Introduction

Southern Africa[1] is an important part of the scene in the narrative of human evolutionary history. The subcontinent has produced several early hominin taxa, from the Australopithecines and the early representatives of the genus Homo (Pickering et al., 2011) to the first anatomically Modern Humans. Today the region is home to several ethnicities among them the autochthonous Khoi San speaking groups whose members are considered to be the descendants of the first people of Southern Africa. Upon their early interactions with other groups, notably the proto-Khoekhoe, until recent times, their territory remained mainly restricted to the dry Kgalagadi basin, with a population essentially shared between modern day Namibia, Botswana, South Africa and Zimbabwe. Their ancestors existed in the region for thousands of years before the arrival of proto-Khoekhoe herders around 2000 years ago and then the subsequent arrival of Bantu-speaking groups from East and Central Africa around 1500 years ago (Pleurdeau et al. 2012, Mitchell 2002) followed by European colonisers in the 17th century. The lifestyle and particular adaptations of one of the last remaining hunter and gatherer populations of Southern Africa, evolving in an environment that is strongly marked by aridity, has attracted the attention of scholars and travellers since the 18th century. The San communities, even though they have now largely transitioned to become sedentary herders (Lee 1978) are often cited as an example in anthropological research (; Demangeon 2018, Penn 2013 Thondhlana and Shackleton 2015; Pamo 2011; Schuster et al. 2010). In contrast, our knowledge of the interactions between the ancestors of the San and their environment is still limited due to a lack of systematic studies of well-preserved remains from prehistoric sites.

This work aims at investigating the relationship between the Late Stone Age populations in Southern Africa and one element of this environment: the plant world. The study is based on the study of archaeobotanical macroremains (charcoal, wood and charred, desiccated and mineralised seed/fruit remains) from three sites: Leopard Cave and Geduld in present-day Namibia and Toteng in Botswana (Figure 1). Together they span a chronological period of more or less 2900 years, from ca. 3700 cal BP to ca. 800 cal BP.

The three sites are situated within the vast Kgalagadi basin covering a territory of approximately 2.5 million km^2 in Southern Africa and hosting a large diversity of landforms including rocky outcrops, extensive sand flats and major paleolake basins. New and advanced research methods have in the past few decades brought to light the diversity of the Southern African Quaternary paleoclimates and environments, predominantly by using multi-proxy approaches (Eitel et al. 2006). Close links exist between climate, topography, soil types, vegetation, flooding patterns and the temporal and spatial evolution of the environment. Major environmental changes, are widely viewed as a significant driver of human evolution in Southern Africa and in Africa as a whole[2] (Scott and Woodborne 2007; Chase & Meadows, 2007). One source of information on past plant formations and their evolution through time is provided by pollen studies. The survival of pollen is dependent however on the nature of deposits, and the dry environments that prevail in Southern Africa are usually unfavourable to the preservation of this type of organic markers (Wadley 2006). Despite the rarity of adequate "preservation containers" (Scott & Neumann, 2018), several studies have been conducted in the region since the 1950s allowing for reconstructions of the Pleistocene and Holocene vegetation cover in different areas. Scott el al. (2012) summarised these results allowing a closer view of pollen sequences over a wide region and providing clues to a better comprehension of paleoclimatic conditions. At the same time, the study has revealed the heterogeneous and fragmentary nature of the available data suggesting that supplementary, high-resolution pollen information in association with other palaeoenvironmental proxies is still much needed. The scarcity of sites, non-standardised methods of interpretation and low taxonomical resolution are among the factors that make it difficult to come up with a consistent and continuous regional palaeoenvironmental reconstruction. In order to compensate for bad preservation, alternative pollen sources notably from marine cores and hyrax[3] dung are also considered (for example Gil-Romera et al. 2006, 2007, Scott and Woodborne 2007b, Lim et al. 2016, Scott, Marais and Brook 2004). While these can be very rich in information on the past vegetation, their depositional history, and thus geographical and floral representativeness, is quite different from that of terrestrial and fluvial/lacustrine deposits.

[1] The southernmost region of the African continent, comprising the countries of Botswana, Angola, Lesotho, Malawi, Mozambique, Namibia, South Africa, Eswatini, Zambia and Zimbabwe is referred to in this work as Southern Africa or as the African subcontinent.

[2] During the Quaternary period, people have become dominant environmental agents. This development was influenced strongly by significant environmental changes such as seasonality of rainfall. In fact, a significant degree of precipitation reduction leading to extreme aridity prevailed in large areas of southern Africa, therefore having a major influence on landscape developments.

[3] Hyraxes are small herbivorous mammals belonging to the order of *Hyracoidea*. Four of these live in Africa, a fifth can also be found in the Middle East.

Figure 1. Map of Southern Africa with the localisation of the study sites. Map author: David Pleurdeau.

Another basis of information on past plant formations, especially those that grew near settlement sites and with which past populations interacted, is provided by the study of charred wood remains from archaeological contexts. The archaeobotanical field dealing with this material – anthracology (from the Greek word *anthrax* – charcoal) – is developed here, together with the study of seed and fruit remains.

The analysis of charred wood from archaeological settlements, camp fires and graves brings to light the human use of fuel and timber wood, thus addressing different aspects of the wood economy of past populations (Ludemann and Nelle 2017). Moreover, when certain methodological procedures are respected, charcoal remains stemming from domestic fires (used for cooking, heating, etc.) are likely to provide a representative reconstruction of the ligneous vegetation that was exploited for fuel over a longer period of time and thus indirectly of the local landscape dynamics (Ludemann and Nelle 2017). In some instances, charcoal can also be used as a proxy for reconstructing past climates (Thornton-Barnett 2013). Indeed the expression "timber does not fly" (Leroi-Gourhan in Neumann 1992) applies here as wood charcoal is usually found *in situ* and provides an idea of the environment within which it is found (Dotte-Sarout et al. 2015).

Charcoal studies are still rare in Southern Africa. One major reason for this is the lack of covered and/or stratified deposits, notably in rock shelters and caves, where organic remains are better preserved than they are in shallow open-air sites (Eichhorn and Jürgens 2003). The highest number of studies are concentrated in South Africa, Lesotho and Eswatini, a region where rock shelters are abundant (Esterhuysen 1996, Esterhuysen and Mitchell 1996, Thornton-Barnett 2013, Allsop 1998, Sievers 2006, 2016, Wadley et al. 2011, Shackleton and Prins 1992). Few anthracological studies have so far been undertaken in Namibia and none in Botswana (Vogelsang et al. 2002 and 2010) (Table 1).

Despite the development of anthracology during the last decades, our vision of human-plant interactions remains patchy in this part of the world. Antonites and Antonites (2014), for example, bemourn the lack of anthracological studies concerning Early Farming Bantu communities in South Africa, and their regret applies to the geographical regions and periods of Southern African Prehistory. Majority of the above-mentioned studies concern mainly Pleistocene occupations. Holocene settlements have for various reasons been less in focus.

At most sites from the LSA period, systematic collecting of archaeobotanical remains was not part of excavation priorities. Even when plant remains were collected and analysed, for example at Big Elephant and Geduld in Namibia, and providing interesting results on fruit collection and seasonality, a lack of a systematic sampling of charcoal remains prevented more detailed anatomical and statistical approaches analysis (Wadley, 1979, 2016, Smith et al. 2010, Kinahan 1995, Jacobson 1987). Questions pertaining to past practices of management and exploitation of wood resources as well as the anthropogenic impact on the vegetation are thus difficult to address adequately. For the same reasons, little is known on the distribution of plant species during the Late Pleistocene and the Holocene.

Table 1. Summary of general published charcoal studies in Africa from both the Pleistocene and Holocene periods

Country/region	Site	Period	References
South Africa	Elands Cave Bay	Pleistocene	Allsop 1998
South Africa	Free State	Holocene/Pleistocene	Thornton-Barnett 2013
South Africa	Rose Cottage, Sibudu	Pleistocene	Wadley 1991, 2006, Wadley et al. 2011
South Africa	Sibudu	Pleistocene	Lennox & Bamford 2015, 2016, 2017, Sievers 2006, 2016
South Africa	general	Holocene: farming communities	Antonites and Antonites 2014
South Africa	general	Present	Robbertse et al. 1980
South Africa, Lesotho	Caledon River	Holocene/Pleistocene	Esterhuysen 1996
Lesotho	Western Lesotho	Holocene/Pleistocene	Esterhuysen & Mitchell 1996
Swaziland	Lubombo Mountains	Holocene	Prior & Williams 1985
Namibia	Kaokoland	Holocene/Pleistocene	Eichhorn 2002, Vogelsang et al. 2002, 2010
Mozambique	Chibuene	Holocene: farming communities	Ekblom et al.2014
Cameroon	Dibamba	Holocene: Iron Age	Höhn & Neumann 2017
Central Africa	Muyambe Forest	Holocene	Hubau et al. 2011
Togo	Bassar area	Holocene: Iron Age	Eichhorn & Robion-Brunner 2017
Namibia	Kunene region	Holocene/Pleistocene	In Vogelsang and Eichhorn
Namibia	Northern Namibia	Holocene	Ritcher and Eichhorn 2002
West Africa		Not reported	Rolando 1997

Besides charcoal remains, this study is based on seed/fruit assemblages collected during the excavations at Leopard Cave and Geduld. These types of plant remains can more often be identified at the species level than can charcoal and thus provide a higher taxonomic resolution. Moreover, seed and fruit remains bear witness to other activities than fuel collection, notably foraging for food, fodder and medicinal uses (Thornton-Barnett 2013). In Southern Africa, most fruit/seed studies concern Middle Stone Age sites like Sibudu (Sievers 2015, Sievers 2017, Wadley 2004, 2006),with much less that can be said about Holocene/LSA settlements (Symes 2008, Symes, 2012). From some hunter-gatherer sites in Lesotho there is, for example, mention only of the presence of seed deposits and without further details (Plug 1997).

The objective of this work is thus to produce new data on Late Stone Age environments and plant economies. The botanical identification of charcoal remains from the three sites mentioned above will allow for the reconstruction of the vegetation communities present in the surroundings of the sites during the second half of the Holocene. The perspective is comparative across space and time. Thus, did the populations inhabiting Leopard Cave, Geduld and Toteng benefit from similar environments or did the composition of the flora vary from one site to another? Did the vegetation communities change over time, for example, due to overexploitation and/or climatic change? Can we detect changes in the vegetation that might be linked to changes in the subsistence system such as the introduction of domestic livestock (a question much debated in the context of Southern African Holocene Late Stone Age communities)? Have some species disappeared between this period and today?

Through anthracological analysis, questions can be addressed related to how past populations organised the acquisition of wood for fuel and other uses. Did the past populations visit different habitats for collecting wood? Is it possible to deduce species selection? Were some species avoided as it can sometimes be the case among populations inhabiting these regions today?

Seed/fruit analysis allows approaching several other aspects of past plant economies such as the collecting of plants for food. Through the presence of different species, supplementary information may be gained on the composition of the vegetation cover. Did communities collect fruits and seeds from the same species as those they used for fuel or are there discrepancies between the two datasets? Where were seeds and fruits collected (catchment areas) and when (seasonality)? How were they prepared and consumed?

This book has two introductory chapters (chapters 1 and 2) describing the environmental and archaeological context, while a third chapter is dedicated to the material and methods comprising a section dealing specifically with

the constitution of a reference collection; an indispensable tool for the identification of archaeological charcoal samples. The anatomy of the wood species making up the comparative collection is presented in detail as an appendix, in the form of plates and descriptions. Chapter four presents the results of first-hand ethnographical field research in the form of interviews and surveys on plant exploitation and use conducted among present-day local Damara and San communities. In chapter five, the results of identifications of wood charcoal and seed/fruit remains from Leopard Cave, Geduld and Toteng are presented. The taxa identified are described in detail, followed by a presentation of the quantitative results from each site. The discussion in terms of paleoenvironment and plant uses constitutes chapter 6 followed by a conclusion and future perspectives. The latter addresses the actions that can be employed in advancing archaeobotanical studies in southern Africa, including expanding the study to neighbouring sites and beefing up the reference collection.