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2025

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Isaacs, Nazreen . (2025). Understanding hunter-gatherer animal consumption at Welgelegen Shelter during the later stone age in Mpumalanga, South Africa [Master's dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/50290

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Understanding hunter-gatherer animal consumption at Welgelegen Shelter during the later stone age in Mpumalanga, South Africa



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A Dissertation Submitted to the Archaeology Department in the School of Geography, Archaeology and Environmental Studies, Faculty of Science, University of the Witwatersrand, in fulfilment of the requirements for the degree Master of Science.

Supervisors: Prof. Alex Schoeman and Dr Jerome Reynard

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Name: Nazreen Isaacs
Date: 19/12/2025
Signature:



ABSTRACT

In the shadow of Ecca group sandstone rock shelters, where humans and animals once shared spaces, this research delves into the relationships that shaped survival, society and coexistence between humans and animals long before the world we know today. This study examines faunal remains from the Welgelegen Shelter, Mpumalanga, South Africa, to investigate patterns of animal consumption among a hunter-gatherer community over the past 600 years - a period characterised by important economic, technological, social, and political change. By analysing these remains, this research establishes a link between faunal assemblages and paleoenvironmental conditions, offering insights into species diversity, resource availability, and the impacts of environmental shifts on hunting efficiency. Through an exploration of ungulate ecology, accumulation agents, seasonality, meat procurement, butchering, carcass transport decisions, the role of wetlands, fire, and hunting strategies, this study enhances our understanding of the complex interactions between humans, animals, and their environment during this transformative era.

To contribute to this growing body of knowledge, faunal remains excavated by A. Schoeman in 2022 from the Welgelegen Shelter were analysed, building upon the excavation report by Murray Schoonraad and Peter Beaumont (1971). This analysis aims to inform on hunter-gatherer subsistence strategies as well as paleoenvironmental changes at the site during the Later Stone Age and other historic periods.

My study provides new insights into the interplay between humans, carnivores, and environmental factors in shaping the Welgelegen faunal assemblage. The taphonomic analysis on both zoogenic and anthropogenic marks infers on ungulate ecology, agents of accumulation, seasonality, meat procurement, butchering and carcass transport decisions, environmental phenomena and hunting strategies. The presence and type of anthropogenic marks infer on meat procurement, butchering and carcass transportation as well as hunting strategies. The large presence of carnivore marks in both phases suggests that the site was shared between humans and carnivores. The decreasing presence of human modifications in Phase B suggests a shift in site use over time, while paleoenvironmental evidence indicates long-term ecological stability. The findings contribute to the broader understanding of Late Stone Age hunter-gatherer strategies in Mpumalanga and their interactions with the environment.

ACKNOWLEDGEMENTS

This dissertation is the culmination of years of hard work, curiosity, and unwavering support from many individuals and institutions, without whom this journey would not have been possible.

First and foremost, I would like to express my deepest gratitude to my supervisors, Prof. Alex Schoeman and Dr Jerome Reynard as well as Prof. Sarah Wurz for their invaluable guidance, patience, and encouragement throughout this research. Their expertise, constructive feedback, and belief in my abilities have been instrumental in shaping this work and my growth as a researcher.

I extend my sincere thanks to the University of the Witwatersrand and the Ditsong Museum of Natural History for providing the academic environment, resources, and the opportunities that made this research possible.

Finally, I acknowledge the past researchers and scholars whose work laid the foundation for this study. Research is a continuous journey of learning and discovery, and I am grateful to be a part of this ever-growing field.

For My Family

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CHAPTER 1: INTRODUCTION

In the quiet rock shelter of Welgelegen, the echoes of a shared world between humans and animals still linger. This was once a place where the last //Xegwi speakers in South Africa sought refuge, their stories woven with memories of hunting and survival. When Potgieter (1955) interviewed them, their words carried the presence of animals that no longer roamed, vanished, replaced by farmland. Yet, through my faunal analysis, I can trace their presence, piecing together the remains of a lost landscape. Bone by bone, I reach deeper into time, uncovering the creatures that once filled these spaces, sharing life with the hunters who remembered them long after they were gone (Figure 1.1).



Figure 1.1 Inside the Welgelegen Shelter.

This research builds on previous hunter-gatherer, faunal and palaeoenvironmental studies in South Africa (Potgieter 1955; Schoonraad & Beaumont 1971; Klein 1976 also 1980; Korsman 1990; Korsman & Plug 1994; Plug 1997; Klein *et al.* 1999; Wanless 2007; Lyman 2017 and Bader *et al.* 2020) and will investigate whether the array of animals were consumed by hunter-gatherers or animals which will ultimately add to our understanding of animal consumption during the Later Stone Age (LSA) and historical periods. Periods during which South Africa hunter-gatherers made use of a variety of food sources including a range of small, medium and large animals (Klein & Cruz-Uribe 1996).

The Welgelegen Shelter is a large rock shelter – 41m wide, 13m deep and currently a maximum of 2m high above the deposit level. The shelter rests on the bank of the Vaal River near Ermelo,

Mpumalanga, South Africa (Figures 1.2 & 1.3) (Schoonraad & Beaumont 1971). During the dry season, the site is situated 6m above the Vaal River (Schoonraad & Beaumont 1971). In October 1967, excavations by Schoonraad & Beaumont (1971) took place. The excavations revealed a lower stratum that contained sparse assemblages such as stone artefacts, as well as an upper stratum with LSA and Iron Age material, such as stone artefacts, rubber, and an abundance of faunal remains. They dated the start of the upper layer to about 1200 AD (Schoonraad & Beaumont 1971). The fauna recovered was analysed and curated between February and November of 1968 and lodged with the Museum of Man and Science. The museum closed in 1977, and the collection's subsequent whereabouts are unknown and thus could not be reanalysed as part of this study.

The analysis of faunal remains provides key data that can be used to understand agents of accumulation, seasonality, meat procurement strategies, butchering techniques, carcass transport decisions, hunting strategies as well as providing valuable insights into the present and paleoenvironment (Klein 1980; Martin 1999; Reitz & Wing 2008; Lyman 2008; Reynard 2021). Identifying changes in subsistence behaviour is important as it helps us understand responses to resource availability, socio-cultural change, and food procurement strategies. These insights can reveal patterns in social organisation, and technological development over time. Additionally, it informs us about the impacts of human activities on ecosystems and can guide conservation efforts and sustainable practices in modern contexts (Binford 2001).

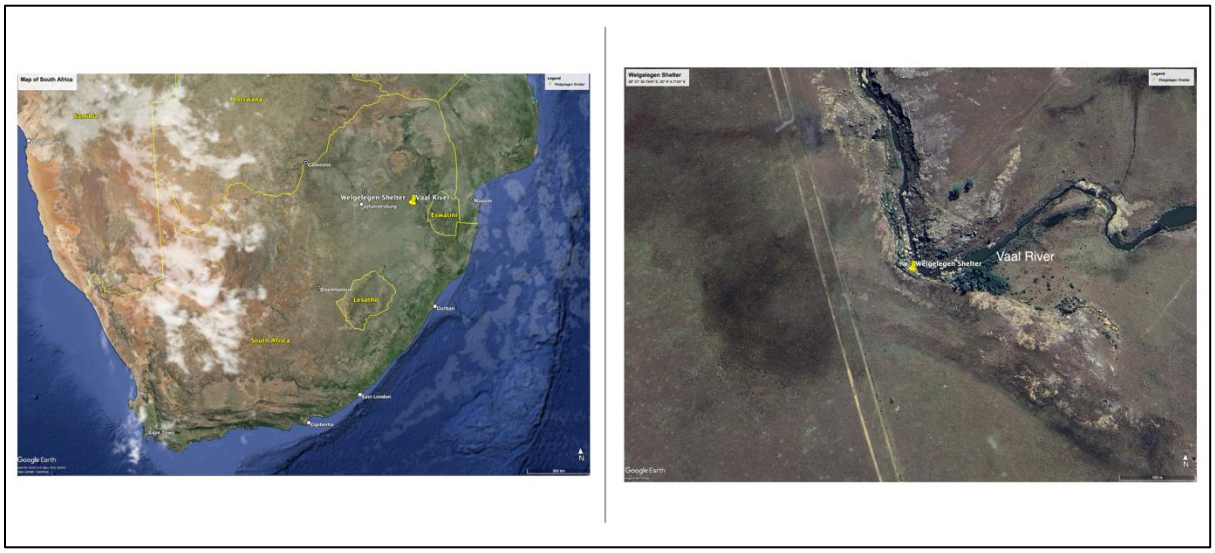


Figure 1.2 Google Earth Map showing the location of the Welgelegen Shelter, Mpumalanga, South Africa.

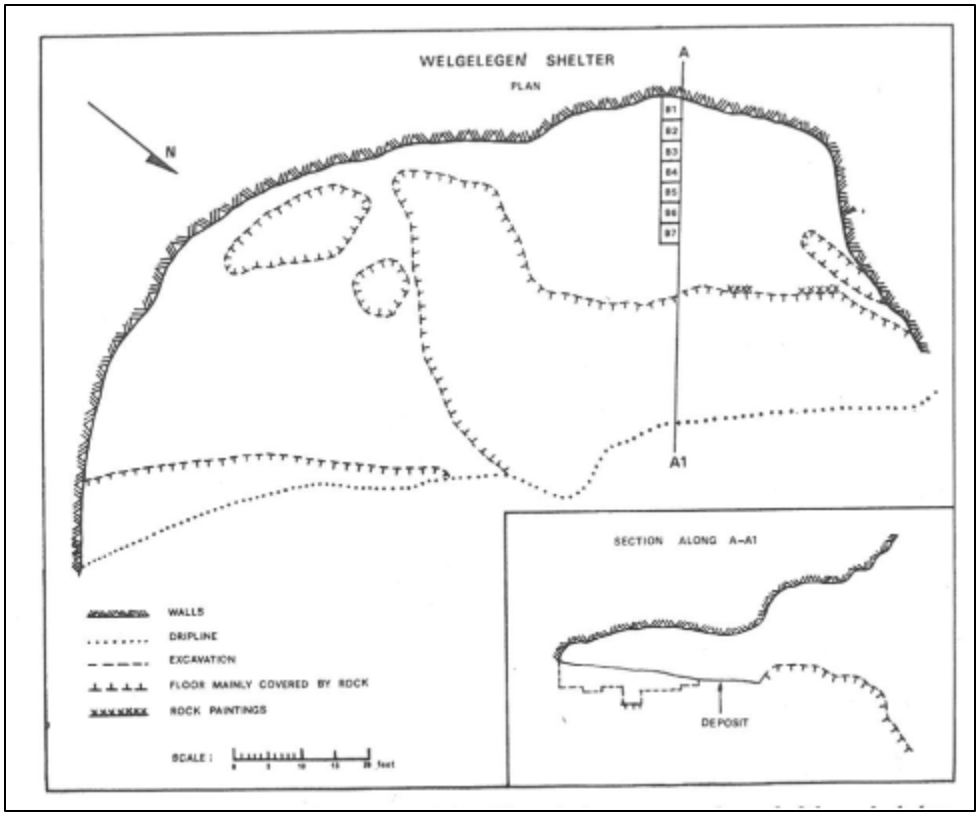


Figure 1.3 Plan and section drawing of the Welgelegen Shelter from Schoonraad and Beaumont (1971).

1.1 Aim

The aim of the study is to examine faunal remains from the Welgelegen Shelter to understand hunter-gatherer animal consumption patterns, economic roles and palaeoenvironments in the central part of the Mpumalanga region of South Africa during the LSA and historic periods.

1.2 Research Questions

1. How can the faunal remains from Welgelegen Shelter inform on hunter-gatherer animal consumption and economic patterns in the Mpumalanga region during the LSA and historic periods?
2. What does the taxonomic composition of fauna at Welgelegen Shelter suggest about the changes in palaeoenvironmental conditions at the site during the LSA and historic periods?

1.3 Objectives

My aim will be achieved by completing the following objectives:

- Taxonomically identify faunal remains from the Welgelegen Shelter to infer palaeoenvironmental conditions;

- Undertaking a basic taphonomic analysis of the faunal remains to infer the agents of accumulation and animal consumption patterns;
- Use these data to explore subsistence behaviour, economies and palaeoenvironmental conditions during the LSA and historic periods at Welgelegen Shelter.

1.4 Rationale

This study will expand on the insights that can be gained from reading Schoonraad and Beaumont's (1971) brief excavation report by identifying and taphonomically analysing fauna that was excavated from a test pit in 2022. Given the abundance of faunal remains and the relatively limited number of artefacts recovered in the excavation, the question arises whether it is feasible to claim that Welgelegen may have served as an animal/carnivore den. Taphonomic analyses of fauna from the Welgelegen site is vital in assessing whether animals or people brought in the faunal remains by distinguishing between anthropogenic and zoogenic taphonomic marks. Furthermore, fauna is a key proxy for the palaeoenvironment therefore examining identified taxa may highlight palaeoenvironmental conditions in this region during the last 600 years. If anthropogenic, the analysis of fauna will inform on hunter-gatherer diet, and help us to better understand the human-animal relationships in the LSA and historic periods in this region of northeastern South Africa.

Thesis Outline

Every chapter opens with an introduction outlining its layout and structure. In Chapter 2, relevant literature on archaeology in Mpumalanga explores topics such as the background of the site, current and previous environments, ungulate resource ecology, the archaeological sequence of Lake Chrissie, the colonial frontier, fauna as a paleoenvironmental and cultural proxy, ethnographic insights into hunting and food practices as well as taphonomy. Chapter 3 looks at the methodology and materials that was used to analyse the faunal remains as well as why that method was used. This includes the materials used, quantification, taxonomic identification, taphonomy and limitations of the methods used. In chapter 4, I outline the results of my analysis (NISP/MNI/MNE/skeletal part profiles/bovid size classes/dietary preferences and primary accumulators). Chapter 5 focuses on the discussion around themes that include ungulate ecology, agents of accumulation, seasonality and shelter use, meat procurements strategies, past and current environment, hunting strategies and finally Chapter 6 concludes my dissertation and touches on limitations and future avenues of research.

CHAPTER 2: LITERATURE REVIEW

This chapter reviews the relevant literature on the archaeology of Mpumalanga, South Africa, to contextualise the current study. The focus is on synthesising previous research conducted in the northeastern regions of South Africa, with an emphasis on environmental reconstructions, archaeological investigations, and faunal analyses. Particular attention is given to the archaeology of Lake Chrissie (also known as Chrissiesmeer) and its surroundings, as well as ungulate resource ecology, taphonomic studies that shed light on subsistence strategies, site use, and environmental interactions during the LSA and historic periods. By examining these themes, this chapter establishes a foundation for understanding the regional dynamics that shaped human behaviour and ecological adaptations in the Mpumalanga highveld during this period.

2.1 Site Background

The Welgelegen Shelter is an archaeological site located in the Ermelo district of Mpumalanga, South Africa. The site is situated 6m above the Vaal River and has a marked overhang over a distance of 91.4m upstream of the shelter (Schoonraad & Beaumont 1971). The region falls within a highveld grassland (Mucina & Rutherford 2006: p. 33) and the average height above sea level is 152.4m (Potgieter 1955). Rainfall in grassland biomes varies between 400-2000mm depending on the local topography and climatic conditions and the annual temperature ranges between 0.2°C - 24.1°C (Clark *et al.* 2022).

The site's significance is twofold. It is in one of the few landscapes in South Africa where San speakers lived as communities well into the twentieth century, and aspects of their belief systems and lifeways were recorded (Potgieter 1955). Secondly, its substantial and well-preserved faunal assemblage means that research on it has the potential to inform discussions on palaeoenvironments as well as animal and human interactions.

2.2 Current and Previous Environment

2.2.1 Current Environment

Mpumalanga's physical landscape is shaped by a combination of geological, topographical, and climatic factors, which together influence the region's vegetation. Potgieter (1955) states that the area is part of the Ecca group, which forms the larger Karoo Supergroup. Mucina & Rutherford (2006: p. 284,286,385) also adds that the Ecca group primarily consists of shale, mudstone, claystone, siltstone, chert, dolomite and coal, quartzite and pyrite. Soils that are commonly found include apedal, eutrophic, plinthic and shallow soils (Mucina & Rutherford 2006). The province is characterised by a highland topography, with broad to narrow etched valleys of headwater drainages, a result of post-African erosion processes that have back worked into the African surface (Partridge & Maud 1987). The Vaal head streams are flanked by gentle valley sides with gradients ranging from 1 in 20 to 1 in 100.

These geological and topographical factors play a pivotal role in shaping the region's vegetation, which consists primarily of grassland and savanna biomes, with grasslands covering 61% of the area (Fourie *et al.* 2015; Ferrar & Lötter 2007: p. 10). The Welgelegen Shelter is located on the north-eastern highveld grassland which falls under the Mesic Highveld grassland (Figure 2.1; Mucina & Rutherford 2006: p. 33). With an extent of more than 100,000 km², the Mesic Highveld Grassland Bioregion is one of the largest in South Africa (Mucina & Rutherford 2006: p. 47).

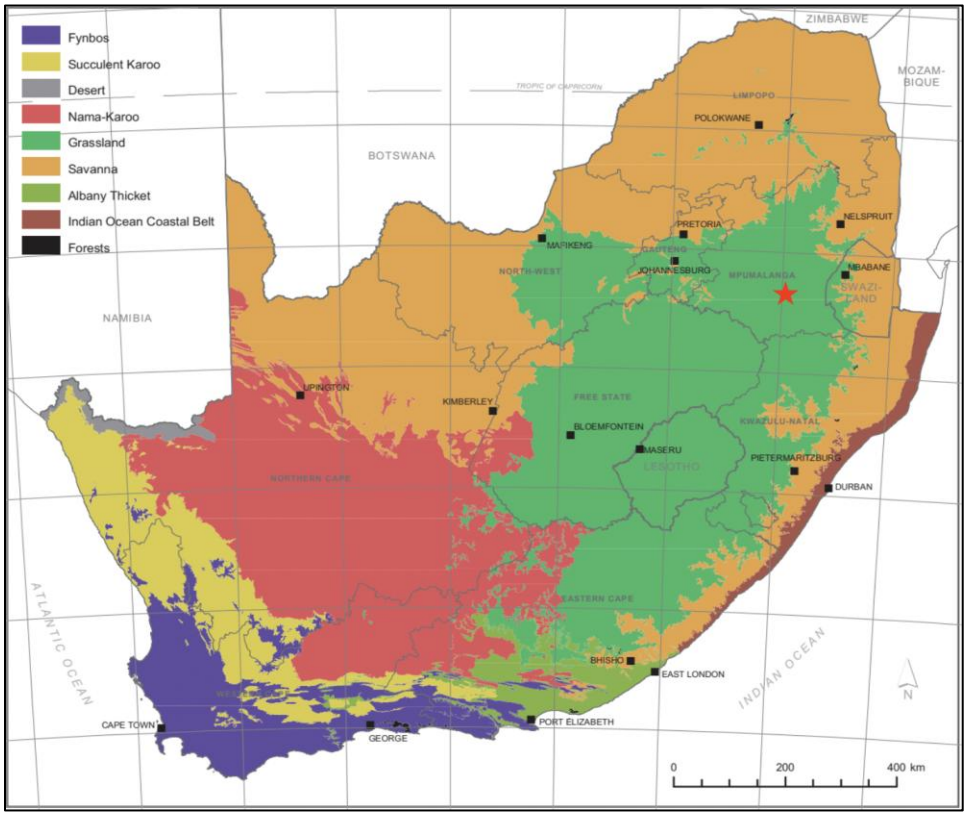


Figure 2.1 The different biomes in South Africa. The area of the Welgelegen Shelter (marked with a star) falls within the grassland biome (Mucina & Rutherford 2006: p. 33).

Grassland biomes consist of vegetation that is physiognomically monolithic (Potgieter 1995; Mucina & Rutherford 2006: p. 44-45). Grasslands are dominated by hemicryptophytes (grasses), Poaceae, the canopy cover is moisture dependent, and the altitude ranges between 300-2850m (Mucina & Rutherford 2006). Dominant grasses surrounding the Lake Chrissie area in Mpumalanga are *Eragrostisplana, E. curvula*, *Heteropogoncontortus*, *Trachyponspicatus* and *Themedatriandra* (Mucina & Rutherford; Mashaba *et al.* 2025) (Appendix A, which lists grassland and vegetation species).

Before the introduction of wattle trees during the last century, the area was treeless except for brushwood and thickets near ravines (Potgieter 1955). The historical scarcity of trees in the

Mpumalanga region, as noted by Potgieter (1955), is significant for understanding both the environmental context and the subsistence strategies of past populations. This idea can be assessed by the data presented below.

Grasslands are also fire-prone ecosystems (Mucina & Rutherford 2006: p. 356; Yan & Liu 2021). Additionally, the lack of trees would have influenced the types of fuel used for fires. Without ample wood available, people may have had to rely on alternative materials, such as grasses, brushwood, and thickets near ravines. The use of different materials for burning could have impacted the firing temperatures, which are crucial for understanding the taphonomic processes that bones underwent at the site (Shipman & Rose 1984; Lyman 2008). The lower combustion temperatures of grasses and brushwood compared to wood could have affected the way bones were preserved or altered during heating. This is particularly important when interpreting the archaeological evidence for bone processing, as bones exposed to high heat, especially during prolonged burning, may show specific thermal alterations, such as cracking or discolouration, which could provide insights into the subsistence practices and technological methods of the people in this area. The data assessed below could provide insights into whether fuel sources influenced both the preservation of faunal remains and the strategies employed by the hunter-gatherers (Ferrar & Lötter 2007; Mucina & Rutherford 2006; Partridge & Maud 1987; Brain 1981).

Potgieter (19555) and Mucina & Rutherford (2006: p. 355) state that the grasses in this specific region are ‘sour’ (grasses that become less palatable and digestible as they mature) and that sour grasses comprise mostly of the Panicoideae subfamily, which are highly susceptible to grassland fires. This is backed up by Ellery (1992), who indicates that due to dry winters with the lack of rainfall, where vegetation is dry, favourable conditions are created for fires.

A phytolith and pollen study by Brough (2023) showed that the environment of the Welgelegen Shelter has remained stable for the last 2000 years and is characterised as a grassland with wetlands. Throughout the sequence, the vegetation was dominated by monolithic grasses, specifically sour grasses (Panicoideae), which are highly susceptible to fire (Ellery 1992). These grassland areas would have been subject to frequent wildfires, which could influence both the availability of food sources and the movement patterns of ungulates. The existence of wetlands further supports the biodiversity in the region, drawing various species to the shelter's vicinity (Potgieter 1955; Mucina & Rutherford 2006).

2.2.2 Wetlands

The Welgelegen Shelter benefits from the ecological advantages provided by riverine environments. Rivers such as the Vaal create unique ecological niches within the broader grassland landscape, supporting a range of flora and fauna that depend on consistent water availability (Braune & Rogers 1987). These riverine corridors sustain lush vegetation throughout the year, offering reliable grazing grounds that attract and support species like waterbuck (which were found

in the original Welgelegen fauna) (Schoonraad & Beaumont 1971), which are closely associated with water sources (Spies 2015). The Schoonraad & Beaumont (1971) taxonomic list (Appendix B) will be confirmed by the analyses in Chapter 4. The presence of perennial water and grazing opportunities reduces the need for seasonal migrations commonly observed in more arid environments, allowing for more stable faunal populations. This ecological stability would have significantly influenced human subsistence strategies, as predictable access to key resources such as water-dependent mammals would reduce the need for extensive mobility (inferred by Western 1975). Consequently, the proximity of the Welgelegen Shelter to the Vaal River likely made it an attractive location for sustained human occupation, providing both ecological richness and strategic advantages in resource exploitation. This ecological data can set expectations for the data that will be presented below.

Four of South Africa's major rivers – the Tugela, the Vaal, the Olifants and the Pongola – have their sources in the grasslands of Mpumalanga (Chutter 1963; Oliff 1963; Maggs 1980; Heath *et al.* 2010). Wetlands are one of the most valuable ecosystems in terms of biodiversity (Ferreira *et al.* 2023). Wetlands are dominated by riparian vegetation that grows seasonally on permanent wet soil. These areas create habitat for birds, mammals, reptiles and amphibians (Balwan & Kour 2021). The pan system around Chrissiesmeer is the largest wetland area in South Africa. It is home to various frog, insects, birds, small game and predator species This includes various water birds and endangered species such as cranes (Allan *et al.* 1997).

The current state of wetlands in Mpumalanga is characterised by environmental importance, rich biodiversity, and ongoing conservation efforts. The Grass and Wetlands Region of Mpumalanga are a significant area with hilly to mountainous grasslands, wetlands, lakes, and rivers that are crucial for birdlife and form a fragile ecosystem (Balwan & Kour 2021). It, therefore, can be said that wetland vegetation plays important ecological roles, including stabilising shorelines, filtering water and providing habitats for wildlife. The current fauna, taken from Nooitgedachtdam Nature Reserve, consists of an array of fish, reptiles, amphibians, birds and mammals (Appendix G).

2.2.3 Resource Ecology

The South African grassland biomes cover almost 30% of the land's surface, dominating the Highveld plateau (Mucina & Rutherford 2006; Prinsloo *et al.* 2021). The ecological functioning of grassland is shaped by fire, frost, rainfall and wetlands which, all interact with herbivores to maintain the open system. Grasslands support impressive ungulates and ungulate migrations as well as a range of carnivores and smaller mammals that all make up the structure of the ecosystem.

As food sources, various ungulate species often concentrate on either the grass or the browsing components of plants, or both (Shipley 1999). Ungulates therefore interact with forage resources across temporal and spatial scales (Bailey *et al.* 1996; Owen-Smith *et al*. 2010) and forage in the

form of browse vs grass are presented to the herbivores in distinct ways at each of these scales (Venter *et al*. 2019) (Figure 2.3).

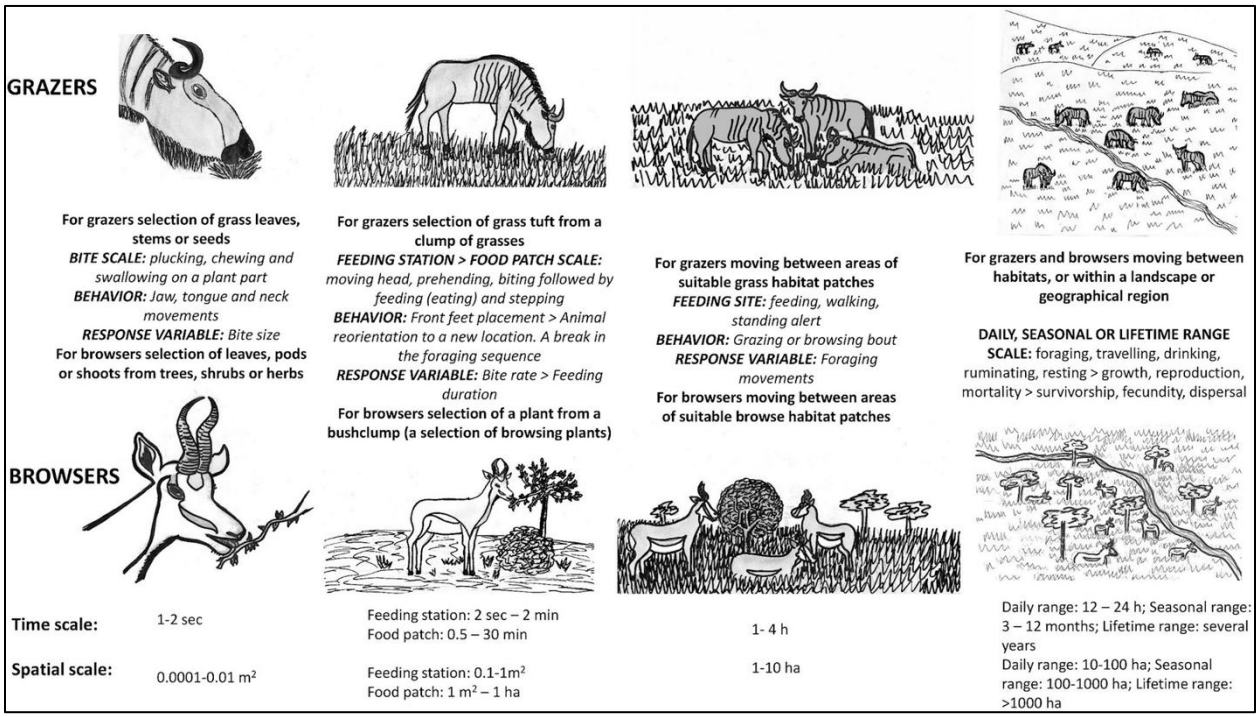


Figure 2.2 The different temporal and spatial scales that grazers and browsers interact with forage resources. Adapted by Bailey & Provenza (2008), sketched by Venter et al. (2019).

Herbivores respond to topographic and forage distribution patterns (Bailey *et al*.1996). Food for foraging ungulates is found in homogeneous patches with respect to environmental factors (Bailey *et al.* 1996; Owen-Smith 2002; Bailey & Provenza 2008; Prins & Van Langevelde 2008). For example, blue wildebeest that seek out short grass patches need to sometimes move through tall grass habitats to get to them (Owen-Smith & Traill 2017). The forage resources for grazers are spread out horizontally over the landscape. However, for browsers, it's more complicated due to food resources providing less continuous assemblages of plant parts of different nutritional value (Venter *et al.* 2019). Browsers and grazers adjust their movements to find high-value food (Fortin 2003; de Knegt *et al*. 2007; Venter *et al.* 2015).

Animal movement is a fundamental ecological process that affects various levels of biological organization. It's not just about a single animal's survival, but also about the larger-scale dynamics of populations, communities, and entire ecosystems (Turchin 1996; Fryxell *et al.* 2008; Delgado *et al.* 2009).

2.2.4 Environmental History

The paleoenvironment of Mpumalanga has varied over time. The region is currently characterised by grasslands, although it has experienced changes in vegetation, climate and habitats throughout history. During the last 2,000 years of the late Holocene, South Africa's climate has fluctuated between warm, wet periods and cooler, dry spells droughts (Norström *et al.* 2009; Sjöström 2013). The warmest and wettest conditions occurred during the Medieval Warming Period (MWP), from 950 AD to 1250 AD (Holmgren *et al.* 2003; Woodborne *et al.* 20160. This was followed by a shift to cooler and drier conditions as a result of the Little Ice Age (LIA), which lasted from 1400 AD to 1800 AD (Holmgren *et al.* 2003; Norström *et al.* 2009).

Recent paleoenvironmental studies indicate fluctuations in precipitation, vegetation and wetland conditions during the late Holocene (Sjöström *et al.* 2017). Sjöström *et al*. (2017). Even with a growing number of climate records from Southern Africa, the region's climate history during the Holocene remains uncertain. This is likely because of the variety of proxy records used and the different ways they are interpreted. These variations in rainfall, temperature and vegetation composition influenced the shaping of current habitats. Furthermore, studies on phytoliths and pollen in the Welgelegen area indicate that the area was always and still is a grassland (Mucina & Rutherford 2006; Brough 2023). Potgieter (1955) suggests the same.

Palaeoenvironments provide valuable insights into understanding the region's ecological history and the interactions between ancient societies and their natural surroundings. The region was home to hunter-gatherer groups who took advantage of the area's abundance of flora and fauna. Overall, the available evidence suggests the environment in Mpumalanga during the Holocene was characterised by a mix of warmer and cooler microclimates, with people inhabiting sites in the foothills and along river valleys.

The patterns in shelters in the surrounding regions show a similar relationship between environments and species. Border Cave (BC), located in the KwaZulu-Natal province, offers a contrast in its paleoenvironment, primarily characterised as a grassland and savannah habitat. Similar to Welgelegen, this environment supported a variety of grazing species, but also shows evidence of savannah influence, which would have supported a different set of faunal species. The faunal assemblages at BC suggest that climatic conditions influenced the migratory patterns and abundance of large herbivores, which also relied on nearby water sources (Klein 1977; Brain 1981).

The paleoenvironment at Bushman Rock Shelter (BRS) was a savannah/woodland mosaic, providing a combination of open grassland and woody vegetation. This mixed environment allowed for both browsing and grazing species to thrive. The presence of marula kernels further supports the idea of a savannah/woodland mix, as this fruit-bearing tree is indicative of such an environment. The flora and fauna of BRS highlight the role of seasonal resources in shaping

hunting strategies and subsistence behaviour, including the hunting of low-ranked prey when high-ranked species were scarce (Badenhorst & Plug 2012). The thought behind this is that, according to the diet breadth model, hunter-gatherers will first pursue high-ranked prey when they are encountered (MacArthur & Pianka 1966; Badenhorst 2015). Low-ranked prey are usually ignored to give all efforts in search of high-ranked prey (Badenhorst 2015; Dusseldorp 2009).

The paleoenvironment of Honingklip is documented as fluctuating over the last 10,000 years, shifting between grasslands, savannah, forests, and wetlands. These changes would have had a direct impact on the availability of faunal resources. The variability in habitat types suggests that environmental stressors, such as fire and droughts, might have played a role in driving animal populations to adapt to changing conditions. The mixed habitats would have created opportunities for both large and small prey to coexist in the area, influencing hunter-gatherer strategies (Korsman & Plug 1992).

Due to the complex interactions between climatic changes, habitat modifications, human hunting activities and environmental changes during the Later Stone Age there was a considerable impact on animal populations in South Africa during the last 40 000-2000 years (last Glacial Maximum and late Holocene) (Chase *et al.* 2017). Climatic changes during the Later Stone Age were characterised by fluctuations in temperature and precipitation patterns, which affected the availability of resources for animals. These climatic shifts altered the suitability of habitats and the distribution of animal species, leading to changes in population sizes and community compositions (Mucina & Rutherford 2006). Environmental changes, such as the expansion and contraction of grasslands and wetlands influenced the availability of food, water, and shelter for animals.

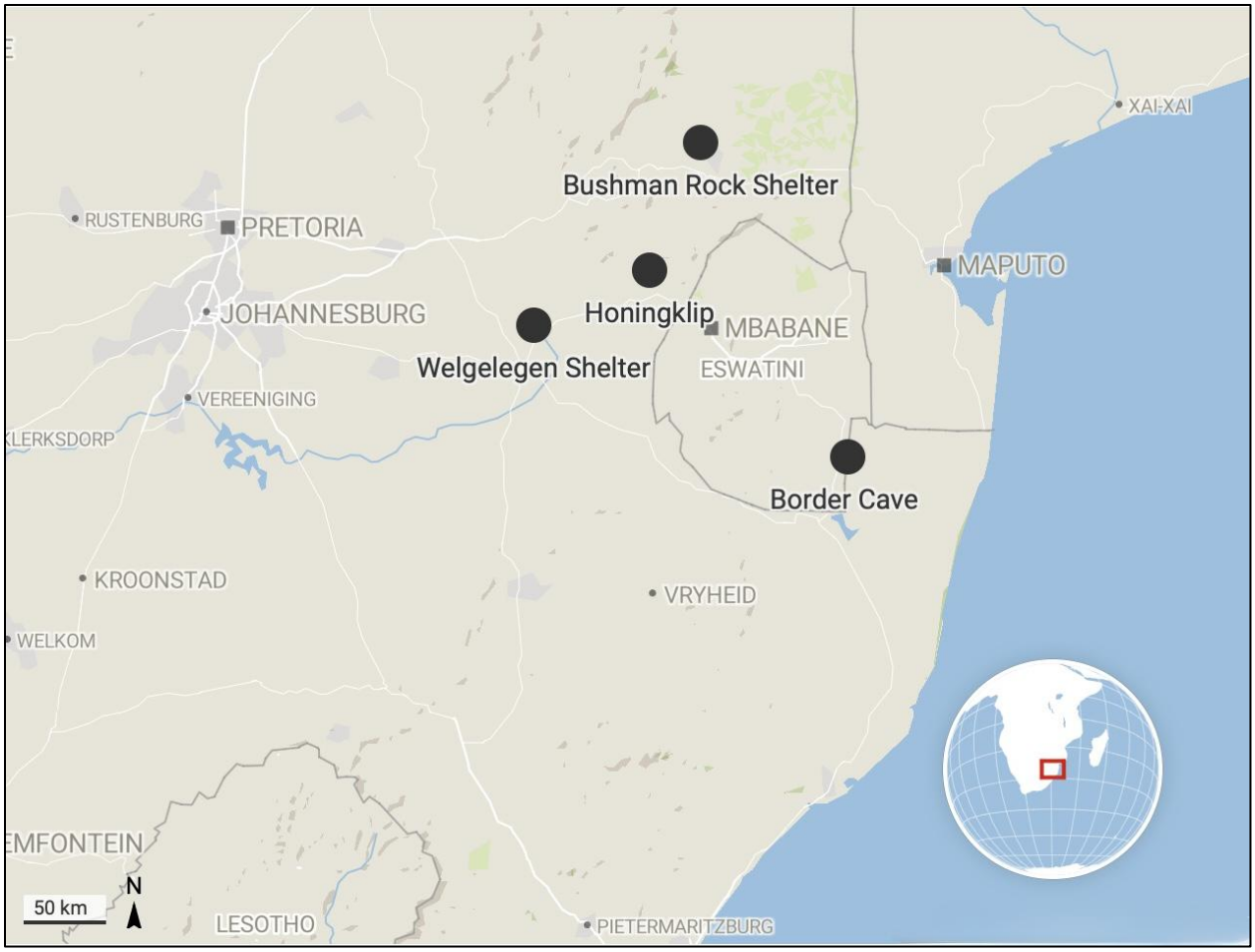


Figure 2.3 Google Earth and Open Street Map showing the location of the Welgelegen Shelter relative to Border Cave, Bushman Rock Shelter and Honingklip.

2.3 The Archaeological Sequence - Lake Chrissie

The landscape of Mpumalanga has been a focal point for human occupation for over 1.7 million years, offering a rich array of plant and animal resources that early humans utilised for subsistence (Esterhuysen & Smith 2007; Mitchell 2002). This period spans multiple archaeological eras, each characterised by distinct technological and subsistence strategies that reflect broader cultural and environmental changes. I focus on the Holocene occupants.

Table 2.1 Description of terms used in this chapter.

Word	Description
San	Also referred to as 'bushmen', are the earliest known indigenous hunter-gatherer inhabitants of South Africa (Barnard 2019).

KhoeKhoe	KhoeKhoe are one of the indigenous groups of South Africa that practiced pastoralism (Sadr 2008).
Boer	Are decedents of Dutch, German and French Huguenot settlers (Keane 1900).
Bokoni	Is a complex network of stone-walled settlements and agricultural terraces in Mpumalanga, South Africa. They were inhabited by agro-pastorlists (Schoeman 2024).
Mfecane	Was a period of intense social, political and military upheave in southern Africa during the early 19th century (Eldredge 1992).

2.3.1 Later Stone Age

The LSA (starting about 20,000 years ago) was noted by a series of technological innovations and social transformations within early hunter-gatherer communities (Deacon 1999). Microlithic tools became more common, while the heavy MSA scrapers appeared less frequently (Deacon 1999; Low *et al.* 2025). Animals were being trapped and hunted with spears and arrows, which were mounted with well-crafted stone blades (Low *et al.* 2025). Hunter-gatherer bands moved with the seasons as they followed migrating game, and overhanging rock shelters became the favourite occupation site of choice (Low *et al.* 2025).

The LSA occupational sequences reflect the archaeology of the ancestors of San and Khoe communities from 40,000 years ago until recently (Dusseldorp *et al.* 2013). The LSA has not been extensively looked at in Mpumalanga; however, indicators for these periods have been excavated from Bushman Rock Shelter, Border Cave, Honingklip, and Heuningneskrans (Esterhuysen & Smith 2007; Badenhorst & Plug 2012; Klein 1977; Klein 1984; Korsman & Plug 1992) and it is known that San communities lived near Lake Chrissie as recently as the 1950s (Potgieter 1955; but also see Schlebusch *et al*. 2016). LSA surface scatters have also been investigated in the vicinity of Piet Retief, and De Wittekrans northwest of Ermelo is a Later Stone Age archaeological site complex with rock art that includes classic San rock art as well as historical art (Nel & Karodia 2013).

The beginning of the Iron Age in South Africa can be identified by clay ceramics and iron beads, which suggests that hunter-gatherers had social contact with farmers around AD 500 (Low *et al.* 2025). Evidence from the Welgelegen Shelter may hint at a different relationship between hunter-gatherers and farmers (Schoonraad & Beaumont 1971). Farmers with metal tools occupied the

shelter with hunter-gatherer groups. A similar symbiotic relationship can be seen with the Batwa San from Lake Chrissie and the Swazi well into the 20th century (Schoonraad & Beaumont 1971).

There is a growing body of research on the interaction between hunter-gatherers, herders, farmers and the colonial frontier. Much of the work on pastoralism in South Africa has focused on the spread of pastoralists, and their relationship with hunter-gatherers in northern South Africa remains under-explored (although see Hall & Smith 2000). This will all later be explored. A notable exception is Wadley *et al.* (2022), collaborative research on Kaingo Sheep Rock Shelter in the western Waterberg, Limpopo. This study examines the site's use by LSA hunter-gatherers between approximately 4370- and 170-years BP. Findings include rock art depicting a large, fat-tailed sheep, numerous microlithic end scrapers, over 500 ostrich eggshell beads, and ceramics from the Eiland facies. Over the last 2000 years, research suggests possible relationships between hunter-gatherers, herders, and farmers.

The origins and spread of pastoralism in Africa can be traced back to 8000 years ago (Smith 1992). This is when domestic cattle, sheep and goats were brought into North Africa from the East. Pastoralism then expanded across the Sahara during a wet environmental period (Smith 1992). When the Sahara dried out due to climatic shifts, pastoralists moved into West Africa, East Africa and southern Africa around 2000 years ago (Smith 1992 also see Webley 1986). In southern Africa, pastoralism grew in arid and semi-arid western regions and was practised by both Bantu and Khoekhoe-speaking groups (Smith 1992). The spread of pastoralism in southern Africa created complex interactions between herders and local hunter-gatherers.

Sadr (2015) also mentions that domesticated cattle were introduced to southern Africa around 2000 years ago. The timing of livestock introduction is backed by radiocarbon dating; however, the manner of introduction remains debated (Sadr 2015). The main theory includes the large migration of Khoe-speaking pastoralists from East Africa, trade with hunter-gatherers as well as the infiltration by herding groups (Blundell 2006; Sadr 2015). The analysis of stone tools from LSA sites, faunal remains and ceramics suggests two distinct infiltration routes: infiltration along the Atlantic seaboard, moving south to the southern tip of Africa and infiltration through the middle Limpopo River basin, coming from the Zambezi River basin. These infiltrations involved small groups of hunter-gatherers who carried northern stone tools and introduced livestock and pottery into new regions (Sadr 2008; Sadr 2013; Sadr 2015).

Lander and Russell (2018) indicate that pastoralism emerged in southern Africa between 550 BC and AD 1050 through livestock, pottery, metal and crops. These findings suggest that pastoralism was present in southern Africa before and during the arrival of agro-pastoralist groups.

There is a significant body of work on the interaction between hunter-gatherers and farming communities in the Shashe-Limpopo : E.g., Wilmsen *et al.* 1990; Wadley 1996 ; Hall 2000; Hall & Smith 2000; Van Doornum 2008, 2014 and subsequent papers; Pargeter & Bradfield 2012; Forssman 2013; Forssman & Van Zyl 2022; Forssman *et al*. 2023). Especially relevant to my research is the economic roles these hunter-gatherers played in the broader economies.

Notably, second millennium farming community sites were accompanied by stonewalled settlements (Marker & Evers 1976). These basic settlements can be seen in the Lydenburg area (Marker & Evers 1976; Delius *et al.* 2012). Trade was a key part of the economy in early societies. By the 1700s, as trade grew, economically powerful canters of control emerged. With the arrival of Portuguese trading posts, the Mpumalanga region became a major route for both local and international traders (Evers 1974; Thompson 2001; Chewins 2016; Roque 2017).

2.3.2 The Arrival of Farmers in northeastern South Africa

The Lydenburg sequence outlines the arrival and development of early farming communities in northeastern South Africa during the first millennium. It is based on archaeological evidence from sites near Lydenburg, Mpumalanga, and provides insights into the region's early agricultural and social transitions. Early Settlement (c. 400–600 CE): the first farming communities settled in the region, introducing domesticated crops (sorghum and millet) and livestock (cattle, sheep, and goats).

Pottery traditions, such as Lydenburg-style ceramics, emerged, reflecting early social and cultural identities. Metalworking, particularly iron smelting, is evidence of trade networks. Cultural and Economic Expansion (c. 600–900 CE): population growth led to more permanent settlements with evidence of homesteads and grain storage structures. Farming intensified, with cattle playing a central role in economic and social systems. The production of iron tools and weapons expanded, supporting hunting, agriculture, and trade with neighbouring communities. The presence of prestige goods suggests emerging social hierarchies and interaction with broader regional trade networks, possibly linked to the Indian Ocean trade (Maggs 1980; Plug & Badenhorst 2010; Badenhorst 2010; Schoeman 2020; Olatoyan *et al.* 2022; Becher *et al*. 2024). The arrival of new populations had a profound consequence for a regional social landscape that up until that point was an exclusive domain of hunter-gatherer groups (Kinahan 2019; Haacke & Eiseb 2002). Furthermore, the assumed separation between hunter-gatherers and pastoralists seem to be supported by rock art, which appears to show that hunter-gatherer populations in southern Africa formed part of a single ideological tradition based on egalitarian values (Lewis-Williams 1984; Kinahan 2019). The Lydenburg sequence marks an important phase in the early history of farming communities in southern Africa, illustrating the transition from small-scale subsistence farming to more complex societies with social stratification, trade, and technological advancements.

During the second millennium, the Bokoni region, encompassing areas like Komati Gorge, witnessed the emergence of a sophisticated agrarian society characterised by extensive stone-walled settlements and terraced agriculture. Archaeological investigations, particularly at Komati Gorge Village 1, have unveiled early homesteads that shed light on the construction techniques and habitation patterns of these communities (Birin *et al.* 2021).

The Bokoni people developed an intricate system of agricultural terraces, which were integral to their farming practices. These terraces, often associated with stone-walled homesteads, facilitated intensive cultivation in the region's challenging terrain. Recent studies suggest that the construction of these terraces was a gradual process, closely tied to the daily farming activities of the inhabitants (Schoeman 2024). The landscape of Bokoni is marked by numerous stone circles, mazes, and interconnected roadways, reflecting a complex societal structure with advanced agricultural and architectural practices. The strategic placement of settlements, often on elevated terrains, indicates a need for defence against external threats, highlighting the socio-political dynamics of the time.

The archaeological findings at Komati Gorge and surrounding areas provide valuable insights into the Bokoni's innovative land-use strategies and social organisation, offering a deeper understanding of pre-colonial agrarian societies in southern Africa (see Delius *et al.* 2012; Birin *et al.* 2021).

Bokoni formed part of a broader economy, which included trade from the Indian Ocean through sites such as Chibuene (Delius *et al.* 2012). This site located near present-day Vilanculos in central Mozambique, stands as a testament to early trade activities along the south-eastern African coast (Badenhorst *et al*. 2011). Occupied from approximately AD 600 to AD 1700, Chibuene was a pivotal coastal trading station that connected the Indian Ocean trade network to the African interior. Archaeological excavations have uncovered a diverse array of artifacts, including imported glazed pottery, glass beads, iron fragments as well as animal furs and skins (Pwiti 1991; Badenhorst *et al*. 2011). The presence of these imported goods suggests that Chibuene served as a crucial entry point for commodities destined for inland areas, facilitating the movement of goods such as glass beads and ceramics into the interior of southern Africa (Badenhorst *et al.* 2011).

2.3.3 The Colonial Frontier

About 60km south of Komati Gorge, the Lake Chrissie San maintained a continuous presence in the Lake Chrissie region well into the 20th century, a rarity compared to other hunter-gatherer groups that were displaced or destroyed during the early colonial and frontier expansions. Hunter-gatherers of southern Africa remained isolated from the expanding world until the 15th century.

The colonial frontier in southern Africa was a dynamic and often violent space where European expansion clashed with indigenous resistance (Thompson 2001). From the late 17th century

onwards, Dutch, British, and later Boer settlers pushed deeper into African territories, driven by the search for land, trade opportunities, and political control. This expansion led to frontier wars, forced displacements, and shifting alliances between colonial powers and African chiefdoms (Thompson 2001).

The Portuguese established a significant presence in Mozambique starting in the late 15th century, initially focusing on coastal trading posts to control lucrative trade routes. Over time, they expanded their influence inland, establishing forts and engaging in the trade of commodities such as gold, ivory, and slaves (Thompson 2001; Chewins 2016; Roque 2017). Contact with the Portuguese is evident in the presence of Portuguese loanwords in the //Xegwi language spoken in the Lake Chrissie area.

In parallel to colonial contact, were internal political changes, such as the *mfecane* (18th century). This was a period of widespread warfare, migration and state formation in South Africa driven by internal African dynamics such as the rise of the powerful kingdoms in eastern South Africa in part related to trade as well as climate change. It led to the displacement of numerous societies across the country (Heese 1971; Thompson 2001; Makhura 2007; Rowe 2009; Chewins 2016).

The introduction of domestic livestock occurred during the first millennium (Bousman 1998; Sadr 2015). The San acquired sheep through the process of dispersal from central Africa. It is difficult to establish what part of San communities played in the trade networks, like into Great Zimbabwe. The incorporation of domestic livestock into the economies of hunter-gatherers profoundly affected their ways of life (Thompson 2001). It appears that they provided greater regions (e.g. Great Zimbabwe, Mozambique) as well as colonial invaders later on with goods from hunting (Blundell 2006).

Alas around 2000 years ago, population movements brought the first farming communities into southern Africa. Hunter-gatherer groups had been small, whereas farming/herding groups were large. Early Bantu-speaking communities had a mixed economy that combined agriculture with raising livestock like cattle, sheep, and goats. The shift to a pastoral lifestyle fundamentally changed their mindset, as unlike mobile hunter-gatherers who didn't accumulate possessions, these new herders began to see livestock as a form of wealth. This change may also point to an emerging wealth gap among the San people (Thompson 2001).

The expansion of Boer and British influence into the Lakes District of Mpumalanga was driven by the pursuit of land, trade opportunities, and political dominance. The Boers, in their quest for self-governance, established independent republics such as the Zuid-Afrikaansche Republiek (ZAR), pushing into territories occupied by African chiefdoms. This expansion often resulted in violent clashes, forced removals, and shifting power dynamics as indigenous groups resisted colonial encroachment (Keegan 1987; Thompson 2001; Seleti 2017).

In the nineteenth century, the expansion of Boer and British influence into the Lakes District of Mpumalanga was driven by the pursuit of land, trade opportunities, and political dominance. The Boers, in their quest for self-governance, established independent republics such as the Zuid-Afrikaansche Republiek (ZAR), pushing into territories occupied by African chiefdoms. This expansion often resulted in violent clashes, forced removals, and shifting power dynamics as indigenous groups resisted colonial encroachment (Omer-Copper 1977; Keegan 1987; Thompson 2001; Seleti 2017).

At the same time, the British sought to extend their control over strategic trade routes and mineral-rich areas, leading to further conflicts, including the Anglo-Zulu War (11 January 1879-4 July 1897) (O'Connor 2006) and the South African War (Anglo-Boer War) (11 October 1899- 31 May 1902) (Pretorius 2012). The discovery of gold and diamonds intensified these struggles, as European colonial powers vied for dominance over economically valuable regions (Keegan 1987; Omer-Copper 1977; Thompson 2001; Seleti 2017). Indigenous societies, caught between the competing forces of Boer and British colonialism, experienced profound disruptions to their way of life. Many were displaced, forced into labour, or integrated into colonial economies under exploitative conditions. The legacy of this period is deeply embedded in Mpumalanga's historical landscape, with remnants of fortifications, battle sites, and contested land claims continuing to shape historical discourse and identity in the region (Keegan 1987; Omer-Copper 1977; Thompson 2001; Seleti 2017).

The Lake Chrissie San's involvement in the colonial world was largely in the form of labourers, herders or servants. This could be because of the collapse of traditional economies. They were also very knowledgeable of local terrains, which made them valuable guides for colonial settlers, hunters and military expeditions.

The Lake Chrissie San maintained a continuous presence in the Lake Chrissie area well into the 20th century. This could have been facilitated by the ecology and geography of the region. The Lake Chrissie region provided an ecologically diverse and resource-rich environment (grasslands & wetlands) (Potgieter 1955) that allowed for a semi-autonomous foraging and hunting lifestyle. The remote geography (pans, pools, caves, shelters) (Potgieter 1955) gave the San protection from displacement, colonial invaders or Bantu-speaking agro-pastoralists. The Lake Chrissie San also had a flexible subsistence strategy. They didn't just rely on foraging and hunting but also integrated livestock keeping and trade (Potgieter 1955; for similar patterns see Wadley & Jacobs 2006; Marean *et al.* 2007; Henshilwood & Marean 2003; Thompson 2001). This was most likely possible with Bokoni in the near vicinity (Maggs 2008; Delius *et al.* 2012; Birin *et al*. 2021). This flexible economic strategy helped them survive the changing landscape.

2.4 Hunter-Gatherers and Hunting

2.4.1 Hunting Strategies and Technological Adaptations

The LSA, is marked by notable shifts in subsistence strategies, influenced by environmental and cultural changes. It was a period of significant advancements in human hunting technologies and strategies. Hunting techniques included trapping and snaring (Wadley 2010), group hunting (Potgieter 1955), and the use of fire for hunting, landscape management as well as symbolic/ritualistic rock art (Mitchell 2000; Henshilwood 2007; Gowlett & Wrangham 2013). One of the major developments in the LSA was the refinement of projectile technology, including the use of bows and arrows, spear throwers (atlatls), and microlithic tools mounted on shafts to create composite weapons (Lombard & Phillipson 2010). These innovations allowed hunters to target animals from a greater distance and with more precision, increasing hunting success rates. Additionally, the use of poisoned arrows-evident from ethnographic studies of San hunter-gatherers in southern Africa-would have enabled hunters to take down large prey more effectively (Mitchell 2002).

Besides technological advancements, humans also improved their hunting strategies. Cooperative hunting, where groups of individuals worked together to ambush or drive animals into traps or natural enclosures, became more common (Lombard *et al*. 2021, 2022). Evidence from archaeological sites shows that humans strategically targeted specific species, often focusing on larger game that provided substantial food resources.

As hunting technology became more effective, hunting pressure on large mammals intensified. Over time, this may have had significant ecological consequences. Large-bodied animals typically have slower reproductive rates and longer gestation periods, making them particularly vulnerable to overhunting. When hunting pressures exceed a species' reproductive capacity, population decline, and even local extinctions can occur (Plug 2017; Dusseldorp & Reynard 2022).

Notably for this study, due to the Lakes Area, Potgieter (1955) indicated that game pits, different types of snares and traps, including fish traps and dogs were used. The hunter-gatherers in this area did not make use of bow and arrows, however, children hunted low-ranked prey (E.g., mice and birds). There was also a tactic of hiding in the grass and driving groups of game over traps. Hunting strategies focused on large game, gathering plant resources, seasonal foraging and environmental adaptation (for similar patterns in the MSA onwards see Henshilwood & Marean 2003; Wadley & Jacobs 2006; Marean *et al.* 2007).

2.4.2 Faunal Remains and Subsistence Intensification

Subsistence intensification refers to the strategies employed by past human populations to extract resources from their environment to meet their dietary needs (Reynard *et al.* 2016b; Reynard &

Henshilwood 2017). This can be influenced by increasing populations or environmental changes. However, carnivores (e.g. hyenas, leopards, jackals & wild dogs) can also deposit, modify and rearrange bones. This also means that carnivore activities can complicate the interpretations of subsistence intensification. The analysis of faunal remains can provide crucial insights into these strategies.

Faunal analysis such as bone surface modification (BSM) (burning and butchering marks) can provide insights into occupational intensity and human subsistence practices (Egeland 2012) and how these practices/strategies show shifts in hunting, prey selection and processing techniques (Dusseldorp & Reynard 2022). This can be linked to the diet breadth model. The diet breadth model describes how low-ranked prey are adapted to the diet as the abundance of high-ranked prey declines (MacArthur & Pianka 1966; Dusseldorp 2012). Prey is usually ranked according to body size and environmental stressors (Winterhalder & Goland 1997; Winterhalder & Smith 2000; Thompson *et al.* 2019; Ben-Dor & Barkai 2024).

This topic is particularly relevant to zooarchaeology and taphonomy, as it helps differentiate between anthropogenic and natural accumulations of faunal remains (Brain 1981). Topics such as: site formation processes – understanding whether bones were modified by humans (e.g., butchery marks) or by carnivores (e.g., tooth marks, digestion damage), resource competition & coexistence – how early humans adapted to seasonal shifts in carnivore activity, possibly using shelters opportunistically when predators were absent, paleoenvironmental and climatic context-seasonal changes may reflect shifts in resource availability, influencing when and how both humans and carnivores occupied certain spaces and broader implications for human behaviour-whether shelter use patterns indicate structured settlement strategies, risk management, or mobility influenced by predator presence are explored (Chase & Meadows 2007; Kuhn *et al.* 2011).

2.4.3 Comparative Sites

The animal remains from Welgelegen as well as the butchering techniques as seen in BSM can be compared to other studies and findings in the vicinity of the same area to better understand the uniqueness, or not, of the Lake Chrissie hunter-gatherer animal consumption patterns and the behaviour of the animals. To achieve this, I will compare the Welgelegen fauna with that of Hongingklip (Korsman 1990; Korsman & Plug 1994), Iron Pig Shelter (Bader *et al.* 2020), Border Cave (Klein 1977), Bushman Rock Shelter (Badenhorst & Plug 2012), and Heuningneskrans (Klein 1984).

Ideally, such comparisons should be made with contemporaneous sites in the same region or landscape. Such sites, however, are scarce, and consequently, I included BC and BRS. While these sites represent Late Pleistocene contexts and are not directly comparable in time to the Historic Period occupation of Welgelegen, they provide valuable insights into long-term patterns and

variability in meat-procuring strategies within the broader environmental and cultural framework of southern Africa. It, however, is essential to acknowledge the temporal gap between these sites and Welgelegen, particularly with the start of the BC being dated to nearly 200,000 years ago (Grün & Beaumont 2001). This considerable chronological difference inevitably reflects variations in hunting strategies, shaped by differing technological, environmental, and socio-cultural factors. Despite these limitations, the comparison offers an opportunity to explore how subsistence practices may have evolved over time and to assess broader patterns of human-environment interaction in the region.

Upper Pleistocene human-environmental interactions, which are characterised by adaptations to climatic shifts and resource availability, provide insights into long-term relationships between humans and their environments (Gaffney 2021). The upper Pleistocene saw major shifts in sea levels, vegetation and animal distribution. Species distribution influenced animal populations, which impacted human hunting techniques. These past responses provide insights into the response to climate changes. The scale of human activity and its impact on the environment have increased in the past 400 years, the fundamental relationships between humans and the environment remain (Jones 2010; Pires *et al*. 2010; Verstaeten 2014; Nanavati *et al*. 2022).

Welgelegen Shelter is the only published site in the Lakes District. The excavation took place in 1967 by M. Schoonraad and P. Beaumont. The site contains rock art, lithics, fauna and pottery (Schoonraad & Beaumont 1971). Stratum 1 was associated with the LSA, and Stratum 2 was associated with the hunter-gatherer and farming communities (Schoonraad & Beaumont 1971). From the evidence, it is thought that there was contact or coexistence between the farmers and hunter-gatherers (Schoonraad & Beaumont 1971).

Iron Pig Rock Shelter (Bader *et al.* 2020), which is approximately 47 km from Welgelegen, contained unearthed shards of pottery (which resembled pottery from Bokoni villages) which were found to be undiagnostic; however, Early Farming rim sherds were documented (Bader *et al.* 2020). Notably, no fauna has been published.

East of Iron Pig and northeast of Welgelegen is Honingklip (HKLPV), which is a small rock shelter that contains traces of rock paintings as well as a stone wall at the north and west entrances that is stratigraphically associated with the last phases of hunter-gatherer protection against intruders, predators and the natural elements (Korsman & Plug 1994). Potgieter (1955) describes similar walls used by San hunter-gatherers in the Lake Chrissie area. This suggests evidence of two phases of occupation: pre-contact LSA and a contact period between LSA and farmers (Korsman & Plug 1994). Korsman (1990) also suggests that Honingklip appeared to be a hotspot for aggregations of bands of hunter-gatherers from the mid-Holocene to approx. 200 years ago. Honingklip also experienced a shortage of resources, which led to migration (Korsman & Plug 1992). The terrain between Lake Chrissie and Honingklip was even enough to make movement between the two sites possible (Korsman 1990). The heavier reliance on human modifications and the absence of

significant carnivore marks might suggest an environment where human subsistence activities were more focused on hunting rather than scavenging or secondary processing of carnivore remains. At Heuningneskrans, while poor bone preservation makes it challenging to study patterns of accumulation, some trends are still evident.

East-northeast of Welgelegen sits Border Cave, which is located along the Lebombo Mountains and is characterized by a mix of savannah, woodland, and grassland, supporting a diverse faunal assemblage that includes both forest-adapted and open-environment species (Klein 1977). This variety would have encouraged broad-spectrum foraging strategies, including hunting small ungulates and exploiting plant resources from multiple biomes. In contrast, Bushman Rock Shelter in the Limpopo Province exhibits greater woodland components alongside grassland, offering access to arboreal resources and potentially supporting a higher frequency of browsing species (Badenhorst & Plug 2012).

Border Cave has a significant presence of both anthropogenic and zoogenic marks (Klein 1977). Cut marks represent tool usage and gnaw marks, scavenging. This reflects the adaptive strategies and subsistence practices of the hunter-gatherers that occupied the area. The remains also reflect a mutual avoidance relationship between humans and large carnivores (Klein 1977). The higher frequency of anthropogenic marks in both the MSA and LSA layers at Border Cave suggests that humans were the primary accumulators, though carnivores did contribute to the faunal assemblage. Additionally, Klein (1977) notes that the age profile of ungulates in the assemblage points to the seasonal use of the cave, possibly by humans during certain times of the year. Notably, bones are heavy to carry, which indicates they only brought back the necessities, which also correlates with the ages of ungulates and seasonality (Klein 1977). Environmental changes influenced hunting (Klein 1977). Klein (1977) also indicates that environmental changes influenced hunting. The paleoenvironment was dense with low thickets along water courses and large expanses of grassland and savannah (Klein 1977).

Bushman Rock Shelter, which is northeast of Welgelegen, has significant anthropogenic marks which highlight human activities in the accumulation (Badenhorst & Plug 2012; Porraz *et al.* 2015). Burnt bone was a good indicator for this. The evidence indicates that hunter-gatherers selected large bovids and that they were successful hunters (Badenhorst & Plug 2012). It can be noted that not all fauna was accumulated by humans. Individuals occupied the shelter continuously, however, when they weren't there, it was likely occupied by animals (Badenhorst & Plug 2012). There was a presence of low-ranked animals, and this area was occupied by the San.

North-northwest of Welgelegen is Heuningneskrans Shelter consisted of poorly preserved remains which made it difficult to study. It could be assumed that due to the presence of large carnivores that the site could have been shared by humans and large carnivores. This again brings up the mutual avoidance relationship (Klein 1984).

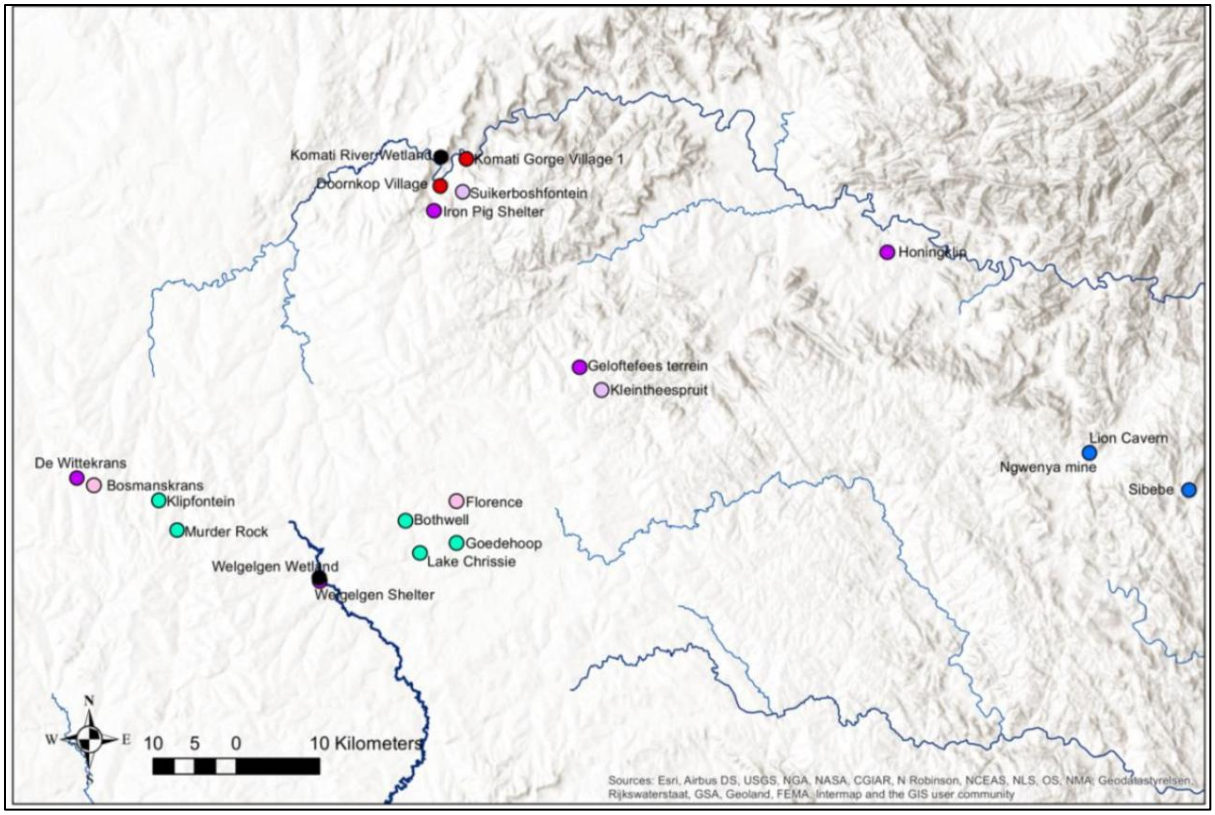


Figure 2.4 Archaeological sites in the Lakes District and surrounding areas. Black dots indicate wetlands, red represents Bokoni villages, purple are excavated shelters with rock art, pink indicates rock art sites, blue are LSA sites without rock art and green are sites associated with Tlou-tle. The Welgelegen Shelter falls within the wetland area. Illustrated by Alex Schoeman.

The archaeological and zooarchaeological evidence from Mpumalanga highlights the complex relationship between early humans and their environment. The technological innovations, subsistence strategies, and environmental adaptations evident in the MSA and LSA underscore the dynamic nature of human occupation in the region. Appendix C,D,E and F for list of fauna from the respective sites.

2.4 Fauna as a Paleoenvironment & Cultural Proxy

The analysis of faunal remains can be used as a proxy for the paleoenvironment and paleoenvironmental change. The specific ecologies of large mammals play an important role in elucidating both contemporary and past environments (Reynard 2021). Large mammals (herbivores), especially ungulates, have diets and habits that are closely linked to the vegetative regimes as well as the landscapes they make use of (Wells 1962). Ungulates, however, are highly adaptive and often change their dietary preferences based on seasonal plant availability and migratory habits (Skinner & Chimimba 2005; Abraham *et al.* 2022). Therefore, Wells (1962) suggests that there is a complicated relationship between faunal communities, biomes, local

environmental conditions and regional ecological resilience. Therefore, by studying the distribution, abundance and species composition of animal remains in archaeological sites over time, researchers can infer shifts in human subsistence strategies, hunting and gathering practices, domestication efforts, trade networks and symbolic uses of animals. Shifts in the types of animals being hunted or domesticated, changes in hunting techniques or the appearance of tools for butchering purposes can indicate cultural changes within a society (Reynard 2021).

Furthermore, the presence of exotic or non-local animals may suggest the existence of trade networks or land distance exchange systems. Furthermore, the deposition of animal remains in ritual contexts such as burial sites or ceremonial deposits can provide insights into the cultural significance of certain animals within a society (Plug & Badenhorst 2010).

Southern Africa has a rich record of archaeofaunal and palaeontological faunas which have been critical in inferring past environments and ecology (Reynard 2021). Faunal data have been key in exploring environmental change from the Pleistocene to the Holocene. Previous studies, which ranged from the Western Cape, Eastern Cape, Mpumalanga, Bloemfontein and Lesotho (e.g., Klein 1972, 1976, 1980; Faith & Behrensmeyer 2013; Brink 2016; Phelps *et al.* 2020; Toffolo 2024) have played crucial roles in documenting environmentally induced faunal turnover across South Africa and are therefore important records in southern Africa environmental data. There are many taphonomic biases that affect species abundance such as large herbivores being difficult to identify taxonomically because of bone density-mediated fragmentation (Reynard *et al.* 2024), this is a result of under-represented species. Bovid-size classes are an important aspect of abundance and taphonomic analysis may be the key to deter these biases (Reynard 2021). This is linked to the preservation of faunal remains and whether the remains are affected by whether they were covered, in the open-air, in a cave or if there were traces of carnivores and humans (Reynard 2021).

Klein (1980) contends that it is nearly impossible to assume the relative abundance of mammal species in fossil assemblages reflects the abundance in live communities from which they came from. Klein (1980) further suggests that it is reasonable to assume that mammal frequencies were altered by the process of bone accumulation which ultimately makes it difficult to use fossil faunas for detailed reconstruction of environments. However, there are examples of faunal samples that were accumulated by the same agencies (e.g., LSA hunter-gatherers) (Klein 1980). Differences between species frequencies between samples are likely to reflect a difference between paleoenvironments from which the samples were derived. It can therefore be assumed that one environment contained more animals (e.g., grazers) than other environments (Klein 1980). Fossil faunas also contain species which were never observed in that specific region or site, given the known habitat preferences of those species (Klein 1980). In these examples, the presence of species may be an indicator of past environmental difference or change (Klein 1980; Smith *et al.* 2019).

In archaeological sites, changes in the environment and changes in culture are the foundation of shifts between the abundance of species through time (Klein 1980; Smith *et al.* 2019). Domestic stock was diffused beyond the areas of Iron Age occupations in South Africa and some of the Late Holocene faunas listed in those areas can be used to create routes of diffusion (Klein 1979) or the impact of domestic animals had on indigenous wildlife species (Dusseldorp 2016). In grassland, Jones *et al.* (2023) indicates that faunal differences reflect major social and technological differences between farmers and hunter-gatherers.

Faunal remains found at Welgelegen Shelter identified by Schoonraad and Beaumont (1971) ranged from fish, reptiles, birds and mammals (Appendix B). The fauna is generally dominated by smaller animals. Some small animals include *Ardea cinerea* (grey heron*), Columba livia* (rock pidgeon*),* Serpentes (snakes*), Apodemus* (field mice*), Lepus (*hares*), Geochelone (*tortoise*), Suricata suricatta (*meerkat*) and Hystrix cristata* (porcupine). In contrast, small animals that can be currently found in the area include *Lepus (hares), Hystrix cristata* (porcupine), *Cynictis penicillate* (yellow mongoose) and *Atelerix frontalis* (South African hedgehog) (Appendix G: Muller 2013).

Increases in the abundance of small fauna at a site may suggest subsistence intensification (compare to Stiner *et al.* 2000; Badenhorst 2008; Dusseldorp 2016; Manyanga & Pangeti 2017; Dusseldorp & Reynard 2022; Lombard *et al.* 2022). Subsistence intensification occurs when more meat-yielding (higher-ranked) prey such as large ungulates are over-hunted, and are replaced by smaller, less meaty (lower-ranked) prey such as birds, hares or hyrax in human diets (Dusseldorp 2012).

Plug (1997) analysed animal remains from various sites to reconstruct past environments and human-animal interactions. The research revealed that during the Last Glacial period, species diversity was limited, and small bovids were underrepresented. With the onset of the Holocene, improved climatic conditions led to increased biodiversity, which coincided with a rise in human population and more frequent occupation of rock shelters. This study underscores the dynamic relationship between environmental changes and human subsistence practices in the region

Moshebi's Shelter, located in the Sehlabathebe Basin of Lesotho, is a significant Later Stone Age (LSA) archaeological site that has provided valuable insights into the subsistence strategies and environmental contexts of past hunter-gatherer communities (Badenhorst *et al.* 2019). The analysis of faunal remains from Moshebi's Shelter revealed a diverse array of species, including mammals, birds, reptiles, amphibians, fish, and molluscs. Notably, the assemblage lacked domestic livestock, suggesting a reliance on wild resources. Common taxa such as mole rats and vlei rats were identified, likely representing natural intrusions. However, the predominance of small- and medium-sized antelope and rock hyrax indicates targeted hunting practices by the site's occupants. These findings reflect an open grassland environment interspersed with wooded microhabitats in nearby valleys. The presence of species like zebra, absent in highland Lesotho

during the 19th century but known earlier in the Holocene, and bushpig, which may suggest denser vegetation or contact with communities in KwaZulu-Natal, further contextualizes the paleoenvironment (Badenhorst *et al.* 2019). The findings from Moshebi's Shelter contribute significantly to our understanding of hunter-gatherer subsistence strategies in highland Lesotho. The emphasis on hunting specific fauna reflects adaptive strategies to the available resources and environmental conditions (Badenhorst *et al.* 2019).

2.5 Ethnographic Insights into Hunting and Food Practices

While ethnographic studies have provided rich accounts of subsistence strategies in other parts of the world (Ingold 1980; Kelly 2007), South Africa has comparatively few detailed records of hunting and food traditions from indigenous groups prior to the arrival of farming communities and European colonisation. This scarcity is largely due to historical disruptions, the displacement of communities, and the under-documentation of oral traditions. Consequently, much of what is known about early subsistence strategies relies on archaeological and zooarchaeological data rather than first-hand ethnographic descriptions (Mitchell 2002; Jones *et al.* 2023).

Potgieter (1955) indicated that Lake Chrissie hunter-gatherers made little use of bow and arrows. However, butchering marks do not discount for bow-and-arrow hunting. This is because most marks are made post-mortem from butchering and fleshing, and arrows only penetrate flesh. There is also no way to tell if poisoned arrows were used.

Archaeological evidence has played a crucial role in reconstructing past human-environment interactions. Changes in species abundance within faunal assemblages are often interpreted as indicators of environmental and cultural shifts (Klein 1980). In particular, the introduction of domestic livestock during the first millennium altered subsistence patterns, as evidenced by faunal remains that suggest diffusion beyond known farming community settlements (Klein 1979; Badenhorst 2010; Arnold *et al.* 2013; Sadr 2015). The presence of livestock in regions traditionally associated with hunter-gatherers suggests complex interactions between pastoralists and foragers, but without detailed ethnographic records, it is difficult to ascertain the full extent of these interactions (Sadr 2015; Lombard *et al*. 2022).

Maggs (1980) highlighted how faunal assemblages in South African grasslands reflect major technological and social changes between sites occupied by farming and hunter-gatherer communities. Zooarchaeological studies from sites like Welgelegen Shelter have revealed a dominance of small game, including fish, reptiles, birds, and mammals (Schoonraad & Beaumont 1971). Such patterns suggest subsistence intensification, where a decline in large ungulate populations led to a dietary shift toward smaller, lower-ranked prey such as hares and hyrax (Stiner *et al.* 2000; Badenhorst 2008; Dusseldorp 2012; Lombard *et al.* 2022).

The diet breadth model is ranked according to caloric value, which is generally measured by body size (Reynard & Henshilwood 2017). Hunter-gatherers consumed a wide range of faunal species and resources. This can be a result of changes in prey availability, environmental changes, energy requirements and refugee situations (Reynard & Henshilwood 2017). Bigger and top prey always take preference; the hunt takes up more energy, but the reward is great. Based on the caloric favours, it doesn't matter how abundant low-ranked prey are, they will almost always be ignored. This also suggests that when top prey are over-hunted and if hunter-gatherers are desperate, low-ranked prey will come into play (MacArthur & Pianka 1966; Kelly 2007; Winterhalder 2001; Dusseldorp 2012; Reynard & Henshilwood 2017). Schoonraad & Beaumont's (1971) faunal list includes large amounts of low-ranked prey (see Appendix B). Without corresponding ethnographic accounts, it, however, remains challenging to determine whether these shifts were the result of environmental pressures, cultural preferences, or evolving hunting strategies.

The role of fauna as a proxy for social change is well-established in archaeology. By analysing species composition, distribution, and butchery patterns, researchers can infer changes in hunting techniques, domestication efforts, and even trade networks (Reynard *et al.* 2016a,b; Badenhorst 2017). The presence of non-local faunal remains at archaeological sites often suggests long-distance exchange systems, but without ethnographic records, it is unclear how these networks operated and whether they were embedded in broader cultural or economic frameworks (Sadr 2013; Lander & Russell 2018). Ritual deposits of animal remains also indicate symbolic or ceremonial practices, yet the lack of recorded indigenous perspectives limits a deeper understanding of their significance (Plug & Badenhorst 2010).

Unlike other regions where indigenous oral histories complement archaeological findings (e.g., Berkes 2012), South Africa has limited detailed ethnographic accounts of precolonial subsistence practices for hunter-gatherer groups, whereas farming communities are comparatively well represented in the ethnographic record. This absence presents a challenge for researchers attempting to reconstruct past foodways and hunting traditions. While some early colonial-era observations provide fragmented insights (Seroto 2019), they are often filtered through a Eurocentric lens and fail to capture indigenous perspectives in their entirety.

The scarcity of ethnographic data underscores the need for interdisciplinary approaches that integrate archaeology, oral histories, and ethnographic research. Collaborative efforts with indigenous communities could help fill gaps in the record, preserving traditional ecological knowledge and offering new perspectives on past subsistence strategies. By acknowledging these limitations, future research can strive for a more holistic understanding of South Africa's rich and complex hunting and food traditions.

The faunal composition of the Lake Chrissie region before European intervention provides critical insight into past ecological conditions and human-wildlife interactions. Historical records and

zooarchaeological evidence highlight a diverse range of species that thrived in the area, reflecting a well-balanced ecosystem shaped by both natural and anthropogenic factors.

Potgieter (1955) documented a rich assemblage of wildlife in the Lake Chrissie area before the introduction of European hunters. This assemblage was documented by word of mouth by early European settlers. The area supported large herbivores such as blesbok (*Damaliscus pygargus phillipsi*), springbok (*Antidorcas marsupialis*), reedbuck (*Redunca arundinum*), blue wildebeest (*Connochaetes taurinus*), and ostrich (*Struthio camelus*). Avifaunal diversity included Egyptian geese (*Alopochen aegyptiaca*), storks (*Ciconiidae*), and black locust birds (*Tchagra senegalus*), suggesting the presence of varied wetland and grassland habitats. The absence of European hunting pressures allowed for stable population dynamics among these species, with natural predator-prey relationships maintaining ecological balance. The arrival of European settlers and subsequent hunting activities led to significant declines in these populations, altering the region's faunal landscape (Potgieter 1955).

Comparative data from Schoonraad & Beaumont's excavations at Welgelegen Shelter provide additional insight into the faunal diversity of the broader Mpumalanga region. Their findings reveal a diverse array of species, including:

- Aquatic and avian fauna: Freshwater mussel (*Unionidae*), cowrie (*Cypraeidae*), barbel (*Clarias gariepinus*), grey heron (*Ardea cinerea*), rock pigeon (*Columba livia*), and ostrich.
- Small mammals and reptiles: Field mouse (*Muridae*), hare (*Lepus spp.*), tortoise (*Geochelone*), meercat (*Suricata suricatta*), and various snake species.
- Carnivores: Wild cat (*Felis lybica*), wild dog (*Lycaon pictus*), and porcupine (*Hystrix africaeaustralis*).
- Large herbivores and ungulates: Warthog (*Phacochoerus africanus*), aardvark (*Orycteropus afer*), impala (*Aepyceros melampus*), klipspringer (*Oreotragus oreotragus*), springbok (*Antidorcas marsupialis)*, brown duiker (*Sylvicapra grimmia*), waterbuck (*Kobus ellipsiprymnus*), zebra (*Equus quagga*), buffalo (*Syncerus caffer*), kudu (*Tragelaphus strepsiceros*), and ox (*Bos taurus*).

The comparison of historical accounts and archaeological data underscores the ecological richness of the Lake Chrissie region before European impact. The faunal evidence from Welgelegen Shelter aligns with ethnographic and historical sources, suggesting continuity in species presence over extended periods. The decline in certain species post-European arrival further highlights the role of human intervention in shaping regional biodiversity.

2.6 Taphonomy

Taphonomy, the study of post-mortem processes affecting organic remains, is crucial for understanding how faunal assemblages are shaped by both natural and cultural factors (Lyman

1994: p. 1-4). My research focuses on the taphonomic alterations of large mammal remains, examining how environmental conditions, biological activity, and human interventions influence faunal remain preservation and fragmentation. By analysing these processes, my research aims to reconstruct past environments and assess how taphonomic modifications influence zooarchaeological interpretations.

Taphonomic analysis encompasses the study of the various processes that affect animal remains from the moment of death until their recovery (Lyman 1994: p. 1-4). While definitions of taphonomy have evolved over time, they share a common focus on the transformation of organic materials through biological, chemical, and physical processes. Efremov (1940) originally framed taphonomy as the transition of remains from the biosphere into the lithosphere, emphasising its role in fossilisation. Later, this view was broadened to include all post-mortem processes that contribute to the formation of fossil deposits, highlighting the complexity of preservation and destruction (Gifford 1981). Researchers often note that both natural and cultural agents shape the faunal record, underscoring the discipline's relevance to archaeological contexts (Efremov 1940; Behrensmeyer 1978; Brain 1981; Binford 1981; Lyman 1994, 2008; Marean 1991; 1998; Schiffer 1987). Within these perspectives, a key concern is the role of taphonomic processes in altering faunal remains, particularly in the fragmentation of bones into unidentifiable pieces (Reynard *et al.* 2014). My project builds on this understanding, engaging with the ways these processes shape faunal assemblages and influence interpretations of past environments and human-animal interactions.

Studying the taphonomy of an assemblage is important because it adds to researchers' understanding of faunal use habits as well as procurement and processing patterns (Grody 2016). Orton (2012) relates consumption, butchery techniques and food behaviours to taphonomic research. The analysis of bone surface modifications helps in identifying possible accumulators of a faunal assemblage at a site and can be used as indicators of early modern human and carnivore interactions and competition (Thompson *et al.* 2017).

Examples of taphonomic influences include both natural (i.e. weathering, animal influence, root etching) and human (burning, butchering, tool making) influences on faunal remains (Lyman 1994: p. 294-350 & 354-381, 2008: p. 267-280; Klein & Cruz-Uribe 1984; Thompson 2010; Orton 2012). Each taphonomic influence comes with its own identification and quantification methods. The taphonomic influences which will be analysed are (but not necessarily limited to): cut marks and other human influences; root etchings; burning; weathering; level of fragmentation; types of breakages and any animal influence on the faunal remains (e.g., bite/gnaw marks). Environmental conditions that affect faunal remains preservation include soil acidity, climate, site location and soil matrix (Nord *et al.* 2005; Kibblewhite *et al.* 2015).

Badenhorst *et al*. (2021), make note that the role of large carnivores and humans makes use of shelters. Carnivores (e.g., Leopard, hyena and wild dogs) use the shelters when people do not occupy them (Brain 1981; Stiner & Munaro 2002; Henshilwood 2008; Reynard & Henshilwood

2017). Carnivores could have left remains in the shelters and these remains would have eventually become incorporated with the anthropogenic accumulators (Henshilwood 2008; Reynard & Henshilwood 2017).

Behrensmeyer 1978; Marean & Spencer 1991; Lyman 1994: p. 294-391; Lyman 2008: p. 267-279; Selvaggio 1994; Reitz & Wing 2008: p. 137-140; O'Connor 2000 (a,b) suggests that the exposure to the elements, gnawing by rodents or carnivores, trampling, burning and butchering are indications of modification and fragmentation of bones. Stiner *et al.* (1995) & Outram *et al.* (2005) also suggest that archaeological assemblages contain fragmented and burnt faunal remains. Further fragmentation be caused by chemical changes by water percolation, gastric acids, penetration of roots, chemical composition of soil and natural decomposition (Behrensmeyer 1978; Gifford 1981).

2.6.1 Anthropogenic Modifications

Research suggests that analysing surface modifications on faunal remains caused by taphonomic processes provides insight into both human and carnivore subsistence strategies (Reynard *et al.* 2024). Anthropogenic modifications, such as cut and percussion marks, are strong indicators of human butchery and marrow extraction activities (Binford 1981; Potts & Shipman 1981; Shipman & Rose 1983, 1986; Bunn & Kroll 1986). Long bones are particularly prone to displaying such surface modifications associated with human processing (Binford 1981; Brain 1981; Bunn & Kroll 1986; Shipman 1986). As a result, cut and percussion marks are most found on long bone fragments (Binford 1981; Brain 1981; Fisher 1995).

Percussion marks and carnivore tooth marks are widely recognised as evidence of marrow extraction, whether by humans or scavengers (Binford 1981, 1984; Brain 1981; Bunn 1981; Blumenschine & Selvaggio 1988; Lyman 1994: p. 281, 2008: p. 279-281; Reitz & Wing 2008: p. 142). Some researchers however, caution that distinguishing between human and animal induced modifications can be challenging (Bunn & Kroll 1986; Lyman 1994), as cut marks may sometimes result from natural processes such as animal trampling (Shipman 1981; Shipman & Rose 1984). Despite this, percussion-marked long bone shafts are considered highly indicative of human activity (Blumenschine & Selvaggio 1988; Marean *et al.* 2000). Overall, studies on surface modifications caused by taphonomic processes provide valuable evidence for reconstructing human and carnivore subsistence behaviours.

2.6.2 Unidentifiable Faunal Remains

Zooarchaeological studies involve the assessment of animal remains although analyses are usually restricted to identified fauna (Butler & Lyman 1996; Reitz & Wing 2008; O'Connor 2000a,b). The majority of faunal remains are defined as 'unidentified' because they cannot be identified to species, genus, family, order or size class (Enloe 1993; O'Connor 2000a,b). Identifiable bone can be classified into elemental or taxonomic groups, which serve as the fundamental statistical units

in analyses. Unidentified bone, however, cannot be incorporated into these zoological classifications, requiring the creation of artificial typologies to categorise these fragments (Driver 2005).

2.6.3 Bone Fragment Lengths

The size of long bone fragments is a useful indicator of fragmentation within a faunal assemblage (Brain 1969, 1974, 1981). Fragmentation occurs through both pre- and post-depositional taphonomic processes (Lyman 1994: p. 379-380; 2008: p. 250-251) and is a result of dynamic stress or tension causing bones to crack (Wright & Hayes 1977). Larger bone fragments may be the result of human activities, such as marrow extraction (Enloe 1993), or may be influenced by taphonomic factors like fluvial activity or recovery bias, which could remove smaller fragments (Monahan 1995). Additionally, large fragments may suggest the presence of larger animals in the assemblage (Badenhorst & Plug 2012). Smaller fragments, on the other hand, are often associated with human practices like burning (Stiner *et al.* 1995), post-depositional events like trampling (Voigt 1983), or the remains of smaller animals (Thompson & Henshilwood 2011).

Brain (1969, 1974, 1981) extensively recorded bone fragment lengths and documented other important features, including cut marks, carnivore damage, surface abrasion, and pathology (Brain 1974). In his early study of the fauna from Bushman's Rock Shelter (Brain 1969), he measured all unidentified long bone fragments, categorizing them based on their size. He observed that fragments in the upper levels, associated with farming material culture, were smaller compared to those from the deeper LSA and MSA layers. This greater fragmentation in the upper layers was attributed to post-depositional trampling when the cave was used as a tobacco barn. Brain (1981) also noted that bone fragment lengths from MSA and LSA contexts displayed a "remarkably consistent" distribution, indicating similar fragmentation processes across both assemblages.

Brain (1981) suggested that human-produced fragments typically exhibit less variation and a narrower size range compared to those produced by hyenas. While he proposed that larger fragments might be indicative of hyena activity, he was uncertain about reliably distinguishing between human and carnivore-produced fragments (Thackeray 2007). In a similar study on the Kromdraai fauna from the Pleistocene, Brain (1981) observed that the short fragment lengths and limited size range mirrored those found at LSA sites. He hypothesized that the intense fragmentation in the assemblage was likely due to hominid activity but also recognized that the decalcification of the breccias might have played a role in the process (Brain 1981).

2.6.4 Animal Size

An animal's most prominent and significant characteristics are its size and weight. In South African faunal assemblages, bovids are typically the most abundant in both species' diversity and overall numbers; however, these archaeofaunal remains are often highly fragmented (e.g., Brain

1981; Klein & Cruz-Uribe 1984). Due to the difficulty in assigning fragmented bovid remains to specific taxonomic groups, faunal analysts have developed size classifications to categorise them (Brain 1974; Vrba 1976; Bunn *et al.* 1980; Lyman 2008). Brain (1974) specifically suggested that unidentified antelope remains to be grouped into four size classes based on their overall dimensions.

Chapter Summary

The literature review in this chapter provides a foundation for this study. It also highlights the rich archaeological background and environmental/climate patterns of the study area as well as the importance of faunal studies. These studies indicate that eastern South Africa is an important area of study for understanding paleo-climatic/environmental change as well as fauna-environment-human interactions. Methods adapted from the various studies above are discussed in the next chapter.

CHAPTER 3: MATERIALS AND METHODS

In this chapter, I discuss the fauna sampled for this study as well as the methodology utilised to conduct the taphonomic analysis. It provides descriptions of terms used in taphonomic studies.

3.1 Materials

The materials studied were excavated from stratigraphic layers that form part of Schoonraad & Beaumont's (1971) second phase. Faunal remains recovered from the 2022 excavation season at Welgelegen Shelter were analysed. The focus of this study was on mammal remains from square XVIII C, which was excavated in quadrants A to D, from the top 18 stratigraphic layers. Not all layers yielded faunal remains. I analysed the faunal remains from 13 layers. These layers were combined into two clusters: the upper two layers (KBL & Black) formed Phase B and the lower 11 layers (Black 5, VDGB, Black 6, Bone 4, Ash, RBK, Olive 2, Pale Ale, MA, Black Clay, KA/SB) Phase A (Figure. 3.1). The upper layers have not been dated, but the lower layers date from 1439 - 1510 AD, suggesting that the sample spans the last 500 years.

The faunal sample was separated into identifiable (ID) and non-identifiable (non-ID) mammal specimens. 'Identifiable' here refers to specimens that can be identified to at least skeletal elements and class (Lyman 2008: p. 6-7). 'Non-Identifiable' refers to specimens that cannot be identified to skeletal elements (e.g., Klein 1976; Villa & Mahieu 1991). Taphonomic analysis was conducted on ID specimens and non-ID fragments >4cm. Bone surface modification (BSM) was only documented on specimens with cortical surfaces.

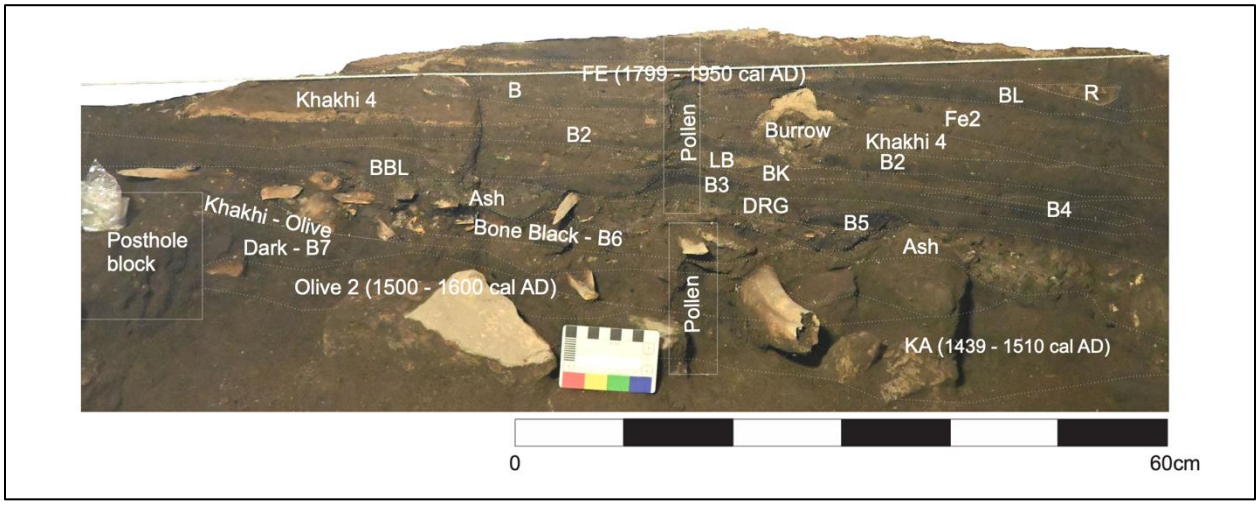


Figure 3.1 Profile drawing of the northwest section of the Welgelegen Shelter.

3.2 Taxonomic Identification

Faunal remains were identified to taxa and/or element using the faunal collections from the University of the Witwatersrand and the Ditsong Natural Museum of Natural History. Taxa can be a species, genus, family or a higher taxonomic category (Lyman 2008: p. 6-7; Kitchener *et al.* 2022). The identification methods followed Driver (2005) and Klein and Cruz-Uribe (1984) whereby the specimens are first identified to elements, with this used to identify taxa. The data was entered into an Excel spreadsheet which included but was not limited to accession data; taxa; element; side; epiphyseal fusion; long bone breakage; bone surface modification (BSM) and specimen length. Generally, teeth, patella, horn cores, distal phalanges and hyoids were used to identify specimens to taxa.

Animal remains that could not be identified beyond Family were grouped by size class. Specimens that could only be identified to bovid (Bovidae) were categorised according to Brain's (1974) bovid (antelope) size classes (Table 3.1). Brain (1974) distinguished these categories based on the animal's weight. These size-based categories are designed in southern Africa where there are multiple species of bovids that are commonly identified in archaeological sites. Non-bovid faunal specimens that can only be identified to the level of Order (Mammalia) were classified as small, medium or large mammals based on Brain's (1974) bovid size classes. 'Small mammals' are any animal below 1 kg such as hares, hyrax and porcupine. 'Medium mammals' include sheep-size animals such as leopards, and 'large mammals' include animals similar in size to an eland (Bunn *et al.* 1980).

Table 3.1 Bovid Size Classes and Examples (Brain 1974).

Bovid size class (Brain 1974)	**Klein (1976) equivalent**	**Weight range (kg)**	**Species examples**
I	Small	4.5 - 23	*Raphicerus* species (sp.) (steenbok)
II	Small-medium	23 - 84	*Antidorcas marsupialis* (springbok), *Redunca arundinum* (southern reedbuck)
III	Large-medium	84 - 296	*Tragelaphus strepsiceros* (kudu), *Oryx gazella*

			(gemsbok), *Connochaetes gnou* (black wildebeest)
IV	Large	296 - 900	*Syncerus caffer* (African buffalo), *Tragelaphus oryx* (eland)
	Very Large	> 900	*Pelorovis /Syncerus antiquus* (giant buffalo)

Unidentified long bone fragments were classified as small, medium or large mammals based on long bone cortical thickness measurements following Reynard *et al.* (2014). Cortical thicknesses <2 mm were classified as 'small mammals', those between 2 and 6 mm were classified as 'medium mammals', and cortical thicknesses >6 mm were classified as 'large mammals' (Table 3.2).

Table 3.2 Mammal size classes based on cortical thickness (Reynard et al. 2014).

Mammal Size Classes	**Long Bone Cortical Thickness Rage (mm)**
Small Mammal	<2
Medium Mammal	2-5.9
Large Mammal	6-19.9

3.3 Quantification

The Quantification of taxa is based on two measurements: the number of identified specimens (NISP) and the minimum number of individuals (MNI). NISP and MNI are used to describe relative taxonomic abundance in faunal assemblages (Gifford *et al.* 1980; Bunn & Kroll 1986). MNI is defined as the minimum number of elements necessary to account for a set of individual animals. It is a derived unit as it may or may not consider individual variations such as age, sex and size (Lyman 2008: p.38-46). These measurements have both advantages and disadvantages, and the preferred units for documenting archaeo-faunal abundance has been a contentious issue in zooarchaeology (Plug & Plug 1990). While NISP is a primary unit, its shortcomings are linked to the variation in counts of taxa with fragmented bone assemblages (Klein & Cruz-Uribe 1984; Lyman 2008). MNI is often used to counteract issues of fragmentation. Criticisms of MNI, however, include sensitivity to sample size, and that the uneven distribution of body parts across a site could affect abundance estimates (Plug & Plug 1990). Moreover, there are often issues

related to calculating MNI since analysts often use differing methods in their calculations (Klein & Cruz-Uribe 1984).

3.2.1 Number of Identified Specimens (NISP)

NISP is the raw count of identified specimens within a sample (Klein & Cruz-Uribe 1984; Todd & Rapson 1988; Lyman 1994a: p. 100, 2008: p. 27). For this study, NISP values are derived from the total number of specimens identified at least to the skeletal element or class level, which includes bovid and mammal size classes (Bunn *et al.* 1980; Lyman 2008: p. 27). Since certain elements like ribs, vertebrae, and cranial remains cannot be classified beyond the class level, they are grouped into mammal size categories. One advantage of using NISP counts is that it is simple to compute and offers an estimate of the relative frequency of taxa present in the sample (Klein & Cruz-Uribe 1984). This method does not account for taphonomic factors such as differential preservation, transport, butchery, or fragmentation, which can influence the accuracy of these estimates (Klein & Cruz-Uribe 1984; Martin 1999; Lyman 2008).

3.2.2 Minimum Number of Individuals (MNI)

MNI is the minimum number of individuals needed to account for all specimens of a specific taxon in a sample, providing an estimate of the number of animals represented in the assemblage (Lyman 1994: p. 100, 2008: p. 38-39; Peres 2010). To calculate MNI values, skeletal elements are typically sorted by left and right sides, and the highest count from these sides represents the minimum number of individuals for that taxon. One advantage of this method is that it offers an estimate of the likely number of individuals in a sample (Klein & Cruz-Uribe 1984). However, the method has its limitations, as it can either underestimate or overestimate the abundance of certain taxa, depending on the skeletal element being considered (Martin 1999; Lyman 2008).

To clarify, all identified species were tallied up and all specimens were identified to element and size class. NISP (Klein & Cruz-Uribe 1984; Lyman 2008; Todd & Rapson 1988; Reitz & Wing 2008). MNI (Klein & Cruz-Uribe 1984; Lyman 2008; Reitz & Wing 2008). MNE (Binford 1984; Lyman 1994, 2008).

3.4 Skeletal Parts

Carcasses are defined according to skeletal parts often linked to butchery strategies (Blumenschine *et al.* 1991; Faith & Gordon 2007). Four skeletal part regions were noted in this study: distal, hind and fore limbs, and the skull (Table 3.3), these skeletal parts have high survival rates.

Carcasses are divided into skeletal parts to help infer on past human (or zoogenic) behaviours related to hunting, butchering and transportation patterns (Blumenschine *et al.* 1991; Faith & Gordon 2007; Thompson 2020). Different skeletal parts have different amounts of meat and

marrow (Faith & Gordon 2007). Analysing which skeletal parts are present or absent can reveal how animals were butchered, and which parts were favoured for consumption (Faith & Gordon 2007). They can also indicate transport decisions (e.g. high survival elements such as limbs might be found further from the kill site) (Lupo 2001; Faith & Gordon 2007). Skeletal parts also help infer on MNE's.

Table 3.3 Skeletal Parts.

Skeletal part	Elements
Distal limb	Phalange, Carpals, Tarsals, Metapodia
Hind limb	Femur, Tibia, Patella
Fore limb	Humerus, Radius, Ulna (Radio-ulna)
Skull	Cranium, Mandible, Horn core

3.4.1 Minimum Number of Elements (MNE)

The MNE values involve the counts of the portions of an individual skeletal element in a sample (Binford 1984; Lyman 1994: p. 102-103, 2008: p. 220). The MNE counts for this sample were calculated using all skeletal parts (skull, upper limbs, lower limbs and distal limbs) (Table 3.3). Lyman (2008: p. 220-226) suggests limitations such as calculation errors when calculating values, identification errors which may lead to an overestimation or underestimation of elements.

3.5 Taphonomy

Taphonomic analyses document butchery processing and patterns critical in determining the accumulation agent of the bone assemblage (Gifford 1981; Johnson 1985; Fisher 1995; Blumenschine *et al*. 1996; Grody 2016). BSM is linked to external taphonomic agents such as rodent, carnivores or human activity (Potts & Shipman 1981). The proportion of anthropogenic to zoogenic marks can be compared to infer who the dominant faunal remain collector at a site is (Thompson *et al.* 2017). Anthropogenic BSM such as cut marks and percussion marks, and zoogenic BSM (tooth marks, rodent gnawing and gastric acid-etching processes) was documented to determine whether animals or people were the dominant faunal remain collector based on BSM frequencies following the method of Thompson *et al.* (2017).

3.5.1 Fragmentation

Fragment size can be used to indicate the degree of fragmentation (Brain 1974; Voigt 1983; Outram 2001; Lyman 2008: p. 251). The maximum lengths of specimens were measured to the closest millimetre with a digital calliper (Driver 2005). The cortical thickness for identified and unidentified long bones was measured according to Reynard *et al* (2014) to infer the relative size of an individual.

3.5.2 Bone Surface Modification

Any surface modifications (e.g. anthropogenic or zoogenic marks, burning, trampling and natural surface modification) on a bone was recorded. All bone fragments were examined with an Olympus SZ51 microscope under oblique lightning. The magnification of this microscope ranged from 1X to 40X with a zoom ratio of 5:1. Microscope pictures were taken using an Olympus EP50/SZ61. See Table 3.4, 3.5, 3.6 and 3.7 for bone modification types.

3.5.2.a Anthropogenic Bone Surface Modification. The specimens were analysed for anthropogenic bone surface modifications, which include cut and percussion marks. Anthropogenic marks include scrape, chop and slice marks (Potts & Shipman 1981; Fisher 1995) (Table 3.4). Cut marks are elongated, narrow linear striations or grooves (Potts & Shipman 1981; Fisher 1995). These marks are 'V'-shaped in profile and reflect the shape of the tool's cutting edge. Scrape marks often appear as multiple lines. They are closely spaced parallel striations that are elongated, linear and narrow (Fisher 1995). Chop marks are broad, short depressions with wide 'V'-shaped profiles (Fisher 1995). Slice marks are elongated grooves with multiple parallel striations (Shipman & Rose 1983). Percussion marks include percussion pits and notches (Blumenschine & Selvaggio 1988; Blumenschine 1995). Percussion marks are associated with the dynamic impact of stone tools on bone (Fisher 1995; Blumenschine *et al.* 1996). Percussion pits are small circular depressions which vary in size. Pits were only recorded if associated with micro striations in or close to the pit. Percussion notches are semi-circular in shape, and the inner surface has negative flake scars (Blumenschine & Selvaggio 1988). The location and frequency of cut marks and percussion marks can help zooarchaeologists document butchery activities and hunting (Egeland 2003; Grody 2016).

Table 3.4 Anthropogenic Modification Types.

Modification Type	**Description**
Cut/Slice Marks	'V'-shaped in cross section with parallel striations in grooves (Potts & Shipman 1981; Shipman & Rose 1983; Fisher 1995; Lyman 1994: p. 297 and Lyman 2008: p. 281).
Scrape Marks	Broad, parallel shallow grooves (Gifford-Gonzalez 2018).
Chop Marks	A wide depth to width ratio in cross section with fractures from points of impact (Walker & Long 1977; Binford 1981; Lyman 1987: p. 281; Fisher 1995 and Gifford-Gonzalez 2018).
Percussion Pits	Small patches of micro-striations or pits with micro-striations (Blumenschine & Selvaggio 1988; Noe-Nygaard 1989; Blumenschine *et al.* 1996 and Lyman 2008: p. 281).
Percussion Notches	Linked to the removal of bone flakes. Small grooves with micro-striations and fractures radiating from points of impacts (Blumenschine & Selvaggio 1988; Blumenschine *et al.* 1996).

***3.5.2.b Zoogenic Bone Surface Modifications*.** The specimens were analysed for zoogenic bone surface modifications including tooth and gnaw marks, and gastric acid etching (Potts & Shipman 1981; Fisher 1995; Blumenschine *et al.* 1996) (Table 3.5). Carnivore teeth marks are identified as pits or scores, which are generally 'U'- shaped in profile where the surface often shows crushing (Blumenschine et al. 1996). Carnivore chewing can also produce modifications such as striations, furrows, jagged edges and chipped edges (Fisher 1995). Gnaw marks are grooves with a rounded, flat base. These gnaw marks lack parallel striations associated with anthropogenic modifications (Potts & Shipman 1981; Binford 1981; Brain 1981; Lyman 1994: p. 297-298; Blumenschine et al. 1996; O'Connor 2000a,b; Lyman 2008: p. 277-278; Reitz & Wing 2008: p. 135). Gastric acid etching is caused by the digestion of faunal remains ingested by raptors and carnivores (e.g. hyenas) (Fisher 1995). Gastric acid etching is associated with erosion, polishing and perforation (Fisher 1995) (Table 3.5). The analysis and identification of zoogenic modifications such as tooth pits, scores, gnaw marks and gastric acid etching are critical in understanding how faunal assemblages were accumulated (Pickering *et al.* 2008).

Table 3.5 Zoogenic Modification Types.

Zoogenic Modification	**Description**
Tooth Pits	Circular depression in bone surface, Presence of crushing (Pickering & Wallis 1997).
Tooth Scores	Grooves that are 'U'- shaped (Blumenschine 1988, Selvaggio & Wilder 2001).
Gnawing	Furrows along the shaft (Brain 1981).
Gastric Acid Etching	Corrosion of bone with smooth edges (Dewar & Jerardino 2007).

Blumenschine (1988) suggests that it is also possible to determine whether faunal assemblages were accessed first by humans or carnivores. The frequency of tooth marks and percussion marks on long bone shafts and epiphysis shows the differential assemblage accumulation (Hutson & Cain 2008). The destruction of shafts to access marrow indicates that humans accessed the animal before carnivores (Selvaggio & Wilder 2001).

3.5.2.c Burning Patterns. Burnt bone can be the result of meat cooking or just being discarded into a fire (Nicholson 1993; Brain 1993; Stiner *et al.* 1995). The source of exposure to heat and thermal alteration to a bone can also be because of natural fires (Clark & Ligouis 2010). Gifford-Gonzalez (2018) suggests that inferences should be made cautiously and only after extensive examination and context of the bone. The colouration and intensity of the heat alteration can provide insights into intentional heating and accidental burning (e.g. hearth structures near bones affect the colour) (Clark & Ligouis 2010). The colouration caused by heat alteration is dependent on the temperatures to which the specimens are exposed to (Shipman *et al.* 1984) (Table 3.6). Shipman *et al.* (1984) incorporated a five-stage colour method when defining bone fragments as burnt. This colour coding was adapted to categorise the Welgelegen fauna.

Table 3.6 Burning Stages and Colour Association.

Burning stage	Colour
0	Brown colouration
1	Localised burning on certain regions of specimens
2	Black colouration
3	Grey colouration
4	White colouration

3.5.2.d Trampling Modifications. The surface of the specimens was assessed for trampling marks. These marks are often like butchery modifications; however, they differ in morphology (Domínguez-Rodrigo *et al.* 2009) (Table 3.7). Trampling marks are usually multiple, closely spaced and intersecting marks which vary in length, breadth and curvature (Andrews & Cook 1985). For this study, trampling marks were identified by the description of Domínguez-Rodrigo *et al.* (2009) and Reynard (2014): for trampling scratches, lines, grooves and pits. Abrasion, sheen and polish are linked to trampling activities (Reynard 2014).

Table 3.7 Trampling Modification Types.

Trampling Modification	Description
Trampling Scratches	Shallow, fine lines which resemble micro-striations of percussion marks (Fisher 1995; Domínguez-Rodrigo *et al*. 2009; Reynard 2014).
Trampling Lines	Furrows that resemble 'V'-shaped cut marks (Reynard 2014).
Trampling Groove	Visible 'V'-shaped furrows (Reynard 2014).
Trampling Pits	'V' and 'U' -shaped with a raised platform on the side of the depression (Reynard 2014).

3.5.2.e Natural Bone Surface Modifications. The surface of specimens was analysed for 'natural' modifications. These include weathering, abrasion, root etching and manganese staining. Weathering characteristics were identified using Behrensmeyer's (1978) descriptions: cracking, flaking, rough weathered patches and splintering. Weathering in my specimens was just noted whether they were absent or present. Abrasion is defined as shiny and polished appearance on a bone surface (Reynard *et al.* 2016a). This can be caused by natural or non-natural agents. Abrasion was recorded either being present or absent. Root etching is identified by a distinctive sinuous/wavy line that has 'U'-shaped profiles. Root etching are lines that are thin, and shallow produced by acids secreted by roots (Fisher 1995). Manganese staining occurs on the surface of

the bone as a black surface coating in spots (Fernandez-Jalvo & Andrews 2003). Bone surfaces were assessed for any of these modifications and were marked present or absent.

3.4 Palaeoenvironmental Analyses

Palaeoenvironmental conditions can be linked to large herbivore dietary preferences. In this study, dietary preference is grouped into three feeder-types: grazers, browsers and mixed feeders (Skinner & Chimimba 2005) (Table 3.8).

Ungulate dietary preferences are linked to environmental conditions, particularly vegetation types and availability (Parker *et al.* 2009; Sanchez-Hernandez *et al.* 2020). Ungulates are divided into grazers, browsers and mixed feeders (see Table 3.8). This allows them to exploit available resources to their specific habitats (Owen-Smith 1997, 2007; Parker *et al.* 2009; Hempson *et al.* 2015; Gangon & Chew 2000).

Table 3.8 Dietary Preferences (Owen-Smith 1997, 2007).

Dietary Preference	**Diet**	**Water Dependency**	**Examples**
Grazers	Grasses & Sedges	Requires frequent access to water	Blue wildebeest (*Connochaetes taurinus*) Hartebeest (*Alcelaphus buselaphus*)
Browsers	Leave, shoots, herbaceous dicots & fruits	They obtain a significant portion of their water intake from their food; thus they are less dependent on regular water access	Bushbuck (*Tragelaphus scriptus*) Steenbok (*Raphicerus campestris*)
Mixed Feeders	A mix of both grasses, woody plants & herbaceous dicots	Requires frequent access to water	Springbok (*Antidorcas marsupialis*) Eland (*Tragelaphus oryx*)

It is also important to note that feeding types can be blurred during climatic changes and periods (e.g. droughts) when animals consume any available resources (Owen-Smith 1997 & 2007).

Chapter Summary

In this chapter, the materials and methods used to analyse the faunal sample from Welgelegen were presented. Faunal material from 13 layers were included in the analysed sample. The methods and techniques used to assess the fauna follow standard zooarchaeological and taphonomic practises. Taphonomic analyses were undertaken on all specimens identified to element, and non-identifiable specimens > 4 cm. Bone surface modifications were noted and used to infer agents of accumulation and subsistence strategies. Specimens identified to specific herbivore types were assigned dietary preferences which may be used to indicate local environmental conditions.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter details the results from the zooarchaeological and taphonomic analysis of large mammal faunal sample from the Welgelegen Shelter. The results are based on the methods described in the previous chapter and informed by the literature review. The first part of this chapter reports on the quantification of the sample in terms of the number of specimens, skeletal parts and taxa. The second part reports on the taphonomic analyses.

4.1.1 Sample Size

The entire faunal sample analysed for this study comprises a total of 639 specimens (Table 4.1). Faunal remains were grouped into Phase B (Layers KBL & Black) and Phase A (Layers Black 5, VDGB, Black 6, Bone 4, Ash, RBK, Olive 2, Pale Ale, MA, Black Clay, KA/SB). A significant portion of the assemblage (n= 389; 60.9%) consists of non-identifiable specimens, which primarily include fragmentary long bones that cannot be attributed to specific taxa (Table 4.1).

Table 4.1 ID Bones and Non-ID Bones.

Layers	**ID Bones**	**Non-ID Bones**	**Total**
Phase B	141 (33%)	275 (66%)	416 (100)
Phase A	109 (48.9%)	114 (51.1%)	223 (100)
Total	250 (39.1%)	389 (60.9%)	639 (100)

4.1.2 Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI)

The total NISP for Phase B is 315 (Table 4.2). The most prevalent bovid size class of is size II (NISP=64). Small mammals make up 17.5% of the total sample (NISP=55). The majority of species identified in this phase are wildebeest (*Connochaetes* sp.) (NISP=6). Both the black wildebeest (*Connnochaetes gnou*) (NISP=3) and the blue wildebeest (*Connochaetes taurinus*) (NISP=1) were identified. Phase A yields a smaller sample size (NISP=182). The most common bovid size class is size III (NISP=34; 18.7% of total NISP). Medium mammals make up 20.9% of taxa (NISP=38). This phase includes a range of species such as black wildebeest (*Connnochaetes*

gnou), reedbuck (*Redunca arundinum*), springbok (*Antidorcas marsupialis*) and hippopotamus (*Hippopotamus amphibius*).

Regarding the combined sample, the total NISP of both phases is 497, with specimens identified as BOV 2 the most common (NISP=90) and black wildebeest the most common species. The total MNI of the combined sample is 53. Bovid III had the highest MNI total of 12 (Table 4.2).

Table 4.2 Total Number of Specimens at the Welgelegen Shelter.

Order	Scientific Name	Common Name	Phase B	NISP %	Phase A	NISP %	Total NISP	Total MNI
Rodentia	*Cryptomys hottentotus*	Mole rat	1	0.3			1	1
Ruminantia	*Connnochaetes Gnou*	Black wildebeest	3	1	1	0.5	4	1
	Connochaetes taurinus	Blue wildebeest	1	0.3			1	1
	Connochaetes sp.	wildebeest	2	0.6			2	1
	Tragelaphus oryx	Eland	1	0.3			1	1
	Redunca fulvorufula	Mountain reedbuck			1	0.5	1	1
	Redunca arundinum	Southern reedbuck			1	0.5	1	1
	Antidorcas marsupialis	Springbok			1	0.5	1	1
	Kobus ellipsiprymnus	Waterbuck	1	0.3			1	1
	Hippopotamus amphibius	Hippo			1	0.5	1	1
	Bovid	BOV I	16	5.1	9	4.9	25	7
		BOV I/II	6	1.9	5	2.7	11	2
		BOV II	64	20.3	26	14.3	90	8
		BOV II/III	25	7.9	16	8.8	41	7
		BOV III	46	14.6	34	18.7	80	12
		BOV III/IV	18	5.7	7	3.8	25	3
		BOV IV	20	6.3	7	3.8	27	3
	Mammal	Small	55	17.5	28	15.4	83	N/A
		Medium	44	14	38	20.9	82	N/A
		Large	12	3.8	7	3.8	19	N/A

	Total		**315**	**100**	**182**	**100**	**497**	**52**

4.1.3 Minimum Number of Elements

The MNE in both samples are limited to high survival bovid elements (crania, mandibles, limb bones, metapodia and phalanges). In both the Phase B (Table 4.3, Figure. 4.1) and A samples (Table 4.4 and Figure. 4.2), metapodials have the highest MNE values.

Table 4.3 Phase B MNE.

Skeletal part	Element	Anatomical region	BOVI NISP	MNE	BOVII NISP	MNE	BOVIII NISP	MNE	BOV III/IV NISP	MNE	BOVIV NISP	MNE	Total NISP
	Cranial	Fragment	1	1	3	*3*	4	*3*	..	..	2	*1*	**11**
		Body	..	..	3	*3*	..	*1*	1	*1*	..	*2*	
Skull	**Mandible**	Ramus	..	..	2		1		2		4		**13**
		Distal	..	..	..	..	..	*1*	..	*1*	..	*3*	
		Proximal	..	..	..	..	1		..		1		
	Humerus	Shaft	..	..	..	..	2		1		3		**8**
			..	..	..	..	..	..	..	..	..	..	
		Distal	..	..	..	..	..	..	..	..	..	..	
		Proximal	..	..	..	..	..	..	..	..	..	..	
		Shaft	..	..	..	..	..	..	..	..	..	..	
	Metacarpal	Complete			..	..	..	..	..	..	..	..	**0**
		Distal	1	1	..	2	..	4	..	..	..	1	
		Proximal	..		1		..		..	..	1		
	Radius	Shaft	..		3		5		..	..	2		**13**
		Distal	..	..	1	1	..	..	..	..	..		
		Proximal	..	..	1		..	..	..	..	2		
Upper Limbs	**Ulna**	Shaft	..	..	1		..	..	..	..	..	1	**5**
		Distal	..	..	..	1	..	1	..	..	..	..	
		Proximal	..	..	..		..		..	..	..	..	
Lower		Shaft	..	..	2		2		..	..	..	..	
Limbs	**Femur**	Complete	..	..	..		..		..	..	..	..	**4**

						1		4		1			
		Distal	..	..	1		..		..		..	..	
		Proximal	..	..	..		2		..		..	..	
		Shaft	..	..	..		..		1		..	..	
	Metatarsal	Complete	..	..			2		..		..	..	**6**
		Distal	..	..	..	2	..	3	..	6	..	1	
		Proximal	..	..	1		..		..		..		
		Shaft	..	..	2		4		7		2		
	Tibia	Complete	..	..	..		..		..		..		**16**
		Distal	..	2	2	6	2	5	..	1	..	1	
		Proximal	..		2		2		1		..		
	Metapodial	Shaft	3		6		4		..		1		**23**
		Distal	..	1	..	..	1	2	..	2	..	..	
		Proximal	..		..	..	..		2		..	..	
		Shaft	..		..	..	..		..		..	..	
		Complete	..		..	..	1		..		..	..	
Distal Limbs	**Phalanges**	Fragment	1		..	..	2		..		..	..	**7**
Total			**6**	**5**	**33**	**19**	**35**	**24**	**15**	**12**	**18**	**10**	**106**

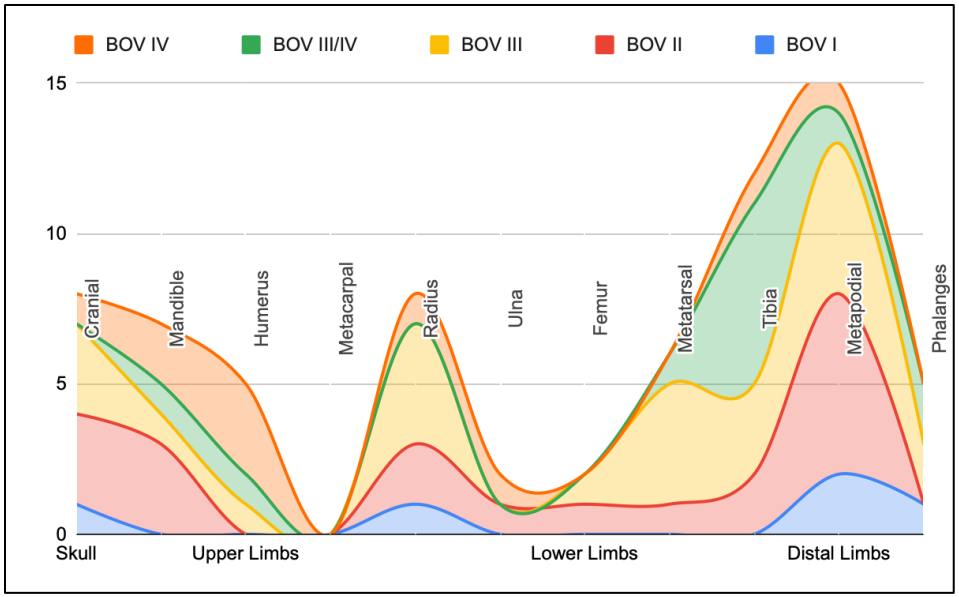


Figure 4.1 Representation of Phase B MNE.

Table 4.4 Phase A MNE.

Skeletal part	Element	Anatomical region	BOVI NISP	MNE	BOVII NISP	MNE	BOVIII NISP	MNE	BOVIII/IV NISP	MNE	BOVIV NISP	MNE	Total NISP
	Cranial	Fragment	..	..	1	1	2	1	2	1	4	2	**9**
		Body	..	..	..				..	..			
Skull	**Mandible**	Ramus	..	..	1	1	1	1	..	..	2	1	**4**
		Distal	..		..	..	..		..	..	..	..	
		Proximal	..	1	..	..	..	1	..	..	..	..	**2**
	Humerus	Shaft	1		..	..	1		..	..	..	..	
						..				..		..	
		Distal	1		..	..	..		..	..	..	..	
		Proximal	..	1	..	..	..	3	..	..	..	..	**4**
		Shaft	..		..	..	..		..	..	..	..	
	Metacarpal	Complete	..		..	..	3		..	..	..	..	
		Distal	..		..		..		..	..	..	..	
		Proximal	..	1	..	1	1	1	..	..	..	..	**2**
	Radius	Shaft	1		1		..		..	..	..	..	
			..	..	..	..			..	..	..	..	
		Distal	..	..	..	..	1		..	..	..	..	
		Proximal	..	..	..	..	..	1	..	..	..	..	**2**
Upper Limbs	**Ulna**	Shaft	..	..	..	..	1		..	..	..	..	
		Distal	..		..	..	..		..		..	..	
		Proximal	..	2	..	..	..	1	1	1	..	..	**4**
		Shaft	1		..	..	1		..		..	..	
	Femur	Complete	1		..	..	..		..		..	..	
		Distal	..		..								
Lower Limbs	**Metatarsal**	Proximal	..	..	1	..	..	..	..	..	..	..	**1**

		Shaft	..	..	..	1	..	..	..	..	..	..	
		Complete	.	..	..		..	..	..	..	..	..	
				..			..	..	..	..	..	..	
		Distal	..		..		..		..		..	..	
		Proximal	..	1	..	4	..	1	..	1	..	..	**9**
		Shaft	..		6		1		1		..	..	
	Tibia	Complete	1		..		..		..		..	..	
		Distal	..		1		1		..		..		
		Proximal	..	1	3	4	..	1	1	1	..	1	**11**
	Metapodial	Shaft	1		1		2		..		1		
		Distal	..		..	..	1		1		..		
		Proximal	..		..	..	..		..		..		
		Shaft	..	1	..	..	..	3	..	1	..	1	**7**
		Complete	..		..	..	1		..		..		
Distal Limbs	**Phalanges**	Fragment	1		..	..	2		..		1		
Total			**8**	**8**	**15**	**12**	**19**	**14**	**6**	**5**	**8**	**5**	**55**

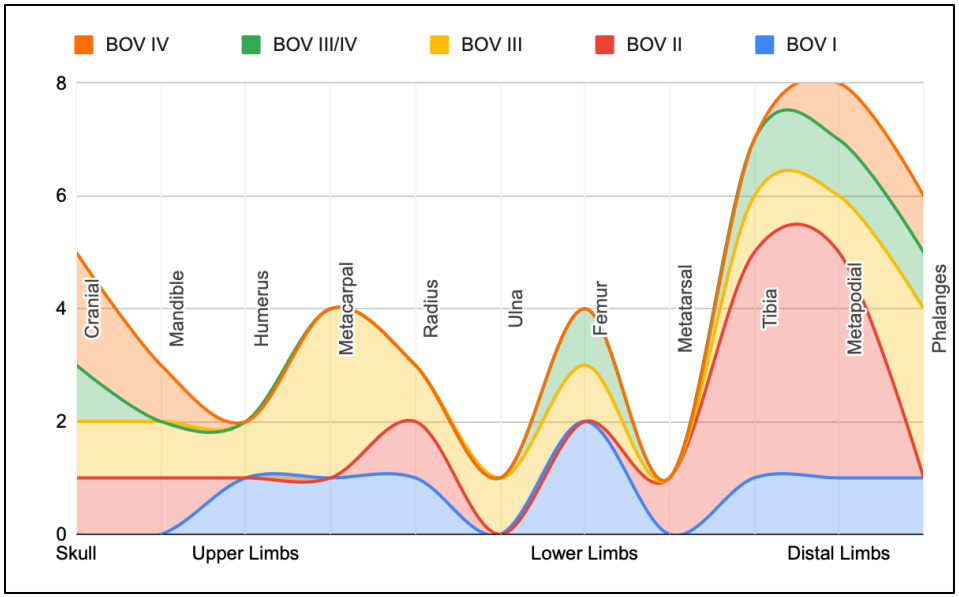


Figure 4.2 Representation of Phase A MNE.

The data reveal significant shifts in skeletal part representation across phases, with cranial (skull) elements showing a marked increase in Phase B. Across all size categories and phases, skull proportions are consistently lower in Phase A and increase significantly in Phase B. This could reflect changes in preservation conditions or differential use or processing of skeletal parts. Distal elements appear stable across phases, especially for smaller-size categories, which implies better preservation or consistent representation. Forelimbs and hindlimbs representation fluctuate, increasing among small mammals in Phase A. This can also be seen as a decrease from Phase A to Phase B as Phase A is stratigraphically below Phase B (Figure. 4.3).

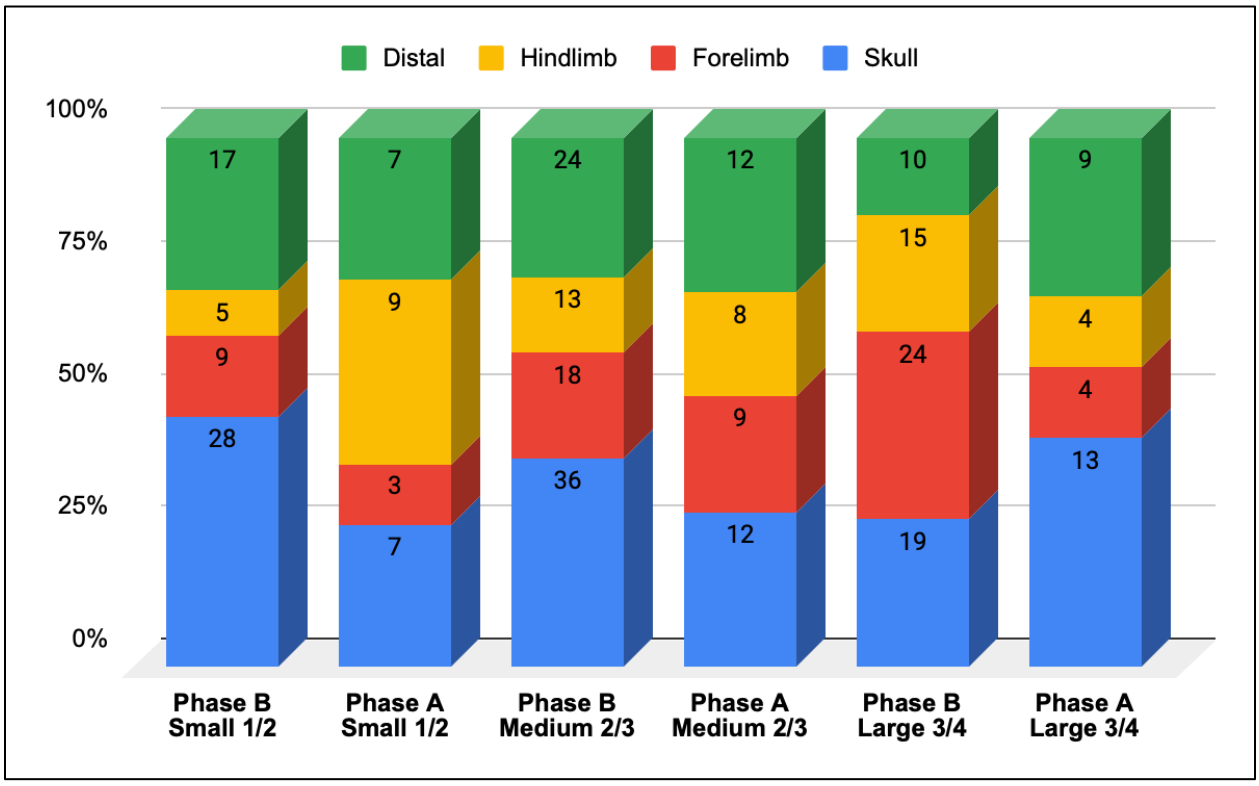


Figure 4.3 Skeletal part distribution across two phases and three size categories using NISP, which included bovid and mammal size classes. Small = size 1 & 2, Medium = size 2 & 3, and Large = size 3 & 4.

4.1.4 Bovid Size Classes

Phases B and A are dominated by bovid size class II and III, respectively. The data shows an increase in medium to large bovid remains from Phase A to Phase B, which may reflect significant

changes in faunal communities or human activities over time (Figure. 4.4). Phase A was the only phase with a very large size 5 mammal (the hippopotamus tusk).

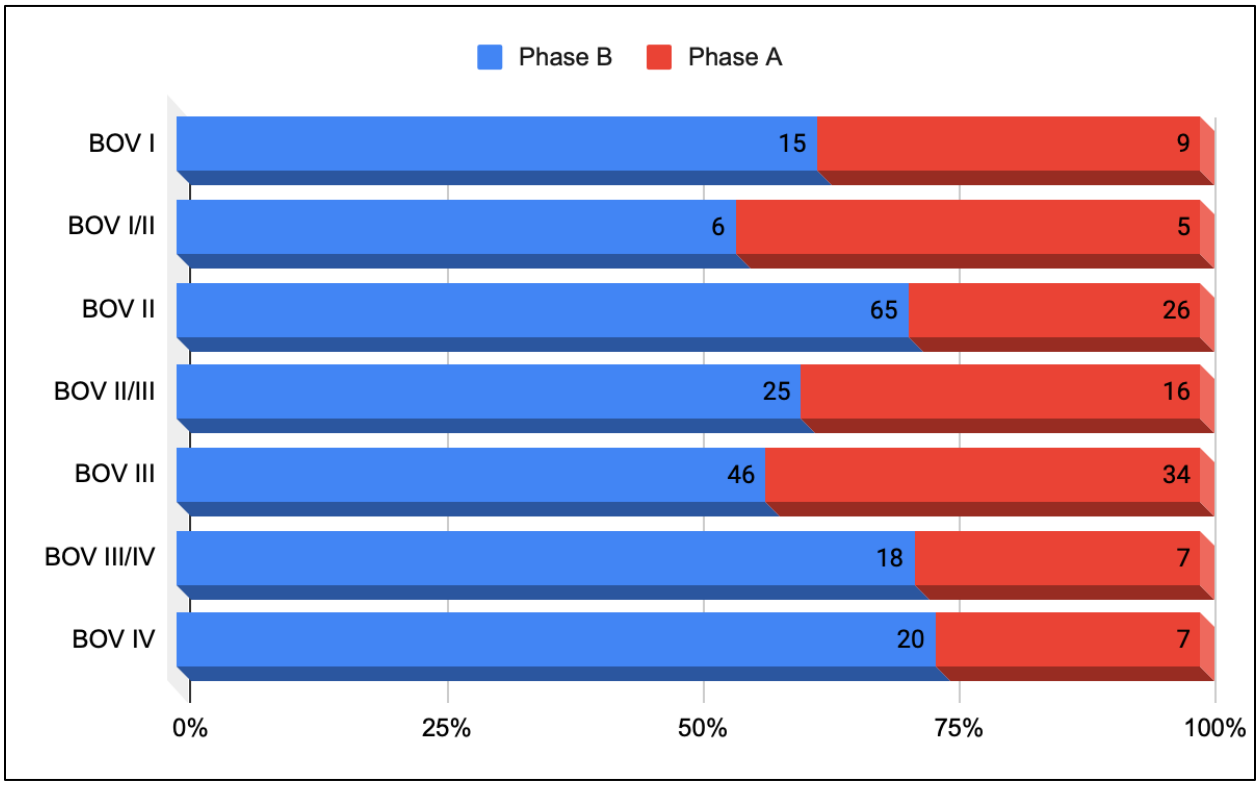


Figure 4.4 Proportional representation of various bovid size categories across two phases (Phase B in blue and Phase A in red). Each bar corresponds to a specific bovid size class, ranging bovid I (the smallest) to bovid IV (the largest), with the percentage of representations for each phase depicted side by side. NISP in rows.

4.1.5 Dietary Preferences

Grazers are the most abundant dietary group in both phases but are more common in Phase B (Table 4.5). Browsers are not common in both phases. Mixed Feeders are only represented in Phase B, with one specimen and no mixed feeders in Phase A. Phases B and A are dominated by grazers (Table 4.5 and Figure. 4.5). It must be stressed that with such a small sample these are speculative interpretations of the patterns in the data. In terms of the number of taxa (13), Phase B has 8 specimens that consist of 4 species (black and blue wildebeest, eland and waterbuck), while Phase A has 5 specimens and 5 species (black wildebeest, mountain reedbuck, southern reedbuck, springbok and hippopotamus).

Table 4.5 Dietary Preferences.

Dietary Preferences	Phase B	Phase A	Total
Grazers	8	4	12
Browsers	0	1	1
Mixed Feeders	1	0	1

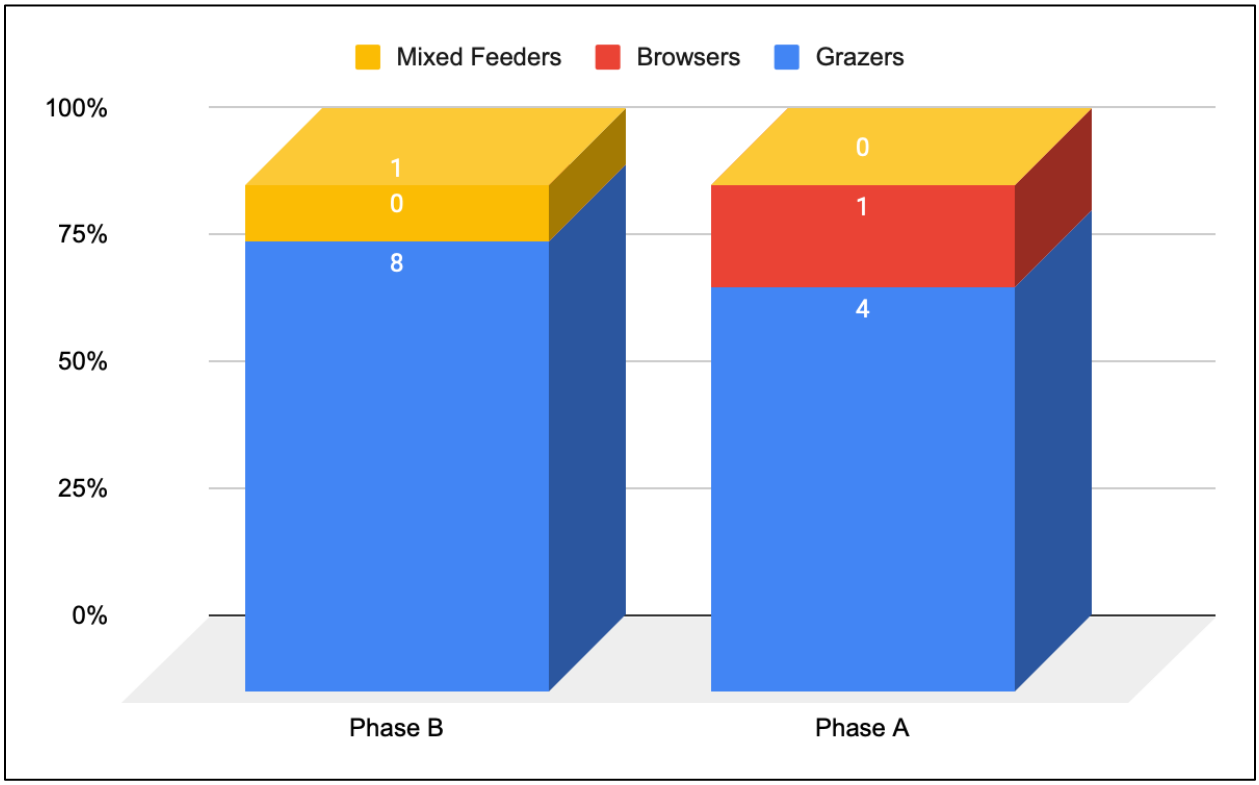


Figure 4.5 Dietary Preferences for Phases B & A. NISP in rows.

4.1.6 Taphonomic Analysis

Zoogenic, anthropogenic and burning marks are present in both phases. Tooth marks dominate both phases (n=227; 35.5%), but a compelling proportion of bones exhibit cut marks (n=133; 20.8%). Tooth marks dominate Phase B (n=147; 35.3%), followed by cut marks (n=56; 13.5%), burning (n=56; 13.5%) and percussion marks (n=23; 6%). In Phase A, tooth marks are also the most prevalent BSM (n=80; 35.9%). Anthropogenic marks (cut marks: n=77; 34.5% and

percussion marks: n=47; 21.1%) are more common here than in Phase B. The frequency of burning is notably lower in Phase A (n=7; 3%) than in Phase B. In both Phase B and A, gastric acid etching is low (Phase B = 0.5% & Phase A = 0%) (Table 4.6, 4.7 and Figures 4.6, 4.7, 4.8 & 4.9).

Anthropogenic marks are more common in Phase A than in Phase B (χ^2= 89.791; df=1; p<0.001). There is also a difference between anthropogenic and zoogenic marks in Phase B and Phase A (χ^2= 27.802; df=1; p<0.001). Medium mammals had the highest frequencies of percussion marks (n=9; 28.1%) and tooth marks (n=14; 43.8%) whereas small mammals had the greatest proportion of cut marks (n=22; 27.2%). Large mammals had low frequencies of percussion marks (n=4; 21.1%) and cut marks (n=4; 21.1%) but a higher percentage of tooth marks (n=8; 42.1%) (Table 4.8).

The proportion of percussion marks relative to tooth marks on long bone, mid-shaft fragments in Phase B was 0.4% and in Phase A, 0.3% (Table 4.9). Medium to large mammals had the highest frequencies of percussion, cut and tooth marks (Table 4.9). Tooth marks dominated the taphonomic data (medium mammals = 0.13% & large mammals = 0.12%).

Table 4.6 Percussion marks (PM), cut marks (CM), tooth marks (PM) and gastric acid etching (GAE) data.

	N	**PM**	**CM**	**TM**	**GAE**	**GM**
Phase B	416	23 (6%)	56 (13.5%)	147 (35.3%)	2 (0.5%)	0
Phase A	223	47 (21.1%)	77 (34.5%)	80 (35.9%)	0	3 (1.3%)
Total	639	70 (11%)	133 (20.8%)	227 (35.5%)	2 (0.3 %)	3 (0.5%)

Table 4.7 Bone Surface Modification.

Bone surface modification	**Phase B n (%)**	**Phase A n (%)**
Anthropogenic Marks (PM & CM)	79 (19.5)	124 (55.6)
Burning	56 (13.5)	7 (3%)
Zoogenic Marks (TM.)	147 (35.3)	80 (35.9)
Total	(416) 100	(223) 100

Table 4.8 Taphonomic data related to Size Class of Mammals.

	N	PM	CM	TM
Small Mammal	81	10 (12.3)	22 (27.2)	32 (40)
Medium Mammal	32	9 (28.1)	7 (21.9)	14 (43.8)
Large Mammal	19	4 (21.1)	4 (21.1)	8 (42.1)

Table 4.9 Thompson table showing the proportion of percussion-marked (PM) relative to tooth marked (TM) long-bone mid-shaft fragments.

	Midshaft Fragments	Midshaft Fragments with TM	Midshaft Fragments with PM	PM/(TM+ PM)
Phase B	135	66	53	0.4%
Phase A	52	22	10	0.3%



Figure 4.6 Zoogenic and Anthropogenic Marks. The dip on the bone surface which appears rough, and circular is a zoogenic (carnivore) tooth mark (Pickering & Wallis 1997). Anthropogenic marks (cut marks) are shown as elongated with narrow striations (Potts & Shipman 1981; Fisher 1995).

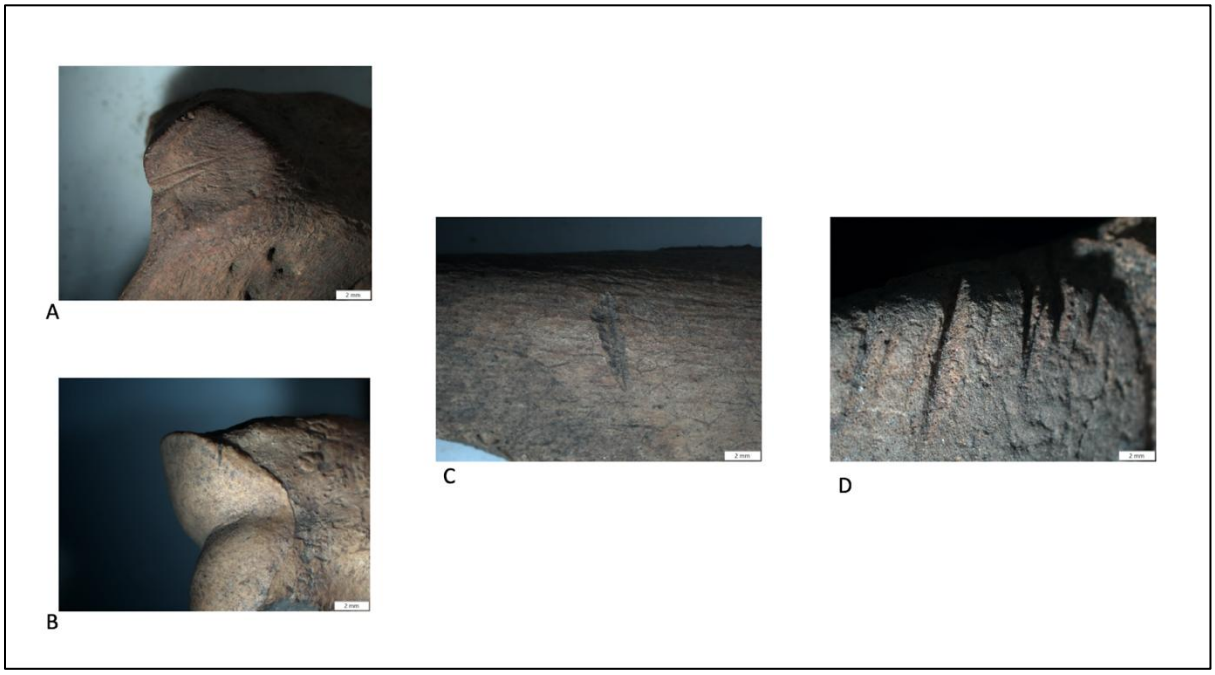


Figure 4.7 Prominent anthropogenic marks (cut marks) in Phase B on: A- Phalanges, B- Tarsal, C- Cranial and D- Talus. These cut marks are shown to be elongated with narrow striations (Potts & Shipman 1981; Fisher 1995).

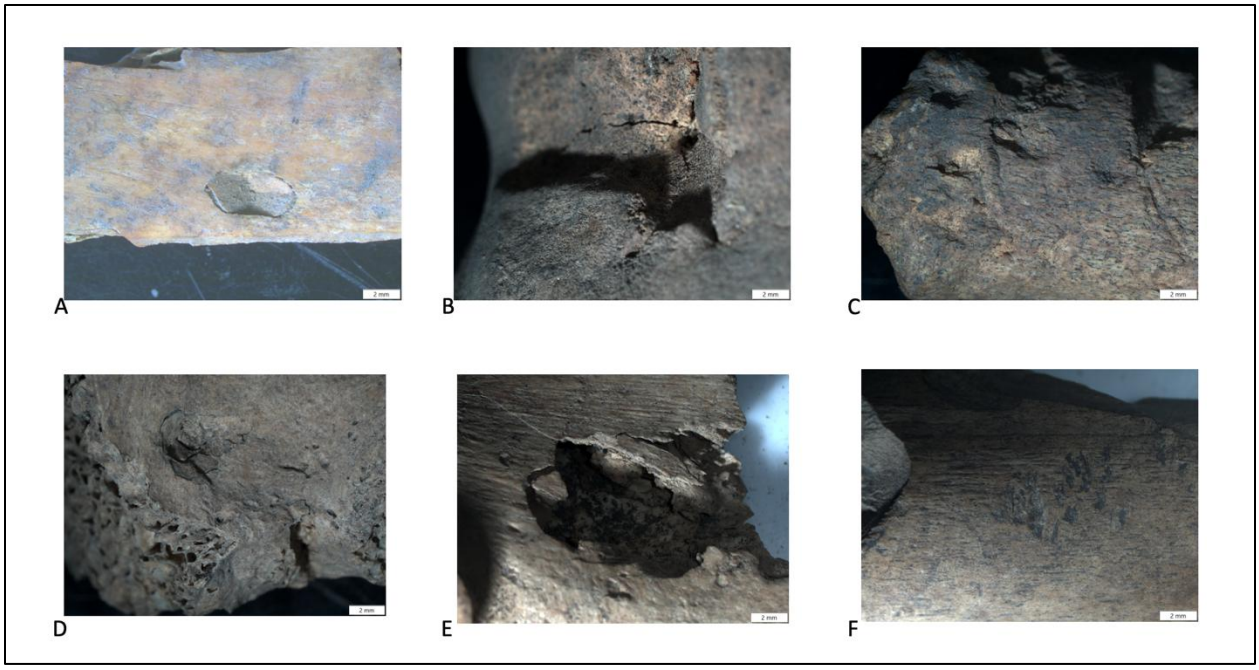


Figure 4.8 Zoogenic Marks: A- fang/tooth pit (a dip on the bone surface which appears rough and circular), B- fang/tooth pit, C- fang/tooth pit and scores (deep grooves). D- fang mark /tooth pit, E- fang mark/ tooth pit and F- gnaw marks (furrows) (Blumenschine 1988; Selvaggio & Wilder 2001).

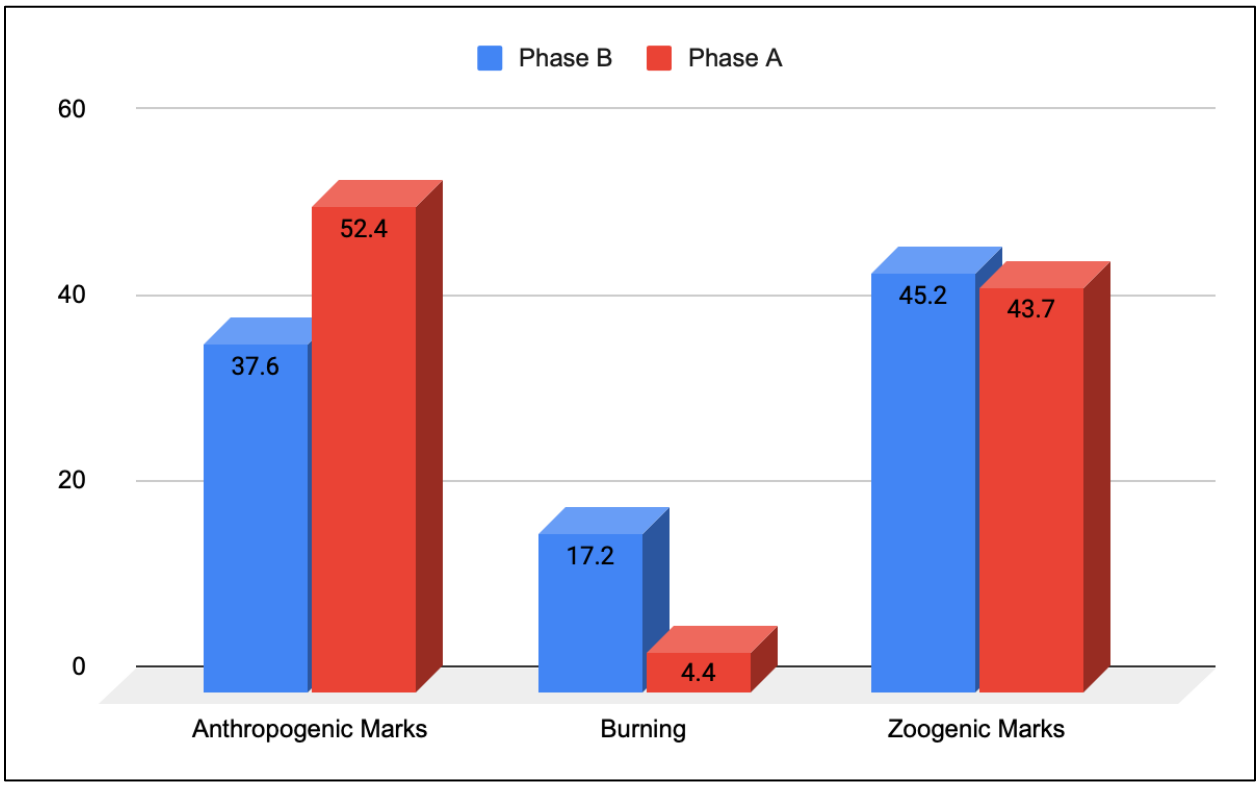


Figure 4.9 Comparison of the frequencies of three key taphonomic indicators (anthropogenic, burning and zoogenic) between Phase B in blue and Phase A in red. These indicators provide insight into the primary agents responsible for accumulating and modifying the faunal assemblage during each phase. The values are shown as percentages from the phase totals and not the raw N.

Chapter Summary

The results of the taphonomic analyses are presented in this chapter. The sample consists of 639 specimens. The remains were grouped into two phases (Phases B & A). The total number of NISP for both phases is 496, with Bovid II the most prevalent size class, and wildebeest the most common species. The total MNI in both phases was 53. The highest MNE values are for metapodia in both samples. There are no significant differences between anthropogenic and zoogenic marks in both the phases. Phase B was abundant in zoogenic marks (35.3%), followed by anthropogenic marks 19.5% and burning 13.5%. Phase A, anthropogenic marks accounts for 55.6%, followed by zoogenic marks (35.9%) and then burning at 3%. Large mammals had most of the anthropogenic marks, and it can be highlighted that carnivore marks dominated the data. These indicators provide insights into the primary accumulators.

CHAPTER 5: DISCUSSION

In this chapter, the results of the analyses are discussed and compared to other archaeofaunal assemblages from Stone Age sites in Mpumalanga, South Africa. First, large herbivore distribution and ecology lays down the foundation, then agents of accumulation for the two phases are discussed. This section will be followed by a discussion of possible meat procurement strategies and finally, the effects of the current and past environment.

5.1 Large Herbivore Distribution and Ecology

5.1.1 South African Grassland Ungulate Species

South African grasslands (covering almost 30% of the land's surface) are dominated by grazing ecosystems and a diverse range of ungulate species (Mucina & Rutherford 2006; Prinsloo *et al.* 2021). It is important to note that only nine taxa were identified in this study and therefore statements regarding using fauna as a paleoenvironmental proxy are cautionary.

Eland are highly versatile in their habitat selection and occur in the karoo, grasslands as well as savanna biomes (Skinner & Chimimba 2005: p. 639). This movement stems from their independence from surface drinking water and their ability to utilise any available food resources (Taylor 196a; Skinner & Chimimba 2005: p. 639-641). They are gregarious animals and occur in small herds and at times in large aggregations of over 700 (Wilson 1975; Skinner & Chimimba 2005: p.639). The eland social organisation is unique due to them being in mixed herds during the summer with males, females and offspring and during the autumn they disperse in numerous small groups of 4-10 with all sexes and classes (Skinner & Chimimba 2005: p. 639). They are independent of drinking water and movements are influenced by fresh sprouting grass (Taylor 1969; Skinner & Chimimba 2005: p.640-641). Eland have been classified as mixed feeders (Hofmann 1973, 1989); however, this may be a misconception. Foraging plants include *Colophospermum mopane, Combretum apiculatum, Grewia spp., Ozoroa insignis, Lonchocarpus capasaa, tagetes minuta, Bidens pilosa* and *Acanthospermum spp (*Skinner *et al.* 2005: p. 640-641). Grass species include *Harpechloa flax, Themeda triandra* and *Tristachya leucothrix.* Historical records indicated that the eland was distributed throughout South Africa, from the Western Cape to Mozambique and Namibia (du Plessis 1969; Plug & Badenhorst 2001). It is also present in Lesotho, Swaziland and Botswana. Its frequent presence in archaeological sites e.g. Honingklip (Korsman & Plug 1992) and Border Cave (Klein 1977) supports the idea that they were widely distributed.

Black wildebeest are found in the central plateaus open plains associated with the Karoo and open grassland areas (Rowe-Rowe 1994). They have a social organisation that includes territorial males, female herds and bachelor groups. The territorial males are attached to their territories all year

(Von Richter 1971). The female herds which include females, their offspring's and subadult males wonder freely throughout territories and are disregarded by territorial males (Von Richter 1971). Herd sizes vary with the density of the population and numbers can include up to 60 individuals (Von Richter 1971). Black wildebeest are predominantly grazers however during the cold months they browse on karroid bushes when grass starts to lose its nutritional value (Skinner & Chimimba 2005: p. 643-644). The grasses *Sporobolus* spp., *Themba triandra* and *Cynodon dactylon* are important foods which karroid shrubs include *Nenax microphylla*, *Salsola rabieana*, *Osteospermum leptolobum*, *Nolletia ciliaris* and *Pentzia* spp. (Von Richter 1971). Their preference for grazing is short grass. They are dependent on water and drink regularly. Historical and archaeological evidence confirms that the black wildebeest was native to the central grasslands and shrublands of South Africa and Lesotho. Its historical range extended from south of Pretoria to the borders of Swaziland in the east and Botswana in the west (du Plessis 1969; Plug & Badenhorst 2001).

The southern reedbuck are distributed all around the southern parts of Africa (Howard 1986). Reedbuck need certain essential requirements such as tall grass, reed beds, herbaceous cover and a supply of water. Grasslands with water availability (streams & rivers) are favoured (Skinner & Chimimba 2005: p. 677). Due to these essential requirements, their distribution is patchy. They occur singly, in pairs or n groups between 15-20 (Skinner & Chimimba 2005: p. 677). Notably, they are not gregarious They are exclusively grazers; however, during the winter months when grasses' nutritional values are low, they tend to eat small amounts of herbs (Venter 1979; Jungius 1971). Vegetation includes yellow thatch (Hyperthelia dissolute), giant spear grass (*Trachypogon spicatus*), buffalo grass (*Panicum maximum*), spear grass (*Heteropogon contortus*) and red couch grass (*Hermarthria altissima*) (Skinner & Chimimba 2005: p. 678).

Springbok species are found in arid regions and open grasslands. Factors that affect their habitat choice include the availability of their preferred food, the height and density of vegetation which affects visibility (Skinner & Chimimba 2005: p.691-692). They are gregarious, moving in small herds during the dry months. During the rainfall seasons, the herds move in areas where rain has fallen to feed on fresh green vegetation and from in aggregations of all ages, sexes and numbers (Skinner & Chimimba 2005: p.691). Males are territorial and stay in their territories all year round (Novellie 1975). Springboks belong to the intermediate group of feeders (Hofmann *et al.* 1995). Their diets consist of shoots, leaves of karroid shrubs and the leaves of several shrubs and trees (Skinner & Chimimba 2005: p.692). Plants include *Acacia mellifera, A. hebeclada* (Nagy & Knight 1994), *Pentzia incana, P. tenuifolia, P. globose, P. lanata, Rhus ciliate* and *Acacia tortilis* (Bigalke 1972). Important grass species include *Themeda triandra, Cynodon* spp*., Panicum* spp*., Eragrostis* spp. and *Sporobolus* spp.

According to historical records, the distribution of the springbok included Lesotho, the western region of Kwa-Zulu-Natal, Gauteng Province as well as central parts of the Northern Province. It

was abundant in the past and great herds were recorded as they migrated across these geographical ranges (du Plessis 1969; Plug & Badenhorst 2001). Springbok remains have been found in a range of archaeological sites (e.g. Heuningneskrans (Klein 1984) throughout history. The extinct springbok (*Antidorcas bondi*) has also been recorded in palaeontological sites in South Africa. They have been linked to the late Pleistocene and early Holocene (Brown & Verhagen 1985; Plug & Engela 1992). The springbok was reintroduced in many parts of South Africa due to their decreasing populations or extermination during colonial periods due to overhunting, land transformation and fencing disrupting migration patterns (du Plessis 1969).

5.1.2 South African non-Grassland Ungulate Species

Species identified in the taphonomic analysis were not limited to grasslands but rather ranged across other biomes and ecosystems that include woodlands, savannahs, mountains and wetlands. The waterbuck can be found near water sources, and they have high water requirements (Taylor *et al.* 1969). Their habitat is in areas with open areas in reed beds, floodplains and in woodlands. Melton (1978) indicates that waterbuck habitat preference is determined by the proximity to drinking water as well as grass quality especially *Panicum maximum*. Waterbucks are gregarious, occurring in small herds of 6-12 and occasionally in larger herds of up to 30 (Skinner & Chimimba 2005: p.682). Their social organisation consists of territorial males, nursery herds and bachelor herds. They are roughage feeders and select the most abundant species available (Hofmann 1973; Tomlinson 1980). Grasses that are selected include *Brachiara spp., Chloris spp., Cynodon dactylon, Digitaria spp., Heteropogon contortus, Panicum spp.* and *Themeda triandra* (Skinner & Chimimba 2005: p.682). They also favor hydrophytic plants such as *Setaria spp., Hemarthria altissima, Cyperus spp., Phragmites spp.* and *Typha spp.* The waterbuck's historical distribution includes the ranges of eastern and southeastern Botswana along the Limpopo River and the Notwani River in Gaborone (Plug & Badenhorst 2001). In South Africa they used to occur along most of the rivers in the northern half of Kwa-Zulu-Natal and the Vaal River (du Plessis 1969; Plug & Badenhorst 2001). Waterbuck remains are not often found in archaeological assemblages. However, they have been found at the Welgelegen Shelter (Schoonraad & Beaumont 1971) and Border Cave (Klein 1977).

Blue wildebeest are associated with savannah woodland; the availability of shade and drinking water is an essential habitat requirement (Lease *et al.* 2014). Seasonal movements take place during the dry season to short grass areas. There are also long-distance migrations to seek better grazing patches (Skinner & Chimimba 2005: p. 646-648). They are gregarious, occurring in herds of 20-30 or even larger in the thousands. Their social organisation consists of territorial males, female herds and bachelor groups. They are water-dependent with a preference for feeding on areas of short, green, lawn-like grasslands. They are particularly partial to fresh sprouting grass on burnt areas or fresh grass sports after rainfall. In the past, the blue wildebeest did not occur south of the Orange River and the southern areas of Kwa-Zulu-Natal in South Africa. Everywhere else, its

distribution was large wherever there were suitable habitats. Archaeological samples suggests that the distribution included Kwa-Zulu-Natal and sometimes the central Karoo south of the Orange River (Plug & Badenhorst 2001).

Mountain reedbucks are closely related to the southern reedbuck – their distributional range is associated with mountains opposed to grasslands. They inhabit dry, grass-covered, stony slopes of hills and mountains. They also tend to avoid open grasslands. They occur in small groups of 3-8 but they can increase in size (Irby 1977). Their social organisation included territorial males, non-territorial males, females, young and bachelor groups. Mountain reedbucks are mostly grazers; however, they are also selective feeders who prefer different grasses that change with the seasons (Irby 1976a,b). They feed on green, soft leaves of grass and avoid the stems. Grasses include red grass (Themeda triandra), thatch grass (Hyparrhenia spp.) and T. triandis is utilised during the dry seasons. The mountain reedbuck distribution during recent years appears to be similar to the present. Its past distribution was much wider, expanding to central Zimbabwe (Plug & Badenhorst 2001).

Hippopotami occur widely on the African continent (Skinner & Chimimba: p. 557). Their meat and fat are highly prized for cooking purposes and their hide and teeth for curios. An essential habitat requirement is sufficient open water to which they can be fully submerged. Seasonal flooding may cause them to move from their home pools temporarily. Hippos are amphibious feeders mostly nocturnally on dry land and spending the day in the water. They live in social groups that vary in size with a territorial bull, females, calves, and bachelor groups (Klingel 1991). Where food is plentiful, they tend to remain in the vicinity of the home pool and will wander up to 10k away. The types of grass consumed are dependent on their availability and during dry seasons, aquatic vegetation may be utilised. They prefer to feed on open areas with short green grasses such as couch grass (C. dactylon). Based on historical records, hippos once lived throughout the subregion wherever there was open water and deep rivers. This included South Africa's coastline and nearby areas, extending as far as the Berg River in the Western Cape. They are dangerous and difficult to hunt, therefore their remains are not common in archaeological assemblages (du Plessis 1969; Plug & Badenhorst 2001).

The past distributions of each species were much wider than the present. The numbers of these species have decreased with some of them disappearing completely. The main causes include (du Plessis 1969):

- activities associated with the growth of human civilization
- hunting/extermination
- and natural causes (e.g. endemic diseases).

5.2 Agents of Accumulation

Identifying the primary accumulators of faunal remains is fundamental in determining whether the assemblage reflects anthropogenic or non-human activity (Brain 1981; Pickering *et al.* 2008; Chase & Meadows 2007; Kuhn *et al*. 2011; Thompson 2017). There can be a possibility whereby the majority of marks and modifications are zoogenic, or from natural processes; however, the absence of anthropogenic marks (e.g. cut marks) cannot eliminate the possibility that the primary agent and primary intervention in butchering animals was human. The overprinting of anthropogenic and zoogenic marks confuses the order of primary and secondary accumulators. Accumulators may also serve as a record of the natural environment, reflecting predator-prey dynamics and/or scavenger behaviour. The analysis of bone surface modifications at Welgelegen demonstrates the interplay between various agents of accumulation, with carnivores and humans both contributing to the assemblage in distinct yet overlapping ways.

Zoogenic marks play a crucial role in taphonomic studies by providing evidence of animal interactions with skeletal remains (Brain 1981; Henshilwood 2008; Badenhorst & Plug 2012; Reynard & Henshilwood 2017). These marks offer insights into past ecological interactions, predator-prey dynamics, and post-mortem processes that affect skeletal remains (Brain 1981). Carnivore tooth marks are significantly more abundant than percussion marks in the combined sample (χ^2=108.120; df=2; p<0.0001). Carnivore marks are common on a variety of elements (including long bones, cranial fragments and mandibles), with both phases showing similar patterns in terms of bovid size classes (Bovid 1- 4). The chi-square test confirms that there is no significant difference between the frequency of these marks across both phases, which suggests that carnivore activity was consistent throughout the sequence.

Despite the dominance of carnivore tooth marks, the high frequency (35.3% in phase B and 35.9% in phase A) of zoogenic marks does not align with the site only being a carnivore den. Previous research has shown that gastric acid etching is common on faunal remains retrieved from carnivore dens (Brain 1981; Dewar & Jerardino 2007) and long bones from hyena dens tend to be less fragmented (Brain 1974; Binford 1981; Pickering *et al*. 2013). The data show that no long bones from the Welgelegen sample display gastric acid etching. Given this, the shelter may instead have served as a seasonal site for both humans and carnivores (most likely when human presence was minimal). Interestingly, the assemblage did present remains with both cut marks and zoogenic marks on the same specimens, which supports the theory that there may have been a co-dependant relationship between humans and carnivores (for similar processes elsewhere see Brain 1981; Henshilwood 2008; Skinner & Chimimba 2005, Reynard & Henshilwood 2017). In other words, carnivores (which may have been domesticated dogs) may have also chewed on what was already there (Brain 1981).

It is also important to note that carnivores can impact skeletal element preservation by causing breakage, disarticulation, displacement and surface modifications (e.g. tooth/gnaw marks) (Henshilwood 2008; Badenhorst & Plug 2012; Reynard & Henshilwood 2017). These actions can alter the original assemblage, which makes it challenging to interpret past events and agents of accumulation (Blumenschine 1988; Moraitis & Spiliopoulou 2010; Camarós *et al*. 2013; Nagaoka 2015). This could therefore potentially affect the integrity of the assemblage. The kinds of elements gnawed on and the intensity of damage could be related to resource availability and foraging efficiency for both carnivores and humans (Ngoaka 2015).

Anthropogenic marks (cut, chop and/or burn marks) (Binford 1981; Potts & Shipman 1981; Shipman & Rose 1983; Blumenschine & Selvaggio 1988; Fisher 1995; Blumenschine *et al.* 1996; Lyman 1994, 2008; Gifford-Gonzalez 2018) are more prevalent in Phase B (PM/CM - 19.5% and burning - 13.5%) than in Phase A (PM/CM - 55.6% and burning - 3%), suggesting that anthropogenic activity was more common during the phase A period. The occurrence of both anthropogenic and zoogenic marks on the same bone raises the intriguing question of primary access to the faunal remains, and highlights the complex relationship between human and animal activities (Badenhorst *et al.* 2021). Therefore, it can be suggested that the agents of accumulation resulted from both anthropogenic and zoogenic activities. It must be highlighted again that the order of the first and the secondary accumulators cannot be identified.

The prevalence of tooth marks (pits, punctures and gnawing) (Pickering & Wallis 1997; Brain 1981; Selvaggio & Wilder 2001) raises the possibility that domestic dogs (*Canis familiaris*) may have been present at the site. The fact that human occupations at the site occurred over the last 500 years strengthens the idea of dogs may have occupied the space. Mitchell (2014) critically evaluates archaeological, genetic, and ethnographic evidence to reconstruct the significance of dogs within Later Stone Age (LSA) pastoralist contexts. His findings suggest that, while dogs played an important role in herd protection and subsistence strategies, their symbolic and social functions were more limited than among hunter-gatherers. Mitchell (2014) also argues that dogs were present in the first millennium in the Mpumalanga area, which most likely suggests that the shelter was used by dogs or that dogs were used as herders for livestock or alarms for larger predators. The presence of dogs also could indicate that agro-pastoralists made use of the shelter. However, we cannot exclude the idea of wild dogs. Wild dogs make use of shelters when people do not occupy them (Brain 1981; Stiner & Munro 2002; Henshilwood 2008; Reynard *et al.* 2016b; Reynard & Henshilwood 2017).

5.2.1 Seasonality and Shelter Use: Comparative Sites

Seasonal patterns of shelter use in South African archaeological sites provide crucial insight into human-animal interactions, site formation processes, and broader palaeoenvironmental reconstructions. Seasonal patterns of shelter use are evident in South African archaeological sites,

with evidence suggesting that humans and large carnivores alternated their occupation of spaces such as sites as Border Cave (Klein 1977) and Bushman Rock Shelter, driven by resource availability and seasonal migration (Badenhorst & Plug 2012). Klein (1977) argues that large carnivores and humans avoided direct competition by occupying shelters at different times. At Bushman Rock Shelter**,** the zooarchaeological data suggests a mutual avoidance relationship between humans and large carnivores (Badenhorst & Plug 2012). Bushman Rock Shelter also indicates human dominance in faunal accumulation, with a significant presence of anthropogenic modifications such as burnt bones (Badenhorst & Plug 2012). Carnivores, however, likely contributed when the shelter was not occupied by humans. The emphasis on large bovids at this site, coupled with evidence of successful hunting, parallels the findings of this study in which humans likely targeted similar species. Again, the seasonal occupation of shelters by both humans and carnivores is suggested, reflecting a shared use of space (Henshilwood 2008).

Honingklip (Korsman & Plug 1992) presents an example of an almost exclusive human activity. In contrast to Honingklip, the presence of large carnivore remains at Heuningneskrans indicates mutual avoidance between humans and carnivores (Klein 1984). The site likely experienced shared use, with humans and carnivores occupying the shelter at different times. At Welgelegen, the low presence of both zoogenic and anthropogenic marks on the same faunal remains suggests a shared or alternating use of space between humans and carnivores. In Phase B, lower frequencies of anthropogenic marks suggest that human activity was secondary to those made by carnivores, or that the shelter was used less frequently, or if the marks were made by dogs, that the number of dogs had increased. While in Phase A, human activity became more prominent, as evidenced by the higher occurrence of anthropogenic marks. The options of wild carnivores and domestic dogs are viable; however the data cannot emphasise the particular agent.

There is support for seasonality in the ethnographic studies focused on the San descendants in the Lake Chrissie region. Notably, they inhabited sandstone caves and rock shelters near Lake Chrissie during the winter and harsh weather, while temporary open-air campsites were preferred in milder seasons (Potgieter 1955). During the dry season, when shelters and caves were used more frequently and smaller family units were common, they relied more heavily on stored plant foods, small game, and scavenging, while in the wet season, when groups aggregated, they focused on hunting larger game animals (Potgieter 1955). This pattern, however, was more complicated during periods of unrest, such as the *Mfecane* in the early nineteenth century and the subsequent Swazi raids and conquest of the area, when the San sought refuge in the caves, lakes, and swamps of the Lake Chrissie region irrespective of the season (Potgieter 1955; for more information on the regional conflicts see Eldredge 1992; Makhura 2007; Rowe 2009).

The dominance of Bovid II and Bovid III in the faunal assemblages of both phases does not support an exclusive focus on only small mammals during the harsher winter conditions. However, the Welgelegen assemblage's inclusion of aquatic resources such as freshwater mussels (not included

in this analysis) adds a unique dimension to the understanding of their subsistence strategies. The increase in medium to large bovid remains from Phase A to Phase B, however, might speak to the additional use of shelters as refugia, irrespective of the season (Figure. 4.4). The pattern, however, is not clear because if the Swazi invasions or colonisation of the region and related pressures on land were reflected at Welgelegen, we might have expect to see more distinct evidence of dietary shifts consistent with diminished large game availability (Sherwood & Forssman 2024) we don't clearly see this at this site.

5.3 Meat Procurement Strategies

5.3.1 Butchering Techniques

The analysis of cut and percussion marks at archaeological sites, such as Welgelegen, allows insights into butchery practices, which reveals how hunter-gatherer communities adapted their meat processing techniques to environmental conditions, prey availability, and nutritional needs (Binford 1981, 1984; Brain 1981; Bunn 1981; Blumenschine & Selvaggio 1988; Lyman 1994, 2008; Reitz & Wing 2008). In both phases of the Welgelegen Shelter assemblage**,** cut marks were observed on various skeletal elements, indicating human butchering and processing of small, medium and large mammals. Frequencies of cut marks did not differ significantly between the two phases, suggesting that subsistence strategies remained relatively consistent over time. However, it can be noted that overall anthropogenic marks in Phase B were high. These anthropogenic marks were present on a range of skeletal elements, including long bones**,** ribs**,** vertebrae**,** and sesamoids**,** with certain marks appearing "clean cut", indicating differences in butchering technique**.** The marks that appear to be "clean cut" with deep 'V' marks can suggest that a tool was used (Olsen 1988).

The frequencies with which cut marks occur on a bone can vary based on factors such as the material of the cutting tool, the skill of the butcher, the size of mammal, and the amount of flesh presented on a particular element (Thompson 2010). The position of cut marks may reflect specific butchery practices. For example, the presence of cut marks on long bones suggests filleting (Domínguez-Rodrigo 1999; Galán & Domínguez-Rodrigo 2013), while cut marks on ribs, vertebrae, and phalanges may point to skinning (Reynard *et al.* 2016b).This pattern aligns with other archaeological sites where these techniques have been identified as indicative of meat extraction and skinning (Wadley & Jacobs 2006; Reynard & Henshilwood 2017).

The butchering techniques observed at Welgelegen reflect a nuanced understanding of resource processing, with distinct patterns of cut, chop, and percussion marks indicating targeted strategies for meat extraction, marrow processing, and carcass utilisation (Binford 1981; Potts & Shipman 1981; Shipman 1983, 1986; Bunn & Kroll 1986; Reynard *et al.* 2024). At Welgelegen, both small and large mammals display cut marks, indicating that hunting strategies at Welgelegen were diverse and included both small and large prey as per the taxonomic analysis. This contrasts with

MSA sites such as Klipdrift Shelter where larger ungulates display more cut and percussion marks than smaller ungulates (Reynard *et al*. 2016b). The high frequency of small mammals at Welgelegen may therefore reflect similar environmental pressures or resource scarcity, possibly driven by fire events or shifts in prey availability. At Honingklip (Korsman & Plug 1992), evidence of group hunting, tool use, and meat processing suggests that the hunter-gatherers at this site employed strategies similar to those seen at Welgelegen (Korsman & Plug 1990; Henshilwood & Marean 2003). Honingklip features more pronounced evidence of large game hunting than Welgelegen, likely due to different ecological conditions and available prey. This can be seen in taxonomic lists.

5.3.2 Carcass Transport Decisions

Carcass transport decisions at Welgelegen offer valuable clues about resource management, with skeletal part representation suggesting selective transport of high-yield elements, likely influenced by factors such as prey size, distance from kill sites, and nutritional priorities. It is uncommon to find whole carcasses in archaeological assemblages (Saladié *et al.* 2011). This is because of the selection of element transportation (Bunn & Kroll 1986; O'Connell *et al.* 1988; O'Connell *et al.* 1990; Gifford-Gonzalez 1993; Faith & Gordon 2007; Saladié *et al*. 2011), activities such as cooking, sharing and bone breakage (Blumenschine & Selvaggio 1988; Gifford-Gonzalez 1993; Pickering *et al.* 2005) and carnivore scavenging (Binford 1981; Faith & Behrensmeyer 2006). Therefore zooarcaheologists' make use of the relative abundance of skeletal elements in these faunal assemblages as well as foraging theories. Anatomical parts were chosen, removed and returned for consumption while others were discarded (Schoville & Otárola-Castillo 2014).

Both phases at Welgelegen show a dominance of distal limbs, particularly metapodia, in the skeletal part profiles. This suggests that the bones were either cut up to make it easier to transport, used for their nutritional properties (e.g. marrow), portioning/sharing and pot sizing. However, metapodials have negligible flesh available, which could either mean that they were more likely used for marrow extraction or scavengers brought them in (Brain 1981; Pobiner 2015). The presence of long bone shafts and the low abundance of skull fragments are consistent with the idea that long bones were a primary focus of meat extraction, while skull pieces may have been more difficult to transport due to their density (Lyman 1994, 2008; Marean & Claghorn 2003). The skull representation may be the result of butchering mammals at the site, which is ultimately linked to the processing decisions of humans. In both phases, size classes (Bovid 2/3) reflected more equitability in skeletal element distribution, which suggests that Bovid 1/2 were easier to transport or were caught at the site. Bovid 3/4 have high frequencies of cut marks. The skeletal element distribution at Welgelegen reflects transport decisions based on ease of carrying, the amount of flesh available on different parts of the animal, skin removal or portioning.

At Heuningneskrans (Klein 1984), skeletal part profiles are dominated by long bones, which supports the notion that transport decisions were primarily influenced by the need to efficiently

extract meat. Skull elements at Heuningneskrans were more frequently preserved due to their density, mirroring the patterns observed at Welgelegen. At Honingklip (Korsman & Plug 1992), long bone shafts were similarly abundant, forelimbs and hindlimbs were often represented across size classes, which could indicate selective transport based on the amount of usable flesh (Lupo 2006). In comparison, in his research of Lake Chrissie hunter-gatherers, Potgieter (1955) makes no reference to skeletal part representations; however, there is mention that the hunter-gatherer communities in these areas made use of pans, pools, caves and shelters. For example, the nearest pan (Burgerspan) to the Welgelegen Shelter is located 13.46km away. This could suggest that the transportation of usable flesh was thought about.

5.4 Environment

5.4.1 The Role of Wetlands and Fire

The extent of wetlands across the Lake Chrissie area in which the Welgelegen Shelter is located, plays a crucial role in determining animal distribution, as many species are dependent on water sources for survival. The wetlands act as ecological hotspots, drawing a wide variety of mammals and, consequently, carnivores (Braune & Rogers 1987; Western 1975; Spies 2015; Ferreira *et al.* 2023). Their presence would have made them focal points for human groups, influencing settlement patterns, hunting strategies, and seasonal mobility.

In contrast, fire events, whether natural or anthropogenic, might create temporal and ecological changes in the species composition available for human and carnivore consumption (Yarnell *et al.* 2007). These changes would have prompted shifts in faunal movement, as animals track new growth or retreat to unaffected areas, subsequently influencing human subsistence strategies. Potgieter (1955) indicates that veld fires occurred in the Lake Chrissie area. Before the area was colonised by both Europeans and Iron Age agropastoralists, such fire disturbances would have influenced faunal movements and may explain the dietary patterns seen in these other archaeological sites.

The frequency of grassland fires is also a significant ecological factor in these environments. Fire-prone grasses (*Themeda triandra, Cymbopogon plurinodis, Eragrostis curvula, Sporobolus pyramidal*) as described by Ellery (1992), likely played a significant role in shaping the vegetation structure around Welgelegen Shelter by creating a dynamic environment where fire regimes influenced plant composition and species dominance. These grasses, which thrive in areas prone to regular fires, may have altered the landscape by encouraging the growth of fire-resistant plant species and limiting the spread of more fire-sensitive vegetation. As a result, herbaceous plants that were adapted to fire-prone conditions, including certain grasses and shrubs, would have flourished, influencing the types of available forage for herbivores. This, in turn, would have shaped the foraging patterns and distribution of herbivore species in the region, as they adapted to the availability of resources influenced by the seasonal fire cycles. Additionally, fire-induced

changes in vegetation may have led to the presence of habitats more conducive to certain prey species, such as grassland herbivores, and influenced the seasonal availability of resources for both human and carnivore populations in the area.

The Welgelegen Shelter shares key environmental characteristics with other prominent archaeological sites in South Africa, such as Border Cave (Klein 1977) and Bushman Rock Shelter (Badenhorst & Plug 2012). All three sites are associated with grassland biomes and the presence of wetlands, which would have played a critical role in shaping human occupation patterns by providing essential resources like water, edible plants, and attracting game. Notable differences in vegetation composition suggest distinct ecological dynamics that influenced species availability and subsistence strategies at each location. These environmental distinctions not only influenced the species composition at each site but also shaped human mobility patterns, hunting techniques, and resource management strategies. Thus, the comparative ecological dynamics between Welgelegen Shelter and these other sites provide critical insights into regional adaptations among prehistoric populations in South Africa.

Given the largely consistent grassland-wetland paleoenvironment surrounding the Welgelegen Shelter, the environment attracts and sustains diverse faunal populations that can be seen in both Schoonraad and Beaumont's (1971) fauna and my data. It is also likely possible that both hunter-gatherer and early farming communities adapted their behaviours in response to dynamic ecological processes. This could also mean that they deliberately changed habitats with intensive seasonal burning to manage grassland ecological processes. Fire-driven habitat changes could have temporarily expanded hunting opportunities by attracting grazing animals to freshly burnt areas, while wetlands would have served as reliable refugia during drier periods (Mitchell 2000; Henshilwood 2007; Gowlett & Wrangham 2013). Therefore, understanding how wetlands and fire events structured faunal distributions provides crucial insights into the selective strategies employed by the Lake Chrissie hunter-gatherers.

5.5 Past Environment

The paleoenvironment surrounding the Welgelegen Shelter, situated in the Mpumalanga region of South Africa, has remained largely consistent over time, primarily characterised as a grassland biome with wetlands (Brough 2023). This stability contrasts with the broader climatic fluctuations that have occurred across South Africa, particularly during the late Holocene. climatic shifts, such as periods of warming and cooling, as well as localised fire events, have influenced the distribution and availability of faunal resources in the region. I now turn to the environmental conditions and their implications for the faunal assemblages found at the site.

5.5.1 Paleoenvironment of the Welgelegen Shelter

The Welgelegen Shelter is in a region that has remained predominantly a grassland region with wetlands distributed throughout, supporting a variety of ungulate species with diverse dietary preferences. Phytoliths and pollen analyses from the Welgelegen area reinforce the presence of a grassland environment over time, supporting the claim of stability in the region's vegetation (Potgieter 1955; Mucina & Rutherford 2006; Brough 2023). Furthermore, the paleoenvironment at Heuningneskrans is like that of the Welgelegen Shelter, consisting of savannah, grassland, and bushveld environments. This combination of ecosystems would have supported both grazers, browsers and mixed feeders with species like wildebeest and eland relying on seasonal resources (Appendix B/H). The stability of the environment at Heuningneskrans suggests that, like Welgelegen, the fauna was shaped by long-term environmental continuity rather than major climatic shifts (Klein 1984).

Climatic fluctuations during the late Holocene characterized by periods of droughts, fires, and cooling, may have influenced the abundance and distribution of species (Norström *et al*. 2009). These fluctuations could have been especially impactful in influencing the availability of food sources and the movement of faunal species. An environmental phenomenon (likely a significant fire event) in the region might have further affected the availability of species, driving certain fauna either towards or away from the area (Sjönström 2013). Despite these fluctuations, there is evidence to suggest that the broad grassland and wetland environment persisted, providing a stable foundation for the faunal populations.

5.5.1.a Paleoenvironment and Mammal Ecology. The absence of an animal in an archaeological record may not mean that the animal was absent from the environment (Lyman 1995). It is then safe to assume that the presence of an animal at an archaeological site may not mean that that animal was native to that area. The analysis of archaeological faunal assemblages provides many clues about past environments (Deith & Shackleton 1988; Reitz & Wing 2008: p. 320) – this is based on the assumption that the ecological requirements of modern taxa have not changed during the Holocene, although their distribution might have and that anthropogenic or non-anthropogenic activities altered ecosystems (Reitz & Wing 2008: p. 324). The specific ecologies of large mammals play an important role in elucidating both contemporary and past environments. Ungulates have diets closely linked to the vegetative regimes and landscapes they exploit (Wells 1962). However, they are also highly adaptive and often change dietary preferences based on seasonal plant availability and migratory habits (Skinner and Chimimba 2005). Therefore, environmental interpretations can be detailed when based on a complex of species with specific habitat/ecological requirements (Reitz & Wing 2008). However, there is thus a complicated relationship between faunal communities, biomes, local environmental conditions, and broader regional ecological resilience.

The specific grassland species (eland, black wildebeest, southern reedbuck and springbok) found at the site all demonstrate a preference for grassland habitats with regular access to standing water.

As well as Schoonraad & Beaumont's (1971) original taxonomic list (Appendix B). These species also exhibit a variety of seasonal behaviours, such as migration patterns, shifts between grazing and browsing. This dietary diversity reflects the ecological dynamics of a grassland ecosystem that is interspersed with wetland areas (Taylor 1969; du Plessis 1969; Rowe-Rowe 1994; Mucina & Rutherford 2006; Brough 2023).

However, there were non-grassland species (waterbuck, blue wildebeest, mountain reedbuck and the hippopotamus) identified from the Welgelegen Shelter. Why are these species in the area then? Species that are native to grasslands are expected to be in the Welgelegen area. However, it should be noted that humans also introduce animals, such as the springbok, into new locations (Langemann 2004; Newsom & Wing 2004; Reitz & Wing 2008). The springbok could have already been in the area, or they have been reintroduced (their distribution was extremely low), as the time period correlates with colonialism and anthropogenic activities (du Plessis 1969).

It is also possible that some animals or their parts were traded or bought to that site from a distance (Sykes 2004). This idea can be linked to the hippopotamus tusk. Hippopotamuses' habitat requirements are associated with the areas surrounding the Welgelegen shelter. Historical records for hippopotamus indicate that they occurred throughout the subregion wherever open water and rivers with deep pools were available (du Plessis 1969; Plug & Badenhorst 2001). The trade aspect can be further be supported as they are dangerous and difficult to hunt. This could suggest that extra energy was put into acquiring these animals for trade.

Distant habitats may be represented in archaeological sites because these products were brought in from distant sources through trade networks (Reitz & Wing 2008: p. 322). This may be the case for the waterbuck, blue wildebeest and the mountain reedbuck. Their habitat requirements are not necessarily grasslands. Blue wildebeest take part in long-distance migrations to seek better grazing patches (Skinner & Chimimba 2005: p. 646-648) and are water-dependent with a preference for feeding on areas of short, green, lawn-like grasslands. Fire disturbances in the Lake Chrissie region would have influenced such faunal movements. Notably, in the assemblage, black and blue wildebeest are the most common. The presence of both species may be associated with migratory patterns, or environmental phenomena such as the fires in the Lake Chrissie region.

The mountain reedbuck is definitely not from the immediate vicinity, which suggests that it was brought from somewhere else. The closest mountain range is the Drakensberg in Kwa-Zulu-Natal. This would link with the hypothesis of trade networks from the Indian Ocean and Mozambique. Animal products that are brought in from beyond the immediate catchment area are less abundant than the animals within the catchment area (Shotwell 1958). This is exactly the case at Welgelegen.

It is also important to remember that care must be taken to distinguish trade goods, local products and environmental changes as explanations for the presence or non-presence of species at a site (Reitz & Wing 2008: p. 323). Human choices of resources, changes in technology, temporal

aspects of subsistence or differences in archaeological recovery and analysis could produce changes as well. These need to be eliminated before environmental change can be inferred and whether that change was anthropogenic or not (Glassow 2005; Reitz & Wing 2008: p. 323).

5.5.1.b Foraging Resources. Different ungulate species tend to focus on different components of vegetation (Shipley 1999). They interact with forage resources in temporal and spatial scales (Bailey *et al*. 1996; Owen-Smith *et al.* 2010). They forage in the form of grazers, browsers and mixed feeders (Venter *et al.* 2019). The absence of both browsers and mixed feeders in Phase A may reflect a lack of suitable habitat or ecological niches for such dietary generalists during this period. Phase B shows a greater diversity in dietary preferences, with representation from grazers and mixed feeders, and includes a minor decrease in browsers, which may indicate subtle ecological or climatic changes influencing faunal availability and dietary habits. For example, the blue which is not subject to grasslands and prefers short grass patches, might have needed to move through tall grass habitats in order to reach them (Owen-Smith & Traill 2017). The absence of large trees would have meant a limited presence of browsers in the area, as these animals typically rely on trees and shrubs for food (Venter *et al.* 2015; Venter *et al.* 2019). Therefore, it can be reasoned that animals adjust their movements for foraging purposes and that species that are not native to the grasslands of Welgelegen could have just been passing through. This idea is supported by Reynard (2021) who indicates that large ungulate movements have occurred along rainfall gradients near the Drakensberg. Furthermore, Potgieter (1955) also alludes that ungulates used to migrate out of the area during winter. These decisions could have been influenced by water and food-related sources (maybe in pursuit of sour grasses).

5.5.2 Implications for Environmental Stability and Change

The paleoenvironment surrounding the Welgelegen Shelter and other sites in South Africa reveals a picture of ecological continuity with some local fluctuations. Species richness at sites like Welgelegen may be reflective of microclimates within the grassland biome, where some species prefer coarse, sour grasses and access to water (Mucina & Rutherford 2006). Climatic fluctuations, particularly fire events, likely influenced animal behaviour by either driving animals away from the area or making certain species more abundant during certain periods. The seasonal behaviour of species such as the wildebeest and the springbok indicates that the environment provided an array of habitat types, supporting different feeding strategies and migration patterns. Moreover, the wetlands and fire events likely played a key role in animal movement across the landscape, influencing both the availability of resources and the hunting strategies of humans in the area. The consistent presence of grasslands throughout the Holocene, despite periodic climatic changes, may explain the stable faunal assemblages found at Welgelegen with only local disruptions in animal populations rather than drastic ecological transformations.

5.6 Hunting Strategies

The Welgelegen Shelter assemblage reflects a varied hunting strategy that included both large and small prey**,** which was likely influenced by seasonal and environmental factors. The presence of a hippopotamus tusk in the assemblage suggests that both terrestrial and aquatic hunting were employed, reflecting a flexible subsistence strategy. The use of tools**,** group hunting strategies, and symbolic behaviours through rock art provides evidence for cognitive and cultural complexity in hunter-gatherer communities (Potgieter 1955; Henshilwood & Marean 2003).

Honingklip (Korsman & Plug 1992) and Heuningneskrans (Klein 1984) reflect a mix of hunting large game**,** gathering plants, and seasonal hunting and making use of terrestrial & aquatic resources suggesting that hunter-gatherers at these sites adapted to their environmental and social needs in ways similar to those at Welgelegen. These communities adjusted their practices in response to environmental and social conditions, with patterns of behaviour that were comparable across different archaeological sites, including Welgelegen (Klein 1984).

Hunter-gatherers at this site made use of various techniques such as game pits, snares, traps, spears and potentially dogs and ambush hunting (Potgieter 1955). Land and aquatic hunting (grassland and wetland). Small and large prey (browsers, grazers and mixed feeders), which can be seen in my faunal assemblage with bovids and hippopotamus, as well as the presence of different size classes and dietary preferences, could suggest that hunting occurred during all seasons or it was influenced by environmental change (Potgieter 1955). It is important to note that butchering marks do not discount for bow-and-arrow hunting. This is due to the fact that most arrows only penetrate flesh therefore there is no way to tell if arrows (poisoned or not) were used. The taphonomic analysis, and prey species from the Welgelegen Shelter suggests that bow-and-arrow hunting was not a key subsistence strategy. The analysis indicates no evidence of projectile point impact marks on bone, which suggests that other hunting methods were more dominant such as snares, traps and, possibly, the use of dogs.

The diversity of recovered species and butchery patterns at Welgelegen reflects a range of hunting choices for its occupants. Given the abundance of large-sized ungulates, foragers primarily brought long limbs back to the shelter (Lyman 1994; Marean & Claghorn 2003). The presence of diverse butchering marks and the range of both terrestrial and aquatic resources at Welgelegen suggest that hunter-gatherers in this environment had hunting choices. In the context of the southern edge of the Bokoni towns, it can be argued that the hinterland, which comprises of a mix of grasslands, wetlands, and water sources, allowed for strategic decisions in hunting and resource utilisation not possible in the densely occupied Bokoni villages and towns.

Hunting choices likely reflect a high degree of cultural and environmental knowledge, where individuals were aware of the seasonal patterns of prey species, migration routes, and the

availability of different resources. Due to the limited presence of browsers in the area, the inhabitants of the region may have relied more on grazing animals, which would have shaped their hunting and resource management strategies. The ability to selectively transport high-yield parts, such as long bones, while leaving behind less valuable or difficult-to-transport elements like skulls, indicates a strategic, efficient approach to hunting. This efficiency is key in a region where larger, more resource-rich Bokoni towns (Maggs 2008; Delius *et al.* 2012) might have placed additional demands on local ecosystems, if these became areas where cattle were grazed or where Bokoni hunters acquired additional protein. At the same time, the strategic use of both aquatic and terrestrial resources could have been shaped by competition or cooperation with the Bokoni populations or the availability of these resources in periods of environmental stress. The variation in prey size classes and butchering marks might also suggest that hunter-gatherers were adapting their practices in response to shifting ecological conditions, such as resource scarcity or abundance.

This context also means that Welgelegen hunter-gatherers could have had access to cattle and sheep, due to their proximity to Bokoni, but there is no evidence for their inclusion in their diet. Further research is needed to understand this absence, but it is possible that the Lake Chrissie hunter-gatherers did not bring the skeletal remains of domestic species to the site, even if they were obtained elsewhere or they may not have prioritized domestic livestock as a resource in winter, focusing instead on easily accessible game that fit within their traditional subsistence strategies. It is also possible that hunter-gatherers did not raid cattle to avoid conflict with Bokoni communities, nor were they given livestock as gifts. It is also possible that the hunter-gatherers at Welgelegen were less integrated into the agricultural and herding economies of the Bokoni, relying instead on wild fauna and foraging.

The presence of the hippopotamus tusk in Phase A as well as the cowrie shells found by Schoonraad & Beaumont (1971), might suggest that the latter option is least likely. The tusk might suggest that the shelter's inhabitants were involved in trade throughout the sequence, as they were after the expansion of the Swazi polity into the area (Schoonraad & Beaumont 1971; Potgieter 1955). Contact with Portuguese traders in Mozambique might be supported by the presence of Portuguese loanwords in the //Xegwi language spoken in the Lake Chrissie area (Potgieter 1955; Thompson 2001; Chewins 2016; Roque 2017). This trade would have involved skins and various forms of ivory as those were sought-after products on the Mozambican coast (Badenhorst *et al*. 2011). This is similar to elsewhere in South Africa (Huffman 2000) and the East African coast where ivory and animal skins were traded (Pwiti 1991).

CHAPTER 6: CONCLUSION

This study explores a window into the deep, complex bonds the San people shared with animals long before colonial influences reshaped their world. By examining the patterns of animal consumption among hunter-gatherer societies over the last 600 years at Welgelegen Shelter in Mpumalanga, South Africa, this study sheds light on their subsistence strategies and the paleoenvironmental conditions that shaped their way of life. The faunal assemblage from Welgelegen offers critical insights into these dynamics, revealing a deeper understanding of human-animal interactions in the past.

6.1 Key Findings of this Project

The role of carnivores in shaping the faunal assemblage is evident. Taphonomic indicators of zoogenic activity, specifically tooth marks, are abundant in the sample, and suggest periods when the shelter was occupied by carnivores in the absence of human activity. This finding supports the possibility of the use of rock shelters by both humans and carnivores, reflecting complex interactions within shared ecological niches. The predominance of small to medium-sized mammals suggests adaptive strategies in response to environmental pressures and resource availability. The taphonomic analysis indicates that human modifications, such as cut and percussion marks, increased in the upper stratigraphic layers, possibly highlighting a shift towards intensified human occupation and resource exploitation over time. The presence of burning and butchery marks indicates systematic processing of animal resources, reflecting complex subsistence strategies that involved selective hunting and efficient resource utilisation. Comparisons with contemporaneous sites such as Border Cave, Bushman Rock Shelter, and Honingklip underscore the regional variability in subsistence strategies. While some sites exhibit reliance on large-bodied fauna, Welgelegen's assemblage suggests a broader dietary breadth, including smaller mammals and avian species. This variation may reflect localised ecological conditions, cultural preferences, or differential access to resources.

This research also contributes to the limited body of knowledge linking fauna to paleoenvironments in north-eastern South Africa. By examining faunal remains as proxies for environmental conditions, this study highlights the dynamic interplay between climatic factors and human adaptive strategies. Paleoenvironmental evidence from the faunal data suggests long-term ecological stability in the region, with grassland biomes supporting diverse ungulate populations. However, variations in the abundance of specific taxa across stratigraphic layers indicate periods of environmental fluctuation, potentially linked to climatic changes during the Late Holocene. These findings align with broader regional studies that highlight the role of climate in shaping subsistence patterns and settlement dynamics among hunter-gatherer communities. The data suggest that hunter-gatherers at Welgelegen Shelter employed flexible subsistence approaches, adjusting their hunting and processing techniques in response to shifting environmental conditions.

6.2 Limitations

The faunal assemblage analysed in this study was limited to remains excavated in 2022, making the sample size a potential constraint. Preservation biases, including differential bone survival and various taphonomic processes, may have influenced species representation. Differentiating between human and carnivore-induced modifications posed further challenges, potentially leading to ambiguities in site formation processes. The study also lacked stable isotope analysis and ancient DNA techniques, which could have offered deeper insights into dietary practices, mobility, and population dynamics. Furthermore, although comparisons were made with other regional sites, broader inter-regional comparisons were limited due to the availability of comparable faunal datasets.

6.3 Future Avenues of Research

Integrating isotopic studies can refine dietary reconstructions, while genetic analysis of faunal remains could reveal patterns of animal domestication, migration, population continuity, and whether the site housed dogs. Expanding comparative studies to include more sites across north-eastern South Africa and adjacent regions could provide a more comprehensive understanding of subsistence variability. Collaborations with paleoclimatologists, geochemists, and ecologists could enrich interpretations of human-environment interactions. Employing more detailed taphonomic methodologies could improve the understanding of site formation processes and clarify the role of carnivores versus humans in faunal accumulation. Continued excavation and multidisciplinary analyses, including paleoenvironmental reconstructions and taphonomic analyses, will further refine our understanding of past human activities in the region. Further dating: dating the faunal remains can help us identify the colonial periods. Future research on dog gnawing taphonomy and dog size has the potential to unlock hidden clues about ancient human-canine relationships, revealing how these loyal companions shaped and scavenged past landscapes.

In conclusion, the faunal analysis from Welgelegen Shelter provides valuable insights into hunter-gatherer subsistence strategies, human-animal interactions, and paleoenvironmental conditions in the Mpumalanga region. The findings underscore the adaptive capacities of hunter-gatherer communities in north-eastern South Africa, contributing to broader discussions on human resilience and environmental adaptation during the last millennium. This research makes a significant contribution to the understanding of the relationships between humans, animals, and their environments during a transformative period characterised by technological and subsistence shifts.

REFERENCES

Abraham, J., Upham, N., Damian-Serrano, A. & Jesmer, B. 2022. Evolutionary causes and consequences of ungulate migration. *Nature Ecology & Evolution* 6: 1-9.

Allan, D., Harrison, J., Navarro, R., van Wilgen, B. & Thompson, M. 1997. The impact of commercial afforestation on bird populations in Mpumalanga Province, South Africa - Insights from bird-atlas data. *Biological Conservation* 79: 173-185.

Andrews, P. & Cook, J. 1985. Natural modifications to bone in a temperate setting. *Man (New Series)* 20(4): 675-691.

Arnold, E., Greenfield, H. & Creaser, R. 2013. Domestic cattle mobility in early farming villages in southern Africa: Harvest profiles and strontium (87Sr/86Sr) isotope analyses from Early Iron Age sites in the lower Thukela River Valley of South Africa. *Archaeological and Anthropological Sciences* 5: 129-144.

Bader, G.D., Linstädter, J. & Schoeman, M.H. 2020. Uncovering the Late Pleistocene LSA of Mpumalanga Province, South Africa: Early results from Iron Pig Rock Shelter. *Journal of African Archaeology* 18(1): 19-37.

Badenhorst, S. 2008. Subsistence change among farming communities in southern Africa during the last two millennia: a search for potential causes. In: S. Badenhorst, P. Mitchell & J.C. Driver (eds) *Animals and People: archaeozoological papers in honour of Ina Plug*: 215-228. Oxford: Archaeopress.

Badenhorst, S. 2010. Descent of Iron Age Farmers in Southern Africa During the Last 2000 Years. *The African Archaeological Review* 27(2): 87–106.

Badenhorst S., Sinclair, P., Ekblom, A. & Plug, I. 2011. Faunal remains from Chibuene, an Iron Age coastal trading station in central Mozambique. *Southern African Humanities* 23: 1-15.

Badenhorst, S. & Plug, I. 2012. The faunal remains from the Middle Stone Age levels of Bushman Rock Shelter in South Africa. *South African Archaeological Bulletin* 67: 16-31.

Badenhorst, S. 2015. Intensive hunting during Iron Age of southern Africa. *Environmental Archaeology* 20(1): 41-51.

Badenhorst, S. 2017. The zooarchaeology of Iron Age farmers from southern Africa. In: edited by U. Albarella, M. Rizzetto, H. Russ, K. Vickers & S. Viner-Daniels (eds) *The Oxford Handbook of zooarchaeology*: 427-438.

Badenhorst, S., Mitchell, P., Arthur, C. & Capelli, C. 2019. Late Holocene fauna from Moshebi's Shelter, a Later Stone Age site in Lesotho. *Southern African Humanities* 32(1): 83-107.

Badenhorst, S., Ezeimo, J., Van Niekerk, K. & Henshilwood, C. 2021. Differential accumulation of large mammal remains by carnivores and humans during the Middle Stone Age in the Eastern and Western Cape, South Africa. *Journal of Archaeological Science* 35(194): 102752.

Bailey, D.W., Gross, J.E., Laca, E.A., Rittenhouse, L.R., Coughenour, M.B., Swift, D.M. & Sims, P.L. 1996. Mechanisms that result in large herbivore grazing distribution patterns. *Rangeland Ecology & Management/Journal of Range Management Archives* 49(5): 386-400.

Bailey, D.W. & Provenza, F.D. 2008. Mechanisms determining large-herbivore distribution. In: H.H.T. Prins, F. Van Langevelde (eds) *Resource Ecology*. Wageningen UR Frontis Series, vol 23: 7-28. Dordrecht: Springer.

Balwan, W.K. & Kour, S. 2021. Wetland-an ecological boon for the environment. *East African Scholars Journal of Agriculture and Life Sciences* 4(3): 38-48.

Barnard, A. 2019. *Bushmen: Kalahari hunter-gatherers and their descendants*. Cambridge: Cambridge University Press.

Becher, J., Schoeman, A., Whitelaw, G., Buckley, S., Celliers, J.P., Cafisso, S., Besler, M., Regeot, M. & Spiteri, C. 2024. Multi-purpose pots: Reconstructing early farming behaviour at Lydenburg Heads site, South Africa, using organic residue analysis. *Journal of Archaeological Science* 161: 105894

Behrensmeyer, A.K. 1978. Taphonomic and ecologic information from boneweathering. *Paleobiology* 4(2): 150–162.

Ben-Dor, M. & Barkai, R. 2024. Declining Prey Size in the Southern African Pleistocene: evaluating the human impact. https://doi.org/10.20944/preprints202411.1024.v1

Berkes, F. 2012. *Sacred Ecology: traditional ecological knowledge and resource management.* London: Routledge.

Bigalke, R.C. 1972. Observations on the behaviour and feeding habits of the springbok Antidorcas marsupialis. *Zoology Africana* 7(1): 333–359.

Binford, L.R. 1981. *Bones: ancient men and modern myths*. New York: Academic Press.

Binford, L.R. 1984. *Faunal Remains from Klasies River Mouth*. New York: Academic Press.

Binford, L.R. 2001. *Constructing Frames of Reference: an analytical method for archaeological theory building using hunter-gatherer and farmer data*. Berkeley: University of California Press

Birin, R.A., Schoeman, A. & Evans, M. 2021. The construction and habitation of one of the earliest homesteads at Komati Gorge Village 1, Bokoni, South Africa. *Journal of Archaeological Science*: *Reports* 38: 03020.

Blundell, G. (ed). 2006. *Origins: the study of the emergence of humans and humanity in Africa*. Cape Town: Double Storey.

Blumenschine, R.J. & Selvaggio, M.M. 1988. Percussion marks on bone surfaces as a new diagnostic of hominid behaviour. *Nature* 333(6175: 763-765.

Blumenschine, R.J., Whiten, A. & Hawkes, K. 1991. Hominid carnivory and foraging strategies and the socio-economic function of early archaeological sites (and discussion). *Philosophical Transactions: Biological Sciences* 334 (1270): 211-221.

Blumenschine. R.J. 1995. Percussion marks, tooth marks, and experimental determination of the timing of hominid and carnivore access to long bones at FLK zinjanthropus, Olduvai Gorge, Tanzania. *Journal of Human Evolution* 29(1): 21-51.

Blumenschine, R.J., Marean, C.W. & Capaldo, S.D. 1996. Blind tests of inter-analyst correspondence and accuracy in the identification of cut marks, percussion marks and carnivore tooth marks on bone surfaces. *Journal of Archaeological Science* 23(4): 493-507.

Bousman, C.B. 1998. The Chronological evidence for the introduction of domestic stock into southern Africa. *African Archaeological Review* 15: 133-150.

Brain, C.K. 1969. Faunal remains from the Bushmans Rock Shelter, eastern Transvaal. *South African Archaeological Bulletin* 24(94): 52 – 55.

Brain, C.K. 1974. Some suggested procedures in the analysis of bone accumulations from southern African Quaternary sites. *Annals of the Transvaal Museum* 29(1): 1-8.

Brain, C.K. 1981. *The Hunters or the Hunted?: an introduction to African cave taphonomy*. Chicago: University of Chicago Press.

Brain, C.K. 1993. The occurrence of burnt bones at Swartkrans and their implications for the control of fire by early hominids. In: C.K. Brain (ed) *Swartkrans: a cave's chronicle of early man*: 229-242. Transvaal Museum Monograph, no. 8Pretoria: Transvaal Museum.

Braune, E. & Rogers, K.H. 1987. *The Vaal River Catchment: problems & research needs. South African National Scientific Programmes Report No. 143.* Pretoria: CSIR.

Brink, J.S. 2016. Faunal evidence for mid-and late Quaternary environmental change in southern Africa. In: J. Knight & S. Grab (eds) *Quaternary Environmental Change in Southern Africa: physical and human dimensions*: 284-305. Cambridge: Cambridge University Press.

Brown, A.J.V. & Verhagen, B.T. 1985. Two Antidorcas bondi individuals from the Late Stone Age site of Kruger Cave 35/83, Olifantsnek, Rustenburg District, South Africa. *South African Journal of Science* 81(2): 102.

Brough, K. 2023. *Reconstructing the vegetation history of the last 1900 years at Welgelegen, Mpumalanga, South Africa*. Honours Project, University of the Witwatersrand.

Bunn, H., Harris, J. W. K., Isaac, G., Kaufulu, Z., Kroll, E., Schick, K., Toth, N. & Behrensmeyer, A. K. 1980. FxJj50: An early Pleistocene site in northern Kenya. *World Archaeology* 12(2): 109-136.

Bunn, H.T. 1981. Archaeological evidence for meat-eating by Plio_Pleistocene hominids from Koobi For a, Kenya and at Olduvai Gorge. *Nature* 291: 574-577.

Bunn, H.T., Kroll, E.M., Ambrose, S.H., Behrensmeyer, A.K., Binford, L.R., Blumenschine, R.J., Klein, R.G., McHenry, H.M., O'brien, C.J. & Wymer, J.J. 1986. Systematic butchery by Plio/Pleistocene hominids at Olduvai Gorge, Tanzania [and comments and reply]. *Current Anthropology* 27(5): 431-452.

Bunn, H.T. & Kroll, E.M. 1986. Systematic butchery by Plio/Pleistocene hominids at Olduvai Gorge, Tanzania. *Current Anthropology* 27(5): 431-442.

Butler, V.L. & Lyman, R.L. 1996. Taxonomic identification and faunal summaries: what should we be including in our faunal reports. *Society for American Archaeology* 14(1): 22.

Camarós, E., Cueto, M., Teira, L.C., Tapia, J., Cubas, M., Blasco, R., Rosell, J. & Rivals, F. 2013. Large carnivores as taphonomic agents of space modification: an experimental approach with archaeological implications. *Journal of Archaeological Science* 40(2): 1361-1368.

Chase, B., Faith, T., Mackay, A., Chevalier, M., Carr, A., Boom, A., Lim, S. & Reimer, P. 2017. Climatic controls on Later Stone Age human adaptation in Africa's southern Cape. *Journal of Human Evolution* 114: 35-44.

Chase, B.M. & Meadows, M.E. 2007. Late Quaternary dynamics of southern Africa's winter rainfall zone. *Earth-Science Reviews* 84(3-4): 103-138.

Chewins, L. 2016. The relationship between trade in southern Mozambique and state formation: reassessing Hedges on cattle, ivory and brass. *Journal of Southern African Studies* 42(4): 725–741.

Chutter, F.M. 1963. Hydrobiological studies on the Vaal River in the Vereeniging area. *Hydrobiologia* 21: 1–65.

Clark, J.L. & Ligouis, B. 2010. Burned bone in the Howieson's Poort and post-Howieson's Poort Middle Stone Age deposits at Sibudu (South Africa): behavioural and taphonomic implications. *Journal of Archaeological Science* 37(10): 2650-2661.

Clark, V.R., Burrows, J., Turpin, B., Balkwill, K., Lötter, M.C. & Siebert, S. 2022. The Limpopo–Mpumalanga–Eswatini Escarpment—extra-ordinary endemic plant richness and extinction risk in a Summer Rainfall Montane Region of southern Africa. *Frontiers in Ecology and Evolution* 10: 765854.

Low, C.C., Gordon, D.F., Hall, M., Bundy, C.J., Thompson, L.M., Nel, A., Cobbing, J.R, Mobin,A.S. & Vigne, R. "South Africa". *Encyclopedia Britannica.* Retrived from: *https://www.britannica.com/place/South-Africa*

Deacon, H.J. 1976. *Where hunters gathered: a study of Holocene Stone Age people in the Eastern Cape.* South African Archaeological Society monograph series. Claremont: South African Archaeological Society.

Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: uncovering the secrets of the Stone Age*. Cape Town: David Phillip.

Deith, M.R. & Shackleton, J.C. 1988. The contribution of shells to site interpretation: Approaches to shell material; from Franchthi Cave. In: J.L Bintliff, D.A. Davidson, and E.G. Grant (ed.) *Conceptual Issues in Environmental Archaeology*: 49-58. Edinburgh: Edinburgh University Press.

Delgado, M.D.M., Penteriani, V., Nams, V.O. & Campioni, L. 2009. Changes of movement patterns from early dispersal to settlement. *Behavioral Ecology and Sociobiology* 64(1): 35-43.

Delius, P., Maggs, T. and Schoeman, M., 2012. Bokoni: Old structures, new paradigms? Rethinking pre-colonial society from the perspective of the stone-walled sites in Mpumalanga. *Journal of Southern African Studies* 38(2): 399-414.

de Knegt, H.J., Hengeveld, G.M., van Langevelde, F., de Boer, W.F. & Kirkman, K.P. 2007. Patch density determines movement patterns and foraging efficiency of large herbivores. *Behavioural Ecology* 18(6): 1065-1072.

Dewar, G. & Jerardino, A. 2007. Micromammals: when humans are the hunters. *Journal of Taphonomy* 5(1): 1-14.

Domínguez-Rodrigo, M. 1999. Flesh availability and bone modifications in carcasses consumed by lions: Palaeoecological relevance in hominid foraging patterns. *Palaeogeography Palaeoclimatology Palaeoecology* 149: 373–388.

Domínguez-Rodrigo, M., De Juana, S., Gallan, A.B. & Rogriguez, M. 2009. A new protocol to differentiate trampling marks from butchery cut marks. *Journal of Archaeological Science* 36(12): 2643-2654.

Driver, J.C. 2005. *Manual for Description of Vertebrate Remains*. 6th edition. Cortez: Crow Canyon Archaeological Centre.

Du Plessis, S.F. 1969. *The past and present geographical distribution of Perrisodactyla and Artiodactyla in Southern Africa.* M.Sc. Thesis, University of Pretoria.

Dusseldorp, G.L. 2009. *A view to a kill: Investigating middle Palaeolithic subsistence using an optimal foraging perspective.* Leiden: Sidestone Press.

Dusseldorp, G.L. 2012. Studying prehistoric hunting proficiency: applying optimal foraging theory to the Middle Palaeolithic and Middle Stone Age. *Quaternary International* 252: 3-15.

Dusseldorp, G., Lombard, M. & Wurz, S. 2013. Pleistocene Homo and the updated Stone Age sequence of South Africa. *South African Journal of Science* 109(5/6): 1-7.

Dusseldorp, G.L. 2016. Faunal assemblage structure suggests a limited impact of the introduction of domestic stock on Later Stone Age subsistence economies in South Africa. *African Archaeological Review* 33: 363–383.

Dusseldorp, G. & Reynard, J. 2022. Faunal exploitation strategies during the Later Pleistocene in southern Africa. *Oxford Research Encyclopedia of Anthropology*. https://doi.org/10.1093/acrefore/9780190854584.013.559

Efrremov, I.A. 1940. Taphonomy: A new branch of palaeontology. *Pan American Geologist* 74: 81-93.

Egeland, C.P. 2003. Carcass processing intensity and cutmark creation: an experimental approach. *Plains Anthropologist* 48(148): 39-51.

Egeland, C.P. 2012. The use of bone surface modifications to model hominid lifeways during the Oldowan. In: M. Domínguez-Rodrigo (ed) *Stone Tools and Fossil Bones: debates in the archaeology of human origins*: 80-114. Cambridge: Cambridge University Press.

Ellery, W.N. 1992. *Classification of vegetation of the South African grassland biome*. Unpublished PhD thesis, University of the Witwatersrand.

Eldredge, E.A. 1992. Sources of conflict in southern Africa, c. 1800-30: The 'Mfecane' reconsidered. *The Journal of African History* 33(1): 1-35.

Enloe, J.G. 1993. Ethnoarchaeology of marrow cracking: implications for the recognition of prehistoric subsistence organization. In: J. Hudson (ed) *From Bones to Behaviour: ethnoarchaeological and experimental contributions to the interpretation of faunal remains*: 82-97. Carbondale: Center for Archaeological Investigations, Occasional Paper No. 21. Southern Illinois University: Chicago.

Esterhuysen, A. & Smith, J. 2007. The archaeology of Mpumalanga. In: P. Delius (ed*.) Mpumalanga History and Heritage: recapturing the past, defining the future*: 7-18. Pietermaritzburg: University of KwaZulu-Natal Press.

Evers, T. 1974. Iron Age Trade in the Eastern Transvaal, South Africa. *South African Archaeological Bulletin* 29 (113/114): 33-37.

Faith, J.T. & Behrensmeyer, A.K. 2006. Changing patterns of carnivore modification in a landscape bone assemblage, Amboseli Park, Kenya. *Journal of Archaeological Science* 33(12): 1718-1733.

Faith, J.T. & Gordon, A.D. 2007. Skeletal element abundances in archaeofaunal assemblages: economic utility, sample size, and assessment of carcass transport strategies. *Journal of Archaeological Science* 34(6): 872-882.

Faith, J.T. & Behrensmeyer, A.K. 2013. Climate change and faunal turnover: testing the mechanics of the turnover-pulse hypothesis with South African fossil data. *Paleobiology* 39(4): 609–627.

Fernandez-Jalvo, Y. & Andrews, P. 2003. Experimental effects of water abrasion on bone fragments. *Journal of Taphonomy* 1(3): 147-163.

Ferrar, T.A. & Lötter, M.C. 2007. *Mpumalanga Biodiversity Conservation Plan Handbook*. Nelspruit: Mpumalanga Tourism & Parks Agency.

Ferreira, C.S.S., Kašanin-Grubin, M., Solomun, M.K., Sushkova, S., Minkina, T., Zhao, W. & Kalantari, Z. 2023. Wetlands as nature-based solutions for water management in different environments. *Current Opinion in Environmental Science & Health* 33: 100476.

Fisher, J.W. 1995. Bone surface modification in zooarchaeology. *Journal of Archaeological Method and Theory* 2(1): 7–68.

Fortin, D. 2003. Searching behavior and use of sampling information by free-ranging bison (Bos bison). *Behavioral Ecology and Sociobiology* 54(2): 194-203.

Forssman, T. 2013. *The spaces between places: a landscape study of forages on the Greater Mapungubwe landscape, southern Africa*. Unpublished PhD Thesis, University of Oxford.

Forssman, T. & Van Zyl, S. 2022. A preliminary analysis of the backed stone tool assemblage at Little Muck shelter. *South African Archaeological Bulletin* 77(216): 57-66.

Forssman, T., Kuhlase, S., Barnard, C. & Pentz, J. 2023. Forages during a period of social upheaval at Little Muck, southern Africa. *Azania: Archaeological Research in Africa* 58(1): 114-150.

Fourie, L., Royget, M. & Lötter, M. 2015. Landscape connectivity of the grassland biome in Mpumalanga, South Africa. *Austral Ecology* 40: 67–76.

Fryxell, J.M., Hazell, M., Börger, L., Dalziel, B.D., Haydon, D.T., Morales, J.M., McIntosh, T. & Rosatte, R.C. 2008. Multiple movement modes by large herbivores at multiple spatiotemporal scales. *Proceedings of the National Academy of Sciences* 105(49): 19114-19119.

Gagnon, M. & Chew, A.E. 2000. Dietary preferences in extant African Bovidae. *Journal of Mammalogy* 81(2): 490-511.

Gaffney, D. 2021. Pleistocene water crossings and adaptive flexibility within the Homo Genus. *Journal of Archaeological Research* 29: 255-326.

Galán, A.B. & Domínguez-Rodrigo, M. 2013. An experimental study of the anatomical distribution of cut marks on long bone ends. *Archaeometry* 55(6): 1132-1149.

Gifford, D. 1981. Taphonomy and paleoecology: a critical review of archaeology's sister discipline. *Advances in Archaeological Method and Theory* 4: 365-437.

Gifford-Gonzalez, D. 1993. Gaps in zooarchaeological analyses of butchery: Is gender an issue. In: J. Hudson (ed.). *From Bones to Behavior: ethnoarchaeological and experimental contributions to the interpretation of faunal remains*: 181-199. Carbondale: Southern Illinois University.

Gifford-Gonzalez, D. 2018. *An Introduction to Zooarchaeology*. New York: Springer Nature.

Gifford, D.P., Isaac, G.L. & Nelson, C.M. 1980. Evidence for predation and pastoralism at Prolonged Drift: a Pastoral Neolithic Site in Kenya. *Azania* 15(1): 57-108.

Glassow, M.A. 2005. Prehistoric dolphin hunting on Santa Cruz Island. In: G.G. Monks (ed.) *The Exploitation and Cultural Importance of Sea Mammals*: 107-120. Oxford: Oxbow Press.

Gowlett, J.A.J. & Wrangham, R. W. 2013. Earliest fire in Africa: towards the convergence of archaeological evidence and the cooking hypothesis. *Azania* 48(1): 5-30.

Grody, E. 2016. Of buffalo and butchers: coupling traditional procurement studies with taphonomic analyses to explore intensive wild animal processing patterns at two Early Iron Age Sites in the Kruger National Park. *African Archaeological Review* 33(4): 385-409.

Grün, R. & Beaumont, P. 2001. Border Cave revisited: a revised ESR chronology. *Journal of Human Evolution* 40(6): 467-482.

Hall, S. 2000. Forager lithics and early Moloko homesteads at Madikwe. *Southern African Humanities* 12(1): 33-50.

Hall, S. & Smith, B. 2000. Empowering places: rock shelters and ritual control in farmer-forager interactions in the Northern Province. *Goodwin Series: African Naissance: The Limpopo Valley 1000 Years Ago* 8: 30-46.

Haacke, W. & Eiseb, E. 2002. *A KhoeKhoegowab dictionary with English-Khoekhoegowab Index.* Windhoek: Gamsberg Macmillan.

Heath, R., Coleman, T. & Engelbrecht. 2010. *Water quality overview and literature review of the ecology of the Olifants River*: 1-119.

Heese, J.A. 1971. *Die Herkoms van die Afrikaner, 1657-1867: 17-20*. Cape Town: AA Balkema.

Hempson, G., Archibald, S. & Bond, W.J. 2015. A continent-wide assessment of the form and intensity of large mammal herbivory in Africa. *Science* 350(6264): 1056-1061.

Henshilwood, C.S. & Marean, C.W. 2003. The origin of modern human behaviour: critique of the models and their test implications. *Current Anthropology* 44(5): 627–651.

Henshilwood, C. 2007. Fully symbolic sapiens behaviour: innovation in the Middle Stone Age at Blombos Cave, South Africa. In: C. Stringer & P. Mellars (eds) *Rethinking the Human Revolution: new behavioural and biological perspectives on the origins and dispersal of modern humans. MacDonald Institute Research Monograph series*: 123-132. Cambridge: University of Cambridge Press.

Henshilwood, C.S. 2008. *Holocene prehistory of the southern Cape, South Africa: Excavations at Blombos Cave and the Blombosfontein Nature Reserve. Cambridge Monographs in African Archaeology*: 75. Oxford: Archaeopress.

Hofmann, R.R. 1973. *The Ruminant Stomach: stomach structure and feeding habits of East African game ruminants. East African Monographs in Biology* 2. Nairobi: East African Literature Bureau.

Hofmann, R.R. 1989. Evolutionary steps of ecophysiological adaptation and diversification of ruminants: a comparative view of their digestive system. *Oecologia* 78(4): 443-457.

Hofmann, R.R., Knight, M.H. & Skinner, J.D. 1995. On structural characteristics and morphophysiological adaptation of the springbok (*Antidorcas marsupialis*) digestive system. *Transactions of the Royal Society of South Africa* 50(2): 125–142.

Holmgren, K., Lee-Thorp, J., Cooper, G., Lundblad, K., Partridge, T.C., Scott, L., Sithaldeen, R., Talma, A.S. & Tyson, P.D. 2003. Persistent millennial-scale climatic variability over the past 25 thousand years in southern Africa. *Quaternary Science Reviews* 22(21-22): 2311–2326.

Howard, P.C. 1986. Habitat preferences of common reedbuck on farmland. *South African Journal of Wildlife* 16(3): 99-108.

Huffman, T.N. 2000. Mapungubwe and the origins of the Zimbabwe Culture. *Goodwin Series* 8: 14–29.

Hutson, J.M. & Cain, C.R. 2008. Reanalysis and reinterpretation of the Kalkbank faunal accumulation, Limpopo Province, South Africa. *Journal of Taphonomy* 6(3-4): 399-428.

Ingold, T. 1980. *Hunters, Pastoralists and Ranchers: reindeer economies and their transformations*. Cambridge: Cambridge University Press.

Irby, L.R. 1976a. *The ecology of mountain reedbuck in southern and eastern Africa*. Ph.D. Thesis, Texas A & M University.

Irby, L.R. 1976b. A note on mountain reedbuck *Redunca fulvorufula fulvorufula* Afzelius in the Kruger National Park. *Koedoe* 19(1): 63–66.

Irby, L.R. 1977. Studies on mountain reedbuck populations with special reference to Loskop Dam Nature Reserve. *South African Journal of Wildlife Research* 7(2): 73–86.

Johnson, E. 1985. Current developments in bone technology. *Advances in Archaeological Method and Theory* 8: 157–235.

Jones, J.J. 2010. Accounting for the environment: towards a theoretical perspective for environmental accounting and reporting. *Accounting Forum* 34(2): 123-138.

Jones, M., Kapumha, R., Chirikure, S. & Marshall, F. 2023. Hunting and the social lives of southern Africa's First Farmers. *Journal of Archaeological Research* 32: 597-636.

Jungius, H. 1971. *The Biology and Behaviours of the Reedbuck (Reunca arundium, Baddaert 1785) in the Kruger National Park*. Mammalia Depicta. Hamburg: Verland Paul Parey.

Kelly, R.J. 2007. *The Foraging Spectrum: diversity in hunter-gatherer lifeways*. ISD.

Kibblewhite, M., Tóth, G. & Hermann, T. 2015. Predicting the preservation of cultural artefacts and buried materials in soil. *Science of the Total Environment* 529: 249-263.

Kinahan, J. 2019. The origins and spread of pastoralism in southern Africa. *Oxford Research Encyclopedia of African History*. https://doi.org/10.1093/acrefore/9780190277734.013.678

Kitchener, A.C., Hoffmann, M., Yamaguchi, N., Breitenmoser-Würsten, C. & Wilting, A. 2022. A system for designating taxonomic certainty in mammals and other taxa. *Mammalian Biology* 102: 251-261.

Keane, A.H. 1900. *The Boer States: land and people*. London: Methuen & Company.

Keegan, T. 1987. Dispossession and accumulation in the South African interior: the Boers and the Tlhaping of Bethulie, 1833–61. *The Journal of African History* 28(2): 191-207.

Klein, R.G. 1972. The Late Quaternary mammalian fauna of Nelson Bay Cave (Cape Province, South Africa): its implications for megafaunal extinctions and environmental and cultural change. *Quaternary Research* 2(2): 135-142.

Klein, R.G. 1976. The mammalian fauna of the Klasies River Mouth sites, southern Cape Province, South Africa. *South African Archaeological Bulletin* 31(123-124): 75-98.

Klein, R.G. 1977. The mammalian fauna from the Middle and Later Stone Age (Later Pleistocene) levels of Border Cave, Natal Province, South Africa. *South African Archaeological Bulletin* 32(125): 14-27.

Klein, R.G. 1979. Palaeoenvironmental and cultural implications of the late Holocene archaeological faunas from Orange Free State and north-central Cape Province, South Africa. *South African Archaeological Bulletin* 34(129): 34-49.

Klein, R.G. 1980. Environmental and ecological implications of large mammals from Upper Pleistocene and Holocene sites in southern Africa. *Annals of the South African Museum* 81(7): 223- 283.

Klein, R.G. 1984. Later Stone Age faunal samples from Heuningneskrans Shelter (Transvaal) and Leopard's Hill Cave (Zambia). *The South African Archaeological Bulletin* 39(140): 109-116.

Klein, R.G. & Cruz-Uribe, K. 1984. *The Analysis of Animal Bones from Archaeological Sites*. Chicago: University of Chicago Press.

Klein, R.G. & Cruz-Uribe, K. 1996. Exploitation of large bovids and seals at Middle and Later Stone Age sites in South Africa. *Journal of Human Evolution* 31(4): 315-334.

Klein, R.G. & Cruz-Uribe, K., Halkett, D., Hart, T. & Parkington, J.E. 1999. Paleoenvironmental and human behavioural implications of the Boegoeberg 1 late Pleistocene hyena den, Northern Cape Province, South Africa. *Quaternary Research* 52(3): 393-403.

Klingel, H. 1991. The social organization and behaviour of *Hippopotamous amphibiu*s. *African Wildlife: research and management*: 73-75.

Korsman, S.A. 1990. *A reconstruction of the Later Stone Age on the farm Honingklip in the Eastern Transvaal*. MA dissertation. Pretoria: University of Pretoria.

Korsman, S.A. & Plug, I. 1992. Archaeological evidence and ethnographic analogy: interpreting prehistoric social behaviour at Honingklip in the Eastern Transvaal. *South African Journal of Ethnology* 15(4): 120-126.

Korsman, S. & Plug, I. 1994. Two Later Stone Age Sites on the Farm Honingklip in the Eastern Transvaal. *The South African Archaeological Bulletin* 49(159): 24-32.

Kuhn, B., Werdelin, L., Hartstone-Rose, A., Lacruz, R. & Berger, L. 2011. Carnivoran remains from the Malapa Hominin Site, South Africa. *PloS One*: 6(11): e26940.

Lander, F. & Russell, T. 2018. The archaeological evidence for the appearance of pastoralism and farming in southern Africa. *PLoS One* 13(6): e0198941.

Langemann, E.G. 2004. Zooarchaeological research in support of reintroduction of bison to Banff National Park, Canada. In: R.C.G.M. Lauwerier & I. Plug (eds) *The Future from the Past: Archaeozoology in wildlife conservation and heritage management*: 79-89. Oxford: Oxbow Books.

Lewis-Williams, D. 1984. Ideological continuities in prehistoric southern Africa. In: C. Schrire (ed.) *Past and Present in Hunter-Gatherer Studies*: 225-252. Orlando: Academic Press.

Lease, H.M., Murray, I.W., Fuller, A. & Hetem, R.S. 2014. Black wildebeest seek shade less and use solar orientation behavior more than do blue wildebeest. *Journal of Thermal Biology* 45: 150-156.

Lombard, M. & Phillipson, L. 2010. Indications of bow and stone-tipped arrow use 64 000 years ago in KwaZulu-Natal, South Africa. *Antiquity* 84(325): 635-648.

Lombard, M., Lotter, M. G. & Caruana, M. V. 2021. Wonderboompoort, South Africa: A natural game funnel for meat harvesting during the later Acheulean. *Journal of Archaeological Science*: *Reports*: 39:103193.

Lombard, M., Bradfield, J., Caruana, M. V., Makhubela, T. V., Dusseldorp, G. L., Kramers, J. D. & Wurz, S. 2022. The Southern African Stone Age sequence updated (II). *South African Archaeological Bulletin* 77(217): 172-212.

Lyman, R.L. 1987. Archaeofaunas and butchery studies: a taphonomic perspective. *Advances in Archaeological Method and Theory* 10: 249-337.

Lyman, R.L. 1994. *Vertebrate Taphonomy*. Cambridge University Press.

Lyman, R.L. 1995. Determining when rare (zoo-) archaeological phenomena are truly absent. *Journal of Archaeological Method and Theory* 2: 369-424.

Lyman, R.L. 2008. *Quantitative Palaeozoology*. Cambridge: Cambridge University Press.

Lyman, R.L. 2017. Paleoenvironmental reconstruction from faunal remains: ecological basics and analytical assumptions. *Journal of Archaeological Research* 25: 315-371.

Lupo, K. 2001. Archaeological skeletal part profiles and differential transport: an ethnoarchaeological example from Hadza bone assemblages. *Journal of Anthropological Archaeology* 20(3): 361-378.

Lupo, K.D. 2006. What explains the carcass field processing & transport decisions of contemporary hunter-gatherers? Measures of economic anatomy and zooarchaeological skeletal part representation. *Journal of Archaeological Method & Theory* 13(1): 19-66.

MacArthur, R. & Pianka, E. 1966. On the optimal use of a patchy environment. *American Naturalist* 100(916): 603-609.

Maggs, T.M. 1980. The Iron Age sequence south of the Vaal and Pongola Rivers: some historical implications. *Journal of African History* 21(1): 1-15.

Maggs, T. 2008. The Mpumalanga Escarpment settlements: some answers, many questions. In: N. Swanepoel, A. Esterhuysen & P. Bonner. *Five Hundred Years Rediscovered: southern African precedents and prospects*: 169-181. Johannesburg: Wits University Press.

Mashaba, P.N., Myburgh, W.J. & Panagos, M.D. 2025. Spatio-temporal changes in the riparian vegetation associated with the Grassland Biome section of the Olifants River, Mpumalanga, South Africa. *Water SA* 51(3): 215-227.

Makhura, T. 2007. Early inhabitants. In: P. Delius (ed.), *Mpumalanga History and Heritage*: 111-115. Pietermaritzburg: Natal University Press.

Manyanga, M. & Pangeti, G. 2017. Precolonial hunting in southern Africa: a changing paradigm. In: M. Manyanga & S. Chirikure (eds) *Archives, Objects, Places and Landscapes: multidisciplinary approaches to decolonised Zimbabwean pasts*: 277-294. Mankon: Langaa Research & Publishing CIG.

Marean, C.W. 1991. Measuring the post-depositional destruction of bone in archaeological assemblages. *Journal of Archaeological Science* 18(6): 677-694.

Marean, C.W. & Spencer, L.M. 1991. Impact of carnivore ravaging on zooarchaeological measures of element abundance. *American Antiquity* 56(4): 645-658.

Marean, C.W. 1998. A critique of the evidence for scavenging by Neanderthals and early modern humans: new data from Kobeh Cave (Zagros Mountains, Iran) and Die Kelders Cave 1 Layer 10 (South Africa). *Journal of Human Evolution* 35(2): 111-136.

Marean, C.W., Abe, Y., Frey, C.J. & Randall, R.C. 2000. Zooarchaeological and taphonomic analysis of the Die Kelders Cave 1 Layers 10 and 11 Middle Stone Age larger mammal fauna. *Journal of Human Evolution* 38(1): 197-233.

Marean, C.W. & Cleghorn, N. 2003. Large mammal skeletal element transport: applying foraging theory in a complex taphonomic system. *Journal of Taphonomy* 1(1): 15-42.

Marean, C.W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A.I.R., Jacobs, Z., Jerardino, A., Karkanas, P., Minichillo, T., Nilssen, P.J., Thompson, E., Watts, I. & Williams, H.M. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* 449: 905-908.

Marker, M.E. & Evers, T.M. 1976. Iron Age settlement and soil erosion in the Eastern Transvaal, South Africa. *South African Archaeological Bulletin* 31(123/124): 153-165.

Martin, R.E. 1999. *Taphonomy: a process approach.* Cambridge: Cambridge University Press.

Melton, D.A. 1978. *Ecology of waterbuck Kobus ellipsiprymnus (Ogilby, 1833) in the Umfolozi Game Reserve.* D.Sc. Thesis, University of Pretoria.

Mitchell, P.J. 2000. The organization of Later Stone Age lithic technology in the Caledon Valley, southern Africa. *African Archaeological Review* 17: 141-176.

Mitchell, P.J. 2002. *The Archaeology of Southern Africa*. Cambridge: Cambridge University Press.

Mitchell, P. 2014. The canine connection II: dogs and southern African herders. *Southern African Humanities* 26(1): 1-19.

Monahan, C.M. 1995. New zooarchaeological data from Bed II, Olduvai Gorge, Tanzania: implications for hominid behaviour in the Early Pleistocene. *Journal of Human Evolution* 31(2): 93-128.

Moraitis, K. & Spiliopoulou, C. 2010. Forensic implications of carnivore scavenging on human remains recovered from outdoor locations in Greece. *Journal of Forensic and Legal Medicine* 17(6): 298-303.

Mucina, L. & Rutherford, M.C. 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. Pretoria: South African National Biodiversity Institute.

Muller, W. 2013. Species list for Nooitgedachtdam. Unpublished report.

Nagaoka, L. 2015. Differential carnivore damage as a potential indicator of resource availability and foraging efficiency. *Journal of Archaeological Method and Theory* 22: 828-856.

Nagy, K.A. & Knight, M.H. 1994. Energy, water, and food use by springbok antelope (*Antidorcas marsupialis*) in the Kalahari Desert. *Journal of Mammalogy* 75(4): 860-872.

Nanarvati, W., Whitlock, C., de Porras, M.E., Gil, A., Navarro, D. & Neme, G. 2022. Disentangling the last 1000 years of human-environment interactions along the eastern side of the southern Andes (34-52°S lat.). *Proceedings of the National Academy of Sciences of the United States of America* 119(9): e2119813119.

Nel, J. & Karodia, L. 2013. *Heritage Impact Assessment Report, Kangra Coal*. Johannesburg: Digby Wells.

Newsom, L.A. & Wing, E.S. 2004. *On Land and Sea: Native American uses of biological resources in the West Indies*. Tuscaloosa: University of Alabama Press.

Nicholson, R.A. 1993. A morphological investigation of burnt animal bone and on evolution of its utility in archaeology. *Journal of Archaeological Science* 20(4): 411-428.

Noe-Nygaard, N. 1989. Man-made trace fossils on bone. *Human Evolution* 4(6): 461-491.

Nord, A., Tronner, K., Mattsson, E., Borg, G. & Ullén, I. 2005. Environmental threats to buried archaeological remains. *Ambio* 34(3): 256-62.

Norström, E.S., Scott, L., Partridge, T.C., Risberg, J. & Holmgren, K. 2009. Reconstruction of environmental and climate changes at Braamhoek wetland, eastern escarpment South Africa, during the last 16,000 years with emphasis on the Pleistocene-Holocene transition. *Palaeogeography, Palaeoclimatology, Palaeoecology* 271(3-4): 240-258.

Novellie, P.A 1975. *Comparative social behaviour of springbok, Antidorcas m. marsupials and blesbok on the Jack Scott Nature Reserve, Transvaal*. M.Sc. Thesis, University of Pretoria.

O'Connell, J.F., Hawkes, K. and Jones, N.B., 1988. Hadza hunting, butchering, and bone transport and their archaeological implications. *Journal of Anthropological Research* 44(2): 113-161.

O'Connell, J.F., Hawkes, K. & Jones, N.B. 1990. Reanalysis of large mammal body part transport among the Hadza. *Journal of Archaeological Science* 17(3): 301-316.

O'Connor, T.P. 2000a. Zooarchaeology in southern Africa: a view from the north. In: S. Badenhorst, P. Mitchell & J.C. Driver (eds) *Animals and People: archaeozoological papers in honour of Ina Plug*: 8-15. Oxford: Archaeopress.

O'Connor, T.P. 2000b. *The Archaeology of Animal Bones.* Phoenix Mill: Sutton Publishing.

O'Connor, D.P. 2006. Imperial Strategy and the Anglo-Zulu War of 1879. *The Historian* 68(2): 285-304.

Olatoyan, J.O., Neumann, F. H., Orijemie, E. A., Sievers, C., Evans, M., Mvelase, S. & Schoeman, M.H. 2022. Archaeobotanical evidence for the emergence of pastoralism and farming in southern Africa. *Acta Palaeobotanica* 62(1): 50-75.

Oliff, W.D. 1963. Hydrobiological studies on the Tugela River system. *Hydrobiologia* 21(3): 355-379

Olsen, S. 1988. The identification of stone and metal tool marks on bone artefacts. In: S.L. Olsen (ed.) *Scanning Electron Microscopy in Archaeology*: 337-360. Oxford: British Archaeological Reports.

Orton, D. C. 2012. Taphonomy and interpretation: an analytical framework for social zooarchaeology. *International Journal of Osteoarchaeology* 22(3): 320- 337.

Outram, A.K. 2001. A new approach to identifying bone marrow and grease exploitation: why the "indeterminate" fragments should not be ignored. *Journal of Archaeological Science* 28(4): 401-410.

Outram, A.K., Knüsel, C.J., Knight, S. & Harding, A.F. 2005. Understanding complex fragmented assemblages of human and animal remains: a fully integrated approach. *Journal of Archaeological Science* 32(12): 1699-1710.

Owen-Smith, N. 1997. Distinctive features of the nutritional ecology of browsing versus grazing ruminants. *Zeitschrift Fur Saugetierkunde-International Journal of Mammalian Biology* 62: 176-191.

Owen-Smith, R.N. 2002. *Adaptive Herbivore Ecology: from resources to populations in variable environments*. Cambridge: Cambridge University Press.

Owen-Smith, N. 2007. The comparative population dynamics of browsing and grazing ungulates. In: I.J. Gordon & H.H.T. Prins (eds) *The Ecology of Browsing and Grazing*:149–177. Berlin: Springer.

Owen-Smith, N., Fryxell, J.M. & Merrill, E.H. 2010. Foraging theory upscaled: the behavioural ecology of herbivore movement. *Philosophical Transactions of the Royal Society: Biological Sciences* 365(1550): 2267-2278.

Owen-Smith, N. & Traill, L.W. 2017. Space use patterns of a large mammalian herbivore distinguished by activity state: fear versus food? *Journal of Zoology* 303(4): 281-290.

Pargeter, J. & Bradfield, J. 2012. The effects of class I & II sized bovids on microfracture formation and tool displacement: Results of a trampling experiment in southern African stone age context. *Journal of Field Archaeology* 37(3): 238-251.

Parker, K.L., Barboza, P.S. & Gillingham, M.P. 2009. Nutrition integrates environmental responses of ungulates. *Functional Ecology* 23: 57-69.

Partridge, T.C. & Maud, R.P. 1987. Geomorphic Evolution of Southern Africa since the Mesozoic. *South African Journal of Geology* 90: 179-208.

Peres, T.M. 2010. Methodological issues in zooarchaeology. In: A.M. VanDerwarker & T. Peres (ed) *Integrating Zooarchaeology and Paleoethnobotany: a consideration of issues, methods, and cases*: 15-36. New York: Springer.

Phelps, L.N., Broennimann, O., Manning, K., Timpson, A., Jousse, H., Mariethoz, G., Fordham, D.A., Shanahan, T.M., Davis, B.A.S. & Guisan, A. 2020. Reconstructing the climatic niche breadth of land use for animal production during the African Holocene. *Global Ecology Biogeography* 29(1): 127-147.

Pickering, T.R. & Wallis, J. 1997. Bone modifications resulting from captive chimpanzee mastication: implications for the interpretation of Pliocene archaeological faunas. *Journal of Archaeological Science* 24(12): 1115-1127.

Pickering, T.R., Domínguez-Rodrigo, M., Egeland, C.P. and Brain, C.K. 2005. The contribution of limb bone fracture patterns to reconstructing early hominid behaviour at Swartkrans Cave (South Africa): archaeological application of a new analytical method. *International Journal of Osteoarchaeology* 15(4): 247-260.

Pickering, T.R., Egeland, C., Domínguez-Rodrigo, M., Brain C.K. & Schnell, A. 2008. Testing the "shift in the balance of power" hypothesis at Swartkrans, South Africa: Hominid cave use and subsistence behaviour in the Early Pleistocene. *Journal of Anthropological Archaeology* 27: 30-45.

Pickering, T.R., Domínguez-Rodrigo, M., Heaton, J.L., Yravedra, J., Barba, R., Bunn, H.T., Musiba, C., Baquedano, E., Diez-Martin, F., Mabulla, A. & Brain, C.K. 2013. Taphonomy of ungulate ribs and the consumption of meat and bones by 1.2-million-year-old hominins at Olduvai Gorge, Tanzania. *Journal of Archaeological Science* 40(2): 1295-1309.

Pires, M.M., Rindel, D., Moscardi, B., Cruz, L.R., Guimarães Jr, P.R., dos Reis, S.F. & Perez, S.I. 2010. Before, during and after megafaunal extinctions: Human impact on Pleistocene-Holocene tophic networks in south Patagonia. *Quaternary Science Reviews* 250: 106696.

Plug, C. & Plug, I. 1990. MNI counts as estimates of species abundance. *South African Archaeological Bulletin* 45(151): 53-57.

Plug, I. & Engela, R. 1992. The macrofaunal remains from recent excavations at Rose Cottage cave, Orange Free State. *South African Archaeological Bulletin* 47(155): 16-25.

Plug, I. 1997. Late Pleistocene and Holocene hunter–gatherers in the Eastern Highlands of South Africa and Lesotho: a faunal interpretation. *Journal of Archaeological Science* 24(8): 715-727.

Plug, I. & Badenhorst, S. 2001. The distribution of macrornammals in Southern Africa over the past 30 000 Years: as reflected in animal remains from archaeological sites. Present and historical distributions of macromammals in southern Africa. Order - Artiodactyla. *Transvaal Museum Monographs* 12.

Plug, I. & Badenhorst, S. 2010. Ethnography and southern African archaeozoology. In: J. Peters (ed.) *Ethnoarchaeozoology*: 187-201. Documenta Archaeobiologiae 7. Rahden/Westf: Verlag Marie Leidorf.

Plug, I. 2017. Middle and Later Stone Age hunters and their prey in southern Africa. In: U. Albarella, M. Riozzeto, H. Russ, K. Vickers. & S. Viner-Daniels (eds) *The Oxford Handbook of Zooarchaeology*: 385-395. Oxford: Oxford University Press.

Pobiner, B. 2015. New atonalistic data on ecology and energetics of hominin scavenging opportunities. *Journal of Human Evolution* 80: 1-16.

Porraz, G., & Val, A., Dayet, L., Peña, P., Douze, K., Miller, C., Murungi, M., Tribolo, C., Schmid, V.C. & Sievers, C. 2015. Bushman Rock Shelter (Limpopo, South Africa): A perspective from the edge of the Highveld. *The South African Archaeological Bulletin* 70(202): 166-179.

Potgieter, E.F. 1955. *The Disappearing Bushmen of Lake Chrissie: a preliminary survey*. Pretoria: J.L. Van Schalk, Limited.

Potts, R.B. & Shipman, P. 1981. Cut marks made by stone tools on bones from Olduvai Gorge, Tanzania. *Nature* 291(5816): 577-580.

Pretorius, F. 2012. The Second Anglo-Boer War: an Overview. *Scientia Militaria: South African Journal of Military Studies* 30(2): 111-125.

Prins, H.H. & Van Langevelde, F. 2008. Assembling a diet from different places. In: H.H.T. Prins & F.Van Langevelde, F. (eds) *Resource Ecology*: 129-155. Springer, Dordrecht.

Prinsloo, H., Reilly, B. & Myburgh, W. 2021. Identifying potential protected areas in the Grassland Biome of South Africa. *South African Journal of Science* 117(3-4): 1-6.

Pwiti, G. 1991. Trade and economies in Southern Africa: the archaeological evidence. *Zambezia XVIII* (ii): 119–129.

Reitz, E. J., & Wing, E. S. 2008. Zooarchaeology (2nd ed.). Cambridge: Cambridge University Press.

Reynard, J.P., Badenhorst, S. & Henshilwood, C.S. 2014. Inferring animal size from the unidentified long bones from Middle Stone Age layers at Blombos Cave, South Africa. *Annals of the Ditsong National Museum of Natural History* 4(1): 9-25.

Reynard, J.P., Discamps, E., Wurz, S., van Niekerk, K.L. & Henshilwood, C.S. 2016a. Occupational intensity and environmental changes during the Howiesons Poort at Klipdrift Shelter, southern Cape, South Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology* 449: 349-364.

Reynard, J.P., Discamps, E., Badenhorst, S., van Niekerk, K. & Henshilwood, C.S. 2016b. Subsistence strategies in the southern Cape during the Howiesons Poort: Taphonomic and zooarchaeological analyses of Klipdrift Shelter, South Africa. *Quaternary International* 404 (Part B): 2-19.

Reynard, J.P. and Henshilwood, C.S. 2017. Subsistence strategies during the late Pleistocene in the Southern Cape of South Africa: comparing the Still Bay of Blombos Cave with the Howiesons Poort of Klipdrift shelter. *Journal of Human Evolution* 108: 110-130.

Reynard, J.P. 2021. Paradise lost: large mammal remains as proxy for environmental change from MIS 6 to the Holocene in southern Africa. *Southern African Journal of Geology* 124 (4): 1055-1072.

Reynard, J.P., Pearson, A., Akuku, P. & Sarah Wurz. 2024. Taphonomic and zooarchaeological analysis of fauna from the Howiesons Poort and post-Howiesons Poort at Klasies River main site: Examining links between the environment and subsistence behaviour in Marine Isotope Stages 4 and 3. *Quaternary Science Advances* 15: 100220.

Roque, A.C. 2017. The Sofala Coast (Mozambique) in the 16th Century: between the African trade routes and Indian Ocean trade. In: I. Walker, M.J. Ramos, & P. Kaarsholm (eds) *Fluid Networks and Hegemonic Powers in the Western Indian Ocean*: 21-35. Lisbon: Centro de Estudos Internacionais.

Rowe-Rowe, D.T. 1994. *The Ungulates of Natal*. Pietermaritzburg: Natal Parks Board.

Rowe, C. 2009. *Heritage management of archaeological, historical and industrial resources on the Blyde River Canyon Nature Reserve.* MA dissertation, University of Pretoria.

Sadr, K. 2008. Invisible Herders? The archaeology of Khoe Khoe pastoralists. *Southern African Humanities* 20(1): 179-203.

Sadr, K. 2013. A short history of early herding in southern Africa. In: M. Bollig, M. Schnegg, & H-P. Wotzka (eds) *Pastoralism in Africa: Past, Present and Futures*: 171-197. New York & Oxford: Berghahn Books.

Sadr, K. 2015. Livestock first reached southern Africa in two separate events. *PLoS One* 10(8): e0134215.

Saladié, P., Huguet, R., Díez, C., Rodríguez-Hidalgo, A., Cáceres, I., Vallverdú, J., Rosell, J., María Bermúdez de Castro, J. & Carbonell, E. 2011. Carcass transport decisions in *Homo antecessor* subsistence strategies. *Journal of Human Evolution* 61(4): 425-446.

Sánchez-Hernández, C., Gourichon, L., Soler, J., Soler, N., Blasco, R., Rosell, J. & Rivals, F. 2020. Dietary traits of ungulates in northeastern Iberian Peninsula: did these Neanderthal preys show adaptive behaviour to local habitats during the Middle Palaeolithic? *Quaternary International* 557: 47-62.

Schiffer, M.B. 1987. *Formation Processes of the Archaeological Record*. Albuquerque: University of New Mexico Press.

Schlebusch, C.M., Prins, F., Lombard, M., Jakobsson, M. & Soodyall, H. 2016. The disappearing San of southeastern Africa and their genetic affinities. *Human Genetics* 135: 1365-1373.

Schoeman, A. 2020. Archaeology of Farming Communities in Mpumalanga Province and the Adjacent Lowveld in Northeastern South Africa. *Oxford Research Encyclopaedia of African History. https://doi.org/10.1093/acrefore/9780190277734.013.767*

Schoeman, A. 2024. Stone by stone: Women's quotidian farm labor and the construction of the Khutwaneng farmscape in Bokoni, South Africa. In: M. McLeester & J. Casana (eds) Finding fields: The archaeology of agricultural landscapes. *Archaeological Papers of the American Anthropological Association* 35: 13-27.

Schoonraad, M. & Beaumont, P. 1971. The Welgelegen Shelter, Eastern Transvaal. Supplement to the *South African Journal of Science* Special Edition 2: 62-69.

Schoville, B.J. & Otárola-Castillo, E. 2014. A model of hunter-gatherer skeletal element transport: the effect of prey body size, carriers, and distance. *Journal of Human Evolution* 73: 1-14.

Selvaggio, M.M. 1994. Carnivore tooth marks and stone tool butchery marks on scavenged bones: archaeological implications. *Journal of Human Evolution* 27: 215-228.

Selvaggio, M.M. & Wilder, J. 2001. Identifying the involvement of multiple carnivore taxa with archaeological bone assemblages. *Journal of Archaeological Science* 28(5): 465-470.

Seleti, Y. 2017. Book 3: Migration, land and minerals in the making of South Africa - Chapter 1 - State formation in nineteenth-century South Africa. South African History Online. Retrieved from: https://sahistory.org.za/archive/book-3-migration-land-and-minerals-making-south-africa-chapter-1-state-formation-nineteenth

Seroto, Johannes. (2019). The Embodiment of the Indigenous People by European Travel Writers at the Cape Colony, Southern Africa. *Education as Change* 23(1): 1-24.

Shipley, L.A. 1999. Grazers and browsers: how digestive morphology affects diet selection. *Grazing behavior of livestock and wildlife* 70: 20-27.

Sherwood, N.L. & Forssman, T. 2024. Social implications of archaeology at Little Muck Shelter during the contact period: 150-1300 CE. *Koedoe: African Protected area Conservation and Science* 66(2).

Shipman, P. 1981. *Life History of a Fossil: an introduction to taphonomy and paleoecology*. Cambridge: Harvard University Press.

Shipman, P. 1986. Scavenging or hunting in early hominids: theoretical framework and tests. *American Anthropologist* 88(1): 27-43.

Shipman, P. & Rose, J. 1983. Early hominid hunting, butchery, and carcass-processing behaviours:Approaches to the fossil record. *Journal of Anthropological Archaeology* 2(1): 57-98.

Shipman, P. & Rose, J. 1984. Cutmark mimics on modern and fossil bovid bones. *Current Anthropology* 25(1): 116-116.

Shotwell, J.A 1958. Inter-community relationships in Hemphillian (Mid-Pliocene) mammals. *Ecology* 39(2): 271-282.

Skinner, J.D. & Chimimba, C.T. 2005. *The Mammals of the Southern African Sub-region*. Cambridge: Cambridge University Press.

Sjöström, J. 2013. *Late Holocene palaeoenvironmental reconstruction on a peat sequence from northeastern South Africa, using grass phytoliths as main proxy*. Unpublished Master's Thesis, Stockholm University.

Sjöström, J., Norström, E., Risberg, J. & Schoeman, M.H. 2017. Late Holocene paleoenvironmental reconstruction from Mpumalanga Province (South Africa) inferred from geochemical and biogenic proxies. *Review of Palaeobotany and Palynology* 246: 264-277.

Smith, A.B. 1992. Origins and spread of pastoralism in Africa. *Annual Review of Anthropology* 21: 125-141.

Smith, G.M., Ruebens, K., Gaudzinski-Windheuser, S. & Steele, T.E. 2019. Subsistence strategies throughout the African Middle Pleistocene: faunal evidence for behavioral change and continuity across the Earlier to Middle Stone Age transition. *Journal of Human Evolution*: 127: 1-20.

Spies, K.S. 2015. *Ecology of impala (Aepyceros Melampus) and waterbuck (Kobus ellipsiprymnus) in Majele Wildlife Reserve, Malawi.* MSc dissertation, Stellenbosch University.

Stiner, M.C., Kuhn, S.L., Weiner, S. & Bar-Yosef, O. 1995. Differential burning, recrystallization, and fragmentation of archaeological bone. *Journal of Archaeological Science* 22(2): 223-237.

Stiner, M.C. & Munro, N. & Surovell, T. 2000. The tortoise and the hare: small-game use, the Broad-Spectrum Revolution, and Paleolithic demography. *Current Anthropology* 41(1): 39-73.

Stiner, M.C. & Munro, N.D. 2002. Approaches to prehistoric diet breadth, demography, and prey ranking systems in time and space. *Journal of Archaeological Method and Theory* 9(2): 181-214.

Sykes, N. 2004. The introduction of fallow deer to Britain: a zooarchaeological perspective. *Environmental Archaeology* 9(1): 75-83.

Taylor, C.R. 1969. The eland and the oryx. *Scientific American* 220: 89-97.

Taylor, C.R., Spinage, C.A. & Lyman, C.P. 1969. Water relations of the waterbuck, an East African antelope. *American Journal of Physiology* 217(2): 630-634.

Thackeray, J.F. 2007. Hominids and carnivores at Kromdraai and other Quaternary sites in southern Africa. In: Pickering, T.R., Toth, N. & K. Schick (eds) *Breathing Life into Fossils: taphonomic studies in honor of C.K. (Bob) Brain*: 67-73. Bloomington: Stone Age Institute Press.

Thompson, L. 2001. *A History of South Africa. Revised Edition*. New Haven: Yale University Press.

Thompson, J.C. 2010. Taphonomic analysis of the Middle Stone Age faunal assemblage from Pinnacle Point Cave 13B, Western Cape, South Africa. *Journal of Human Evolution* 59(3-4): 321-339.

Thompson, J.C. & Henshilwood, C.S. 2011. Taphonomic analysis of the Middle Stone Age larger mammal faunal assemblage from Blombos Cave, southern Cape, South Africa. *Journal of Human Evolution* 60(6): 746-767.

Thompson, J.C., Faith, J.T., Cleghorn, N. & Hodgkins, J. 2017. Identifying the accumulator: making the most of bone surface modification data. *Journal of Archaeological Science* 85: 105-113.

Thompson, J.C., Carvalho, S., Marean, C.W. & Alemseged, Z. 2019. Origins of the human predatory pattern: the transition to large-animal exploitation by early Homins. *Current Anthropology* 60(1): 1-23.

Thompson, J.C. 2020. Faunal analysis in African archaeology. Oxford Research Encyclopedia of Anthropology. https://doi.org/10.1093/acrefore/9780190854584.013.44

Tomlinson, D.N.S. 1980. Seasonal food selection by waterbuck *Kobus ellipsiprymnus* in a Rhodesian Game Park. *South African Journal of Wildlife Research* 10(1): 22-28.

Todd, L. & Rapson, D. 1988. Long bone fragmentation and interpretation of faunal assemblages: approaches to comparative analysis. *Journal of Archaeological Science* 15(3): 307-325.

Toffolo MB. 2024. Pleistocene archaeology and environments of the Free State, South Africa. *Azania* 59(3): 317-351.

Turchin, P. 1996. Fractal analyses of animal movement: a critique. *Ecology* 77(7): 2086-2090.

Van Doornum, B. 2008. Sheltered from change: hunter-gatherer occupation of Balerno Main Shelter, Shashe-Limpopo confluence area, South Africa. *Southern African Humanities* 20(2):2 49-284.

Van Doornum, B. 2014. Balerno Shelter 3: A Later Stone Age site in the Shashe-Limpopo confluence area, South Africa. *Southern African Humanities* 26(1): 129-155.

Venter, J. 1979. *Ecology of the southern reebuck Redunca arundium Baddaert 1785, on the Eastern Shores of Lake St Lucia, Zululand*. M.Sc. Thesis, University of Natal.

Venter, J.A., Prins, H.H., Mashanova, A., de Boer, W.F. & Slotow, R. 2015. Intrinsic and extrinsic factors influencing large African herbivore movements. *Ecological Informatics* 30: 257-262.

Venter, J.A., Vermeulen, M.M. & Brooke, C.F. 2019. Feeding Ecology of Large Browsing and Grazing Herbivores. *Ecological Studies* 239: 127-153.

Verstaeten, G. 2014. Quantification of human-environment interactions in the past. *Anthropocene* 8: 1-5.

Villa, P. & Mahieu, E. 1991. Breakage patterns of human long bones. *Journal of Human Evolution* 21: 27-48.

Von Richter, W. 1971. Observations on the biology and ecology of the black wildebeest (*Connochaetes gnou*). *South African Journal of Wildlife Research* 1(1): 3-16.

Voigt, E.A. 1983. *Mapungubwe: an archaeozoological interpretation of an Iron Age community*. Transvaal Museum Monograph Number 1: Pretoria: Transvaal Museum.

Vrba, E.A. 1976. The significance of bovid remains as indicators of environmental and predation patterns. In: A.K. Behrenmeyer & A.P. Hill (eds) *Fossils in the Making*: 247-271. Chicago: University of Chicago Press.

Wadley, L. 1996. Changes in the social relations of precolonial hunter–gatherers after agropastoralist contact: an example from the Magaliesberg, South Africa. *Journal of Anthropological Archaeology* 15(2): 205-217.

Wadley, L. & Jacobs, Z. 2006. Sibudu Cave: background to the excavations, stratigraphy and dating. *Southern African Humanities* 18(1): 1-26.

Wadley, L. 2010. Were snares and traps used in the Middle Stone Age and does it matter? A review and a case study from Sibudu, South Africa. *Journal of Human Evolution* 58(2): 179-92.

Wadley, L., Antonites, A.R., Biemond, W., Hodgskiss, T., Jacobs, Z., Laue, G., Mauran, G., Sievers, C., Thorp, C. & Zwane, B. 2022. Late Holocene use of Kaingo Sheep Rock Shelter in the western Waterberg, Limpopo, South Africa. *Southern African Humanities* 35(1): 103-148.

Walker, P.L. & Long, J.C. 1977. An experimental study of morphological characteristics of tool marks. *American Antiquity* 42(4): 605-616.

Wanless, A. 2007. *The silence of colonial melancholy: The Fourie Collection of Khoisan ethnological collection.* PhD thesis, University of the Witwatersrand.

Webley, L. 1986. Pastoralist Ethnoarchaeology in Namaqualand. *Goodwin Series* 5:57-61.

Wells, L.H. 1962. Pleistocene faunas and the distribution of mammals in southern Africa. *Annals of the Cape Provincial Museums* 2: 37-40.

Western, D. 1975. Water availability & its influence on the structure & dynamics of a savannah large mammal community. *African Journal of Ecology* 13(3-4): 265-286.

Wilmsen, E.N., Denbow, J.R., Bicchieri, M.G., Binford, L.R., Gordon, R., Guenther, M., Lee, R.B., Ross, R., Solway, J.S., Tanaka, J. & Vansina, J. 1990. Paradigmatic history of San-speaking peoples and current attempts at revision [and comments and replies]. *Current Anthropology* 31(5): 489-524.

Wilson, D. E. 1975. *Factors affecting roan and sable antelope populations on nature reserves in the Transvaal with particular reference to ecophysiological aspects*. D.Sc. Thesis, University of Pretoria.

Winterhalder, B. 2001. The behavioural ecology of hunter-gatherers. In: C.Panter-Brick, R.H. Layton, P. Rowley-Conwy, & P. Rowley-Conwy (eds) *Hunter-gatherers: an interdisciplinary perspective*: 12-38. Cambridge: Cambridge University Press.

Winterhalder, B. & Goland, C. 1997. An evolutionary ecology perspective on diet choice, risk, and plant domestication. In: K.J. Gremillion (ed.) *People, Plants, and Landscapes: Studies in Paleoethnobotany*: 123-160. Tuscaloosa: University of Alabama Press.

Winterhalder, B. & Smith, E. 2000. Analyzing adaptive strategies: Human Behavioral Ecology at twenty-five. *Evolutionary Anthropology* 9: 51-72.

Woodborne, S., Hall, G., Gandiwa, P., Finch, J.M., Hill, T.R. & Baverstock, J. 2016. A high-resolution proxy rainfall record from isotopic analysis of trees from southern Africa. *Quaternary International* 404(Part B): 191.

Wright, T.M. & Hayes, W.C. 1977. Fracture mechanic parameters for compact bone-effects of density and specimen thickness. *Journal of Biomechanics* 10(7): 419-430.

Yan, H. & Liu, G. 2021. Fire's effects on grassland restoration and biodiversity conservation. *Sustainability* 13(21): 12016.

Yarnell, R.W., Scott, D.M., Chimimba, C.T. and Metcalfe, D.J. 2007. Untangling the roles of fire, grazing and rainfall on small mammal communities in grassland ecosystems. *Oecologia* 154(2): 387-402.

APPENDIXES

APPENDIX A:

Grassland biome vegetation (grass, tree and woodland).

	Species/Genus	**Reference**
Grasses	*Aristida, Eragrostis* and *Tristachya*	(Mucina & Rutherford 2006).
Trees	*Senegalia caffra, Celtis africana, Diospyros lycioides, Parinari capensis, Protea caffra, P. welwitschii* and *Rhus magalismontanum*	(Mucina & Rutherford 2006).
Woody	*Senegalia caffra, Celtis africana, Diospyros lycioide subsp lycioides, Parinari capensis, Protea caffra, P. welwitschia* and *Englerophytum magalismontanum*	(Mucina & Rutherford 2006).

APPENDIX B:

Mammal taxonomic list from the Welgelegen Shelter (Schoonraad & Beaumont 1971).

Common Name	Scientific Name/Genus	Feeder
Freshwater muscle	*Margaritifera margaritifera*	N/A
Cowrie	*Cypraeidae*	N/A
Barbel	*Barbus barbus*	N/A
Grey heron	*Ardea cinerea*	N/A
Rock pigeon	*Columba livia*	N/A
Ostrich	*Struthio*	N/A
Snake	*Serpentes (suborder)*	N/A
Field mouse	*Apodemus*	N/A
Hare	*Lepus*	N/A
Tortoise	*Geochelone*	N/A
Meerkat	*Suricata suricatta*	N/A
Wild cat	*	N/A
Wild hunting dog	*Lycaon pictus*	N/A
Porcupine	*Hystrix cristata*	N/A
Warthog	*Phacochoerus africanus*	N/A
Aardvark	*Orycteropus afer*	N/A
Impala	*Aepyceros melampus*	Mixed Feeder
Klipspringer	*Oreotragus oreotragus*	Browser
Springbok	*Antidorcas marsupialis*	Mixed Feeder
Brown duiker	*Sylvicapra grimmia*	Browser
Waterbuck	*Kobus ellipsiprymnus*	Grazer
Zebra	*Equus spp*	Grazer
Buffalo	*Syncerus caffer*	Grazer
Kudu	*Tragelaphus strepsiceros*	Browser

Ox	*Bos taurus*	Grazer

APPENDIX C:

Mammal taxonomic list from Border Cave and their feeding types (Klein 1977).

Common Name	Scientific Name/Genus	Feeder
Steenbok	*Raphicerus campestris*	Browser
Oribi	*Ourebia ourebi*	Grazer
Klipspringer	*Oreotragus oreotragus*	Browser
Mountain reedbuck	*Redunca fulvorufula*	Grazer
Waterbuck	*Kobus ellipsiprymnus*	Grazer
Roan/Sable	*Hippotragus equinus* *Hippotragus niger*	Mixed Feeder
Impala	*Aepyceros melampus*	Mixed Feeder
Blesbok	*Damaliscus pygargus phillipsi*	Grazer
Hartebeest	*Alcelaphus buselaphus*	Mixed Feeder
Wildebeest	*Connochaetes taurinus* *Connochaetes gnou*	Grazer
Bonds springbok	*Antidorcas bondi*	Mixed Feeder
Kudu	*Tragelaphus strepsiceros*	Browser
Nyala	*Tragelaphus angasii*	Browser
Bushbuck	*Tragelaphus scriptus* *Tragelaphus sylvaticus*	Browser
Eland	*Taurotragus oryx*	Browser
Cape buffalo	*Syncerus caffer*	Grazer
Sheep/goat	*Ovis aries* *Capra hircus*	N/A
Hare	*Lepus spp.*	N/A
Porcupine	*Hystrix africaeaustralis*	N/A
Zebra	*Equus spp*	Grazer

APPENDIX D:

Mammal taxonomic list from Bushman Rock Shelter and their feeding types (Badenhorst & Plug 2012).

Common Name	Scientific Name/Genus	Feeder
Zebra	*Equus spp.*	Grazer
Reedbuck	*Redunca spp.*	Grazer
Warthog	*Phacochoerus africanus*	N/A
Hartebeest	*Alcelaphus buselaphus*	Mixed Feeder
Wildebeest	*Connochaetes taurinus* *Connochaetes gnou*	Grazer
Impala	*Aepyceros melampus*	Mixed Feeder
Kudu	*Tragelaphus strepsiceros*	Browser
Sable	*Hippotragus niger*	Mixed Feeder
Duiker	*Sylvicapra grimmia*	Browser
Steenbok	*Raphicerus campestris*	Browser
Tsessebe	*Damaliscus lunatus*	Grazer
Rhino	*Rhinocerotidae*	Browser
Cape horse	*Equus ferus caballus*	N/A
Hippo	*Hippopotamus amphibius*	Grazer
Klipspringer	*Oreotragus oreotragus*	Browser
Buffalo	*Syncerus caffer*	Grazer
Fish	N/A	N/A
Freshwater crab	*Potamonautes spp.*	N/A

APPENDIX E:

Mammal taxonomic list from Honingklip (Kormsan & Plug 1992).

Common Name	**Scientific Name/Genus**	**Feeder**
Giraffe	*Giraffa camelopardalis*	Browser
Eland	*Taurotragus oryx*	Browser

APPENDIX F:

Mammal taxonomic list from Heuningneskrans (Klein 1984).

Common name	Scientific Name/Genus	Feeder
Porcupine	*Hystrix africaeaustralis*	N/A
Baboon	*Papio spp.*	N/A
Hare	*Lepus spp.*	N/A
Jackal/dog	*Lupulella mesomelas* *Lycaon pictus*	N/A
Brown hyena	*Parahyaena brunnea*	N/A
Lion	*Panthera leo*	N/A
Aardvark	*Orycteropus afer*	N/A
Rock hyrax	*Procavia capensis*	N/A
Burchell's zebra	*Equus quagga burchellii*	Grazer
Springbok	*Antidorcas marsupialis*	Mixed Feeder
Duiker	*Sylvicapra grimmia*	Browser
Cape buffalo	*Syncerus caffer*	Grazer
Hippo	*Hippopotamus amphibius*	Grazer
Warthog	*Phacochoerus africanus*	N/A
Bushpig	*Potamochoerus larvatus*	N/A
Kudu	*Tragelaphus strepsiceros*	Browser
Roan/Sable	*Hippotragus equinus* *Hippotragus niger*	Grazer
Ribbok	*Pelea capreolus*	Mixed Feeder
Hartebeest	*Alcelaphus buselaphus*	Grazer
Tsessebe	*Damaliscus lunatus*	Grazer
Impala	*Aepyceros melampus*	Mixed Feeder
Bonds springbok	Antidorcas bondi	Mixed Feeder
Klipspringer	*Oreotragus oreotragus*	Browser

APPENDIX G:

Mammal taxonomic list for Nooitgedachtdam Nature Reserve (Muller 2013). Nooitgedachtdam is approximately 37.33km away from the Welgelegen Shelter.

Common Name	Scientific Name/Genus	Feeder
Forest shrew	*Myosorex varius*	N/A
South African hedgehog	*Atelerix frontalis*	N/A
Scrub hare / Savannah hare Savannah hare	*Lepus saxatilis* *Lepus victoriae*	N/A
Cape hare / Desert hare Desert hare	*Lepus capensis* *Lepus tibetanus*	N/A
Porcupine Porcupine	*Hystrix africaeaustralis* *Hystricidae*	N/A
Vlei rat	*Otomys irroratus*	N/A
Striped mouse	*Rhabdomys pumilio*	N/A
House mouse	*Mus musculus*	N/A
Pygmy mouse	*Mus minutoides*	N/A
Natal multimammate mouse	*Mastomys natalensis*	N/A
Namaqua rock mouse Namaqua rock mouse	*Aethomys namaquensis* *Micealamys namaquensis*	N/A
Aardwolf Aardwolf	*Proteles cristatus* *Proteles cristata*	N/A
Caracal	*Felis caracal*	N/A
African wild cat	*Felis silvestris*	N/A
African wild cat	*Felis lybica*	N/A
Cape fox / Silver fox	*Vulpes chama*	N/A
Black backed jackal	*Lupulella mesomelas*	N/A
Serval	*Leptailurus serval*	N/A
Cape clawless otter	*Aonyx capensis*	N/A
Spotted necked otter	*Hydrictis maculicollis*	N/A
Large spotted genet	*Genetta tigrina*	N/A
Suricate	*Suricata suricatta*	N/A
Yellow mongoose	*Cynictis penicillata*	N/A
Slender mongoose	*Galerella sanguinea*	N/A
White tailed mongoose	*Ichneumia albicauda*	N/A
Water mongoose / Marsh m	*Atilax paludinosus*	N/A
Aardvark	*Orycteropus afer*	N/A
Rock dassie	*Procavia capensis*	N/A
Burchell zebra Zebra	*Equus burchelli* *Equid quagga*	Grazer
Bushpig	*Potamochoerus porcus*	N/A
Black wildebeest	*Connochaetes gnou*	Grazer

Red hartebeest	*Alcelaphus buselaphus*	Mixed Feeder
Blesbok Blesbok	*Damaliscus dorcas phillipsi* *Damaliscus pygargus*	Grazer
Common duiker	*Sylvicapra grimmia*	Browser
Springbuck	*Antidorcas marsupialis*	Mixed Feeder
Oribi	*Ourebia ourebi*	Grazer
Steenbok	*Raphicerus campestris*	Browser
Grey rhebok	*Pelea capreolus*	Browser
Reedbuck	*Redunca arundinum*	Grazer
Mountain reedbuck	*Redunca fulvorufula*	Grazer
Buffalo African buffalo Long horned giant buffalo	*Syncerus caffer* *Syncerus antiquus*	Grazer

APPENDIX H:

Mammal taxonomic list from the Lake Chrissie region (Potgieter 1955).

Common name	Scientific Name/Genus	Feeder
Blesbok	*Damaliscus pygargus phillipsi*	Grazer
Springbok	*Antidorcas marsupialis*	Mixed Feeder
Reedbuck	*Redunca spp.*	Grazer
Blue wildebeest	*Connochaetes taurinus*	Grazer
Ostrich	*Struthio camelus*	N/A
Geese	*Anserinae*	N/A
Stork	*Ciconiidae*	N/A