nostrils.	Y	Y	Y			Y		
Merwilla plumbea	Asparagaceae	Flowering bulb			Y		Female infertility, male potency and libido, wound healing, laxative, sprains and fractures, boils and sores.	Bulbs	Decoction	Y	Y	Y	Y			Y	2, 3, 4
Mundulea sericea	Fabaceae	Tree	Rocky ridges in open woodland or wooded grassland.			Y	Fish poison	Leaves, roots, bark, and seeds.	Pounded and thrown in water.		Y						1

Table 13. Free State endemic species and their ethnobotanical application. Continued

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Myrothamnus flabellifolius	Myrothamnaceae	Woody shrub	Exposed rocky mountain slopes		Y		Pain, backache, kidney problems, hemmroids, painful menstruation, abrasions, burns.	Leaves, twigs, and roots.	Decoction or dried/burned and powdered.	Y	Y	Y	Y		Y		2, 3, 4, 16
Myrsine melanophloes	Primulaceae	Tree	Forest margins.		Y		Emitic, expectorant, muscle pain, stomache disorders, heart strengthening.	Bark and roots.	Decoction	Y	Y	Y					1, 3, 4
Olea europea* subsp. *Africana	Oleaceae	Tree	Any habitat, epecially woodland, stream banks, and rocky hill slopes.	Y			Humans	Fruit	Eaten	Y							1, 2, 3
							Tea	Leaves	Boiled	Y		Y					
					Y		Sore throat	Leaves	Decoction is gargled.		Y	Y					
							Diuretic, anti-diarrheal	Leaves	Decoction	Y	Y	Y					
							Nosebleed	Leaves	Dried and pounded into snuff.		Y				Y		
Pappea capensis	Sapindaceae	Tree	Most habitats except forests. Highly adaptive.	Y			Humans	Fruit	Raw or as jelly.	Y							1
					Y		Ringworm and baldness.	Seeds	Roasted and crushed for oil.		Y			Y			1
						Y	Rifle oil	Seeds	Roasted and crushed for oil.		Y			Y			1
Pelagonium luridum	Geraniaceae	Herbaceous perennial			Y		Diarrhea, dysentary	Rootstock	Milk or water decoction, powdered and mixed with food.	Y	Y	Y			Y		2, 3, 16
Pelargonium sidoides	Geraniaceae	Herbaceous perennial			Y		Diarrhea, dysentary	Rootstock	Milk or water decoction.	Y	Y	Y					2, 3
Pellaea calomelanos	Adiantaceae	Fern			Y		Boils, abscesses, intestinal parasites.	Rhizomes	Decoction	Y	Y	Y					2, 3, 4, 5,
Pentanisia prunelloides	Rubiaceae	Herbaceous perennial	Grasslands		Y		Burns, swellings, sore joints, rheumatism, heartburn, vomiting, fever, chest pain, toothache, tuburculosis, blood impurities, hemmorhoids, snake bite.	Roots	Decoction	Y	Y	Y					2, 3, 4
							Retained placenta.	Leaves	Poultice		Y						
Pittosporum viridiflorum	Pittosporaceae	Tree	Forests to wooded grassland, especially along streambanks and riverine fringes, in well drained soil.		Y		Aphrodesiac	Root or bark.	Dried, ground and taken in beer.	Y	Y				Y		1, 2, 3, 16, 21
							Stomach complaints, malaria, and other fever related illnesses.	Bark	Decoction		Y	Y					
Plumbago auriculata	Plumbaginaceae	Shrub or scrambler			Y		Headaches, warts, fractures.	Leaves and roots.	Powdered for snuff,podered and applied topically or into scarifications		Y				Y		2, 3, 4, 5
Podocarpus falcatus	Podocarpaceae	Tree	Evergreen montane forest and (less often) in coastal swamp forest and montane wooded grassland in humus-rich sandy soils.	Y			Humans	Fruit	Eaten	Y							1
Rapanea melanophloeos	Mysinaceae	Tree	All forests and evergreen scrub, woodland montain slopes, wooded montane grassland.		Y		Expectorant/emitic.	bark	Decoction		Y	Y					1
							Sore throats and wounds.	Bark	Chewed or dried and ground.		Y				Y		1
Rhamnus prinoides	Rhamnaceae	Tree	Drainage lines, riverine forests, and forest margins in humus-rich soils.		Y		Blood purification and pnuemonia.	Root Bark.	Decoction		Y	Y					1
							Sprains	Leaves	Ground into paste.		Y						1
Rhoicissus tridentata	Vitaceae	Shrubby creeper			Y		Stomache ailments, kidney and bladder complaints, infertility, dysmenorrhea.	Roots	Decoction taken orally or as enema.	Y	Y	Y					2, 3, 4
Rhus lancea	Anacardiaceae	Tree	Acacia woodland and drainage lines.	Y			Humans	Fruit	Eaten	Y							1
							Tea	Fruit	Dried and boiled.	Y		Y			Y		1
Rhus leptodictya	Anacardiaceae	Tree	Most habitats, but especially rocky slopes.	Y			Humans	Fruit	Eaten fresh or femented for beer.	Y		Y					1

Table 13. Free State endemic species and their ethnobotanical application. Continued

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Salix mucronata	Salicaceae	Shrub or tree			Y		Rheumatism, fever, headache.	Branch tips and leaves.	Decoction	Y	Y	Y					2, 3, 20, 21
Scabiosa columbaria	Caprifoliaceae	Herbaceous perennial	Grasslands of summer rainfall regions.		Y		Colic, heartburn, wounds, baby powder.	Leaves and roots	Decoction or dried and powdered.	Y	Y	Y			Y		2, 3, 6, 4
Scadoxus puniceus	Amaryllidaceae	Bulb			Y		cough, gastrointestinal problems, ensure safe labor.	Bulbs and roots	Decoction	Y	Y	Y					2, 3, 4
Senecio serratuloides	Asteraceae	Herbacious perennial			Y		Cuts, swellings, burns, sores, headaches.	Leaves, stems, roots	Powered, Decoction	Y	Y	Y			Y		2, 3, 4, 5
Senna italica	Fabaceae	Perenial			Y		influenza, indigestion, liver and gall bladder complaints, gastrointestinal disorders, dysmenorrhea, uterine pain, wounds, ulcers.	Roots	Decoctions or powdered.	Y	Y	Y			Y		2, 3, 4, 5
Sutherlandia frutescens	Fabaceae	Shrub			Y		Stomach problems, internal cancers, colds, inluenza, chicken pox, diabetes, varicose veins, piles, inflammation, liver problems, backache, rheumatism, stress related ailments.	Leaves	Decoction	Y	Y	Y					2, 3
Tarchonanthus camphoratus	Asteraceae	Tree	Variety of habitats in Kalahari type		Y		Asthma and other chest complaints.	Leaves	Hot poultice.		Y	Y					1
			soils.				Stomach ache.	Leaves	Boiled for tea.			Y					1
Teucrium trifidium	Lamiaceae	subshrub			Y		Colds, fever, influenza, snake bite, back pain, bladder ailments, sore throat, diabetes, whitlow, bee sting, tooth ache.	Stems and leaves	Decoctions and leaf paste applied externally.	Y	Y	Y			Y		2, 3, 16
Thesium hystrix	Santalaceae	Shrublet			Y		Coughs, tuberculosis, blood purification.	Roots	Decoctions	Y	Y	Y			Y		2, 3
Typha capensis	Typhaceae	Reed-like perennial	Wet places.		Y		Venereal disease, ease of labor, dysmenorrhea, diarrhea, dysentary, male potency and libido, female fertility, genital problems, circulation, expulsion of placenta, strengthen uterine contractions.	Rhizomes	Decoction	Y	Y	Y					2, 3, 4
Valeriana capensis	Caprifoliaceae	Herbacious perennial			Y		nervous disorders, hysteria, epilepsy, asthma, brochitis, heart trouble, insomnia.	Rhizomes	Combined with other herbs.	Y	Y						2, 3, 5
Vangueria infausta* subsp. *Infausta	Rubiaceae	Tree	All types of woodland, epsecially on	Y			Humans	Fruit	Eaten raw (whole fruit or as "apple sauce") or dried. Distilled into	Y	Y	Y					1
			rocky ridges and hill slopes or wooded					Seeds	Roasted and eaten.	Y				Y			1
			grassland, near the sea on sand dunes.		Y		Tickbites in stock and dogs.	Leaves	Pounded		Y						1
							Leg swelling.	Leaves	Poultice		Y						1
Withania somnifera	Solanaceae	Perennial shrublet			Y		Wounds, inflammation, hemmorroids, rheumatism, syphilis.	Leaves and root bark	Poultice and decoction.	Y	Y	Y					2, 3, 4, 5
Xysmalobium undulatum	Apocynaceae	Herbaceous perennial	Grassland		Y		Diarrhea, colic, afterbirth cramps, dysentary, stomach cramps, headache, edema, indigestion dysmenorrhea, wounds.	Roots	Decoction and dried and powdered.	Y	Y	Y			Y		2, 3, 4, 5
Zantedeschia aethiopica	Araceae	Evergreen herb	Wet places.		Y		Wounds	Rhizomes	Pounded into a poultice.	Y	Y						2, 3, 16

Table 13. Free State endemic species and their ethnobotanical application. Continued.

Scientific Name	Family	Plant Type	Habitat	Food	Medicine	Utility	Indications	Portion Used	How Used	Edible/ Eaten	Ground Stone Processing	Boiled	Burned	Roasted	Dried	Poisonous	Reference
Zanthoxylum capense	Rutaceae	Tree	Dry to evergreen woodland and on rocky hill slopes. Highly adaptable.		Y		Sore throats, blood poisoning, and related diseases.	Roots	Dried and powdered.		Y				Y		1
							Toothache	Roots	Ground		Y						1
							Stomach cramps.	Leaves	Boiled for tea.	Y		Y					1
							Fever	Roots and leaves	Decoction		Y	Y					1
							Colic	Fruit	Eaten	Y							1
							Gall sickness in cattle.	Bark	Decoction		Y						1
						Y	Perfume	Seeds	Crushed		Y						1
Ziziphus mucronata	Rhamnaceae	Tree			Y		Boils, sores, glandular swellings	Roots and leaves	Decoctions		Y	Y					1, 2, 3, 4
Eragrostis chloromelas	Poaceae	Grass	Low lying areas and in overgrazed and/or disturbed veld.	Y			Eaten	Seed	Ground into bread flour or used to make beer.	Y	Y	Y					22
Miscanthus capensis	Poaceae	Grass	Common along stream banks and moist areas.	Y			Eaten	Seed	Eaten whole or ground for flour.	Y	Y						22
								Rhizome	Chewed by children	Y							
Pennisetum thunbergii	Poaceae	Grass	Damp soils in high altitudes.	Y			Eaten during famine.	Seeds	Eaten whole or ground for flour.	Y	Y						23
Hemarthria altissima	Poaceae	Grass	Wet soil	Y			Eaten by children in Lesotho	Rhizome	Eaten whole.	Y							23
Imperata cylindrica	Poaceae	Grass	Poorly drained damp soil or high rainfall areas.	Y			Eaten by shepherds in Lesotho	Rhizome	Eaten whole.	Y							24

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