A Zooarchaeological Analysis of Faunal Remains from the Middle Stone Age III and Howiesons Poort layers at Klasies River, Eastern Cape, South Africa

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Division of Archaeology

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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.

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Date: 2021/08/10

Signature: 

Abstract

There are few taphonomic studies comparing the agents of accumulation, subsistence strategies and site formation processes of Middle Stone Age III (MSA III) and Howiesons Poort (HP) periods from South Africa. In this study, the results of taphonomic analyses on the faunal assemblages from selected layers from the MSA and HP from cave 1A at Klasies River Main site (KRM) are presented.

The relatively higher abundance of zoogenic modifications in the MSA III assemblage than the HP sample implies more animal activity during the MSA III and indicates that carnivores, probably leopards, brown hyaena and possibly raptors contributed significantly to the accumulation of this assemblage. The presence of anthropogenic modifications in the MSA III sample, although in lower frequencies compared to zoogenic modifications, suggest that humans were present but contributed less significantly to the accumulation of the assemblage. The anthropogenic modifications are more prevalent in the HP sample, inferring that humans were likely the primary accumulators of the HP assemblage. Several subsistence strategies are considered, and a bone marrow extraction focus is evident in both assemblages, at different intensities. The skeletal-part profiles indicate that the 'Klasies Pattern' is clearly evident in the MSA III sample, but less evident in the HP sample. The degrees of burning and trampling implies that the HP reflects periods of fluctuating human occupational intensities, and the MSA III represents periods of constituently low human occupational intensities. The data indicates that post-depositional processes, such as breakage, trampling and water activity affected both assemblages..

Keywords

° Klasies River °Middle Stone Age °Howiesons Poort ° MSA III °Taphonomy °Subsistence strategies °Site formation

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Chapter 1: Introduction

The Klasies River landscape is situated in the Eastern Cape Province in South Africa on the Tsitsikamma coast between Cape St. Francis and Plettenberg Bay (Singer & Wymer 1982; Deacon 1995; Grine *et al.* 2017; Wurz *et al.* 2018). The Klasies River Main site (referred to as KRM) comprises two well-stratified caves (cave 1 and 2), and their associated overhangs (A and B) (Deacon & Geleijnse 1988; Wurz *et al.* 2018). Ronald Singer and John Wymer first conducted research at KRM between 1967 and 1968, followed by Hilary Deacon between 1984 and 1995, and Sarah Wurz since 2015 (Singer & Wymer 1982; Deacon 2004; Wurz *et al.* 2018). The site has provided important artefacts and materials such as hearth structures, lithics, ochre, shellfish remains, some human remains and marine and terrestrial faunal remains, which have contributed to the understanding of early modern human behaviours in southern Africa (Singer & Wymer 1982; Deacon & Geleijnse 1988; Wurz *et al.* 2018). KRM yielded large amounts of macromammal and micromammal specimens, and the analysis of these remains can provide information on palaeoenvironmental conditions, subsistence and butchery patterns and site formation processes. This research focuses on the taphonomic analyses of the macromammal specimens originating from both the Middle Stone Age III (MSA III) and Howiesons Poort (HP) periods from square E50 in cave 1A from the Upper Member, excavated by Hilary Deacon in 1984 (Deacon & Geleijnse 1988; Villa *et al.* 2010). Special attention has been paid to determining the accumulators of these assemblages, subsistence behaviours, site formation processes and occupational intensities.

1.1) Research Problem Statement

Faunal studies from MSA archaeological sites in southern Africa have focused on subsistence strategies in relation to palaeoenvironmental conditions and changes in the lithic technology. These studies include taphonomic analyses focusing on inferring the agents of accumulation, subsistence strategies, occupation intensities and site formation processes (Thompson 2010; Faith 2013a; Thompson & Henshilwood 2014; Reynard *et al.* 2016a,b; Reynard & Henshilwood 2017). However, there are very few taphonomic analyses on the faunal assemblages from the MSA III and HP layers at KRM and this information is thus not known for these periods at KRM. These layers are the focus of this dissertation, investigating whether there is a change in agents of accumulation, subsistence strategies, site formation processes and occupational intensities between the assemblages through taphonomic analyses.

1.2) Research Questions

This research will investigate three research questions:

- Who were the primary accumulators of the faunal assemblages from the MSA III and HP layers at KRM, cave 1A?
- Is there evidence of a change in subsistence strategies and butchery practices in the MSA III and HP faunal assemblages?
- What site formation processes affected the MSA III and HP faunal assemblages?

1.3) Hypotheses

This study investigates four hypotheses:

- The accumulators of the MSA III large mammal assemblage were a combination of humans and other animals
- The primary accumulators of the HP large mammal assemblage were humans
- Both assemblages were affected by post-depositional processes
- Human occupation at KRM was more intensive during the HP than the MSA III

1.4) Aims and Objectives

The aim of this research is to conduct taphonomic analyses of the large mammal remains from selected MSA III and HP layers from square E50 at KRM, cave 1A. The objectives of this study are:

- Conduct a taphonomic analysis on the large mammal assemblage from the MSA III and HP layers and identify the biotic bone surface modifications to infer the possible accumulators of the assemblages.
- Use the taphonomic data to infer possible subsistence strategies and butchery patterns used by humans during the two periods.
- Use the taphonomic analysis to identify the abiotic bone surface modifications associated with site formation processes for the assemblages.
- Use the taphonomic data to infer occupational intensity for the assemblages.

1.5) Rationale

The HP industry in southern Africa is characterised by changes in lithic production patterns compared to the earlier MSA I, MSA II and the overlaying MSA III industries (Wurz 2013; Wadley 2015). The changes observed in the HP lithic industry have been interpreted as an adaptation to unstable environmental conditions (Wurz 2019). The post-HP, specifically during MIS 3, in the southern Cape is characterised by a decrease in human population densities, and this trend has been attributed to

fluctuating arid and very wet conditions (Wurz 2013). The transition between the HP and MSA III industries at KRM has mainly been analysed through the difference in lithic technology associated with these phases (Villa *et al.* 2010). The issues related to the transition between the HP and post-HP MSA industries is a key question in current MSA research (Clark 2011; Dusseldorp 2012; Van Pletzen-Vos *et al.* 2019). The zooarchaeological analysis of the faunal assemblages from these two industries can inform on changes in palaeoenvironmental conditions, site formation processes, foraging and butchery strategies, and subsistence behaviours (Lombard 2009; Clark & Kandel 2013; Dusseldorp 2014; Reynard *et al.* 2016b). The large mammal remains from the MSA III and HP layers at KRM (E50 in cave 1A) were excavated by Hilary Deacon in 1984. These remains have been taxonomically identified (Van Pletzen 2000) and palaeoenvironmental conditions have been interpreted based on this data (Van Pletzen 2000; Van Pletzen-Vos *et al.* 2019; Reynard & Wurz 2020). There have been few taphonomic studies conducted on these assemblages. The most recent taphonomic study on the HP faunal assemblage (square J51, cave 1A) was conducted by Pamela Achieng (2019). This research will provide new information on the faunal assemblages from the HP and MSA III industries at KRM, focusing specifically on agents of accumulation, subsistence behaviour and site formation processes.

Chapter 2: Literature Review

This chapter discusses the Middle Stone Age III and Howiesons Poort industries in the southern Africa and provides the context for this study. It highlights previous studies undertaken at other HP and post-HP (MSA III) sites, including paleoenvironmental reconstruction, taphonomic analyses, subsistence strategies and occupation intensities, and then specifically discusses previous studies undertaken at KRM.

2.1) Introduction

The MSA in southern Africa is well-known for innovation in its lithic technology and subsistence behaviour (Wadley 2015). The MSA industries in southern Africa occurred approximately 300,000 and 30-25,000 years ago (ka), although dates vary regionally (*cf.* Wadley 2015: Table 1, Page 160 – 166). The coastal archaeological sites in southern Africa have received much MSA research focus, particularly those with the Still Bay industry such as Blombos Cave, and the Howiesons Poort industry such as Klasies River, Klipdrift Shelter, Boomplaas Cave, and others (Wadley 2015). These sites yield large amounts of materials and artefacts which have provided information on lithic sequences and subsistence strategies utilised by early modern humans. The transitions between the MSA substages are a key focus in current southern African MSA research, and the transition between the HP and post-HP industries is of particular interest at Klasies River (Wurz 2008; Reynard & Wurz 2020).

2.2) Site Background

The Klasies River landscape is located on a cliffed section of the Tsitsikamma mountain range on the southern Cape coast, in the Eastern Cape (Singer & Wymer 1982; Deacon & Geleijnse 1988; Wurz *et al.* 2018). The landscape (Wurz *et al.* 2018) comprises five coastal caves which are overlaid by fossil dunes (Geelhoutboom Dune), described as cross-bedded sands, which rest on the edge of a coastal platform(Singer & Wymer 1982; Deacon & Geleijnse 1988; Villa *et al.* 2010). The Klasies River Main site (KRM) is a well-stratified, 20-meter sequence of deposits and refers to the westernmost cave group (Figure 2.1) and includes caves 1 and 2, and their associated overhangs (caves 1A and 1B) (Figure 2.2) (Singer & Wymer 1982; Deacon & Geleijnse 1988; Wurz *et al.* 2018).

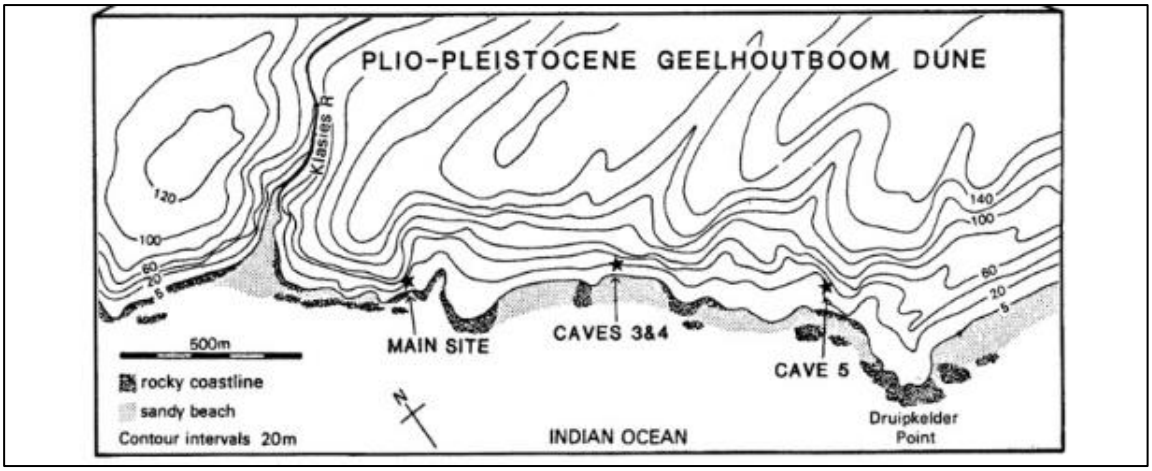

Figure 2.1: Geographic location of Klasies River caves (Deacon & Geleijnse 1988; Figure 1: Page 2)

Figure 2.2: Klasies River main site (caves and overhangs labelled) (Image by Author 2020)

Ronald Singer and John Wymer first excavated the Main site in 1967 and 1968 (Singer & Wymer 1982; Deacon & Geleijnse 1988; Wurz *et al.* 2018). These excavations were extensive and removed most of the deposits in cave 1 and cave 1A, and in limited areas in caves 1B and 2. The analyses of the excavated material from these excavations provided the first interpretations of the stratigraphy and dating of the deposits (Singer & Wymer 1982). Hilary Deacon's excavations took place in a series of sampling squares, which were one meter or less in size in caves 1, 1A, 1B and 2 between 1984 and 1995 to

investigate site formation processes, and to clarify ages of the stratigraphic layers (Deacon & Geleijnse 1988). He also excavated the Witness Baulk in cave 1 between 1991 and 1995 (Wurz *et al.* 2018). Sarah Wurz leads the current excavations at the site, continuing the excavation of the Witness Baulk deposit in cave 1. Archaeological materials from the site include hearth structures, ochre, lithics, shellfish, marine and terrestrial faunal remains (Wurz *et al.* 2018). These materials suggest that the site was a consistent choice for occupation by early modern humans since approximately 120, 000 ka (Deacon & Geleijnse 1988; Wurz 2012; Wurz *et al.* 2018).

The focus of this dissertation is the faunal assemblages from selected MSA III and HP layers. These layers in cave 1A were first excavated by John Wymer in the 'initial cutting' (Figure 2.3) and 'top cutting' (Figure 2.5) (Singer & Wymer 1982). The excavation was recorded in relation to these cuttings and the layers were numbered according to the MSA substages. The culture-stratigraphic sequence of KRM comprises the MSA I, MSA II, HP, MSA III and MSA IV substages (Singer & Wymer 1982). The MSA III materials are from layers 1 to 9, and the HP materials are from layers 10 to 21 (Singer & Wymer 1982). The excavations led by Wymer were conducted using trowels, and the materials from all the layers, apart from the HP layers, were sieved through ½ inch (+/- 12 mm) mesh, and the HP materials were wet-sieved through ¼ inch (+/- 6 mm) mesh (Singer & Wymer 1982: 8).

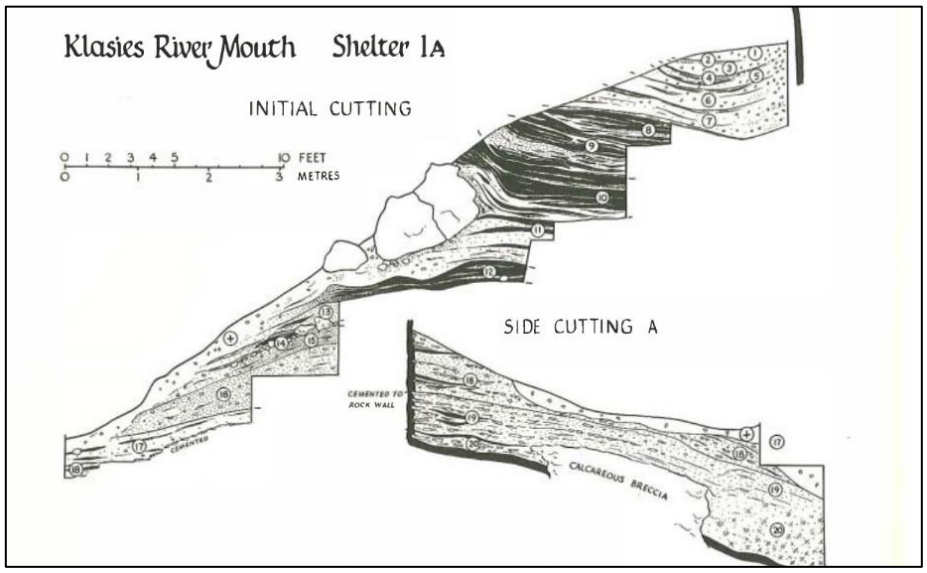

Figure 2.3: Cave 1A - Initial Cutting (Singer & Wymer 1982; Figure 3.7: Page 18)

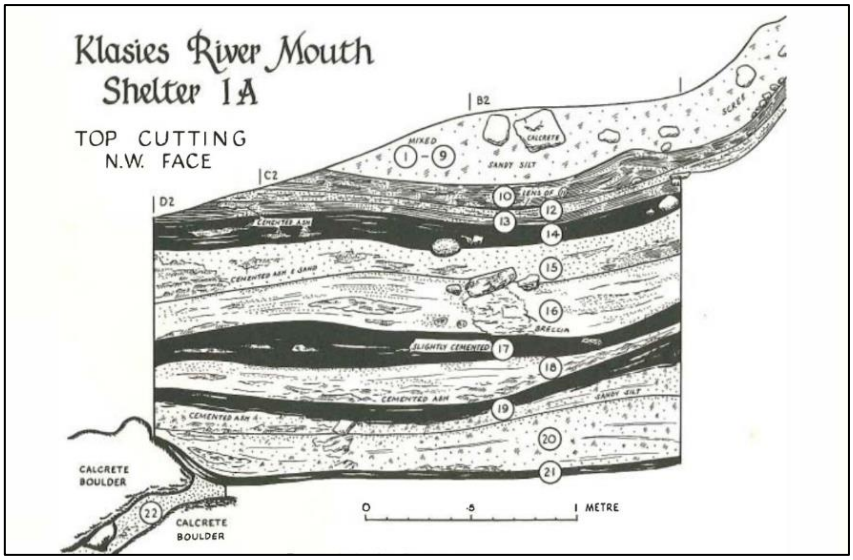

Figure 2.4: Cave 1A - Top Cutting (Singer & Wymer 1982; Figure 3.8: Page 18)

Hilary Deacon subsequently excavated cave 1A in squares E50, H51 and J51 (Figure 2.5 and 2.6) (Deacon & Geleijnse 1988). The stratigraphic layers were divided and categorised as units, and units with similar characteristics were grouped as members (Deacon & Geleijnse 1988). The layers identified by Singer and Wymer as the MSA III and HP substages correlate with the Upper Member identified by Deacon. The sediments from each sampled unit and control squares from these excavations were sieved through 3 mm and 2 mm mesh, respectively (Deacon & Geleijnse 1988; Van Pletzen 2000). The MSA III and HP substages from KRM have a variety of age estimations (Table 2.1).

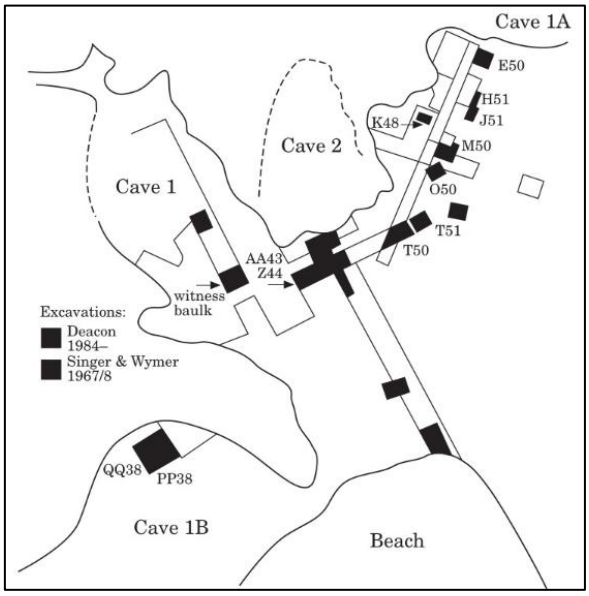

Figure 2.5: KRM site map (Wurz 2002; Figure 1: Page 1002)

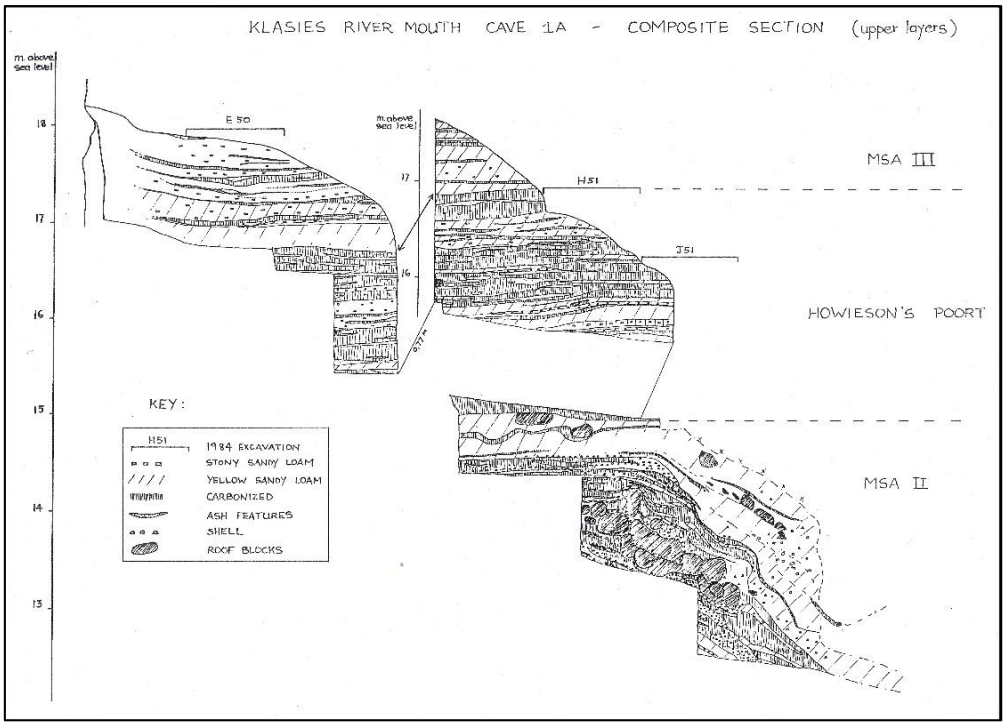

Figure 2.6: Section of the squares excavated by Deacon in the Upper Member (E50, H51 and J51) (Image courtesy of Sarah Wurz, Deacon archive)

Table 2.1: Selected recent published dates for the MSA III and HP industries at KRM

Substage	**Member**	**Age Estimate (Method)**	**References**
Middle Stone Age III (MSA III)	Upper Member	43.4 ± 3.0 ka (OSL)	Feathers (2002); Reynard & Wurz (2020)
		57.0 ± 4.0 ka	Tribolo *et al.* (2013)
Howiesons Poort (HP)	Upper Member	46.7 ± 3.3 ka (OSL/ISRL)	Feathers (2002)
		54 ± 7ka – 48 ± 4 ka (TL)	Tribolo *et al.* (2013); Wadley (2015)
		63.2 ± 2.7 ka (OSL)	Jacobs & Roberts (2017)
		64.1 ± 2.6 ka	Jacobs & Roberts (2017)
		65.6 ± 5.3 ka (U-series)	Vogel (2001)

2.3) Context of the Sample

The sample studied in this research is from selected MSA III and HP layers from cave 1A in square E50 that occurs in the Upper Member. This member is described as carbon partings and sand units with many ash layers in the lower half belonging to the HP in caves 1A and 2 (Deacon & Geleijnse 1988). The member has both low occupational units (brown and yellow units) and high occupational layers (carbon partings and shell middens) (Figures 2.7 and 2.8 adapted from Deacon & Geleijnse 1988 Figure 10 and 11).

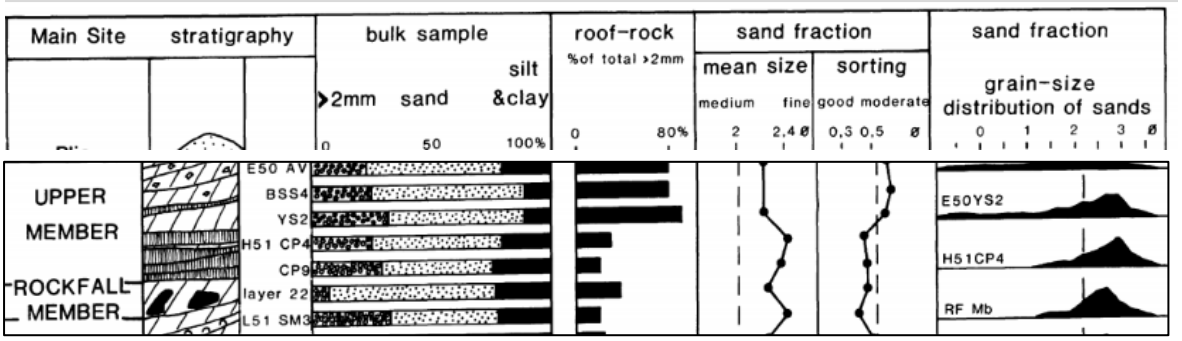

Figure 2.7: Granulometry of selected sediment samples from Klasies River cave 1A (Deacon & Geleijnse 1988, Figure 10: Page 11)

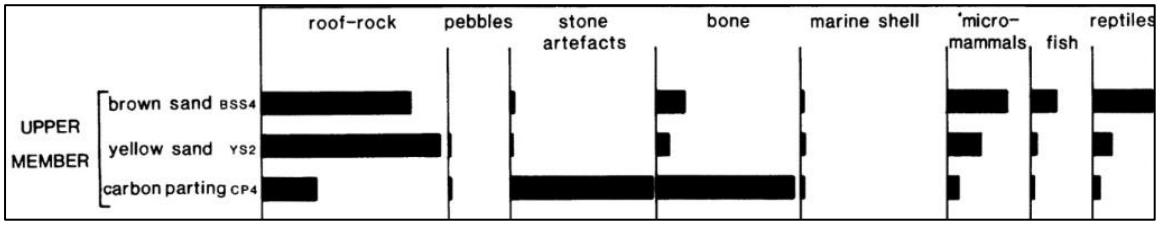

Figure 2.8: Masses of coarse components in two MSA III layers and one HP layer from the Upper Member (Deacon & Geleijnse 1988, Figure 11: Page 12)

Figure 2.8 shows the masses of the coarse components of two MSA III layers (BSS4 and YS2) and one layer from the HP square H51 (CP4) from the Upper Member. Deacon & Geleijnse (1988) imply that these sand and carbon parting units have differential preservation characteristics. The sand units have higher frequencies of micromammal, fish and reptile remains, whereas the carbon parting unit has higher quantities of stone and bone artefacts (Figure 2.8) (Deacon & Geleijnse 1988). The masses and quantities of materials, however, cannot be assumed to be similar for all the sand and carbon partings units in the Upper Member based on what is represented in Figure 2.8. This research includes the taphonomic analyses of the faunal assemblages from seven MSA III layers (CP2; BSS1; BSS2 AF1; BSS2; CP3; BSS3 and CP4) and four HP layers (CP5, YS4, CP6 and CP9) and contain both sand and carbon partings units.

2.4) The Middle Stone Age III and Howiesons Poort

The MSA III industry at KRM shows a distinct change in artefacts and raw materials from the previous MSA industries (Villa *et al.* 2010). The raw material of choice for Deacon's MSA III assemblage is quartzite, with a few silcrete pieces (Villa *et al.* 2010). The industry features retouched scrapers, points, notched pieces and denticulates (Villa *et al.* 2010). Blades, like previous industries, are a prominent feature of the assemblage, however the production strategies differ. Many of the blades in this assemblage vary in width and are removed from the core's lateral edge, and consequently have a cortical back (Villa *et al.* 2010). The post-HP MSA periods are usually associated with low population densities at coastal Cape Floristic Region (CFR) sites, and a general increase in human population densities at inland CFR sites (Mitchell 2008). The HP industry has been recorded in several sites along the southern African coast, including Klipdrift Shelter, Boomplaas Cave, Sibudu Cave and KRM (Wurz 2012; Reynard *et al.* 2016a, 2016b). The HP industry in southern Africa is associated with technology and subsistence behaviour innovations (Lombard 2009; Wadley 2015; Douze *et al.* 2018). The industry shows a definitive change in lithic technology and its application. The raw material of choice in the HP assemblage from Deacon's excavations is quartzite, and quartz and silcrete also feature prominently in this industry (Villa *et al.* 2010).There is evidence of a wider range of raw materials in the HP at KRM, as non-quartzite raw materials are present in significant numbers in the middle HP layers (Wurz 2000). The HP assemblage is dominated by blades and is characterised by higher frequencies of smaller blades than the other MSA industries at KRM (Wurz 2002; Villa *et al.* 2010). There are higher frequencies and variety of formal tools in this industry, such as backed geometrics and notched pieces (Wurz 2002; Villa *et al.* 2010; Wadley 2015; Reynard & Wurz 2020).

There is much debate about the reason behind the changes seen in the HP industry compared to the previous MSA I and MSA II industries at KRM. Singer & Wymer (1982) suggested that the industry represents the arrival of new people at the site with different behavioural characteristics than those occupying the site earlier. Thackeray (1989) proposed that the presence of backed lithic pieces does represent a distinct change in lithic production but argues that the presence of the typical quartzite MSA flakes and blades suggest that the HP lithics were an added typological innovation in the sequence. Deacon (1989,1995) proposed that the HP technocomplex at KRM correlates with changing and unstable palaeoenvironmental conditions. He suggested that the changes seen may relate to coping mechanisms relating to increasing environmental stress.

2.5) Southern Cape Palaeoenvironment

Palaeoenvironmental reconstructions at southern African archaeological sites along the southern coast reflect changes in environmental conditions during the MSA sequence. The general trend for the

southern Cape leans towards drier conditions at approximately 60 ka (d'Errico *et al.* 2017). Yet, as discussed below, local conditions vary as some sites along the coast indicating wetter conditions around the same time (Braun *et al.* 2018; Esteban *et al.* 2019). There are conflicting ideas regarding environmental conditions during Marine Isotope Stage (MIS) 4 (71-57 ka), which was a global glacial period (Reynard & Wurz 2020). The general trend for MIS 4 is cooler conditions with increased climatic instability (d'Errico *et al.* 2017; Reynard & Wurz 2020). The HP industry in southern Africa corresponds to this stage. Sea Surface Temperatures (SSTs) and micromammal data indicate that this period was cool and dry (Avery 1983; Thackeray 1987; Deacon 1989; Ninnemann *et al.* 1999; Braun *et al.* 2018), whereas other researchers argue that the conditions during this stage were more humid than the previous stages (Chase & Meadows 2007; Chase 2010; Carr *et al.* 2016). The MSA III industry in southern Africa corresponds to MIS 3, which is an interglacial period with generally warmer and drier conditions (Ziegler *et al.* 2013; d'Errico *et al.* 2017; Reynard & Wurz 2020). The SSTs in this stage are slightly warmer compared to MIS 4 (Ziegler *et al.* 2013).

Reconstructing the palaeoenvironmental conditions involves analysing a variety of materials, including micromammal, macromammal, marine fauna and botanical remains. Palaeoenvironmental conditions at some southern Cape sites that used these materials are discussed below.

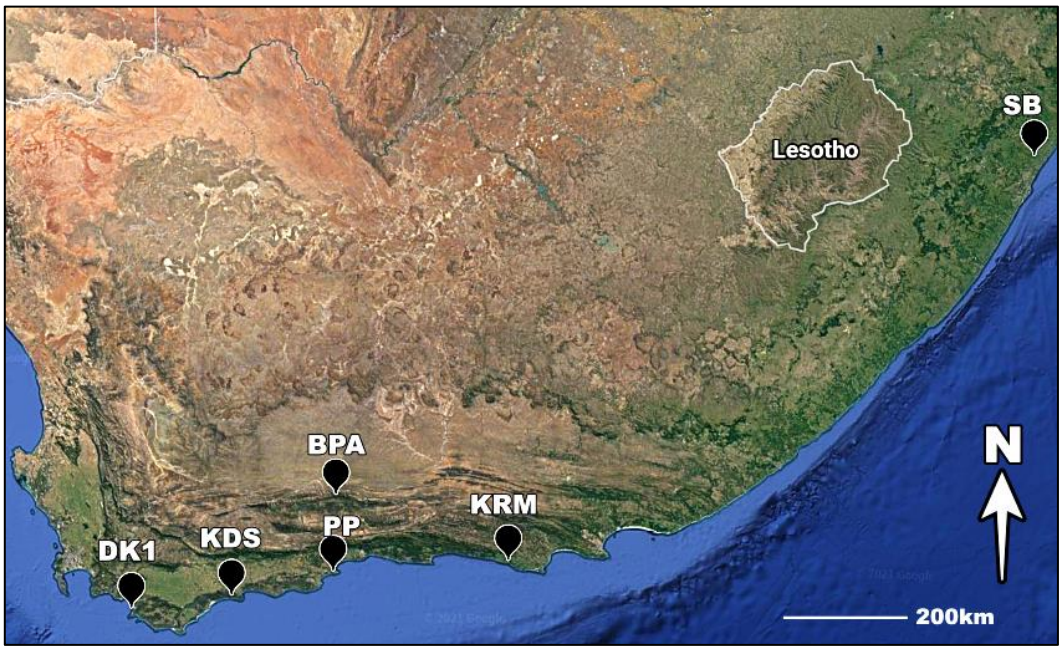

Figure 2.9: Map of MSA sites discussed (DK1: Die Kelders Cave; KDS: Klipdrift Rock Shelter; PP: Pinnacle Point; BPA: Boomplaas Cave; KRM: Klasies River Main site; SB: Sibudu Cave) (Map created on Google Earth 2021)

2.5.a) Boomplaas Cave

Boomplaas Cave (BPA) is located within the Cape Floristic Region (CFR) dominated by fynbos and renosterveld vegetation (Figure 2.9). The HP technocomplex at BPA has an Amino Acid Racemisation (AAR) age estimate of 62.4± 2 ka and occurs in the OCH Member (Miller *et al.* 1999; Faith 2013a; Sealy *et al.* 2016; Pargeter *et al.* 2018). The post-HP industries occur in the BOL, OLP and BP Members, with age estimates ranging from 44, 000 ± 4000 BP to 32, 400 ± 700 BP (Faith 2013a; Pargeter *et al.* 2018). The age estimates of the BP coincide with the MIS 3 interglacial phase (Pargeter *et al.* 2018). The ungulate assemblages from these members include browsers and mixed feeders (Faith 2013a). The HP ungulate assemblage features *Redunca fulvorufula* (Mountain Reedbuck), *Damaliscus* (Tsessebe) and *Equus* remains, which indicate shrubland habitats with grassy components (Faith 2013a). The stable carbon isotope analysis of the enamel of these species indicate that C3 grasses were abundant during the formation of this member (Sealy *et al.* 2016; Pargeter *et al.* 2018). The micromammal assemblage from this member features grassland species, such as the vlei rat (*Otomys irroratus*), and is indicative of an increase in grassland landscapes and an increase in winter rainfall patterns (Faith 2013a). The MSA III member above the OCH Member (BOL) shows an increase in ungulate diversity and has high frequencies of *Aethomys namaquensis* (Namaqua rock rat), which is indicative of a decrease in humidity (Pargeter *et al.* 2018). The OLP Member has high frequencies of *Myosorex varius* (Forest shrew) remains, suggesting more dense and humid conditions than the BOL Member (Pargeter *et al.* 2018). The large mammal assemblage from the BP Member, identified as Late MSA includes *Alcelaphine* species, most likely the hartebeest , which only features in this member which suggests an increase in C4 vegetation (Faith 2013a; Pargeter *et al.* 2018). The palaeoenvironmental conditions at BPA change from a grassland vegetation dominated by C3 grasses and winter rainfall patterns during the HP technocomplex to fluctuating humidity conditions and an increase in dense C4 vegetation during the post-HP and Late MSA industries.

2.5.b) Die Kelders Cave

Die Kelders (DK1) is located on the southwest coast of South Africa (Figure 2.9). The MSA sequence at the site has an age estimation of between 60-70, 000 ka (Feathers & Bush 1998), corresponding to the glacial MIS 4 (Marean *et al.* 2000), contemporaneous with some HP sites. There is no HP industry at the site, however, there is a shift from coarse to more fine-grained lithic raw materials in middle and lower layers 10 and 11, which is a pattern in other sites with HP artefacts (Feathers & Bush 1998; Armstrong 2016). Ungulate species, such as *Connochaetes gnou* (black wildebeest), *Antidorcas marsupialis* (springbok) and *Damaliscus pygargus* (bontebok) suggest a grassy habitat around the cave during MIS 4, and species such as *Redunca arundinum* (southern reedbuck) indicate a water source near

the cave (Marean *et al.* 2000). The large mammal remains suggest that MSA conditions were cooler and moister, and the vegetation was dominated by shrubby and grassy components (Marean *et al.* 2000; Armstrong 2016).

2.5.c) Klipdrift Shelter

Klipdrift Shelter (KDS) is located on the southwest coast of South Africa (Figure 2.9). The HP layers at KDS have an age estimate of between 65.5 ± 4.8 ka and 59.4 ± 4.6 ka, corresponding to the latter part of MIS 4 (Henshilwood *et al.* 2014; Reynard *et al.* 2016a). Lithics from the layers PCA to PAY (listed from earliest to latest: PCA, PBE, PBD, PBC, PBA/PBB and PAY) are associated with the HP industry, and the uppermost HP layer PAY may be a transitional layer into the post-HP MSA industries (Henshilwood *et al.* 2014; Reynard *et al.* 2016a). The high densities of shellfish throughout the HP layers suggest that the shoreline was relatively close to the cave during the HP occupation (Henshilwood *et al.* 2014). The presence of cold-water shellfish species such as *Cymbula granatina* (granite limpet) in layer PBC (65.5 ± 4.8 ka) suggest that the SSTs were slightly cooler than present, however the abundance of warmer-water species such as *Turbo sarmaticus* (South African turban) and *Dinoplax gigas* (giant chiton) indicate slight temperature changes rather than extreme changes (Henshilwood *et al.* 2014). There is an increase in shellfish species favouring sandy conditions in the upper HP layers, whereas the shellfish species composition in the upper PAY layer indicate rocky shores. The increase in sandy conditions in the upper HP layers suggest an increase in dune activity at approximately 60.0 ± 4.0 ka (Henshilwood *et al.* 2014; Reynard *et al.* 2016a). The ungulate richness values at the site suggest that environmental conditions during the HP industry may have been humid (Reynard *et al.* 2016a: 358). The presence of *Taurotragus oryx* (eland) and *alcelaphinae* in the lowermost layer PCA and the presence of small bovids, *Procavia capensis* (rock hyrax) and tortoises in layer PBD indicate a mixed terrain (Reynard *et al.* 2016a). The ungulate assemblage from the middle HP layers features *alcelaphinae*, *equus* (equids) and *Redunca* (reedbuck) remains, indicating an increase in grassy landscapes, particularly in layers PBC and PBA/PBB (Henshilwood *et al.* 2014; Reynard *et al.* 2016a). The ungulate assemblage from the HP layers at KDS indicate a change from mixed terrain in the lower layers to an increase in grassy conditions in the upper layers.

2.5.d) Pinnacle Point

Pinnacle Point (PP 5-6) is located on the Cape south coast (Figure 2.9) and has dates varying from approximately 89 ka to 51 ka (Wilkins *et al.* 2017). PP5-6 provides an in-depth record of early modern human behaviour as the dates correlate with two interglacial periods (MIS 5 and MIS 3) and one glacial period (MIS 4) (Wilkins *et al.* 2017). The general temperature trend for PP 5-6 during MIS 4 is low to medium temperatures, while MIS 3 has medium to high temperatures (Wilkins *et al.* 2017). PP5-6

during MIS 4 shows an increase in C4 plants, and an increase in a mosaic of fynbos, temperate, coastal, and semi-arid conditions (Wilkins *et al.* 2017; Braun *et al.* 2018; Simeonoff 2019). Speleothem data from the surrounding area supports this increase in C4 grasses and an increase in summer rainfall (Esteban *et al.* 2019). The faunal assemblage from the site dating to MIS 4 indicate an increase in tortoise species, most likely the angulate tortoise or the pancake tortoise, which prefer mixed conditions (Simeonoff 2019). There is also a decrease in size 3 ungulates at the site during MIS 4, and since C4 grasses typically support larger mammals, it is likely that the conditions at PP5-6 during MIS 4 was possibly a more equal mix of C4 and C3 plants (Esteban *et al.* 2019; Simeonoff 2019). PP5-6 during MIS 3, in contrast, shows an increase in winter rainfall, C3 vegetation and smaller ungulates and mammals (Wilkins *et al.* 2017). It is likely, from the speleothem and ungulate data, that PP5-6 during both MIS 4 and MIS 3 was a mosaic of fynbos and thicket vegetation with fluctuating rainfall patterns.

2.6) Palaeoenvironmental Conditions at KRM during MIS 4-3

The MSA sequence at KRM has remains of marine mammals, fish, marine birds, and shellfish, suggesting that the coastline was near the cave throughout the sequence, except the HP industry (MIS 4) which is associated with a relatively far away shoreline (Klein 1976; Langejans *et al.* 2012, 2017; Reynard & Wurz 2020). The MSA III industry dates within the earlier parts of MIS 3 (refer to Table 2.1 for dates). A variety of proxies suggest that the environmental conditions during the MSA III at KRM was slightly warmer and wetter than MIS 4, dominated by C3 grasses and more closed vegetation (Langejans *et al.* 2017; Table 1: Page 62). The molluscan assemblage from the MSA III layers show a decrease in *Perna perna* (brown mussel) specimens, which are usually indicators of warmer waters, and a decrease in rocky shore species (Langejans *et al.* 2017). Taxonomic analysis of the assemblage indicate an increase in warm-water incidental species, which may suggest an increase in lagoons and estuaries in the vicinity of the cave (Langejans *et al.* 2017). The macromammal assemblage from these layers features *Arctocephalus pusillus* (Cape fur seal), *Procavia capensis* (rock hyrax), *Taurotragus oryx* (eland), *Syncerus caffer* (African buffalo), *Pelorovis antiquus* (long-horned buffalo), *Redunca* (reedbuck) and *Kobus* (waterbuck) species (Klein 1976; Van Pletzen 2000; Reynard & Wurz 2020). The macromammal assemblage shows an increase in grazer bovid species, and a decrease in browser species, suggesting open landscapes (Klein 1976; Van Pletzen 2000). The presence of the long-horned buffalo in these layers is also an indicator of open landscapes (Reynard & Wurz 2020). The micromammal data also supports an increase in open landscapes as this period featuring high frequencies of grass-favouring species, such as the *Amblysomus hottentotus* (Hottentot golden moles) (Avery 1987; Reynard & Wurz 2020). The presence of reedbuck and *Kobus* species remains indicate a wetland system in the vicinity of the cave (Reynard & Wurz 2020). There is an increase in Cape dune

mole rat frequencies in these layers, suggesting lower sea levels and increased dune activity (Reynard & Wurz 2020).

The HP industry dates within the latter part of MIS 4 (refer to Table 2.1 for dates). When the HP at KRM is considered in general, a variety of proxies suggest that the environmental conditions were cold, dry, with winter rainfall and open environments dominated by C4 grasses (Langejans *et al.* 2017, Table 1: Page 62). Rocky shore molluscan species are the most abundant in the HP layers (Langejans *et al.* 2017). *Perna perna* (brown mussel) makes up a large proportion of these rocky shore species in the previous industry (Mossel Bay phase), while in the HP, other rocky shore species such as *Turbo cidaris* (Crown turban) and alikreukel (*Turbo sarmaticus*) are the most abundant (Langejans *et al.* 2017). These two species prefer more sheltered conditions than the brown mussel (Langejans *et al.* 2017). The taxonomic analysis of the shellfish materials from the HP layers does not show a drastic decrease in SSTs, which is supported by alikreukel isotopic values (Langejans *et al.* 2017). The macromammal assemblage from these layers features the *Arctocephalus pusillus* (Cape fur seal), *Procavia capensis* (rock hyrax), *Hippotragus leucophaeus* (bluebuck), *Raphicerus melanotis* (grysbok) and *Connochaetes* (wildebeest) (Klein 1976; Van Pletzen 2000). The faunal assemblage shows an increase in grazer ungulate species and a decrease in closed vegetation micromammals, such as the *Otomys irrortus* (vlei rat), from the MSA III to HP transition, and an increase in browsing ungulate species in the lower HP layers, suggesting a mixture of closed and open vegetation systems (Klein 1976; Avery 1987; Van Pletzen 2000; Reynard & Wurz 2020). Therefore, the general trend of the KRM palaeoenvironment during the MSA III and HP industries, based on the faunal and molluscan assemblage, is that conditions during MIS 3 was more open with relatively warmer SSTS, and conditions during MIS 4 was a mixture of closed and open vegetation systems with an increase in SSTs relative to MIS 3 (Klein 1976; Van Pletzen 2000; Langejans *et al.* 2017; Reynard & Wurz 2020).

2.7) Taphonomy

The term ‘taphonomy’ was originally defined as the study of the transition of animal remains from the biosphere into the lithosphere (Efremov 1940). Several archaeologists over the years have altered this definition based on specific zooarchaeological research questions and aims. Behrensmeyer and Kidwell (1985) defined ‘taphonomy’ as the study of the processes of preservation and the affect it may have on the information from the assemblage and the interpretations by the archaeologists. Behrensmeyer and colleagues (Behrensmeyer *et al.* 2000) notes that taphonomic research aims to understand the processes that have influenced archaeological remains so that the data can be applied to other research, such as palaeobiological or palaeoenvironmental research. Whitlam (1982) described ‘archaeological taphonomy’ as the study of the transition of artefacts from the time they were abandoned by the subject

until its archaeological recovery and research. Taphonomy involves a variety of processes that play a role in zooarchaeological research, including weathering, preservation, erosion, redeposition, trampling, plant intrusion, human and other animal activities (Peres 2010). Taphonomic studies are central to investigate research questions relating to subsistence behaviours, butchery strategies, consumption, and deposition activities of early modern humans (Orton 2012). The analysis of bone surface modifications play a crucial role in identifying the 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).

Archaeological taphonomic studies can involve a variety of analyses and interpretations, including the analysis of bone surface modifications caused by human and non-human agents, density-mediated attrition, peri-depositional damage (damage at the time of deposition), breakage and fragmentation (Klein & Cruz-Uribe 1984; Lyman 1994c; White & Folkens 2005; Thompson 2010; Orton 2012). Environment plays a significant role in the preservation of faunal remains. Environmental conditions that affect bone preservation include soil acidity, climate, site location and soil matrix (Peres 2010).

2.8) Bone Density Mediated Attrition

Much of the important evidence from taphonomic analyses may have been affected by preservational biases and density-mediated destruction (Lam & Pearson 2005; Lyman 1994c; Faith & Thompson 2018). The interpretations of skeletal element abundances, mortality profiles and species representation in a faunal assemblage can be affected by post-depositional damage (Lam & Pearson 2005; Lyman 2010). Bone density is an important measure of the skeletal element's ability to withstand destruction processes (Lam & Pearson 2005). Measurements of bone densities were first conducted in the 1960s and 1970s by researchers such as Brain, Binford and Behrensmeyer. These measurements confirmed the relationships between bone densities and the ability to survive destructive processes (Lam *et al.* 2003).

2.9) Howiesons Poort and post-Howiesons Poort Faunal Taphonomic Analyses

Taphonomic analyses on the faunal assemblages from MSA sites in southern Africa are important as they give insight into subsistence strategies and prey selection of early modern humans (Thompson 2010; Reynard *et al.* 2016b). There are few examples of taphonomic studies conducted on faunal assemblages from the MSA sequence, some including Boomplaas Cave (Faith 2013b) and Klipdrift Shelter (Reynard *et al.* 2016b; Reynard & Henshilwood 2017), even fewer focus specifically on the HP and MSA III industries.

2.9.a.) Boomplaas Cave

The taphonomic record from BPA shows an intricate relationship between human, carnivore, and raptor accumulations. There are three possible large mammal accumulators at the site: large raptors, carnivores, and humans (Faith 2013a). The HP faunal assemblage originates from the OCH member, and the Post-Howiesons Poort assemblages originate from the BOL, OLP and BP members (Faith 2013a). The OLP member has an estimated date of 44,000 ± 4000 (Faith 2013a), which is similar to the estimated ages for the MSA III industry at KRM. The results of the analysis from the OCH assemblage show no cut or percussion marks on any of the bone fragments (Faith 2013a). There are few anthropogenic modifications in the OLP member (Faith 2013a). Carnivore tooth marks are more common on the size II bovids than the size I bovids in OCH member, and gastric acid etching is more common on the size I bovids in this member (Faith 2013a). Anthropogenic modifications are present on some large ungulates from the OLP member (Faith 2013a). Based on these results, Faith (2013a) concluded that the primary accumulators of the faunal assemblage from the OCH and OLP member were carnivores, with minimal human involvement in the OLP member (Faith 2013a). There is little to no evidence of human involvement in the OCH member, suggesting that human occupation was minimal at the site during the accumulation of the deposits (Faith 2013a). The presence of anthropogenic modifications, although in low frequencies, in the OLP member suggest that humans may have briefly occupied the site at different intervals to carnivores (Faith 2013a).

2.9.b.) Klipdrift Shelter

The taphonomic analyses at KDS included the analysis of bone surface modifications, skeletal-abundances, and mortality rates to investigate subsistence strategies during the HP industry at the site (Reynard *et al.* 2016b). The taphonomic record throughout the HP sequence at KDS does not vary significantly, with the only exception being layers PBD and PAY/PAZ (Reynard *et al.* 2016b). The most common bone modification in the HP faunal assemblage is burning, which is more prevalent in the middle (PBD) and lower (PBE and PCA) layers than the uppermost layers and post-HP (PAY to PAU) layers (Reynard *et al.* 2016b). The high frequencies of burnt fragments and its association with hearth structures suggest that the burning was more likely the result of human activities rather than natural bush fires (Reynard *et al.* 2016b). The faunal assemblages from the HP industry at KDS are highly fragmented, like assemblages from other HP sites such as Sibudu Cave (Clark 2017). Percussion marks are relatively common in the sample, which occur on a wide range of taxa including smaller mammals, tortoises, carnivores, and ungulates (Reynard *et al.* 2016b). The uppermost (PAY) and lowermost (PCA) HP layers have relatively less percussion marks on ungulate phalanges, innominates, calcanea, mandibles, and scapula than the middle layers, suggesting that marrow-extraction of low-

ranked elements was more common in the middle HP layers (Reynard *et al.* 2016a). Cut marks and carnivore modifications are rare in these layers (Reynard *et al.* 2016b). The larger ungulates in the sample have more anthropogenic modifications than the smaller bovids, where cut marks are relatively more common on the fore- and hindlimbs of medium and large sized ungulates. These anthropogenic modifications are related to skinning, bone marrow extraction, disarticulation, and filleting (Reynard *et al.* 2016b). The prevalence of anthropogenic modifications and the evidence for minimal carnivore activity suggest that the faunal remains, including ungulates and small mammals such as *Procavia capensis* (rock hyrax), from the HP layers at KDS were accumulated by humans (Reynard *et al.* 2016b). The lack of anthropogenic involvement in the HP and post-HP layers at BPA, and the prevalence of anthropogenic modifications in the HP layers from KDS may be related to a decrease in human population densities at inland CFR sites, and an increase at coastal sites at between approximately 60, 0000 to 20, 000 years ago (Faith 2013a).

2.10) Faunal Taphonomic Analyses from Klasies River

Milo's 1998 analysis of the KRM fauna comprises one of the few taphonomic studies conducted at the site. His analysis focused on the cave 1 deposits that were excavated by Singer & Wymer, focusing on the earlier layers or industries (MSA I and MSA II) (Milo 1998). Milo concluded that mammals belonging to the larger size classes (sizes III and IV) showed the largest proportion of butchery marks, and the axial of very large (size V) bovids has the highest rates of cut marks (Milo 1998). His taphonomic analyses, however, did not include the HP and MSA III deposits from cave 1.

Achieng (2019) conducted the most recent taphonomic analyses on the HP fauna from KRM, focusing on layer YS5 and CP4 from the lower HP, from square J51 in cave 1A. Smaller bovids (size I) were more abundant in the yellow sand layer YS5, and larger bovids (sizes II and III) were more abundant in the carbonate parting layer CP4 (Achieng 2019). Smaller mammals may be associated with raptors, carnivores, and human accumulators, whereas the larger mammals are usually associated with human and hyaena accumulators (Wadley 2010). Achieng (2019) concluded that there was no significant difference in the frequencies of carnivore tooth marks between the two layers. Rodent gnaw marks were rare in both layers, suggesting minimal rodent activity. Gastric acid etching was significantly more common in layer YS5 than CP4, implying that carnivores or raptors were the primary accumulators of the yellow sand layer (Achieng 2019). In layer CP4, there is significantly more burnt bones, some of which exhibit gastric acid etching, suggesting that carnivores were likely scavenging off human food waste (Achieng 2019). Cut marks were relatively rare in both layers, however the specimens from the carbonate layer have higher frequencies of percussion marks relative to the yellow sand layer, confirming that humans were the main accumulators in layer CP4 (Achieng 2019).

2.11) Subsistence Behaviour Models

Taphonomic and ecological studies on faunal assemblages are important for inferring possible exploitation strategies at sites (Lyman 1987; Discamps *et al.* 2011). There are many factors that can influence which animals are selected for exploitation by humans, some include body size, season availability, search and pursuit times, population levels and ease of capture (Smith 1974; Bayham 1979). Archaeologists can use a variety of methods to infer possible subsistence behaviours and activities at sites, including Optimal Foraging Theory (OFT) models and carcass consumption sequences (Blumenschine *et al.* 1991; Pokines & Symes 2013; Codding & Bird 2015; Will *et al.* 2016). OFT models predict that humans hunt or gather the most profitable resource to maximise the return-rate to the site (Levi *et al.* 2011; Dusseldorp & Langejans 2015). Models within the OFT framework are often used to develop predictions about human foraging behaviour (Pyke 1984, Codding & Bird 2015). OFT models, such as the Central-Place Foraging Model, Diet Breadth and Prey Choice Model and the Patch Choice Model, predicts certain elements of this human behaviour to maximise return rate of resources to a site for consumption (Houston 2011; Levi *et al.* 2011; Benkwitt 2016) (Table 2.2).

Table 2.2: Summary table of Optimal Foraging Theories and Predictions

OFT models	Predictions	References
Central-Place Foraging	Foragers should maximise their energy gained by optimising foraging effort and prey selectivity	Benkwitt (2016)
	Foragers should decrease their foraging effort the further they travel away from the central site	Benkwitt (2016)
	Predicts the optimal behaviour that a forager will use as they travel further away from the site	Olsson & Bolin (2013)
Diet Breadth	When a forager encounters two animal species, the more profitable species (based on body size and caloric value) will be pursued, and the less profitable species will be ignored	Levi *et al.* (2011); Dusseldorp & Langejans (2015)
Prey Choice	Top-ranked prey should always be hunted on encounter unless the preferred prey encounter rates decline, then the hunters are expected to broaden their diet breadth by hunting lower-ranked prey	Levi *et al.* (2011); Clark & Kandel (2013); Codding & Bird (2015)
Patch Choice	Hunters will encounter several diminishing resource patches and must decide whether to spend time exploiting resources from the current patch or spend that time looking for a new patch with more desirable resources	Constantino & Daw (2015)

Carcass consumption sequences refer to the order in which the flesh and contents of carcasses are consumed by humans and carnivores. Skeletal-part profiles have been used by zooarchaeologists to investigate carcass consumption by humans and carnivores and hunting and scavenging activities at the site by both agents (Blumenschine *et al.* 1991; Marean & Spencer 1991; Fourvel *et al.* 2012). The general prediction with carcass consumption sequences is that the agents that had first access to the carcass, generally by hunting, should obtain a relatively even distribution of skeletal parts or one that

favours hind and forelimb flesh and head flesh (Blumenschine *et al.* 1991). Agents that had late access to a kill site should obtain hind and forelimb marrow and head contents, generally by scavenging (Blumenschine *et al.* 1991). The destruction of limb-bone ends is usually explained as damage caused by felids, canids and hyenids (Marean & Spencer 1991). This sequence is based only on the skeletal-part representation of a faunal assemblage at a site and does not necessarily take bone surface modifications that may indicate specific processing activities into account. It is important to note the prevalence of anthropogenic modifications and zoogenic modifications to address the processing activities of both agents.

2.12) Southern Cape Subsistence Behaviour

2.12.a) Boomplaas Cave

The subsistence behaviour at BPA varies over time, as there is evidence of low population density at around 65 ka (Faith 2013b). The decline of human populations at the site at this time may be related to the general decrease in human population densities at inland CFR sites and an increase at coastal CFR sites between 60 ka and 20 ka (Faith 2013a). Based on the taphonomic record from BPA discussed in section 2.8, human involvement is largely absent from the HP and post-HP industries (Faith 2013a). The OCH faunal assemblage is associated with a carnivore/raptor-accumulated assemblage, suggesting minimal or short-lived human occupation at the site during the deposition of the member (Faith 2013a). As there are no percussion marks in the faunal assemblage from this member, it is possible that marrow extraction was not practiced during the HP (Faith 2013a). There is limited evidence for human involvement in the post-HP members, although very few percussion marks (0.7%) are present on large ungulates, implying that it was also minimal during the post-HP industries (Faith 2013a). There is evidence of more extensive human occupation and exploitation of coastal and terrestrial resources at sites along the CFR coastline at similar dates (Faith 2013a). Regarding subsistence behaviours of humans at BPA from the HP and post-HP phases, it is possible that during the brief occupation humans focused on hunting larger ungulates, particularly in the post-HP members (Faith 2013b). The evidence for intensive human occupation and exploitation is more prevalent in the Later Stone Age (LSA) and early MSA faunal assemblages at BPA (Faith 2013a).

2.12.b) Klipdrift Shelter

The subsistence strategies at KDS appear to vary during the HP, as prey focus changes. Percussion marks are present on low-ranked and high-ranked elements and prey, implying that KDS may have had a marrow-based subsistence strategy, where bone marrow extraction was the main focus in selecting bones to transport back to the site (Reynard *et al.* 2016b). This focus on bone marrow extraction is not

specifically linked to only the HP faunal assemblage at KDS, as there is evidence supporting this type of subsistence strategy throughout the MSA sequence (Reynard *et al.* 2016b). The prevalence of these percussion marks on low-ranked elements suggest that the HP layers at KDS represent a period of intensive processing by humans (Reynard *et al.* 2016a). These shifts in subsistence strategies may be related to environmental conditions and increasing occupational intensities (Reynard *et al.* 2016a; Reynard *et al.* 2016b). These shifts in occupational intensities are evident in the shellfish and bone densities and burning data (Reynard *et al.* 2016a). These data indicate that the middle HP layers were the most intensely occupied periods, and the uppermost and lowermost layers were less intense and had a greater influence of non-human accumulators (Reynard *et al.* 2016a).

2.13) Subsistence Behaviour at Klasies River

There have been various subsistence behaviour theories applied to the KRM faunal assemblages, including the 'Schlepp Effect' by Richard Klein (1976), the 'Klasies Pattern' (Klein 1989; Marean & Frey 1997; Bartram & Marean 1999), the scavenging model by Lewis Binford (1984) and evidence for active hunting proposed by Richard Milo (1998), from the earlier MSA layers in cave 1. Lap (2020) has conducted the most recent taphonomic analyses on the MSA II faunal assemblage from the Wurz excavations in cave 1, inferring possible subsistence strategies from four layers from the SASL sub-members. There has also been research investigating the possible use of traps during the MSA I and MSA II industries at KRM by Dusseldorp and Langejans (2015), and competition between early modern humans and carnivores from multiple MSA and HP layers in caves 1, 1A and 1B (Thackeray 1990). There are very few taphonomic studies on the HP fauna at KRM, the most recent being by Achieng (2019) inferring the possible strategies from two HP layers from cave 1A. The studies from all stages at KRM will be discussed in turn in the order they are mentioned here, as this dissertation also discusses subsistence behaviour and may change the perceptions on some of the principles of previous studies.

Klein's (1976) analysis of the Singer and Wymer (1967-68) cave 1 faunal assemblage had two major goals: to determine possible subsistence strategies and interpret possible implications for the skeletal element abundance from KRM. An essential part of Klein's interpretation was the idea of the 'Schlepp Effect' to explain the cranial to post-cranial element ratios and the limb to foot bone ratios among bovid size classes in the assemblage (Klein 1976). The 'Schlepp Effect' occurs when faunal assemblages are dominated by cranial and foot bones (Perkins & Daly 1968; Klein 1976). The 'Schlepp Effect' implies that the skeletal element representation at KRM suggests that the MSA hunters were likely to bring back small animals intact to the site but would bring back selected high-rank elements of larger animals (Klein 1976; Turner 1989; Outram 2000). If this effect played a role in the skeletal element abundances in an assemblage, it is assumed that there would be a significant difference in element abundances

between the camp and kill site (Klein 1976). Occupational sites would be likely dominated by limb-bones with low frequencies of axial elements, whereas there would be high frequencies of cranial and axial elements at the kill or butchery site (Marean *et al.* 1992). Turner (1989) argued that using this theory for the KRM fauna was based on sampling biases, as faunal retention from past excavations was highly selective, while recent excavations feature a wider range of high and low-ranked elements. Klein's (1976) use of the 'Schlepp Effect' does not consider alternative explanations for the contrast in element abundances. It does not consider the effects that density-mediated processes such as carnivore activities or post-depositional processes would have had on the assemblage and element abundances (Marean *et al.* 1992).

Klein's (1989) re-examination of the faunal assemblage concluded that differential transport and destruction and its connection to carcass body sizes provides another explanation for the contrast in skeletal part representation of smaller and larger ungulates at KRM. This contrast and the head-and-foot pattern evident at KRM has been referred to as the 'Klasies Pattern' by researchers (Marean & Frey 1997; Bartram & Marean 1999). The pattern is characterised by relatively complete skeletal elements for small bovids, and larger bovids exhibiting a prevalence of skulls and phalanges (Bartram & Marean 1999). Bartram and Marean (1999) note that long bone elements significantly increases with midshaft identifications (Bartram & Marean 1999; Klein *et al.* 1999). Marean and Frey (1997) argue that bone density-mediated destruction and carnivore activities affect skeletal part abundances

Binford reviewed the faunal assemblage studied by Richard Klein in 1976 (Binford 1984). Binford (1984) argued that the smaller bovids from KRM were likely hunted and the larger bovids were scavenged by humans (Turner 1989; Van Pletzen 2000). He proposed that the representation of larger mammal head and lower limb skeletal parts in the same assemblage analysed by Klein (1976) indicated scavenging activities, as size IV and V mammals were beyond the hunting capabilities of MSA early modern humans (Turner 1989; Outram 2000). Binford supported his scavenging theory with the observation of cut marks on some remains. He argued that the marks observed on smaller animals in the assemblage were consistent with hunting activities, whereas the marks observed on the larger animals were consistent with disarticulation of the lower limbs from not freshly hunted carcasses or scavenging the lower limb elements from carcasses hunted by carnivores (Outram 2000).

Milo's (1998) taphonomic analysis of the faunal assemblages from the early MSA industries (MSA I and II) contrasted with Binford's (1984) assertions and revealed direct evidence for humans hunting large bovids during the early MSA sequence at KRM. This evidence is a large quartzite artefact implanted in the centrum of a cervical vertebra of an adult *Pelorovis antiquus* (giant buffalo) (Milo 1998). The location and orientation of this artefact and the condition of the bone implies that the artefact

did not become embedded in it from post-depositional processes (Milo 1998). The presence of this artefact implanted in the vertebra could indicate the possible use of hafted weapons for hunting or the use of traps in the early phases of the MSA sequence at KRM (Milo 1998). Dusseldorp and Langejans (2015) have suggested that the representation of smaller, nocturnal bovids in the SAS member (equivalent to MSA II) could indicate that trapping or net-hunting was an important hunting strategy. The location and orientation of the artefact suggest that the weapon would have had to pierce the animal's neck at a low angle at close range (Milo 1998; O'Driscoll & Thompson 2018). Milo's analysis also indicates that butchery modifications were common on distal limb elements of larger mammals (Milo 1998). This evidence, along with little evidence of carnivore damage, suggests that early MSA humans at KRM possibly had first access to the higher-ranked skeletal elements of larger bovids and thus were able to hunt larger prey, contradictory to Binford's scavenging theory (Milo 1998; Outram 2000). This analysis, however, does not provide an explanation for the unusual skeletal part abundance pattern in the faunal assemblages from KRM (Outram 2000).

Lap (2020) provides the most recent research on subsistence and processing during the MSA II at KRM. There is a prevalence of percussion-marked long bone fragments and spiral breakages throughout the SASL sub-member, implying that marrow extraction was common during the MSA II phase, particularly marrow-extraction from larger ungulates (Lap 2020). Based on the cut mark data, the butchery strategies may have remained similar throughout the SASL sub-member. She concluded that the presence of cut marks on the ventral surfaces of thoracic and lumbar vertebrae acts as evidence of carcass acquisition sequences as they indicate first or early human access to a carcass (Nilssen 2000). These cut marks indicate that humans acquired the meat through either hunting or aggressive scavenging activities (Nilssen 2000; Lap 2020).

The faunal assemblages from multiple MSA industries from caves 1, 1A and 1B at KRM likely represent intervals of human and carnivore accumulations. Thackeray (1990) used carnivore-ungulate ratios to distinguish between human and carnivore agents of accumulation. Thackeray (1990) used the minimum number of individuals (MNI) data, from previously published papers (Klein 1976), of different taxa from multiple layers and technocomplexes from the caves to calculate various faunal indices. Thackeray (1990) argued that the presence of *Raphicerus* species (Cape grysbok, steenbok etc.) in the KRM MSA faunal assemblages corresponds to an increase in the probability of carnivore accumulations, as high *Raphicerus* occurrence rates at the site are associated with relatively high frequencies of carnivores such as *Panthera pardus* (leopard) or *Hyaena brunnea* (brown hyena). Smaller mammals, such as *Procavia capensis* (rock hyraxes), are generally more abundant in the faunal assemblages with higher abundances of *Raphicerus*, leopard and baboon remains (Thackeray 1990). He argued that these assemblages have little evidence of human activity at the site, such as evidence of

fires, and this implies that carnivores were using the site during times when human occupation was low. In cave 1A, the HP layers (Singer & Wymer 1982 layers 10-21) have low frequencies of carnivore, *Raphicerus*, baboon and rock hyrax remains, whereas the MSA III layers (layers 1-9) have slightly higher frequencies of these remains (Thackeray 1990, refer to Table 1: 102). Therefore, the HP industry at KRM in cave 1A should have more evidence of human activity than the MSA III industry which would have more evidence of carnivore activity, based on the faunal indices calculated by Thackeray (1990).

Achieng (2019) conducted the most recent research on subsistence and processing activities at KRM in two HP layers from square J51 in cave 1A. The cut marks observed on the vertebrae and dorsal rib elements of the smaller bovids (sizes I and II) imply that disarticulation may have occurred. There were also cut marks noted on phalanges and sesamoids which may indicate skinning activities (Reynard *et al.* 2016b; Achieng 2019). Layer CP4 has significantly more percussion marks on long bone and rib shaft fragments than layer YS5, indicating more intense processing in this layer (Achieng 2019). These percussion marks, along with the prevalence of burning and spiral breakages in layer CP4 could reflect a bone marrow extraction strategy like at KDS (Achieng 2019). Skeletal part profiles from these layers has high abundances of hindlimbs and distal limb elements and low cranial abundance, which differs from studies at other HP sites, such as KDS which has higher abundances of cranial parts (Reynard *et al.* 2016b; Achieng 2019). The skeletal profile from the HP layers at KRM exhibit the 'Klasies Pattern' discussed above. This difference in skeletal part abundances indicates different processing focuses at the sites (Reynard *et al.* 2016b; Achieng 2019).

2.14) Summary

This chapter presented an overview of the changes in environmental conditions and subsistence strategies in the southern Cape between MIS 4 and 3. This section provided background on the taphonomic studies from MIS 3-4 sites, most of which feature the HP industry, This dissertation focuses on the taphonomic analyses of selected layers from the MSA III and HP industries at KRM to infer the changes in agents of accumulation, subsistence strategies, site occupation and site formation processes between the industries. This study will enable the comparison of results obtained from other sites to analyse the transition between the HP and MSA III industries through faunal taphonomic studies.

Chapter 3: Methods and Materials

The following chapter discusses the materials sampled for this study as well as the methodology utilised to conduct the taphonomic analyses. It provides descriptions of terms used in taphonomic studies and various advantages and disadvantages.

3.1) Materials

The focus of this research is the large mammal specimens from square E50 from cave 1A from KRM (Figure 3.1). The materials were recovered during the 1984-1995 excavation programme led by Hilary Deacon (Deacon & Geleijnse 1988; Deacon 1995). These macromammal specimens originate from the Middle Stone Age III layers (CP2; BSS1; BSS2 AF1; BSS2; CP3; BSS3 and CP4) and the Howiesons Poort layers (CP5; YS4; CP6 (a); CP6 (b); CP9 (a); CP9 (b) and CP9) (Figure 3.2). The sample comprises the identifiable (ID) and non-identifiable (non-ID) macromammal specimens from these layers. 'Identifiable' here refers to specimens that can be identified to at least skeletal element and class (Lyman 2008). 'Non-Identifiable' refers to specimens that cannot be identified to skeletal element, and these were sorted based on size (> 2cm and < 2cm). Taphonomic analyses were conducted on these fragments, but surface conditions were analysed on those with cortical surfaces.

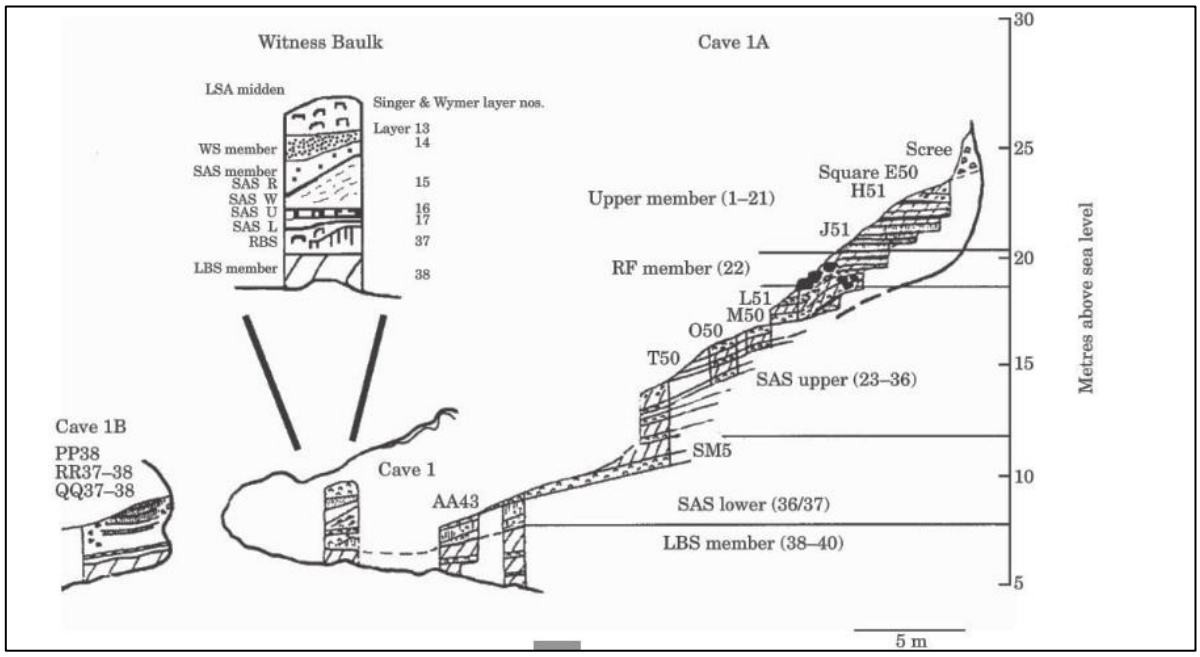

Figure 3.1: Units, members, and squares (Deacon members and Singer & Wymer layers) (Wurz 2002).

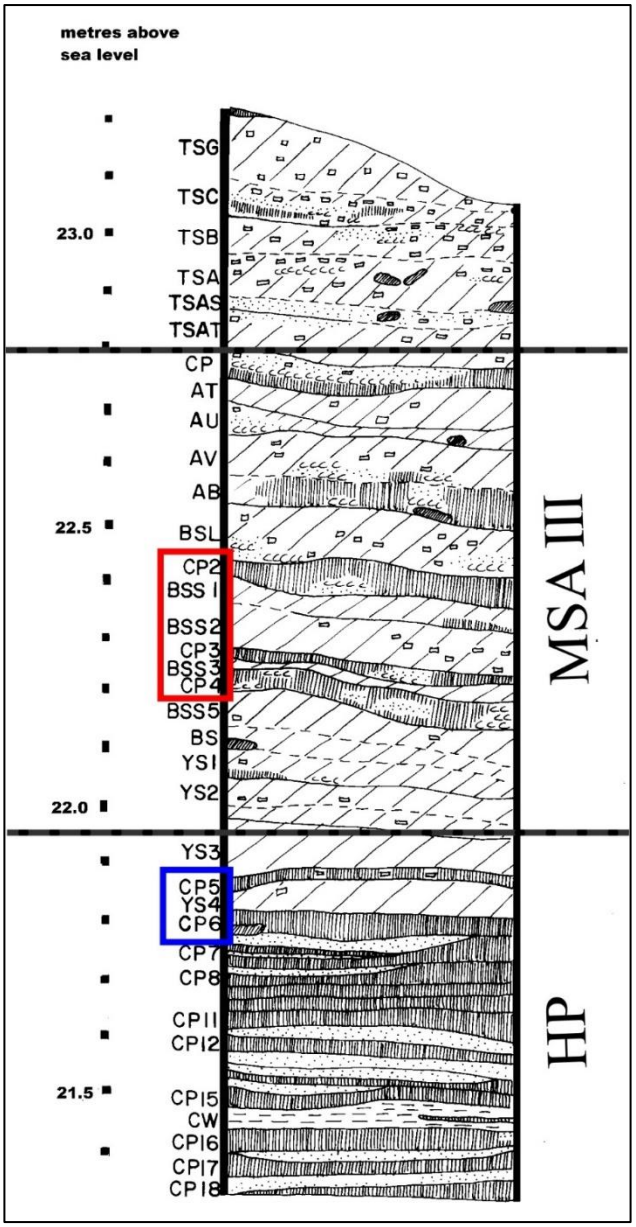

Figure 3.2: Stratigraphy of the MSA III and HP layers in square E50 (Villa *et al.* 2010). Materials for research originate from layers in red and blue boxes.

3.2) Bone Identification

This research focuses on the taphonomy of these remains, therefore higher taxonomic identifications (family, genus, and species) were not prioritised here. Taxonomic identifications for this research are based on the taxonomic information provided in previous research (Van Pletzen 2000; Van Pletzen-Vos *et al.* 2019). Apart from these remains that were previously identified to taxa, further classification was undertaken. Identifiable elements from the sample in this research were classified using faunal comparative collections from the University of the Witwatersrand and the Ditsong Museum of Natural

History. These elements were identified based on diagnostic features, such as articular surfaces and tuberosities. Specimens that could only be identified as 'mammal' were categorised as small, medium, or large mammals (Klein 1976; Milo 1998; Van Pletzen 2000). Specimens identified as bovids were grouped into size classes based on Brain's (1974) size categories (Table 3.1). The cortical thickness of unidentified long bone fragments were measured to infer the relative size of the individual animal (Reynard *et al.* 2014) (Table 3.2).

Table 3.1: Bovid size classes and examples (Brain 1974; Klein 1976).

Bovid size classes (weight range)	**Examples**
I (0 – 23kg)	*Raphicerus* species (sp.) (Steenbok, Grysbok)
II (23 – 84kg)	*Antidorcas* sp. (Springbok)
III (84 – 296kg)	*Connochaetes* sp. (Wildebeest)
IV (296 – 1 000kg)	*Syncerus caffer* (African Buffalo), *Taurotragus oryx* (Common Eland)
V (>1 000kg)	*Pelorovis antiquus* (Giant Buffalo)

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

Mammal size classes	**Long bone cortical thickness range (mm)**
Small mammal	<2
Medium mammal	2 – 5.9
Large mammal	6 – 19.9

3.3) Quantification

The numbers of species and individuals represented in a sample is an important aspect of zooarchaeological research. This is done by using a variety of quantification methods, including the counting of bone fragments, average weights, and average lengths of fragments (Chase & Hagaman 1987). The common abundance and normalisation quantification methods include the Number of Identified Specimens (NISP) (Klein & Cruz-Uribe 1984; Todd & Rapson 1988; Lyman 1994a; Lyman 2008; O'Connor & O'Connor 2008), Minimum Number of Individuals (MNI) (Klein & Cruz-Uribe 1984; Lyman 1994b; Lyman 2008; O'Connor & O'Connor 2008), Normed NISP (Grayson 1984; Reynard *et al.* 2016b), Minimum Number of Elements (MNE) (Binford 1984; Lyman 1994a, Lyman 1994b) and Minimum Animal Units (MAU) (Binford 1984, Todd 1987). These are discussed below. Methods of quantifying faunal remains differ between analysts and factors such as fragmentation and preservation can affect these estimates (Plug & Plug 1990).

Abundance

3.3.1) Number of Identified Specimens (NISP)

The NISP involves the raw count of the identified specimens in the sample (Klein & Cruz-Uribe 1984: 24-25; Todd & Rapson 1988: 307; Lyman 1994a: 290). The NISP values in this research derive from the number of all the specimens that have been identified to skeletal element and at least class level, which includes bovid and mammal size classes (Lyman 1994a: 290). Rib, vertebrae, and cranial elements have been categorised into mammal size classes. The advantages of NISP counts is that it is easy to calculate and provides an estimated relative frequency of the taxa represented in the sample (Klein & Cruz-Uribe 1984: 25). This method, however, does not take into account the taphonomic processes (differential preservation, transportation, butchery practices, fragmentation) that may affect this estimation (Klein & Cruz-Uribe 1984: 25; Lyman 2008: 281; O'Connor & O'Connor 2008: 56).

3.3.2) Minimum Number of Individuals (MNI)

MNI counts involve determining the number of individuals necessary to account for all specimens of specific taxa in a sample, thus estimating the number of animals represented in the assemblage (Lyman 1994b: 38; Peres 2010: 27). Calculating MNI values generally involves sorting the identified skeletal elements into left and right sides, where the highest value of the sided elements represents the minimum number of individuals for that specific taxa (O'Connor & O'Connor 2008: 59). MNI measure taxonomic abundance (Lyman 1994c), therefore MNIs were not calculated for remains identified to the generic bovid and mammal size classes categories as these remains may belong to a number of different species. The advantage of this method is that it will estimate the actual number of individuals in a sample (Klein & Cruz-Uribe 1984: 30). The disadvantage of this method is that it can underestimate or overestimate the abundance of some taxa (Lyman 2008: 78).

Normalisation

3.3.3) Normed NISP (nNISP)

nNISP values refer to the number of elements (NISP values) divided by the number of times the element is represented in an individual's skeleton (Grayson & Fey 2004: 31; Faith 2007: 2007; Van Pletzen-Vos *et al.* 2019: 129). nNISP can also be used to determine the frequency of skeletal groups by adding the nNISP values for the elements in each anatomical region (Table 3.3) and divide it by the number of times those elements occur in that anatomical region (Van Pletzen-Vos *et al.* 2019: 129). Cranial

elements are divided by 2, following Clark (2011: 284). nNISPs are calculated for cranial (skull, maxilla, and mandible) and long bones in this study.

3.3.4) Minimum Number of Elements (MNE)

The MNE values involve the counts of the portions of an individual skeletal element in a sample (Binford 1984: 50; Lyman 1994a: 290; Lyman 1994b: 39). The MNE counts for this sample were calculated for innominate (pelves), upper limbs, lower limbs, distal limbs (Table 3.3). The portions of the elements were identified using Driver's (2005: 27-28) portion codes. There is a high possibility of calculation errors when calculating these values, and there is a risk of identification errors which may result in an overestimation or underestimation of certain regions or portions for some elements (Lyman 1994b: 51).

Table 3.3: Skeletal parts and respective elements

Skeletal part	Skeletal elements
Skull	Crania, mandibles, and maxillae
Upper Limbs	Humerus, radius, ulna, metacarpals, and carpals
Lower Limbs	Femur, tibia, fibula, metatarsals, and tarsals
Distal Limbs	Metapodia, phalanges and sesamoids

3.3.5) Minimum Animal Units (MAU)

The MAU values are calculated by dividing the recovered element frequencies by the number that the specific element region or portion is represented in a single skeleton (Binford 1984: 51). The MAU values are restricted to, and calculated based on, bovid skeletons.

3.4) Taphonomic Analyses

The taphonomic analyses of the materials in this sample include preservation, fragmentation, and surface modifications. The preservation here refers to the surface conditions of the remains. Fragmentation refers to the weights and lengths of the specimens, and the breakage patterns of the ends of long bones. The surface modifications investigated include burning, biotic and abiotic modifications. All specimens, excluding tooth fragments and spongy bone, were analysed using an Olympus microscope under 4.5X, 16X or 40X magnification.

3.4.1) Preservation

The surface conditions of the specimens in the sample were analysed, as it gives insight into what factors play a role in the preservation of the assemblage (Schepartz *et al.* 2003). Three main categories of cortical surface condition types were assessed in this research, exfoliated, porous and chalky surfaces (Schepartz *et al.* 2003; Morin 2010). Spongy bone is included in this section, as frequencies of spongy bone to cortical bone can give insight into preservation factors. Spongy bone has no cortex and is composed of thin interconnected spicules (Morin 2010: 210). Exfoliated surfaces include surfaces that are cracked or where the exterior surface appears to have been removed or flaked off (Schepartz *et al.* 2003: 102; Langley & Tersigni-Tarrant 2017: 285). Exfoliation can be caused by many factors, including mild weathering, burning, moisture and movement (Behrensmeyer 1978: 161). Porous bone is described as less dense and more fragile than other types of conditions and is identifiable by perforations on the bone surface (Langley & Tersigni-Tarrant 2017: 285). Chalky surfaces are identifiable by a powdery exterior surface (Cain 2005: 875). Chalky surfaces have been affected by sediments (Schepartz *et al.* 2003: 102-103), and some heated bones can have a powdery exterior surface (Nicholson 1993: 418).

3.4.2) Fragmentation

The fragmentation intensity of the remains in this sample were assessed in two ways. The first involves the sizes and weights of the specimens (Lyman 1979; Klein & Cruz-Uribe 1984; O'Connor & O'Connor 2008). The second involves the breakage patterns of the ends of the long bones in the sample (Johnson 1985; Todd & Rapson 1988; Villa & Mahieu 1991; White & Folkens 2005).

The maximum lengths of the specimens and the combined length of refitted remains were measured with a digital calliper, as they are less likely to give inaccurate measurements (Klein & Cruz-Uribe 1984: 22). A summary statistics table on the lengths per layer are provided in the next chapter with the following calculations and statistics: maximum length, minimum length, and mean length. The cortical thickness for identified and unidentified long bones was measured based on Reynard *et al.* (2014) to infer the relative size of the individual. The remains in the sample were weighed by layer with a Ohaus scale. The average weights of the individual specimens in the layers were calculated by dividing the total weight of the layer by the total number of remains per layer. The weights of the remains can be affected by many factors, such as weathering and preservation (Lyman 1979: 536). Larger fragments may also impact the average weight as larger fragments will be over-represented while the smaller fragments will be under-represented (O'Connor & O'Connor 2008: 57).

The breakage patterns of the long bone ends were assessed based on Villa & Mahieu's (1991) and Driver's (2005) descriptions of spiral, transverse, irregular, splintered, and eroded breakages. Spiral breakages are characterised by V-shaped fracture outlines (Villa & Mahieu 1991: 34), with usually straight, sharp, and linear edges (White & Folkens 2005: 51). Transverse breakages are described as breaks that are perpendicular to the long axis of the bone (Driver 200: 30). This type of breakage usually has step fractures (Villa & Mahieu 1991: 41) and rough jagged edges (White & Folkens 2005: 51). Irregular breakages are distinguished by small curves along the edges of the bone (Villa & Mahieu 1991: 41) or by a 'zig zag' appearance (Driver 2005: 30). Splintered breakages show a series of transverse fractures and are usually associated with weathering characteristics (Villa & Mahieu 1991: 43; Driver 2005: 30). Eroded breakages are worn, smooth and rounded, and are generally identified by the presence of cancellous bone on the smooth surface (Driver 2005: 30).

3.4.3) Bone Density-Mediated Attrition

The analysis of bone densities and destruction involves a statistical method, usually by using Pearson's product-moment correlation test or a non-parametric test (Lam & Pearson 2005). The correlation test is between the density of skeletal elements and their relative abundances in the assemblage (Lam & Pearson 2005). A statistically significant correlation between the two is generally interpreted to show the occurrence of density-mediated destruction processes, and the observed element abundance does not necessarily reflect human behaviour (Lam & Pearson 2005). If the result is not statistically significant , it could imply that the features of the faunal assemblages were influenced by human activities (Lam & Pearson 2005). This method is the most used, but it does have several disadvantages. Researchers tend to focus more on the statistical significance of the correlation rather than the influences of bone density. Some bone surface modifications may also be affected by density-mediated destruction and this correlation analysis assumes that each individual identifiable element was originally represented in a whole skeleton and parts of this skeleton were not archaeologically recovered (Lam *et al.* 1999; Lam & Pearson 2005).

3.4.4) Bone Surface Modifications

The surface of the remains in this sample were analysed with an Olympus microscope under 4.5X, 16X or 40X magnification for burning, anthropogenic and zoogenic marks, trampling, and natural bone surface modifications. Any specimens that have been identified as cancellous or spongy bone have been included in the analysis for burning patterns but are excluded from bone surface modifications assessment due to the lack of a cortical surface.

3.4.4.a) Burning Patterns

The specimens were analysed for evidence of heat alteration based on their colouration. Burning in this research is not categorised under Anthropogenic Modifications as bones can also be burned by natural bush fires (Clark & Ligouis 2010: 2650). The colouration and intensity of the heat alteration can give insight into intentional, heating by humans cooking the bones , and accidental burning, for example a hearth structure near the bones can affect the colour (Clark & Ligouis 2010: 2650). The colouration caused by heat alteration is dependent on the temperature to which the specimen is exposed to (Shipman *et al.* 1984: 308). The specimens in the sample were grouped into four colouration stages (Table 3.4) (*cf.* Shipman *et al.* 1984: 308; Clark & Ligouis 2010: 2650; Gowlett & Wrangham 2013: 10).

Table 3.4: Burning stages and colour characteristics based on descriptions by Shipman *et al.* (1984: 308); Clark & Ligouis (2010: 2650) and Gowlett & Wrangham (2013:10)

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

3.4.4.b) Anthropogenic Bone Surface Modifications

The specimens were analysed for anthropogenic bone surface modifications, including cut marks and percussion marks. Anthropogenic cut marks include scrape, chop, and slice marks (Potts & Shipman 1981; Fisher 1995). Anthropogenic percussion marks include percussion pits and notches (Blumenschine & Selvaggio 1988; Blumenschine 1995).

Cut marks are elongated, relatively narrow linear striations or grooves (Potts & Shipman 1981: 577; Fisher 1995: 12). These marks are V-shaped and reflect the shape of the tool's cutting edge. Scrape marks are multiple, closely spaced parallel striations that are elongated, linear and relatively narrow (Fisher 1995: 18). Chop marks are broad, relatively short depressions that are V-shaped (Fisher 1995: 19). Slice marks are elongated grooves with multiple parallel striations (Shipman & Rose 1983: 64-65). Percussion pits are small circular depressions, which vary in size, and are associated with microstriations that are in the pit or close to the pit (Fisher 1995: 25-27; Blumenschine et al. 1996: 494).

Percussion notches are semi-circular in shape and the inner surfaces usually have negative flake scars (Blumenschine & Selvaggio 1988: 25).

3.4.4.c) Zoogenic Bone Surface Modifications

The specimens were analysed for zoogenic bone surface modifications and were recorded as present or absent. Data were collected according to variables specifically representing carnivore damage,, including tooth scores and pits, and gastric acid etching (Potts & Shipman 1981; Fisher 1995; Blumenschine *et al.* 1996). Carnivore tooth marks are usually identified as pits or scores, which are U-shaped marks where the internal surface generally shows crushing (Blumenschine *et al.* 1996: 494). Carnivore chewing can produce modifications, such as striations, furrows, jagged edges, and chipped edges (Fisher 1995: 36). Gnaw marks are like anthropogenic modifications and are identified by grooves with rounded or flat bases. These marks lack the fine parallel striations associated with anthropogenic modifications (Potts & Shipman 1981: 577). Gastric acid etching is caused by the digestion of bones ingested by raptors and carnivores, specifically hyaenas (Fisher 1995: 42). These marks are often associated with erosion, polishing and perforation (Fisher 1995: 42).

3.4.4.d) Trampling Modifications

The surface of the specimens were assessed for trampling modifications. These modifications are similar to butchery modifications but differ in microscopic morphology (Dominguez-Rodrigo *et al.* 2009: 2643). Trampling marks are defined as multiple closely spaced and intersecting marks which vary in length, breadth, and curvature (Andrews & Cook 1985: 681). These marks, at first glance, may resemble butchery marks, however, these marks are most common on shafts and are rarely observed on articular surfaces (Andrews & Cook 1985: 681). For this research,these modifications were identified and classified based on the descriptions by Dominguez-Rodrigo *et al.* (2009) and Reynard (2014) for trampling scratches, lines, grooves, and pits. Trampling scratches are shallow, fine lines which resemble the microstriations associated with percussion marks (Fisher 1995: 36; Dominguez-Rodrigo *et al.* 2009: 2647; Reynard 2014: 5; Courtenay *et al.* 2019: 8). Trampling lines are described as furrows where the V-shaped modifications profile resemble cut marks. Trampling grooves are visible V-shaped furrows. Trampling pits and elongated pits are V and U-shaped and have a raised platform on the side of the depression (Reynard 2014: 5). Abrasion, sheen, and polish are also associated with trampling activities (Reynard 2014: 5).

3.4.4.e) Natural Bone Surface Modifications

The surface of the specimens was analysed for "natural bone surface modifications. These are abiotic, and include weathering, encrustation, abrasion, rounding, root etching, acid etching and manganese staining.

Weathering characteristics were identified using Behrensmeyer's (1978) descriptions, such as cracking, flaking, rough weathered patches and splintering (Behrensmeyer 1978: 151). Specimens with weathering characteristics were grouped together and recorded as present or absent.

Encrustation is described as the accumulation of sediments or other minerals that appears as a white or off-white coating on the surface of bones (Boa *et al.* 1998: 727; Pokines & Symes 2013: 334). Encrustation in this research was recorded as present or absent.

Abrasion is defined as a shiny and polished appearance on a bone surface (Madgwick 2014: 163; Reynard *et al.* 2016b: 13). Abrasion can be caused by natural and non-natural agents (Reynard *et al.* 2016b: 13). Abrasion in this research was recorded as present or absent.

Rounding is described as the physical wearing down of (Lyman 1994c: 383). The edges of rounded specimens are smooth and generally have microscopic striations (Lyman 1994c: 383; Reynard 2014: 168). Rounding in this research was recorded as present or absent.

Root etching is distinguished by distinctive sinuous or wavy lines that have a U-shaped profile. Root etching typically consists of multiple lines that are thin and shallow (Fisher 1995: 43). Acid etching produces modifications like gastric acid etching, but there are differences in the morphology and intensity. The surfaces of the specimens were assessed for any features of these modifications.

Manganese staining appears as a black surface coating, usually in spots or patches (Fernandez-Jalvo & Andrews 2003: 156). Manganese staining was identified based on the descriptions by Lopez-Gonzalez *et al.* (2006: 709) and were recorded as present or absent.

3.5) Summary

The methods used in this study are similar to those used by other researchers that study faunal remains (Reynard *et al.* 2014; 2016a) as these standardised methods can be used to compare results between sites. The quantification methods used in this study, despite their disadvantages, are widely used in faunal studies.

Chapter 4: Results

This chapter reports the results of the taphonomic analysis of the bone specimens from selected MSA III and HP layers from square E50, cave 1A, KRM. First, the faunal assemblages are quantified in the form of lengths and weights, NISP, nNISP, MNI, MNE and MAU. Subsequently, taphonomy, including preservation, fragmentation and surface modifications is discussed.

4.1) Sample

This study was undertaken on a sample of specimens from the MSA III and HP layers from square E50 in cave 1A (Table 4.1).

Table 4.1: MSA III and HP non-ID and ID specimens

MSA III layers	Non-ID <2cm n (%)	Non-ID >2cm n (%)	ID n (%)	Total N (%)	% of total	Weight (g)	m^3	Faunal density kg/m^3
CP2	801 (84.1)	98 (10.3)	53 (5.6)	**952 (100)**	**8.4**	**588**	**0.062**	**9.48**
BSS1	1 107 (92.9)	60 (5.0)	24 (2.1)	**1 191 (100)**	**10.5**	**419.3**	**0.044**	**9.53**
BSS2 AF1	113 (89.0)	8 (6.3)	6 (4.7)	**127 (100)**	**1.1**	**72.7**	**0.008**	**9.09**
BSS2	2 219 (92.3)	115 (5.0)	63 (2.7)	**2 307 (100)**	**20.3**	**776.4**	**0.081**	**9.59**
CP3	1 392 (86.1)	185 (11.4)	40 (2.5)	**1 617 (100)**	**14.2**	**905.4**	**0.095**	**9.53**
BSS3	2 690 (93.0)	140 (4.8)	61 (2.2)	**2 891 (100)**	**25.4**	**1 040.3**	**0.109**	**9.54**
CP4	2 046 (89.3)	181 (7.9)	64 (2.8)	**2 291 (100)**	**20.1**	**1 173.3**	**0.122**	**9.61**
Total N (%)	**10 278 (90.3)**	**787 (6.9)**	**311 (2.8)**	**11 376 (100)**	**100**	**4 975.5**	**0.521**	**9.54**
HP layers	**Non-ID <2cm n (%)**	**Non-ID >2cm n (%)**	**ID n (%)**	**Total N (%)**	**% of total**	**Weight (g)**	**m^3**	**Faunal density kg/m^3**
CP5	340 (81.5)	65 (15.6)	12 (2.9)	**417 (100)**	**8.2**	**301.3**	**0.031**	**9.72**
YS4	419 (85.7)	58 (11.8)	12 (2.5)	**489 (100)**	**9.6**	**241.4**	**0.025**	**9.66**
CP6 (a)	732 (76.5)	200 (20.9)	25 (2.6)	**957 (100)**	**18.9**	**1 009.5**	**0.106**	**9.52**
CP6 (b)	636 (74.3)	184 (21.5)	36 (4.2)	**856 (100)**	**16.9**	**928**	**0.097**	**9.57**
CP9 (a)	1 289 (87.9)	169 (11.5)	9 (0.6)	**1 467 (100)**	**28.9**	**711.4**	**0.074**	**9.61**
CP9 (b)	651 (76.1)	174 (20.3)	31 (3.6)	**856 (100)**	**16.9**	**762.3**	**0.080**	**9.53**
CP9	14 (48.3)	14 (48.3)	1 (3.4)	**29 (100)**	**0.6**	**81.1**	**0.008**	**10.14**
Total N (%)	**4 081 (80.5)**	**864 (17.0)**	**126 (2.5)**	**5 071 (100)**	**100**	**4 035.3**	**0.421**	**9.58**
Grand Total N (%)	**14 359 (87.3)**	**1 651 (10.0)**	**473 (2.7)**	**16 447 (100)**	**100**	**9 010.8**	**0.942**	**9.56**

The volume for the excavated deposits analysed here from the MSA III layers is $0.521m^3$, and $0.421m^3$ for the deposits from the HP layers (Table 4.1). The entire sample comprises 16 447 specimens with a total weight of 9 010.8g (Table 4.1). The total weights of the samples analysed for the MSA III and HP

are similar, but there are almost double the amount of specimens in the MSA III sample. Table 4.1 shows the proportion of identifiable (ID) remains and non-identifiable (non-ID) smaller and larger than 2cm. The proportions of ID bones in the MSA III (2.8%) and HP (2.5%) are similar. The number of the non-ID specimens exceeds the number of ID specimens in both samples (Table 4.1). The sample analysed comprises the non-ID >2cm and ID specimens for the MSA III (N= 1098) and the HP (N= 990).

4.2) Quantification

4.2.a) Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI)

The NISP for the MSA III and HP samples are 311 and 124 respectively, and includes all specimens identified to skeletal element and to at least size class. Ribs, vertebrae, and indeterminate cranial elements have been categorised into mammal size classes for both samples. The highest NISP values are associated with medium mammal specimens for both samples (Table 2). Both samples have similar proportions of Cape fur seals (Table 4.2). The MSA III sample is dominated by BOV I , medium mammal and hyrax (Table 4.2). Larger bovids (BOV III to BOV IV/5) and mammals, including the extinct *Megalotragus* ('giant hartebeest'), eland, and extinct long-horned buffalo, occur more frequently in the HP sample (Table 4.2). The MNI values are generally small in both samples, and the total MNI values for the MSA III sample is 27 , and 9 for the HP sample (Table 4.2). BOV I and hyrax have the highest MNI values in the MSA III sample, whereas medium mammals and BOV III have the highest in the HP sample (Table 4.2).

Table 4.2: MSA III and HP NISP and MNI values (see Appendix A Table A.1 and A.2 for layers)

MSA III						
Order	**Taxa**	**Common Name**	**NISP**	**% NISP**	**MNI**	**% MNI**
Rodentia	*Bathyergus siullus*	Cape dune mole rat	1	0.3	1	3.7
Hyracoidea	*Procavia capensis*	Hyrax	39	12.5	9	33.3
Carnivora	*Arctocephalus pusillus*	Cape fur seal	12	3.9	7	25.9
	Carnivore: canid	Carnivore	2	0.6	1	3.7
	Carnivore: felid		4	1.3	2	7.4
	Carnivore: indet.		8	2.6	3	11.1
Ruminantia	Bovidae: BOV I	Bovid	62	19.9		.
	BOV II		20	6.4		.
	BOV II/III		3	1.0		.
	BOV III		34	10.9		.
	BOV III/IV		3	1.0		.
	BOV IV		10	3.2		.
	BOV IV/V		3	1.0		.
	Connochaetes sp.	Wildebeest	2	0.6	1	3.7
	Equid: indet.	Zebra/quagga	1	0.3	1	3.7
	Syncerus caffer	African buffalo	9	2.9	2	7.4

Table 4.2: MSA III and HP NISP and MNI values cont. (see Appendix A Tables A.1 and A.2 for layers)

Mammal: Indet	Small	Mammal	15	4.8		.
	Medium		66	21.2		.
	Large		17	5.5		.
Total			**311**	**100**	**27**	**100**
HP						
Order	**Taxa**	**Common Name**	**NISP**	**% NISP**	**MNI**	**% MNI**
Rodentia	*Hystrix africaeaustralis*	Porcupine	1	0.8	1	11.1
Carnivora	*Arctocephalus pusillus*	Cape fur seal	4	3.2	2	22.2
	Carnivore: indet.	Carnivore	1	0.8	1	11.1
Ruminantia	*Alcelaphine* sp.	Hartebeest	10	8.1	1	11.1
	Antidorcas sp.	Springbok	1	0.8	1	11.1
	Bovidae: BOV I	Bovid	8	6.5		.
	BOV II		7	5.6		.
	BOV III		16	12.9		.
	BOV III/IV		4	3.2		.
	BOV IV		11	8.9		.
	BOV IV/V		4	3.2		.
	Megalotragus sp.	Giant hartebeest	1	0.8	1	11.1
	Pelavoris antiquus	Long-horned buffalo	5	4.0	1	11.1
	Taurotragux oryx	Eland	3	2.4	1	11.1
Mammal: Indet	Small	Mammal	4	3.2		.
	Medium		29	23.4		.
	Large		15	12.1		.
Total			**124**	**100**	**9**	**100**

4.2.b) Bovid Normed NISPs (nNISP)

There are less bovid specimens in the HP sample than the MSA III sample. The nNISP values are limited to bovid specimens, excluding teeth (Table 4.3). The MSA III sample has higher nNISP values for BOV I lower limb elements, especially femora and tibiae, whereas a variety of high survival elements of larger bovid sizes have the highest values for the HP sample (Table 4.3). Figures 4.1 and 4.2 illustrate the skeletal part profile for the bovid size classes using the combined nNISP values. In these figures BOV I , BOV II and BOV II/III are categorised as 'Small bovid' and bovids from size 3 and larger are categorised as 'Large bovid'

Table 4.3: MSA III and HP bovid NISP and nNSIP values

MSA III														
Element	**BOV I**		**BOV II**		**BOV II/III**		**BOV III**		**BOV III/IV**		**BOV IV**		**BOV IV/V**	
	NISP	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**
Cranium	2	1	2	1	1	0.5	1	0.5	..	..	3	1.5	..	..
Mandible	1	0.5	1	0.5	1	0.5	..	..	..	..	1	0.5	..	..
Maxilla	..	..	1	0.5	..	..	..	..	..	..	1	0.5	..	..
Teeth	2	..	..	..	..	..	6	..	1	..	7	..	..	..
Skull	**5**	**0.5**	**4**	**0.7**	**2**	**0.3**	**7**	**0.2**	**1**	**..**	**12**	**0.8**	**..**	**..**
Carpal	4	..	..	..	..	..	2	..	..	..	..	..	..	..
Humerus	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..
Metacarpal	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..
Radius	1	0.5	1	0.5	..	..	1	0.5	..	..	..	..	..	..
Upper limbs	**5**	**0.2**	**1**	**0.2**	**..**	**..**	**5**	**0.5**	**..**	**..**	**..**	**..**	**..**	**..**
Pelves	1	..	..	..	..	..	1	..	..	..	..	..	..	..
Innominate	**1**	**..**	**..**	**..**	**..**	**..**	**1**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
Astragalus	1	..	..	..	1	..	..	..	..	..	..	..	..	..
Calcaneum	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Femur	4	2	..	..	..	..	..	..	..	..	..	..	..	..
Metatarsal	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..
Patella	2	..	..	..	..	..	..	..	..	..	..	..	..	..
Tarsal	1	..	1	..	..	..	4	..	..	..	..	..	..	..
Tibia	5	2.5	1	0.5	..	..	2	0.5	..	..	..	..	..	..
Lower limbs	**13**	**1.4**	**3**	**0.2**	**1**	**..**	**7**	**0.3**	**..**	**..**	**..**	**..**	**..**	**..**
Metapodial	7	1.8	1	0.3	..	..	7	1.8	1	0.3	4	1	2	0.5
Phalanges	26	..	7	..	..	..	5	..	..	..	2	..	1	..
Sesamoid	5	..	4	..	..	..	4	..	1	..	1	..	..	..
Distal limbs	**38**	**1.8**	**12**	**0.3**	**..**	**..**	**16**	**1.8**	**2**	**0.3**	**7**	**1**	**3**	**0.5**
HP														
	NISP	**nNISP**	**NISP**	**nNISP**	*****	*****	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**	**NISP**	**nNISP**
Hyoid	..	..	..	..	..	..	..	..	1	..	..	..	1	..
Mandible	..	..	1	0.5	..	..	..	..	..	..	..	..	..	..
Teeth	..	..	1	..	..	..	17	..			4	..	5	..
Skull	**..**	**..**	**2**	**0.2**	**..**	**..**	**17**	**..**	**1**	**..**	**4**	**..**	**6**	**..**
Carpal	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Humerus	..	..	..	..	..	..	..	..	..	..	..	..	1	0.5
Metacarpal	..	..	..	..	..	..	..	..	..	..	1	0.5	..	..
Radius	..	..	1	0.5	..	..	..	..	..	..	..	..	..	..
Ulna	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..
Upper limbs	**..**	**..**	**1**	**0.2**	**..**	**..**	**2**	**0.2**	**..**	**..**	**1**	**0.2**	**1**	**0.2**
Astragalus	1	..	..	..	..	..	..	..	..	..	1	..	..	..
Femur	1	0.5	..	..	..	..	1	0.5	..	..	..	..	..	..
Metatarsal	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..
Patella	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Tarsal	..	..	3	..	..	..	1	..	..	..	..	..	..	..
Tibia	..	..	..	..	..	..	1	0.5	1	0.5	..	..	..	..
Lower limbs	**3**	**0.2**	**3**	**..**	**..**	**..**	**4**	**0.5**	**1**	**0.2**	**1**	**..**	**..**	**..**
Metapodial	1	0.3	..	..	..	..	..	..	1	0.3	3	0.8	2	0.5
Phalanges	4	..	1	..	..	..	2	..	1	..	2	..	..	..
Sesamoid	..	..	1	..	..	..	1	..	..	..	4	..	..	..
Distal limbs	**5**	**0.3**	**2**	**..**	**..**	**..**	**3**	**..**	**2**	**0.3**	**9**	**0.8**	**2**	**0.5**

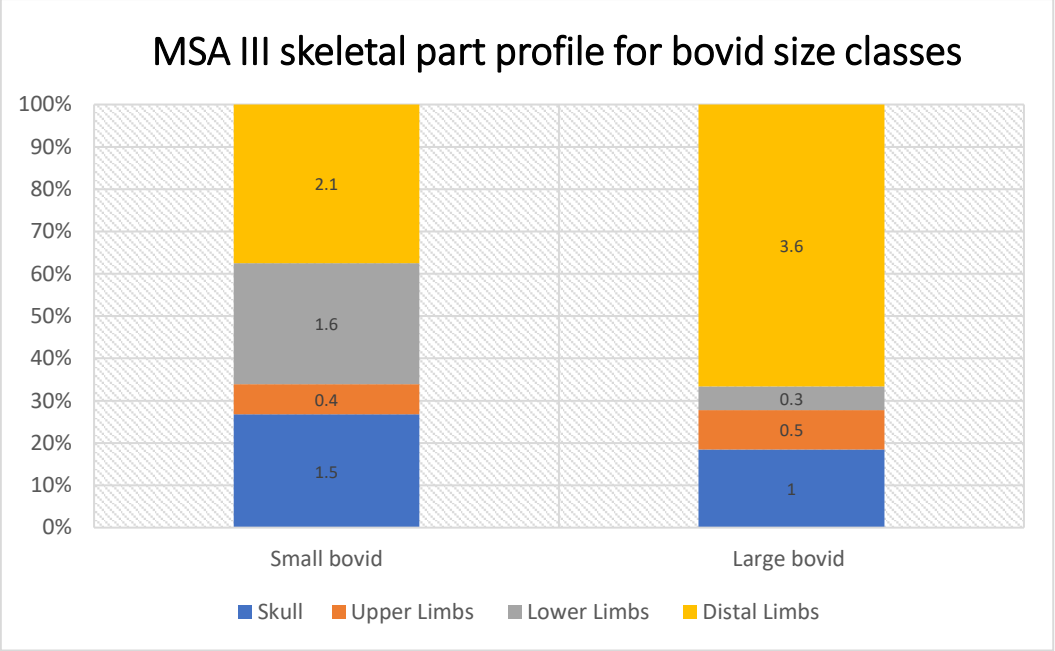

Figure 4.1: MSA III skeletal part profile for small and large bovids (combined nNISP values in columns)

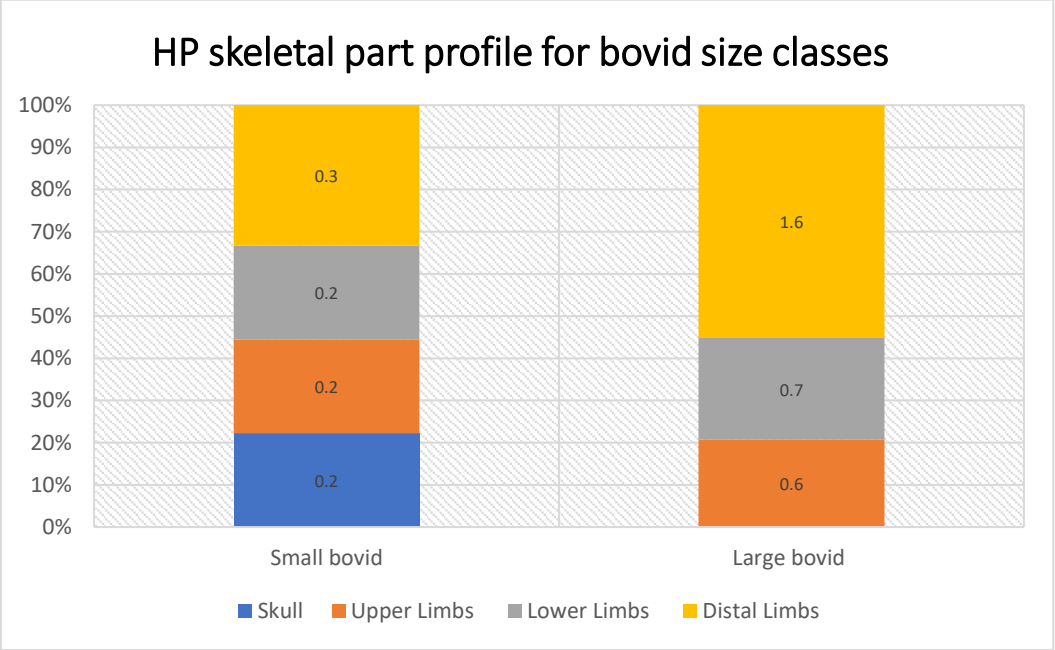

Figure 4.2: HP skeletal part profile for small and large bovids (combined nNISP values in columns)

There are proportionally more distal limbs for large bovids in both samples (Figure 4.1 and 4.2). The small bovids in the MSA III sample have a larger proportion of skull and lower limb elements than the large bovids (Figure 4.1). Skull elements are rare in the HP sample, and there is a larger proportion of upper limb elements in this sample (Figure 4.2).

4.2.c) Minimum Number of Elements (MNE) and Minimum Animal Units (MAU)

The MNE and MAU values in both samples are limited to high survival bovid elements (cranial, mandible, upper limb long bones, lower limb long bones and distal limb long bones). Both samples are dominated by distal limb elements (Table 4.4), where phalanges have the highest MNE values. Complete phalanges have the highest MNE values in the MSA III sample and shafts have the highest value in the HP sample (Table 4.4). Cranial fragments have the highest MAU values in the MSA III sample, whereas metapodial shafts have the highest values in the HP sample (Table 4.4).

Table 4.4: MSA III and HP bovid MNE and MAU values (see Appendix A Tables A.3 and A.4 for layers)

Skeletal part	Element	Anatomical region	MSA III MNE	MSA III MAU	HP MNE	HP MAU
Skull	**Cranial**	Fragment	9	4.5	2	1
	Mandible	Fragment	..	..	1	0.5
		Ramus	4	2	..	..
Upper Limbs	**Humerus**	Distal	1	0.5	1	0.5
		Proximal	..	..	..	..
		Shaft	..	..	..	..
	Metacarpal	Distal	..	..	..	..
		Proximal	1	0.5	1	0.5
		Shaft	..	..	..	..
	Radius	Distal	1	0.5	..	..
		Proximal	2	1	1	0.5
		Shaft	..	..	..	..
	Ulna	Distal	..	..	1	0.5
		Proximal	..	..	..	..
		Shaft	..	..	..	..
Lower Limbs	**Femur**	Distal	..	..	1	0.5
		Proximal	2	1	..	..
		Shaft	2	1	1	0.5
	Metatarsal	Distal	..	..	..	..
		Proximal	1	0.5	..	..
		Shaft	..	..	1	0.5
	Tibia	Distal	3	1.5	..	..
		Proximal	2	1	..	..
		Shaft	3	1.5	2	1
Distal Limbs	**Metapodial**	Distal	7	1.8	3	0.8
		Proximal	2	0.5	..	..
		Shaft	13	3.3	4	1
	Phalanges	Complete	17	0.7	..	..
		Distal	10	0.4	2	0.08
		Proximal	11	0.5	1	0.04
		Shaft	3	0.1	7	0.3
Total MNE			**94**		**29**	

4.2.d) Mammal Size Class by Unidentified Long Bone Cortical Thickness

Most of the unidentified long bone fragments in both samples may represent medium indeterminate mammals based on cortical thickness measurements (based on Reynard *et al.* 2014: 13) (Table 4.5). Both samples have few long bone fragments that may represent small mammals, and the HP sample has a larger proportion of large mammal specimens (Table 4.5).

Table 4.5: Mammal size classes by unidentified long bone cortical thickness (based on Reynard *et al.* 2014) (see Appendix A Tables A.5 and A.6 for layers)

Sample	**Mammal size class by unidentified long bone cortical thickness measurements**			**Total N (%)**	**Sample non-ID >2cm total**	**% of total**
	Small mammal (< 2mm) n (%)	**Medium mammal (2-5.9 mm) n (%)**	**Large mammal (6-19.9 mm) n (%)**			
MSA III	2 (4.4)	33 (71.7)	11 (23.9%)	**46 (100)**	**787**	**5.8**
HP	3 (3.6)	53 (63.9)	27 (32.5)	**83 (100)**	**864**	**9.6**

4.3) Taphonomic Analyses

4.3.a) Preservation

Only bone fragments with cortical surfaces in the MSA III (N=249) and HP (N=246) samples were examined for surface condition, and all teeth fragments and non-mammal remains are excluded from the taphonomic analyses. There are three main categories of surface conditions observed: exfoliation, porous and 'chalky' (Descriptions in Chapter 3). Exfoliated surfaces are the most common condition in both samples. More specimens in the HP sample (24.0%) have this type of condition than the MSA III sample (13.7%) (Table 4.6). Both samples have relatively low quantities of specimens with porous and 'chalky' conditions, although chalky surfaces are notably higher in the MSA III assemblage (Table 4.6). Spongy bone is included in Table 4.6 to show the ratio between spongy and cortical bone. The HP sample has a larger proportion of spongy bone than the MSA III sample (Table 4.6).

Table 4.6: Surface conditions

Sample	Spongy bone n (%)	Cortical bone surface conditions			Total specimens in sample N (%)
		Exfoliation n (%)	Porous n (%)	Chalky n (%)	
MSA III	110 (10.4)	147 (13.7)	17 (1.6)	85 (7.9)	**1 070 (100)**
HP	24 (2.5)	231 (24.0)	14 (1.5)	1 (0.1)	**961 (100)**
Total N (%)	**134 (6.6)**	**378 (18.6)**	**31 (1.5)**	**86 (4.2)**	**2 031 (100)**

4.3.b) Fragmentation

The lengths of the specimens in the MSA III sample range from 8.3 mm to 114.5 mm and in the HP sample they range from 10.1 mm to 80.9 mm (Table 4.7). Only the length of the specimens included in the taphonomic analysis were measured. The HP sample has a slightly higher average length than the MSA III sample, however, the MSA III has a heavier average weight than the HP sample (Table 4.7).

Table 4.7: Summary statistics of specimens from the MSA III and HP layers

MSA III						
Layer	**Total number of specimens per layer**	**Total weight per layer (g)**	**Average weight per individual remain (g)**	**Maximum length (mm)**	**Minimum length (mm)**	**Mean length (mm)**
CP2	952	588	1.6	88.82	12.81	29.83
BSS1	1 191	419.3	2.8	52.55	11.58	25.63
BSS2 AF1	127	72.7	1.7	35.51	9.33	23.18
BSS2	2 307	776.4	3.0	75.82	8.98	24.15
CP3	1 617	905.4	1.8	73.59	10.11	29.44
BSS3	2 891	1 040.3	2.8	66.36	8.39	25.21
CP4	2 291	1 173.3	2.0	114.58	8.81	29.02

Table 4.7: Summary statistics of specimens from the MSA III and HP layers cont.

HP						
Layer	**Total number of specimens per layer**	**Total weight per layer (g)**	**Average weight per individual remain (g)**	**Maximum length (mm)**	**Minimum length (mm)**	**Mean length (mm)**
CP5	417	301.3	1.4	59.59	10.11	27.83
YS4	489	241.4	2.0	47.95	11.15	23.57
CP6 (a)	957	1 009.5	0.9	80.95	20.04	27.45
CP6 (b)	856	928	0.9	70.35	16.5	27.82
CP9 (a)	1 467	711.4	2.1	57.45	20.01	27.40
CP9 (b)	856	762.3	1.1	71.19	16.23	26.09
CP9	29	81.1	0.4	61.22	21.53	35.93

4.3.c) Long Bone Breakage Patterns

The most abundant type of breakage pattern for long bones is spiral breakage in both samples (Table 4.8). The HP sample has proportionally more spiral breakages (71.1%) than the MSA III sample (56.5%) (Table 4.8). Both samples have similar proportions of transverse and splintered breakages, but there are more irregular breakages in the MSA III than the HP (Table 4.8). Splintered breakages are rare in both assemblages.

Table 4.8: Long bone breakage patterns

Sample	**Long bone breakage patterns**					**Total N (%)**
	Spiral n (%)	**Transverse n (%)**	**Irregular n (%)**	**Splintered n (%)**	**Eroded n (%)**	
MSA III	96 (56.5)	20 (11.8)	33 (19.4)	4 (2.3)	17 (10.0)	**170 (100)**
HP	140 (71.1)	23 (11.7)	19 (9.6)	5 (2.5)	10 (5.1)	**197 (100)**
Total N (%)	**236 (64.3)**	**43 (11.7)**	**52 (14.2)**	**9 (2.5)**	**27 (7.3)**	**367 (100)**

4.3.d) Bone Density-Mediated Attrition

Spearman's Rho tests indicate that there is no correlation between bone density and bovid skeletal representation in both samples. *Rangifer tarandus* artiodactyl portion density values from Lam *et al.* (1999) were used as the comparative density values. These density values were compared with the

nNISP of combined bovids, as sample sizes for each bovid size class were too small. The results indicate that the association between the variables is not considered statistically significant in the MSA III sample (r_s = -0.27257, p = 0.21973) (Table 4.9) and the HP sample (r_s = - 0.18442, p = 0.58724) (Table 4.10).

Table 4.9: Density values for the MSA III bovid skeletal part representation. P: proximal; M: medial; D: distal.

Ungulate element and region	Scan code (Lam et al. 1999)	Density	nNISP
1st Phalanx P	P1 – 1	0.48	1.13
1st Phalanx M	P1 – 2	0.56	0.13
1st Phalanx D	P1 – 3	0.71	0.5
2nd Phalanx P	P2 – 1	0.49	0.5
2nd Phalanx D	P2 – 2	0.64	0.88
3rd Phalanx	P3 – 1	0.48	0.5
Carpals	CARPAL	0.67	0.38
Femur P	FE – 1	0.39	1
Femur M	FE - 4	0.57	1
Humerus D	HU – 5	0.48	0.5
Innominate	IL – 2	0.70	0.5
Innominate	IS – 1	0.67	0.5
Metacarpal D	MC – 4	0.59	0.5
Metapodial P	MR – 2	0.57	0.25
Metapodial M	MR – 4	0.54	3.3
Metapodial D	MR - 5	0.41	1.8
Radius P	RA – 1	0.53	1
Radius D	RA – 5	0.49	0.5
Tarsal	TARSAL	0.71	0.7
Tibia P	TI – 1	0.35	1
Tibia M	TI – 3	0.71	1.5
Tibia D	TI – 4	0.53	1.5

Table 4.10: Density values for the HP bovid skeletal part representation. P: proximal; M: medial; D: distal

Ungulate element and region	Scan code (Lam et al. 1999)	Density	nNISP
1st Phalanx D	P1 – 3	0.71	0.13
3rd Phalanx	P3 – 1	0.48	0.13
Carpals	CARPAL	0.67	0.06
Femur M	FE - 4	0.57	0.5
Humerus D	HU – 5	0.48	0.5
Metacarpal P	MC – 2	0.69	0.5
Metapodial M	MR – 4	0.54	1
Metapodial D	MR - 5	0.41	0.75
Tarsal	TARSAL	0.71	0.3
Tibia M	TI – 3	0.71	1
Ulna D	RA – 4	0.38	0.5

4.3.e) Bone Surface Modifications

Burning Patterns

There is a larger proportion of burnt specimens in the HP sample than the MSA III sample (Table 4.11) (Figure 4.3). The MSA III sample has higher frequencies of mild burning patterns (brown and localised), whereas the HP sample has higher frequencies of more intensive burning patterns (black, grey, and white) (Table 4.11, Figure 4.4). A chi-square test indicates that there is a significant difference in the quantities of mild and intensive burning patterns between the samples (X^2= 205.5; df=1; p=0).

Table 4.11: Burning patterns (see Appendix A Tables A.7 and A.8 for layers)

Sample	**Burning description**					**No. of burnt remains n (%)**	**Total number of specimens N**	**% of sample total**
	Brown n (%)	**Localised n (%)**	**Black n (%)**	**Grey n (%)**	**White n (%)**			
MSA III	126 (30.1)	191 (45.7)	64 (15.3)	30 (7.2)	7 (1.7)	**418 (100)**	**1 070**	**37.1**
HP	209 (24.8)	69 (8.2)	267 (31.7)	254 (30.2)	43 (5.1)	**842 (100)**	**961**	**87.6**
Total N (%)	**335 (26.6)**	**260 (20.6)**	**331 (26.3)**	**284 (22.5)**	**50 (4.0)**	**1 260 (100)**	**2 031**	**62.0**

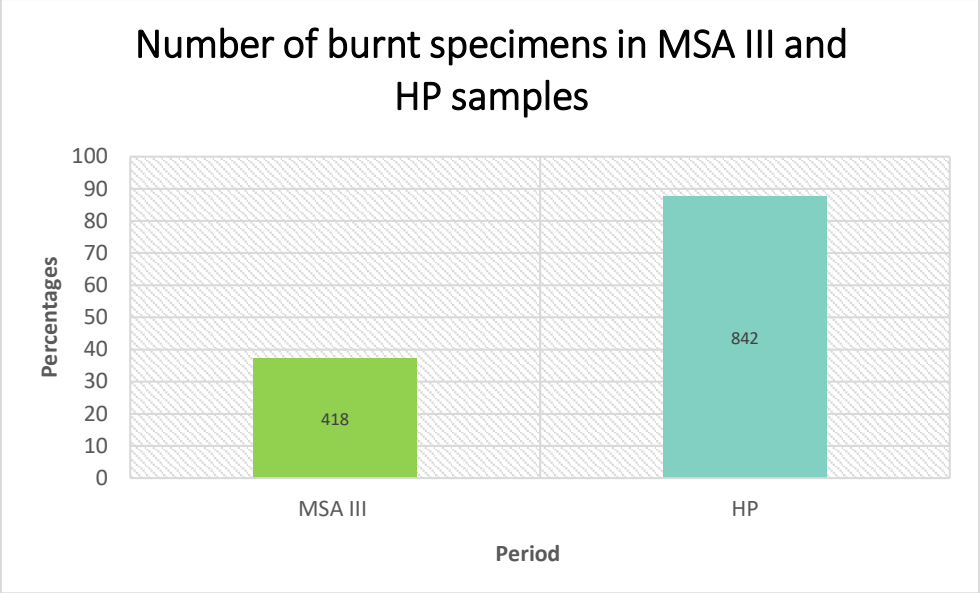

Figure 4.3: Number of burnt specimens in the MSA III and HP samples (raw values shown in columns)

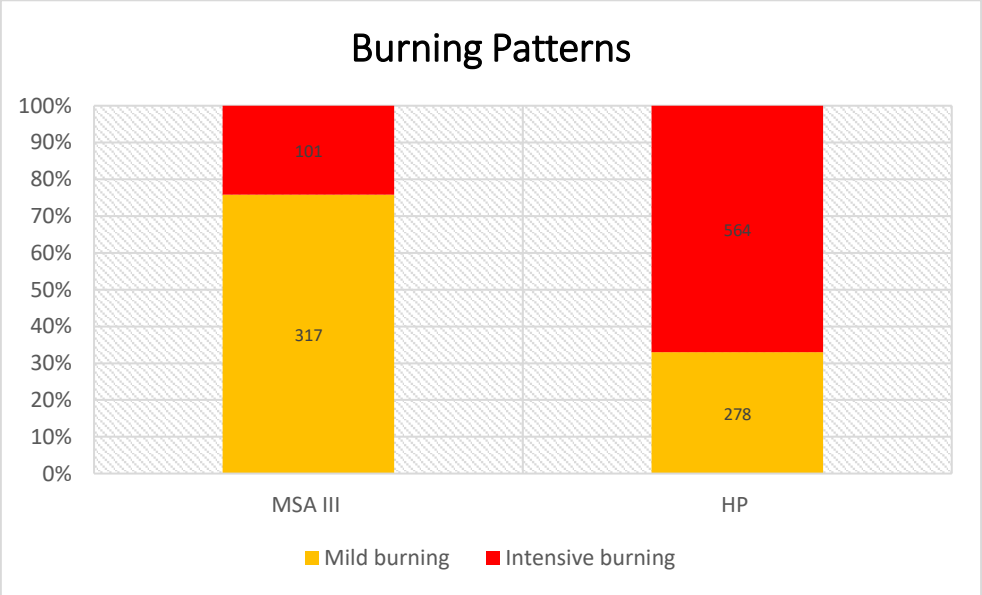

Figure 4.4: Burning patterns (raw values shown in columns). Mild burning includes brown and localised burning, Intensive burning includes black, grey, and white burning

Figure 4.4 shows that the mild burning patterns are more prevalent in the MSA III sample, whereas intensive burning patterns are more prevalent in the HP sample.

Anthropogenic Bone Surface Modifications

Both samples have more percussion marks than cut marks (Tables 4.12 and 4.13), but there are more percussion marked specimens in the HP sample, and slightly more cut marked specimens in the MSA

III (Tables 4.12 and 4.13) (Figure 4.5). Chi-square tests indicate that there is a significant difference in the quantities of cut marked (X^2= 34.227; df=6; p=<0.0001) and percussion marked specimens (X^2= 93.678; df=6; p=0.0) between the samples.

Table 4.12: MSA III anthropogenic bone surface modifications

MSA III layers	**Anthropogenic bone surface modifications**		**No. specimens with both anthropogenic modifications* n (%)**	**Layer total N (%)**
	Cut marks n (%)	**Percussion marks n (%)**		
CP2	8 (6.0)	23 (17.1)	1 (0.7)	**134 (23.1)**
BSS1	5 (6.9)	6 (8.3)	0	**7 (15.2)**
BSS2 AF1	0	1 (7.1)	0	**14 (7.1)**
BSS2	2 (1.2)	15 (9.3)	0	**161 (10.5)**
CP3	11 (5.9)	20 (10.8)	4 (2.2)	**185 (16.7)**
BSS3	11 (5.9)	15 (8.0)	4 (2.1)	**188 (23.9)**
CP4	15 (7.3)	44 (21.4)	3 (1.5)	**206 (28.7)**
Total N (%)	**52 (5.4)**	**124 (12.9)**	**12 (1.3)**	**960 (18.3)**

Table 4.13: HP anthropogenic bone surface modifications

HP layers	**Anthropogenic bone surface modifications**		**No. specimens with both anthropogenic modifications* n (%)**	**Layer total N (%)**
	Cut marks n (%)	**Percussion marks n (%)**		
CP5	1 (1.3)	26 (34.7)	1 (1.3)	**75 (36.0)**
YS4	0	16 (25.8)	0	**62 (25.8)**
CP6 (a)	9 (4.1)	60 (27.1)	1 (0.5)	**221 (31.2)**
CP6 (b)	8 (4.0)	42 (20.8)	3 (1.5)	**202 (24.8)**
CP9 (a)	8 (4.5)	29 (16.4)	1 (0.6)	**177 (20.9)**
CP9 (b)	8 (4.3)	25 (13.5)	1 (0.5)	**185 (17.8)**
CP9	1 (6.7)	6 (40.0)	1 (6.7)	**15 (46.7)**
Total N (%)	**35 (3.7)**	**204 (21.8)**	**8 (0.9)**	**937 (25.5)**

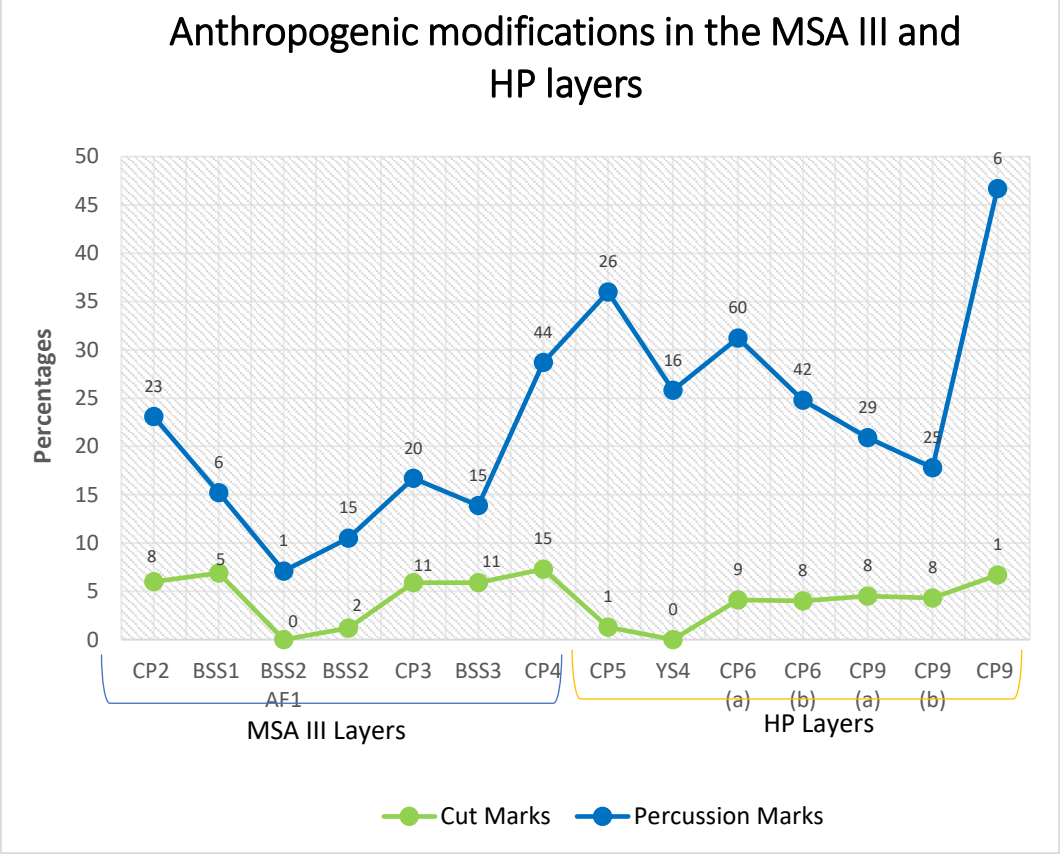

Figure 4.5: Anthropogenic modifications in the MSA III and HP layers (raw values shown on the graph)

Figure 4.5 clearly illustrates that percussion marks are more prevalent in the HP layers, whereas cut marks occur in similar frequencies in both samples.

Anthropogenic Bone Surface Modifications by Skeletal Part

Percussion marks are more common than cut marks on all skeletal parts in both samples. The HP sample has fewer identifiable elements but has more specimens with anthropogenic modifications. Anthropogenic modifications in the MSA III sample are proportionally more common on distal limb elements, and relatively rare on upper limb elements (Table 4.14) (Figure 4.6). In contrast, modifications in the HP sample are proportionally more common on lower limb elements, and relatively rare on skull and distal limb elements (Table 4.15) (Figure 4.6).

Table 4.14: Anthropogenic modifications by skeletal part (based on MSA III NISP values) (see Appendix A Table A.9 for layers). CM: cut marks, PM: percussion mark.

Skeletal Part	**Sample**			
	MSA III			**Total no. of skeletal parts in sample N (%)**
	CM n (%)	**PM n (%)**	**Skeletal parts with both modifications n (%)**	
Skull	1 (3.0)	5 (15.2)	0	**33 (18.2)**
Axial	4 (4.4)	11 (12.1)	0	**91 (16.5)**
Upper Limbs	0	1 (5.3)	0	**19 (5.3)**
Lower Limbs	2 (5.4)	3 (8.1)	1 (2.7)	**37 (13.5)**
Distal Limbs	6 (6.3)	13 (13.7)	0	**95 (20.0)**
Specimens with modifications n (%)	**14 (5.1)**	**33 (12.0)**	**1 (0.4)**	**275 (17.1)**

Table 4.15: Anthropogenic modifications by skeletal part (Based on HP NISP values) (see Appendix A Table A.10 for layers). CM: cut mark, PM: percussion mark.

Skeletal Part	**Sample**			
	HP			**Total no. of skeletal parts in sample N (%)**
	CM n (%)	**PM n (%)**	**Skeletal parts with both modifications n (%)**	
Skull	0	4 (25.0)	0	**16 (25.0)**
Axial	4 (11.1)	11 (30.6)	0	**36 (41.7)**
Upper Limbs	0	2 (40.0)	0	**5 (40.0)**
Lower Limbs	2 (16.7)	5 (41.7)	1 (8.3)	**12 (58.4)**
Distal Limbs	1 (3.6)	6 (21.4)	0	**28 (25.0)**
Specimens with modifications n (%)	**5 (5.2)**	**26 (26.8)**	**1 (1.0)**	**(33.0)**

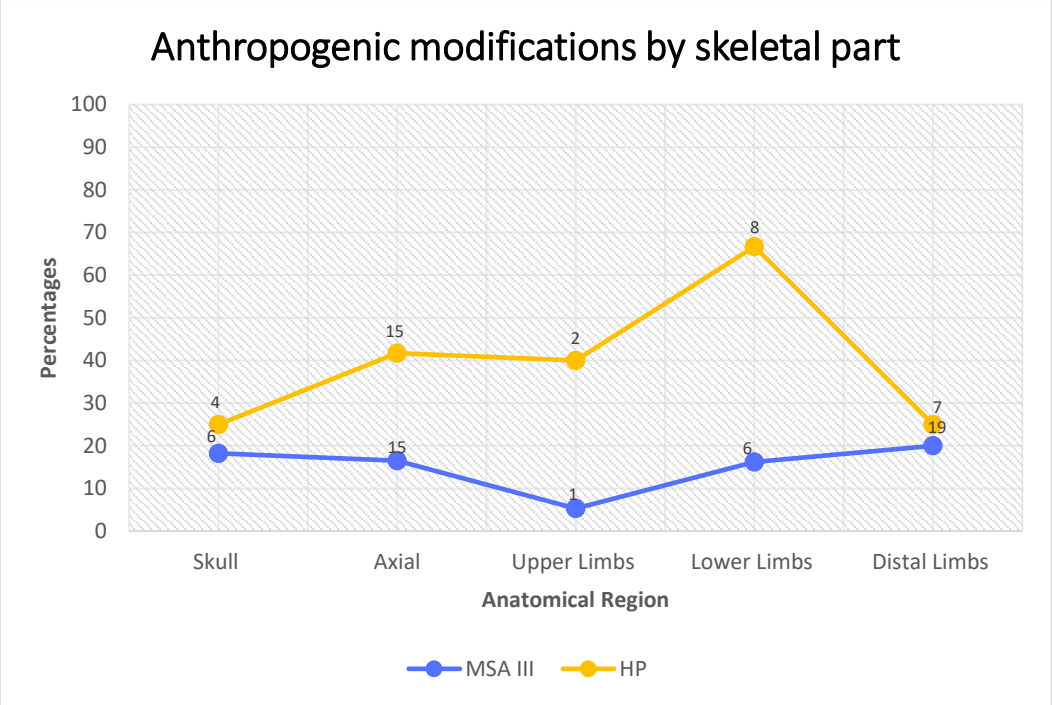

Figure 4.6: Anthropogenic modifications by skeletal part (raw values shown on graph)

Zoogenic Bone Surface Modifications

There are more tooth-marked specimens than other modification types in both samples. There are few specimens with more than one type of zoogenic modifications (Tables 4.16 and 4.17). In the MSA III sample, zoogenic modifications are more common than anthropogenic modifications and it has a large proportion of gastric acid etched specimens (Table 4.16) (Figure 4.7). In contrast, the HP sample has proportionally more anthropogenic modifications and few gastric acid etched specimens (Table 4.17) (Figure 4.7). Gnaw marks are uncommon in both samples and are grouped with tooth marks in Figure 4.7. Chi-square tests indicate that there is a significant difference in tooth marks between the samples (X^2= 54.47; df=6; p=0.0) and between gastric acid etching (X^2= 24.58; df=6; p=0.0004814) in the samples.

Table 4.16: MSA III zoogenic bone surface modifications

MSA III layers	Zoogenic bone surface modifications			Remains with zoogenic modifications* n (%)	Layer totals N (%)
	Tooth marks n (%)	Gastric acid etching n (%)	Gnaw marks n (%)		
CP2	31 (23.1)	14 (10.4)	0	3 (2.2)	**134 (33.5)**
BSS1	20 (27.0)	4 (5.4)	0	2 (2.7)	**72 (32.4)**
BSS2 AF1	2 (14.3)	1 (7.1)	0	0	**14 (21.4)**
BSS2	46 (28.6)	22 (13.7)	0	8 (5.0)	**161 (42.3)**
CP3	35 (18.9)	37 (20.0)	0	8 (4.3)	**185 (38.9)**
BSS3	45 (23.9)	22 (11.7)	1 (0.5)	7 (3.7)	**188 (36.1)**
CP4	28 (13.6)	18 (8.7)	3 (1.5)	1 (0.5)	**206 (23.8)**
Total N (%)	**207 (21.6)**	**118 (12.3)**	**4 (0.4)**	**29 (3.0)**	**960 (34.3)**

Table 4.17: HP zoogenic bone surface modifications

HP layers	Zoogenic bone surface modifications			Remains with zoogenic modifications* n (%)	Layer totals N (%)
	Tooth marks n (%)	Gastric acid etching n (%)	Gnaw marks n (%)		
CP5	5 (6.7)	1 (1.3)	0	0	**75 (8.0)**
YS4	9 (14.5)	3 (4.8)	0	1 (1.6)	**62 (19.3)**
CP6 (a)	14 (6.3)	0	0	0	**221 (6.3)**
CP6 (b)	11 (5.4)	1 (0.5)	0	0	**202 (5.9)**
CP9 (a)	7 (4.0)	1 (0.6)	0	0	**177 (4.6)**
CP9 (b)	4 (2.2)	0	0	0	**185 (2.2)**
CP9	3 (20.0)	0	0	0	**15 (20.0)**
Total N (%)	**53 (5.7)**	**6 (0.6)**	**0**	**1 (0.1)**	**937 (6.3)**

*Remains with multiple zoogenic modifications

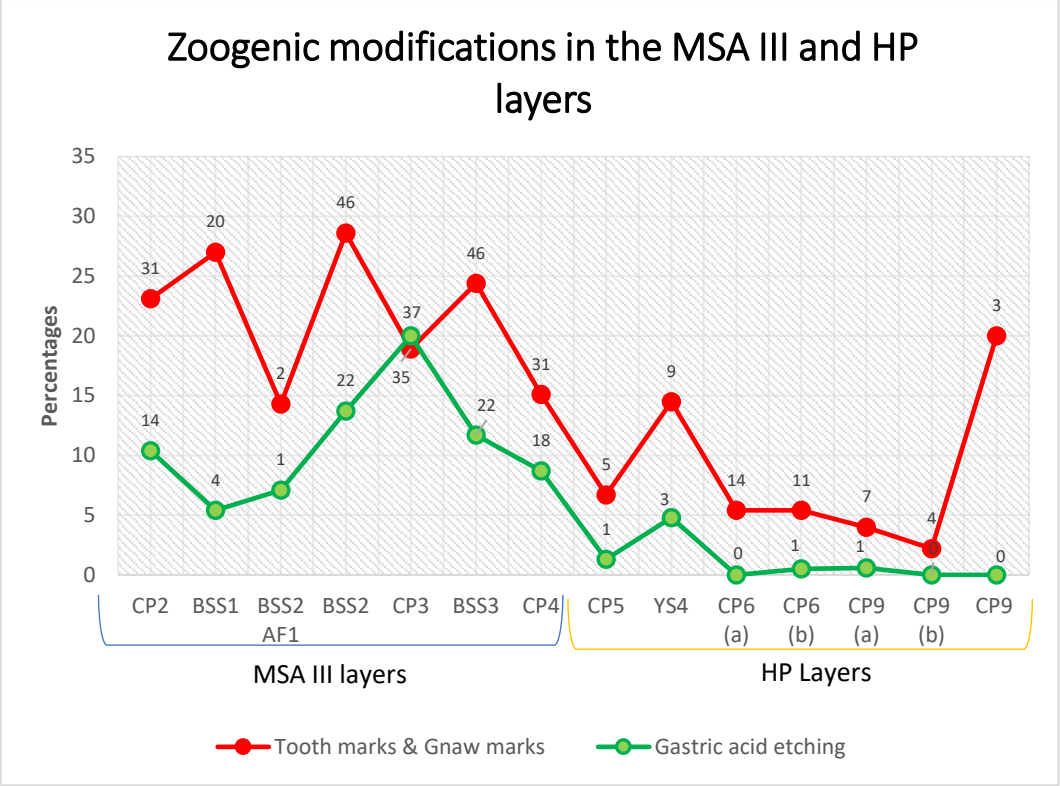

Figure 4.7: Zoogenic modifications in the MSA III and HP layers (raw values on graph)

Figure 4.7 illustrates that zoogenic modifications are more prevalent in the MSA III sample and occur in significantly less frequencies throughout the HP sample.

Zoogenic Bone Surface Modifications by Skeletal Part

Tooth marks are more common on all skeletal parts in both samples (Tables 4.18 and 4.19). Zoogenic modifications in the MSA III sample are proportionally more common on upper and lower limb elements, and rare on distal limb elements (Table 4.18, Figure 4.8). In contrast, zoogenic modifications are not as common on the skeletal parts in the HP sample and are proportionally more common on lower limb elements (Table 4.19, Figure 4.8).

Table 4.18: Zoogenic modifications by skeletal part (Based on MSA III NISP values) (see Appendix A Table A.11 for layers). TM: tooth marks, GAE: gastric acid etching.

Skeletal Part	Sample			
	MSA III			Total no. of skeletal parts in sample N (%)
	TM n (%)	GAE n (%)	Skeletal parts with both modifications n (%)	
Skull	7 (21.2)	2 (6.1)	1 (3.0)	**33 (27.3)**
Axial	20 (22.0)	7 (7.7)	1 (1.1)	**91 (29.7)**
Upper Limbs	7 (36.8)	1 (5.3)	1 (5.3)	**19 (42.1)**
Lower Limbs	15 (40.5)	1 (2.7)	0	**37 (43.2)**
Distal Limbs	15 (15.8)	6 (6.3)	2 (2.1)	**95 (22.1)**
Specimens with modifications n (%)	**64 (23.3)**	**17 (6.2)**	**5 (1.8)**	**275 (29.5)**

Table 4.19: Zoogenic modifications by skeletal part (Based on HP NISP values) (see Appendix A Table A.12 for layers). TM: tooth marks, GAE: gastric acid etching.

Skeletal Part	Sample			
	HP			Total no. of skeletal parts in sample N (%)
	TM n (%)	GAE n (%)	Skeletal parts with both modifications n (%)	
Skull	1 (6.3)	0	0	**16 (6.3)**
Axial	1 (2.8)	0	0	**36 (2.8)**
Upper Limbs	1 (20.0)	0	0	**5 (20.0)**
Lower Limbs	4 (33.3)	0	0	**12 (33.3)**
Distal Limbs	2 (7.1)	0	0	**28 (7.1)**
Specimens with modifications n (%)	**9 (9.3)**	**0**	**0**	**97 (9.3)**

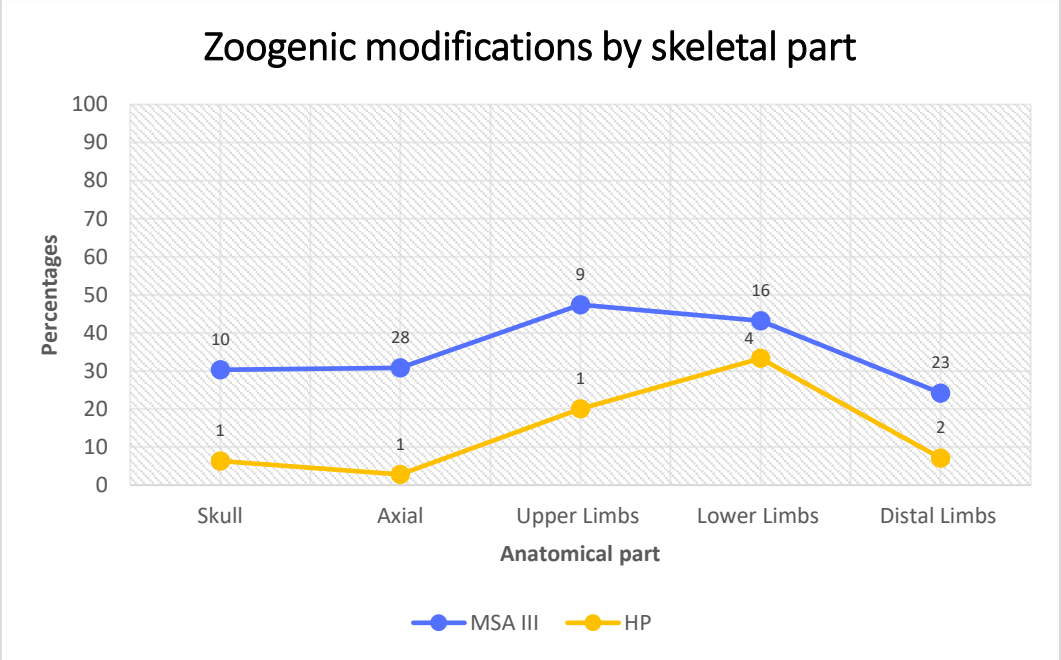

Figure 4.8: Zoogenic modifications by skeletal part (raw values shown on graph)

Figure 4.8 illustrates that zoogenic modifications are more prevalent in the MSA III sample than the HP sample, as with the previous figure (Figure 4.7).

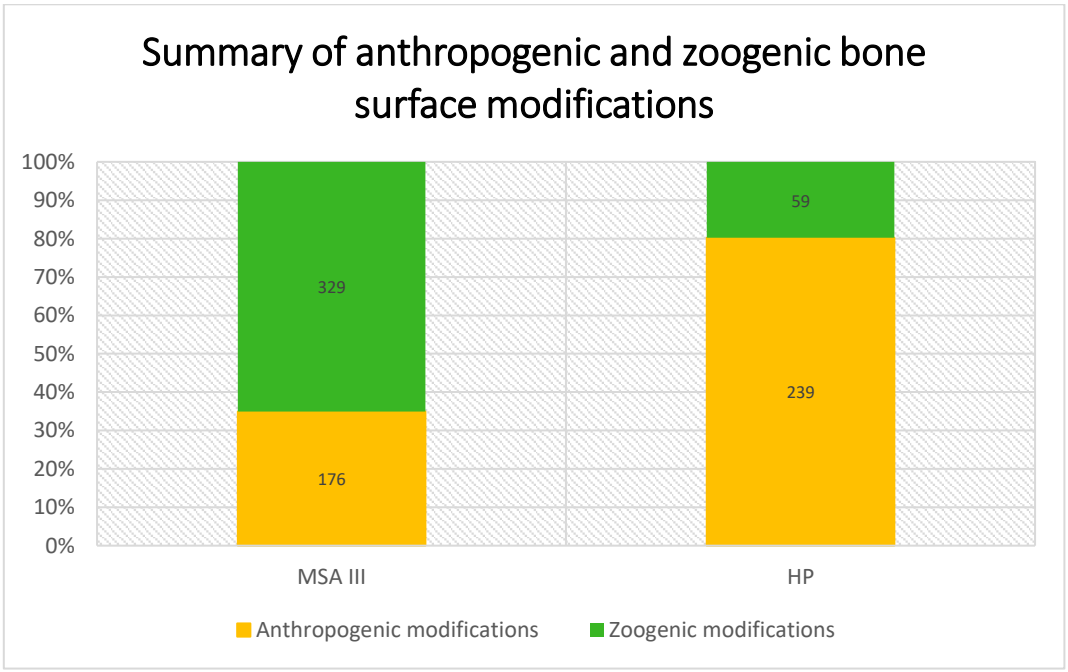

Figure 4.9: Summary of anthropogenic and zoogenic modifications (raw values in columns)

Figure 4.9 shows that the MSA III sample has high frequencies of zoogenic modifications, and relatively less anthropogenic modifications. The HP sample, in contrast, is heavily dominated by anthropogenic

modifications, and relatively few specimens have zoogenic modifications. As mentioned above, there is a significant difference in the quantities of anthropogenic and zoogenic modifications between the samples. A chi-square test also indicates that there is a significant difference in the quantities of anthropogenic and zoogenic modifications on the skeletal parts between the samples (X^2=20.378; df=1; p=<0.0001).

Anthropogenic and Zoogenic Bone Surface Modifications by Bovid Size Class

Most of the anthropogenic modifications in the MSA III sample are on BOV III specimens, with zoogenic modifications being more common on BOV I specimens (Table 4.20) (Figures 4.10). Most of the anthropogenic modifications in the HP sample also occur on BOV III specimens, and the zoogenic modifications, in contrast, occur mostly on BOV IV specimens but in low frequencies (Table 4.21) (Figure 4.11).

Table 4.20: Bovid size classes and anthropogenic modifications

Sample	**Bovid size classes and anthropogenic modifications**							**Remains with modifications n (%)**	**Sample Bovid Total N**	**% of total**
	BOV I n (%)	**BOV II n (%)**	**BOV II/III n (%)**	**BOV III n (%)**	**BOV III/IV n (%)**	**BOV IV n (%)**	**BOV IV/V n (%)**			
MSA III	5 (21.7)	3 (13.0)	0	9 (39.1)	0	4 (17.4)	2 (8.7)	**23 (100)**	**128**	**18.0**
HP	2 (14.3)	2 (14.3)	-	5 (35.7)	1 (7.1)	3 (21.5)	1 (7.1)	**14 (100)**	**43**	**32.6**
Total N (%)	**7 (18.9)**	**5 (13.5)**	**0**	**14 (37.8)**	**1 (2.7)**	**7 (18.9)**	**3 (8.1)**	**37 (100)**	**171**	**21.6**

Table 4.21: Bovid size classes and zoogenic modifications

Sample	**Bovid size classes and zoogenic modifications**							**Remains with modifications n (%)**	**Sample Bovid Total N**	**% of total**
	BOV I n (%)	**BOV II n (%)**	**BOV II/III n (%)**	**BOV III n (%)**	**BOV III/IV n (%)**	**BOV IV n (%)**	**BOV IV/V n (%)**			
MSA III	11 (32.4)	7 (20.6)	1 (2.9)	10 (29.4)	0	5 (14.7)	0	**34 (100)**	**128**	**26.6**
HP	1 (14.3)	1 (14.3)	-	1 (14.3)	0	3 (42.8)	1 (14.3)	**7 (100)**	**43**	**16.3**
Total N (%)	**12 (29.3)**	**8 (19.5)**	**1 (2.4)**	**11 (26.8)**	**0**	**8 (19.5)**	**1 (2.4)**	**41 (100)**	**171**	**24.0**

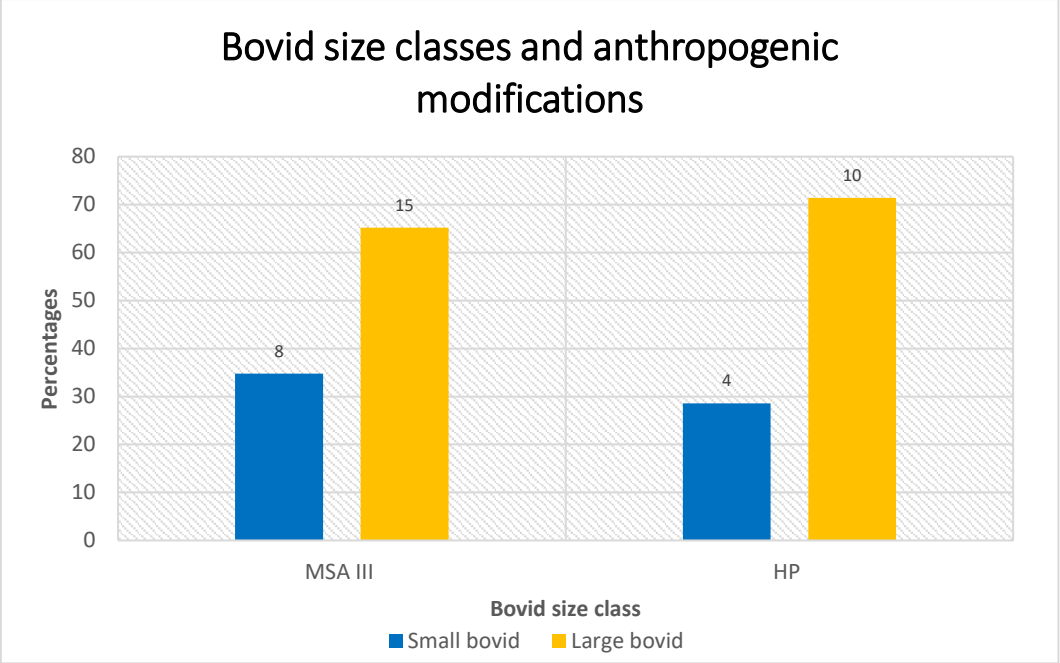

Figure 4.10: Bovid size classes and anthropogenic modifications (raw values shown on graph)

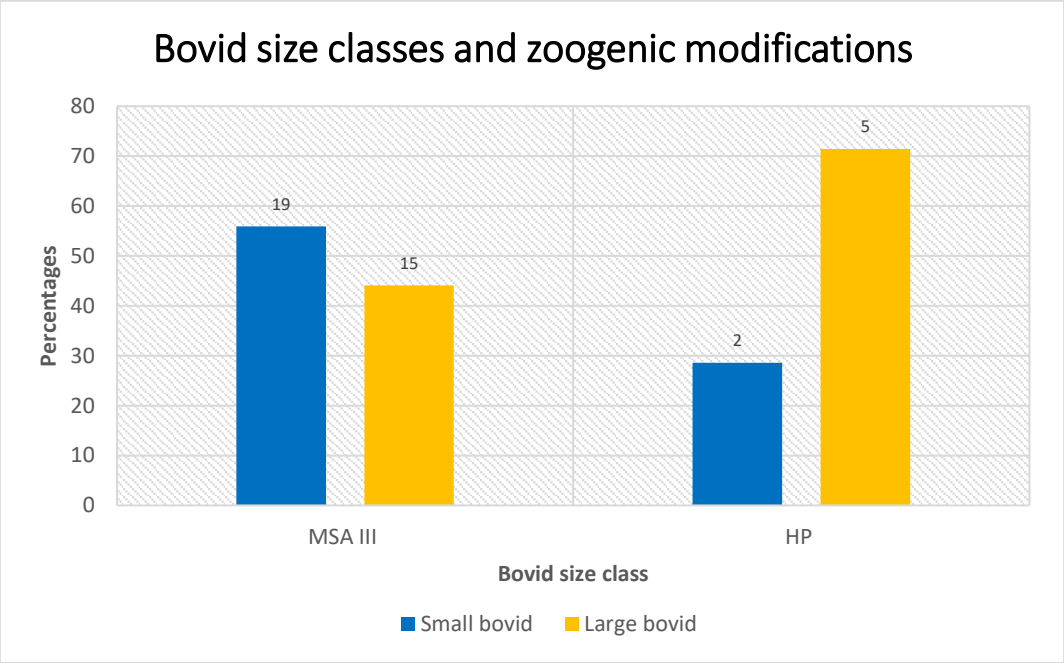

Figure 4.11: Bovid size classes and zoogenic modifications (raw values shown on graph)

Figure 4.10 illustrates that anthropogenic modifications are more common on larger bovids than the smaller bovids. Figure 4.11 illustrates that the zoogenic modifications in the MSA III are more common on smaller bovids, whereas zoogenic modifications in the HP sample are more common on larger bovids.

Unidentified Long Bone Cortical Thickness and Surface Modifications

Most of the modifications in both samples occur on medium size mammal specimens (Table 4.23), with the HP showing the largest proportion of anthropogenic modifications on medium size mammal specimens. In contrast, these medium size mammal specimens in the MSA III have the largest proportion of zoogenic modifications (Table 4.23). Modifications on small mammal specimens are uncommon in both samples. Large mammal specimens in the MSA III sample have similar proportions of anthropogenic and zoogenic modifications, whereas in the HP sample, there is a higher proportion of anthropogenic modifications (Table 4.23).

Table 4.22: Unidentified long bones (based on cortical thickness) (based on Reynard *et al.* 2014)

Sample	**Mammal size class by unidentified long bone cortical thickness measurements**			**Total N (%)**
	Small mammal (<2 mm) n (%)	**Medium mammal (2-5.9 mm) n (%)**	**Large mammal (6-19.9 mm) n (%)**	
MSA III	2 (4.4)	33 (71.7)	11 (23.9%)	**46 (100)**
HP	3 (3.6)	53 (63.9)	27 (32.5)	**83 (100)**
Total N (%)	**5 (3.9)**	**86 (66.7)**	**38 (29.4)**	**129 (100)**

Table 4.23: Unidentified long bone cortical thickness and surface modifications (percentages derived from sample totals in Table 4.20)

Mammalian size classes	**Surface modifications**	**Sample**			
		MSA III		**HP**	
		n	**%**	**n**	**%**
Small Mammal	**AM**	-	-	-	-
	ZM	2	4.4	1	1.2
Medium Mammal	**AM**	12	26.1	26	31.3
	ZM	4	30.4	1	1.2
Large Mammal	**AM**	5	10.9	15	18.1
	ZM	4	8.7	1	1.2

AM = Anthropogenic Modifications, ZM = Zoogenic Modifications

Trampling Modifications

Trampling modifications, defined by Reynard (2014), are significantly higher in the HP sample than the MSA III sample, with trampling lines being the most abundant type in both samples (Table 4.24, Figure 4.12) (X^2=15.037; df=3; p=0.0017). There are few scratches, pits, and grooves in both samples.

Table 4.24: Trampling modifications (see Appendix A Tables A.13 and A.14 for layers)

Sample	Trampling modifications				Total modifications n (%)	Sample total	% of total
	Lines n (%)	Scratches n (%)	Pits n (%)	Grooves n (%)			
MSA III	40 (85.1)	3 (6.4)	3 (6.4)	1 (2.1)	**47 (100)**	**960**	**4.9**
HP	278 (97.2)	2 (0.7)	5 (1.7)	1 (0.3)	**286 (100)**	**937**	**30.5**
Total N (%)	**318 (95.5)**	**5 (1.5)**	**8 (2.4)**	**2 (0.6)**	**333 (100)**	**1 897**	**17.6**

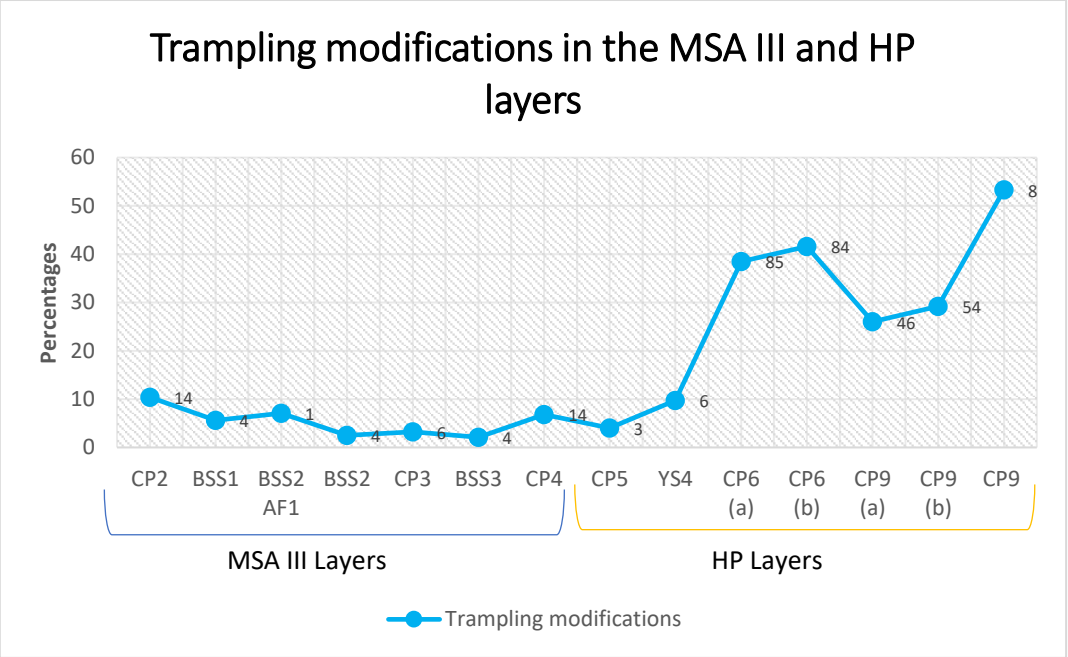

Figure 4.12: Trampling modifications in the MSA III and HP layers (raw values shown on graph)

Figure 4.12 illustrates that trampling becomes significantly more prevalent in the HP layers, and remains at similar frequencies during the MSA III layers.

Natural Bone Surface Modifications

Rounding is the most abundant type of natural bone surface modification in both samples (Table 4.25, Figure 4.13). More specimens with encrustation and manganese staining occur in the MSA III sample, whereas higher frequencies of abraded remains occur in the HP sample (Table 4.25). Both samples have relatively low frequencies of root and acid etching (Table 4.25, Figure 4.13).

Table 4.25: Natural bone surface modifications

Sample	Natural bone surface modifications							Sample total N
	Weathering n (%)	Encrustation n (%)	Abrasion n (%)	Rounding n (%)	Root etching n (%)	Acid etching n (%)	Manganese staining n (%)	
MSA III	598 (62.3)	434 (45.2)	403 (42.0)	835 (87.0)	94 (9.8)	15 (1.6)	880 (91.7)	**960**
HP	553 (59.0)	76 (8.1)	808 (86.2)	906 (96.7)	113 (12.1)	2 (0.2)	700 (74.7)	**937**
Total N (%)	**1 151 (60.7)**	**510 (26.9)**	**1 211 (63.8)**	**1 741 (91.8)**	**207 (10.9)**	**17 (0.9)**	**1 580 (83.3)**	**1 897**

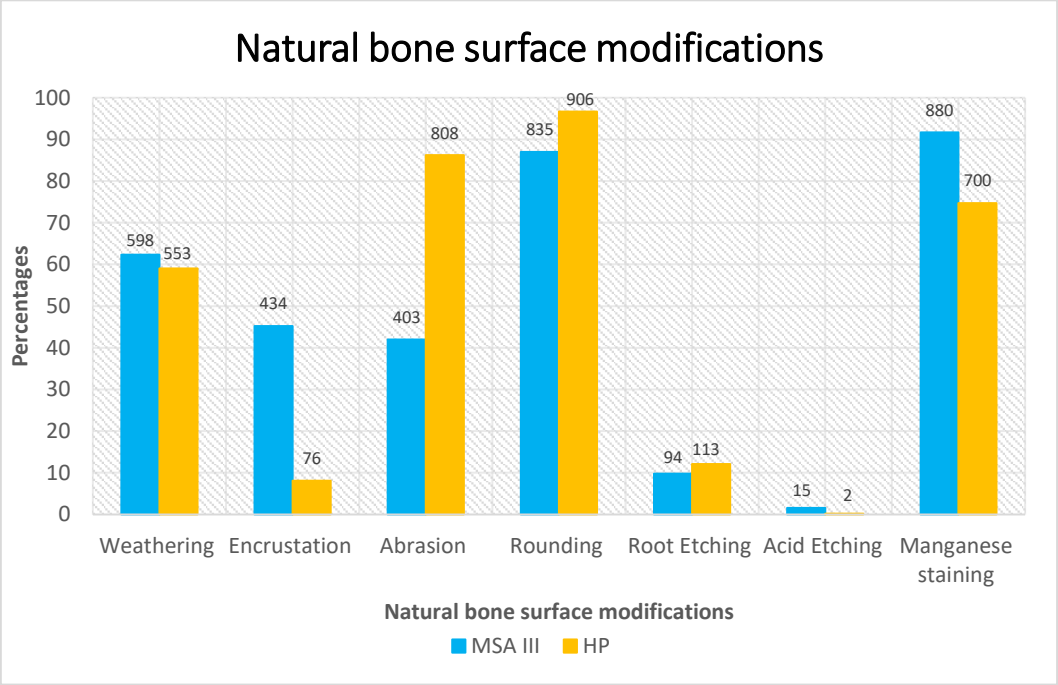

Figure 4.13: Natural bone surface modifications

Figure 4.13 illustrates that both samples have similar proportions of some natural modifications, however there are large differences in the proportions of encrustation and abrasion between the samples.

4.4) Conclusion

The results from the analysis of the large mammal fauna from the selected square E50 MSA III and HP layers at KRM cave 1A are presented in this chapter. The data include the identifiable remains, quantification, preservation, fragmentation, and bone surface modifications. Spearman's Rho tests conducted showed no significant correlation between the density values and the skeletal part profiles for both samples. Fragmentation and fracture patterns of long bones are also presented in this section, showing that spiral breakages are the most common in both assemblages. There are significant differences in the quantities of anthropogenic modifications relative to zoogenic modifications between the assemblages, where the MSA III has more zoogenic modifications and the HP has more anthropogenic modifications. There are also noticeable differences in the burning patterns between the two assemblages.

The bone surface modification data presented indicate that both samples were affected by numerous processes, including those by anthropogenic, zoogenic, and natural agents. These results will be discussed below to infer the possible agents of accumulation, subsistence strategies, occupational intensity, and site formation processes for each sample.

Chapter 5: Discussion

This chapter includes a discussion of the results in relation to the research questions presented in Chapter 1. First, the agents of accumulation for the two assemblages are discussed, followed by the possible subsistence strategies, then changes in occupational intensities are discussed and finally, site formation processes.

5.1) Agents of Accumulation

The analyses of the two assemblages sampled for this study suggest different agents of accumulation in the MSA III and HP on the basis of animal size and bone surface modifications. Although there is no significant difference in animal size based on long bone cortical thickness between the two periods, there is a significant difference in bovid size classes. The MSA III sample is dominated by small size I bovids, whereas larger size III bovids dominate in the HP sample.

The MSA III sample has higher frequencies of tooth marks and gastric acid etching (Appendix Figure B.1 and B.2) than the HP sample, the difference was shown when a chi-square test comparing the frequencies of zoogenic modifications between the two samples was undertaken. Tooth marks in this sample occur mostly on axial elements, and are mostly observed on BOV I specimens, whereas gastric etching occurs mostly on axial and distal limb elements and occurs mostly on BOV II and BOV III remains (Appendix B: Figures B.1 and B.2). The frequencies of zoogenic modifications in the MSA III assemblage increases as bovid sizes increase. The higher frequencies of zoogenic modifications in the MSA III suggest that carnivores, and possibly raptors, contributed significantly to the accumulation of this assemblage given that gastric acid etching can be caused by both carnivores and raptors (Fisher 1995). Remains of indeterminate carnivores have been recovered from the MSA III in cave 1A in the sample excavated by Deacon (Van Pletzen 2000; Reynard & Wurz 2020). Gastric acid etching on small size I bovids have been attributed to raptors at BPA (Faith 2013a) and DK1 (Marean *et al.* 2000). Although size II and III bovids are typically too large a prey for raptors (Thompson 2010), Armstrong & Avery (2014) indicate that large raptors such as *Aquila verreauxii* (Verreaux's Eagle) can accumulate and cause etching on size II bovids in the CFR. As zoogenic data for this research was based on variables specifically representing carnivore damage, the role of raptors in these assemblages can be assumed but not concluded.

There is evidence to suggest that KRM was possibly occupied by carnivores, specifically the cave-dwelling carnivores such as leopards and brown hyaena, during periods of low human occupation (Thackeray 1990). Thackeray's (1990) carnivore/ungulate ratio for the MSA III assemblage from cave 1A supports carnivore accumulation. Various criteria have been established to differentiate between

leopard and hyaena accumulations. Leopards may feed on a variety of animals but tend to focus on specific animals such as baboons (*Papio ursinus*), rock hyraxes (*Procavia* capensis) and small ungulates. The presence of these animals, especially baboons, may indicate leopard activity (Thackeray 1990; Badenhorst *et al.* 2021). Thackeray's (1990: 102) leopard index (LI) for the MSA III suggests that there is a high probability of some accumulation by leopards. Leopard damage usually includes pits and furrows (Fisher 1995; Blumenschine *et al.* 1996). Brown hyaena can accumulate bones of many different animals, ranging in size from small mammals to large ungulates (Thackeray 1990; Badenhorst *et al.* 2021).

Even though there were no brown hyaena remains and one leopard remain recorded in the MSA III assemblage from cave 1A (Klein 1976; Thackeray 1990), there is evidence to support possible hyaena and possible leopard activity. Hyaena damage is highly variable and includes high frequencies of gastric acid etching on large bovids (Kuhn 2011). In the MSA III assemblage analysed here, 14% of specimens with tooth marks also exhibit gastric acid etching. It can be inferred that specimens with both tooth marks and gastric etching may have been accumulated by brown hyaenas, particularly if the etching is prevalent across most size classes (Faith 2013a). This type of pattern occurs across small and medium sized fauna in the MSA III assemblage. As hyaenas are the only carnivores to regurgitate bone flakes from larger animals and break bones, it is possible that they are the carnivore responsible for the gastric etching in the MSA III sample. Leopard accumulations would most likely feature skull and post-cranial remains of size I or II animals, and relatively complete skeletons of larger animals with few tooth marks (Brain 1969; de Ruiter & Berger 2000). In the MSA III assemblage analysed here, there are large proportions of skull and post-cranial remains of skull and post-cranial remains of smaller bovids (I and II), but the larger bovid skeletal representations are relatively incomplete. The higher proportion of specimens with tooth marks without etching in this sample may be the result of leopard activity or hyaena chewing on bones after humans discarded them. This could suggest that the site was occupied by both carnivores and humans at different intervals (Marean *et al.* 1992)

The prevalence of smaller bovid sizes (BOV I) in the MSA III may be the result of animal accumulations as smaller animals tend to be accumulated by carnivores or raptors (Marean *et al.* 2000; Thompson 2010). As shown in Chapter 4, there are less anthropogenic modifications than zoogenic modifications in the MSA III. These anthropogenic modifications occur mostly on medium size mammal and size III bovid specimens, whereas the zoogenic modifications, as discussed above, are more prevalent on the smaller bovid sizes. It is not unlikely that in some cases, smaller animals were collected by humans as well (Wadley 2010). The high carnivore ratio (Table 5.1) in the MSA III sample, the highest in the cave 1A sequence, may also be the result of animal accumulations (Van Pletzen-Vos *et al.* 2019) and a low intensity human occupation phase (Wurz 2000; Van Pletzen-Vos *et al.* 2019).

Decreased frequencies of anthropogenic modifications also suggest lower human occupational intensities during the MSA III. The post-HP MSA periods are associated with low population densities at the CFR coastal sites (Mitchell 2008), a trend also seen in the post-HP layers at KDS (Reynard *et al.* 2016a). The MSA III sample studied here comprises layers with lesser cultural material (BSS layers) and more cultural materials (CP layers) (Deacon & Geleijnse 1988). Anthropogenic modifications are more prevalent in the CP layers in the MSA III. The BSS layers tend to have more specimens with zoogenic modifications, a trend that is observed in low human occupational layers at Boomplaas (Faith 2013a). The lower frequencies of anthropogenic modifications suggest that humans may have contributed less significantly to the accumulation of the long bones in this assemblage than carnivores, which is evident in the proportion of percussion marks relative to tooth marks on long bones calculated in Table 5.2. It is, therefore, likely that carnivores were the primary accumulator of the smaller and medium sized animals in the MSA III, while humans generally accumulated the larger sized animals.

Table 5.1: Carnivore/bovid ratio for the MSA III and HP samples (based on NISP values, see Chapter 4: Table 4.2)

Sample	Carnivore NISP	Bovid NISP	Carnivore/bovid ratio
MSA III	26	146	**17.8**
HP	5	70	**7.1**

Table 5.2: Proportions of percussion marks relative to tooth marks on long bones for the MSA III and HP samples (calculated following Thompson *et al.* 2017). PM: percussion marks, TM: tooth marks.

Sample	Total long bone fragments	Specimens with PM	Specimens with TM	PM/(PM+TM)
MSA III	100	26	40	**39.4%**
HP	102	49	6	**89.1%**

In contrast to the MSA III, the HP sample has significantly more anthropogenic modifications than zoogenic modifications. Tooth marks in the HP occur in low frequencies and are most common on large size IV bovid lower limb elements. Gastric acid etched remains are rare in this sample, as there are no identifiable elements that are etched. This absence of gastric etched remains differs from inland HP sites, such as BPA, which record a prevalence of gastric etching in the HP assemblage (OCH member) (Faith 2013a). However, low frequencies of zoogenic modifications have been recorded at coastal HP sites, such as KDS (Reynard *et al.* 2016b). In the HP layers at KDS, zoogenic modifications are more prevalent in the upper HP layers (PAY and PAZ), which are less intense human occupation periods (Reynard *et al.* 2016b). A taphonomic analysis of an HP sample from J51 (cave 1A) by Achieng (2019) indicates that the YS5 layer in her research has more gastric acid etched remains than the CP4 layer,

and this is also observed in my study, where layer YS4 has more gastric etched remains than the CP layers. Due to the low frequencies of zoogenic modifications in this HP sample from KRM studied here, it is unlikely that carnivores or raptors played a significant role in the accumulation of this assemblage.

Anthropogenic modifications in the HP sample occur mostly on medium size mammal, BOV III and BOV IV specimens, and in significantly higher frequencies than zoogenic modifications. Percussion marks are common in this sample and occur on a variety of taxa and elements, whereas cut marks are rarer in the HP layers. Anthropogenic marks are more prevalent in the CP6 (a and b) layers (Chapter 4: Table 4.11). The taphonomic analysis from the HP sample analysed by Achieng (2019) also records low frequencies of cut marks, and this pattern is also seen in the HP layers at KDS (Reynard *et al.* 2016a). The prevalence of anthropogenic modifications in the HP sample studied in my research, as well as the proportion of percussion marks relative to tooth marks presented in Table 5.2, implies that early modern humans were the primary accumulators of the long bones, and more likely the faunal assemblage in general, with minimal contribution from carnivores and raptors. This inference differs from the HP layers at an inland CFR site, such as BPA, which records little to no evidence of anthropogenic involvement in the HP member (Faith 2013a). This inference, however, is similar to that made by Reynard *et al.* (2016a) at KDS and by Achieng (2019) for the occupational HP layer (CP4) at KRM. The proportion of percussion marks relative to tooth marks in the two samples analysed in my research implies a significant increase in anthropogenic involvement in the HP layers than the MSA III layers (Table 5.2), supporting the different roles of animals and humans as the accumulators of the assemblages.

Larger bovids are more numerous in the HP sample analysed here than the other size classes (Chapter 4: Table 4.2). Larger animals are typically associated with human accumulations (Milo 1998; Dusseldorp & Langejans 2015). There is variability in bovid size classes associated with other HP assemblages. A trend for a prevalence of smaller bovids has been recorded at KDS in the uppermost HP layers (PAY and PAZ) (Reynard *et al.* 2014). At DK1 the MIS 4 layer 10 shows a prevalence of larger bovid sizes (size III), while smaller bovids (size I) dominate in the underlying layer 11 (Marean *et al.* 2000). At BPA, the HP assemblage records high frequencies of size II bovids (Faith 2013a). At Sibudu Cave (SB), the HP assemblage is dominated by smaller bovids (size I), such as *Philantomba monticola* (blue duiker) (Clark 2011; Dusseldorp 2014). Apart from SB, larger bovids are more prevalent in assemblages from other HP sites. The carnivore/bovid ratio for the HP sample is substantially lower than the MSA III sample (Table 5.1). These values could suggest a decrease in animal activity in the HP layers compared to the MSA III layers.

5.2) Subsistence Strategies

5.2.1) Human Processing Strategies

There are significant differences in the quantities of cut and percussion marks between the MSA III and HP samples. Generally, cut marks occur in low frequencies in both samples, with cut mark frequencies marginally more common in the MSA III than the HP sample. Percussion marks, in contrast, are significantly more prevalent in the HP sample. Cut marks in the MSA III sample occur mostly on distal limb elements, mainly on metapodial shafts, which may be associated with filleting activities (Dominguez-Rodrigo 1999; Galan *et al.* 2009). There are few chop marks in the MSA III where they are most common on unidentifiable remains. The presence of chop marks on mammal or ungulate ribs may suggest early access to a carcass by humans (Pickering *et al.* 2013). Slice and scrape marks are more prevalent in the MSA III, and these modifications occur mostly on distal limb long bone elements from a variety of mammal and bovid sizes, suggesting filleting or skinning activities at the site (Binford 1981; Dominguez-Rodrigo 1999; Galan *et al.* 2009; Val & Mallye 2011; Walshe 2014; Reynard *et al.* 2016a). For the post-HP MSA layers at SB, the number of specimens preserving surface modifications is low, however, anthropogenic modifications are more common than carnivore modifications (Clark & Plug 2008). The bovid assemblage from these post-HP layers at SB feature smaller and larger bovids, and the frequencies of larger bovids increases throughout the assemblage. In contrast to the post-HP MSA III at KRM where the focus in on a variety of mammal and bovid sizes, the focus at SB during the post-HP MSA is on larger bovids (Clark & Plug 2008; Dusseldorp 2012).

In the HP, cut marks occur mostly on axial elements, mainly on rib fragments, and in low frequencies. In contrast to the MSA III, there are no cut marks on any long bone fragments in the HP, suggesting minimal filleting activities. There are also few chop marks in this sample, and as in the MSA III, these marks are most common on unidentifiable remains. There are, however, chop marks on medium mammal rib specimens and one large bovid astragalus . Large bovids from HP sites typically show signs of human processing, as seen in the HP layers at SB where cut marks are most common on larger ungulates (Clark 2017). Reynard *et al.* (2016a) note that larger sized ungulates tend to have more of these anthropogenic modifications than the smaller sized ungulates in the HP layers at KDS, and this trend is also observed in previous research at KRM (Achieng 2019). The presence of chop marks on the large bovid tarsal as discussed in Chapter 2.13 may suggest distal-limb dismemberment, an inference similar to that made by Reynard *et al.* (2016b) at KDS. The HP sample for my research records a few scrape and slice marks on medium size mammal ribs, and small and large bovid tarsal bones, which may suggest disarticulation activities (Reynard *et al.* 2016a). There are also slice marks on a large bovid sesamoid which could infer skinning activities at the site.

The cut mark data from both samples suggest similar subsistence strategies. The data from the MSA III indicates a focus on filleting and skinning activities, whereas there appears to be a focus on disarticulation and dismemberment activities in the HP. There is evidence to suggest that KRM people had early access to carcasses in both periods, however, this evidence is limited in the cut mark data. Frequencies of cut marks on bones can vary due to a variety of factors including cutting tool material, taxon and size, and the amount of flesh on elements (Thompson 2010). These factors and small sample sizes may have contributed to the low frequencies of cut marks recorded in the MSA III and HP (*cf.* Achieng 2019) at KRM.

Percussion marks from the MSA III sample mostly occur on distal limb and axial elements. Overall, there is a low proportion of identifiable long bones that exhibit percussion marks. However, percussion marks are more common on the metapodial shafts of larger bovids. Most of these metapodial shafts with percussion marks also have spiral fractures, suggesting that marrow extraction by humans, possibly hyaenas and leopards occurred during the MSA III at KRM. In the MSA III from KRM, percussion marks on low-utility elements such as phalanges and compact bones are rare. Intensive burning is not as prevalent in this MSA III sample as the HP sample at KRM, and a relatively low proportion of burnt elements have percussion marks.

There are significantly more percussion marks in the HP than the MSA III assemblages at KRM. The percussion marks in the HP are most common on axial elements. Overall, there is a larger proportion of identifiable long bones that exhibit percussion marks in this sample compared with the MSA III sample. These percussion marks in the HP are common on metapodial shafts of larger bovids, similar to the MSA III sample. Most of the percussion-marked long bones in the HP sample also have spiral fractures, suggesting marrow extraction. There is also a large proportion of unidentifiable long bones that have percussion marks, and most of these, like the identifiable long bones, also have spiral breakages. The prevalence of long bone fragments with spiral breakages and percussion marks in this sample suggest that marrow extraction was common during the HP. This inference of a marrow extraction strategy is also observed in the HP layers at KDS (Reynard *et al.* 2016a). Intensive burning is also more prevalent in the HP than the MSA III sample at KRM, and a relatively large proportion of burnt elements also exhibit percussion marks. The percussion marks on low-utility elements are relatively more common in the HP sample (Chapter 4: Table 4.13) than the MSA III sample, however there are significantly less low-utility elements in the HP sample than the MSA III sample which may account for this difference. The proportion of low-utility elements with percussion marks in this HP sample is substantially lower than that seen at other HP sites, such as KDS (Reynard *et al.* 2016a). This indicates that, while both periods may have had a marrow-extraction based subsistence strategy, the HP represents a period of more intensive processing by humans at KRM than the post-HP. Intensive

processing strategies are also observed in other HP layers at KRM (*cf.* Achieng 2019) and at KDS (Reynard *et al.* 2016a).

5.2.2) Skeletal Part Profiles and Subsistence Behaviour Debates

The skeletal part profile for bovids in the MSA III indicate a relatively high abundance of distal limb elements across all size classes, and cranial elements are also relatively common in this assemblage. Bovid size classes I , II and III reflect more equitability in skeletal element distribution. This may imply that smaller bovids were likely transported whole to the site. The bovid skeletal part profile in the HP also indicate a relatively high abundance of distal limb elements, however, there is less equitability in skeletal element distribution for all bovid sizes. This may indicate that the most profitable elements of bovids were transported back to site and not whole carcasses, as implied by the MSA III skeletal part profile. This differs from the HP layers at KRM analysed by Achieng (2019) who recorded an abundance of distal limbs as well as hindlimbs, and an equitable skeletal distribution for bovid sizes I , II and III. The HP sample has low representation of skull elements, which is surprising as skull elements generally preserve better than other elements (Lyman 1994a; Marean & Cleghorn 2003). This low representation of skull elements may be due to small sample sizes or fragmentation, but it may also reflect transport and processing activities in the HP. The lack of cranial elements in an assemblage has been used to suggest increased foraging distances and may suggest more intensified periods of subsistence (Clark 2011; Reynard & Henshilwood 2017).

Most of the anthropogenic modifications in this study occur on larger ungulates. In the MSA III sample these are prevalent on BOV III specimens, whereas in the HP, they occur mostly on BOV IV specimens. This pattern is referred to in the scavenger/hunter debate in which Binford (1984) proposed that cut marks observed on larger mammals are associated with disarticulation of the lower limbs from scavenging carcasses killed by carnivores. Binford (1984) also argued that the overrepresentation of large bovid cranial elements in an assemblage may imply scavenging activities by humans, as cranial fragments are the parts most often left by carnivores . This trend, however, is not seen in the HP as large bovid cranial elements are absent from the sample (Chapter 4: Figure 4.2).

Dusseldorp and Langejans (2015) suggest that a dominance of smaller bovids and a representation of small nocturnal animals in an assemblage may imply the use of traps. The MSA III sample is dominated by smaller bovids and has small nocturnal mammals, such as porcupines and grysbok (Reynard & Wurz 2020). However, anthropogenic modifications are rare on smaller mammals in this sample. The higher frequencies of zoogenic modifications on these smaller animals implies that carnivores contributed more to the accumulation of the small mammals in this sample. Cut marks in the HP are most common on large bovid tarsal and medium mammal rib fragments, which are typically associated with

disarticulation and early access to a carcass (Pickering *et al.* 2013). The anthropogenic marks and the low frequencies of zoogenic modifications, implies that scavenging was not common during the HP period and active hunting was more common. The abundance of larger bovids in the HP also supports the scenario of hunting as an important strategy during this period (Dusseldorp & Langejans 2015).

Distal limb elements are common in larger bovids in both the MSA III and HP. This high abundance of distal elements in the HP sample from this research and previous research at KRM (*cf.* Achieng 2019) differs from studies from other HP sites, such as KDS, which has a high prevalence of skull/cranial elements (Reynard *et al.* 2016a). The abundance of distal limbs in both samples may be related to transport decisions, as distal limbs would be relatively easy to carry back to the site. As discussed in Chapter 2, KRM faunal assemblages have been shown to exhibit a skeletal part profile pattern that is dominated by head and/or foot bones, also known as the 'Klasies Pattern' (Marean & Kim 1998). A common trend with the 'Klasies Pattern' is the representation of relatively complete skeletal elements for smaller bovids, and larger bovids are typically represented by high proportions of cranial and distal limb elements (Bartram & Marean 1999). The same pattern documented in my study. Klein (Klein 1989) and colleagues (Klein et al. 1999) argue that this pattern implies that smaller bovids were transported back to site whole and selected profitable elements of larger bovids were transported back to the site. Bartram and Marean's (1999) studies at DK1 show that other MIS 4 faunal assemblages also exhibit the 'Klasies Pattern'. Although overrepresentation of cranial and foot bones may occur in some cases, they suggest it was caused by carnivores, such as hyaenas, scavenging on vertebrae and pelves rather than cranial and limb elements (Marean *et al.* 1992). Experiments by Marean *et al.* (2000) show that spotted hyaenas are more likely to choose axial and innominate elements for consumption over other elements. Therefore, a pattern of low frequencies of axial and innominate elements and higher frequencies of limb elements may not be due to transport decisions, but rather carnivore ravaging at a site.

The 'Klasies Pattern' is seen in both samples in this study, which reflects more equitability in skeletal element distribution for smaller bovid sizes (sizes I and II), and larger gaps in element proportions for the larger bovids. In the MSA III sample, distal limb elements dominate in this sample. The nNISP and MNE values indicate that cranial and lower limb elements make up a relatively large proportion of the bovid skeletal part profile, when only high-survival bones are considered (Chapter 4: Table 4.3 and 4.4). When looking at all the nNISP values from the MSA III sample, cranial elements dominate over lower limb elements, especially for large bovids (Chapter 4: Table 4.3; Figure 4.1). When considering all the nNISP values, it suggests that cranial elements were favoured over lower limb, whereas the MNE values suggest that high-survival parts of cranial and lower limb elements were favoured during the MSA III. The lower representation of lower limbs in the nNISP values may be due to a small number

of identifiable lower limb element for larger bovids. The low representation of bovid upper limbs in the nNISP and MNE values suggest that these skeletal parts were not favoured as much as other skeletal parts during this period. The skeletal part representation for smaller and larger bovids in the MSA III implies that the smaller bovids were likely accumulated by carnivores and some may have been transported whole back to the site. Larger bovids were processed at the kill site, and selected profitable elements were transported back to the site. The pattern is less evident in the HP sample, as there is less equitability in skeletal element distribution for larger bovids (Chapter 4: Figure 4.2). In the HP sample, distal limb elements also dominate in this sample. The nNISP and MNE values indicate that lower limb elements make up a relatively large proportion of the bovid skeletal part profile, when only high-survival bones are considered. When looking at all the nNISP values from the HP sample, lower limbs dominate in the sample compared to other skeletal group, suggesting that lower limbs were favoured, especially from larger bovids. The MNE values from the HP also suggest that lower limbs were likely favoured after distal limbs. The low representation of bovid cranial elements in the nNISP and MNE values suggest that these parts were not favoured as much as other skeletal part during this period. The nNISP and MNE values for the HP bovid sample are relatively lower compared to the MSA III sample, and this is due to the smaller number of identifiable bovid remains in the sample. This differs from other HP layers at KRM, such as those analysed by Achieng (2019), where the skeletal part representation for larger bovids is dominated by cranial and distal limb elements thus exhibiting the 'Klasies Pattern'. There is also little evidence of the 'Klasies Pattern' present in the earlier MSA II at KRM (Lap 2020). The small bovid skeletal part representation from my HP sample may imply that small bovids were transported back to the site whole, as with the MSA III sample. The large bovid skeletal part representation in the HP suggests that upper and lower limbs were transported back to the site over cranial elements (Chapter 2: Figure 4.2). The lack of large bovid cranial elements in the HP may be due to the relatively low number of identifiable bovid elements due to small sample sizes or increased transport distances.

5.3) Site Formation Processes

Transverse and irregular breakages are indicative of post-depositional processes. As seen in Chapter 4 (Section 4.3: Table 4.8), the MSA III has a larger proportion of these types of long bone breakage patterns than the HP sample. This implies that post-depositional processes contributed more to these breakages in the MSA III than the HP. The taphonomic analyses of the MSA III long bones with transverse and irregular breakages suggest that the breakages were likely caused by mild burning activities and post-depositional processes. The taphonomic analyses of the HP long bones with transverse and irregular breakages imply that the breakages were likely caused by burning and trampling activities. Both the MSA III and HP sample show no significant correlation between bone density values

and bovid skeletal abundance (Section 4.3, Tables 4.9 and 4.10). The lack of bone density-mediated attrition in both samples implies that the characteristics of the faunal assemblages were caused by human or animal activities (Lam & Pearson 2005).

Abrasion is present in both samples in this research, although it is more prevalent in the HP sample. A large proportion of abraded specimens from both samples also exhibit rounding and manganese staining suggesting that these bones could have been transported by moving water (Fisher 1995). Manganese staining is also recorded in both samples and is more prevalent in the MSA III sample. The lower proportion of stained specimens in the HP sample may be due to the higher frequencies of black burnt specimens, as it is sometimes difficult to distinguish between staining and burning. These high proportions of manganese-stained specimens in both samples differ from other HP sites, such as KDS which records very few stained specimens in the HP layers (Reynard *et al.* 2016b). This staining can be caused by water activity (Lopez-Gonzalez *et al.* 2006) or manganese rich sediments at the site (Marin-Arroyo *et al.* 2014). Root etching is present in both samples, in low frequencies (Appendix B: Figure B.3). Rounding is also recorded in both samples (Appendix B: Figure B.4), but the HP exhibits a slightly larger proportion. The majority of the rounded specimens in both samples also exhibit staining. The MSA III has a larger proportion of rounded specimens exhibiting staining than the HP. The data indicates that while both assemblages were at some point affected by water, there is evidence of possibly higher water content in the MSA III.

5.4) Occupational Intensity

There is some evidence that between MIS 4 and 3, human population densities at inland CFR sites decrease and increase at coastal CFR sites at approximately 60 ka (Faith 2013a). This trend of decreasing human populations at inland CFR sites by 60 ka is seen at BPA (Faith 2013a). Occupational intensities can be inferred from taphonomic data such as trampling modifications (Reynard 2014; Reynard & Henshilwood 2018), burning activities (Cain 2005) and anthropogenic modification (Reynard in press).

The HP sample has significantly higher proportions of burnt bones than the MSA III sample. Most of these specimens are burnt black and grey (Appendix B, Figure B.5), which suggest burning from human activities, such as cooking or site maintenance, rather than natural bush fires or accidental burning (Cain 2005). These burning patterns in the samples may explain why the HP sample has a relatively smaller number of identifiable remains compared to the MSA III sample. Burning has been recorded as occurring in high frequencies at other HP sites, such as KDS (Reynard *et al.* 2016b) and SB (Clark & Ligouis 2010) and is usually associated with human occupation. High frequencies of burning may also be related to site maintenance (Cain 2005). Most of the specimens in the MSA III sample show localised

burning or are burnt brown. This burning pattern may be associated with accidental burning activities, for example a hearth structure near the bones (Clark & Ligouis 2010: 2650). Burning is not only less prevalent in the MSA III sample, but there are a fewer bones burnt black and grey which implies less human activity and lower human occupational intensities, or different cooking techniques.

Trampling is significantly more prevalent in the HP than the MSA III. Although it is hard to distinguish animal trampling from human trampling and group size, the trampling exhibited in the HP, along with the evidence for human activity, may infer higher human occupational intensity during this period than the MSA III (Appendix B; Figure B.6). The high degree of fragmentation in the HP may also be attributed to trampling. Transverse breakages on long bone fragments have also been attributed to occupation intensity (Reynard & Henshilwood 2018). The MSA III and HP samples in my research have similar proportions of long bones with transverse breakages, therefore difference in occupational intensities between the samples cannot be inferred using this attribute. Bone surface modifications may also suggest fluctuating human occupation at a site (Thompson et al. 2017). The higher frequencies of zoogenic modifications in the MSA III implies carnivores used the site more than humans, whereas the high frequencies of anthropogenic modifications in the HP would imply human occupation. Abrasion has also been used to infer occupational intensities at KDS (Reynard *et al.* 2016a) and previous research at KRM (Achieng 2019). Both studies recorded higher frequencies of abraded bone in higher occupational phases than lower occupational phases (Reynard *et al.* 2016a; Achieng 2019). In my samples, the HP has significantly more abraded bones than the MSA III (Chapter 4: Table 4.25). The high frequencies of abraded bones, along with the other evidence for human activity, in the HP suggest increased human activity and higher human occupational intensities. Abrasion can also be caused by various geological and biological processes (Fisher 1995; Fernandez-Jalvo & Andrews 2003). It cannot be solely used to infer occupational intensities unless abrasion is present with other indicators of occupational intensities. On the whole, the data indicates that the HP sample in this research reflects periods of fluctuating human occupational intensities, while the MSA III sample represents periods of relatively consistent low human occupation.

5.5) Conclusion

The results indicate that the MSA III and HP faunal assemblages may represent different agents of accumulation. The data suggest that the accumulators of the MSA III assemblage were a combination of possibly leopards, hyaenas and humans. In contrast, the primary accumulators of the HP assemblage were humans, which is also observed in other HP layers at KRM (*cf.* Achieng 2019) and coastal HP sites , such as KDS (Reynard *et al.* 2016). Both samples have higher frequencies of percussion marks than cut marks, and spiral breakages are the most abundant type of long bone breakage in both samples

suggesting similar subsistence strategies. This abundance of percussion marks, and spiral breakages may infer a bone marrow-extraction strategy, which is also seen at other HP sites, such as KDS (Reynard *et al.* 2016a) and in other HP layers at KRM (Achieng 2019). Percussion marks are proportionally more prevalent in the HP sample than the MSA III samples, suggesting more intense processing and marrow extraction activities in this period. The higher frequencies of intensive burning patterns and trampling in the HP suggest higher occupational intensity than the MSA III. Burning has also been recorded occurring in high frequencies at other HP sites, such as KDS (Reynard *et al.* 2016b) and SB (Clark & Ligouis 2010). The data imply that both assemblages were affected by post-depositional processes, possible water activity due to the prevalence of rounding and manganese staining, however, the lack of bone density-mediated attrition in both samples suggest that both assemblages were more affected by human or leopard and hyaena activities than post-depositional processes.

Chapter 6: Conclusion

In this concluding chapter, the outcomes of the study are summarised in section 6.1 with regards to the hypotheses stated in Chapter 1. Section 6.2 addresses the limitations of the study and the final section, Section 6.3, addresses the future avenues of taphonomic analyses on the MIS 4-3 MSA at KRM.

6.1) Hypotheses Outcomes

This study investigated five hypotheses:

Hypothesis 1: The accumulators of the MSA III faunal assemblage were a combination of human and carnivores

This study indicates that the MSA III layers sampled from square E50 were accumulated by a combination of humans and carnivores. The MSA III has a prevalence of small size I bovids, on which zoogenic modifications dominate. Anthropogenic modifications are more common on the larger bovids, implying that carnivores or raptors were responsible for the accumulation of the small bovids, and humans were responsible for the large bovid accumulation. The zoogenic modifications are more prevalent in the BSS layers, which are low human occupational layers, whereas anthropogenic modifications are more prevalent in the CP layers, which are high human occupational layers.. The proportion of percussion marks to tooth marks indicate that carnivores were likely the primary accumulators in this sample, with humans contributing less significantly. The results affirm the set hypothesis suggesting that both humans and carnivores, probably leopards and hyaenas contributed to the accumulation of the assemblage, where humans were more active during the CP layers and carnivores were more active during the BSS layers.

Hypothesis 2: The primary accumulators for the HP faunal assemblage were humans

In contrast to the MSA III sample, this study indicates that the HP layers sampled from square E50 were accumulated by humans. The sample has a prevalence of larger size III bovids, on which anthropogenic modifications dominate. Anthropogenic modifications are particularly more prevalent in the CP layers and are more common than zoogenic modifications on all bovid size classes. Zoogenic modifications are rare in this sample, suggesting that carnivores, and possibly raptors had little to no significant involvement during the HP. Layer YS4 has a slightly

larger proportion of zoogenic modifications, however, anthropogenic are also more prevalent in the layer. The proportion of percussion marks relative to tooth marks indicate that humans were the primary accumulators of this sample. The results affirm the set hypothesis suggesting that humans were the primary accumulators of the HP assemblage.

Hypothesis 3: Both assemblages were affected by post-depositional processes

The MSA III and HP assemblages were affected by post-depositional processes, however, the lack of bone density-mediated attrition in both samples suggest that both assemblages were more affected by human or leopards and hyaena activities than post-depositional processes. The long bone breakage data indicate that the higher frequencies of transverse and irregular breakages in the MSA III imply that this assemblage was more affected by post-depositional processes. It is likely that these types of breakages can be attributed to mild burning activities and post-depositional processes, such as trampling. In contrast, these types of breakages occur less frequently in the HP and are most likely related to intense burning and trampling activities. The high prevalence of rounded remains in both samples suggest that both assemblages were affected by movement, possibly trampling. The high prevalence of manganese-stained remains in both assemblages suggest that both samples were affected by water. The larger proportion of manganese-stained remains in the MSA III sample, suggest that possibly dripping water played a more significant role during the MSA III than the HP. The results affirm the hypothesis that both assemblages were affected by post-depositional processes, however, the MSA III sample seems to have been more affected by these processes than the HP sample.

Hypothesis 4: Human occupation at KRM was more intensive during the HP than the MSA III

The significantly higher frequencies of burning, anthropogenic modifications and trampling in the HP suggest that human occupation was more intense during this period than the MSA III. The carbon partings units from both samples have higher frequencies of burning and trampling than the sand units, suggesting higher occupational intensities or larger group sizes during the CP layers. The high frequencies of zoogenic modifications throughout the MSA III sample supports the scenario of lower human occupation during this period. Bone surface modification data indicate that the HP sample represents a period of fluctuating occupational intensities, as modifications indicating site occupation such as anthropogenic and trampling modifications fluctuates throughout the HP layers (*cf.* Section 4.3: Figures 4.5 and 4.12). In contrast, the MSA III sample represents a period of consistently low occupational intensities as frequencies of anthropogenic and trampling modifications remain consistently low throughout the MSA III layers. This trend is consistent with other sites, that also record higher occupational intensities during the HP and decreased human population densities during the post-

HP periods. The results affirm the set hypothesis suggesting that human occupation at KRM was more intense during the HP than the MSA III.

6.2) Limitations

This study's limitations are related to small sample sizes and the relatively low quantities of identifiable elements from the two assemblages. The HP assemblage was highly fragmented, resulting in an abundance of elements measuring under 2 cm also contributed to the small sample size. This made inferences for specific element processing activities by humans difficult and may have caused the lack of cranial representation in the HP skeletal part profile. An increased sample size may give more insight into the differences in carnivore/human occupation and subsistence strategies between the two periods.

6.3) Future Studies

The sample size in these samples was relatively small, so future taphonomic studies should include more MSA III and HP layers from square E50. This would increase the sample size and also enable comparisons of trends between the industries. An increased sample size from the HP layers would affect the skeletal part profile in this research and enable more comprehensive comparisons between taphonomic studies from other HP sites, such as Klipdrift Shelter, Sibudu Cave and Boomplaas Cave. A comprehensive analysis of the entire MSA sequence from square E50 could also provide a more comprehensive understanding of the role of humans, carnivores , and post-depositional processes throughout the MSA period at KRM. Comparisons between tooth mark occurrence and acid etching ratios could prove to be a potential proxy for determining the impact of carnivore accumulations at the site, and comparisons between percussion mark and tooth mark ratios can also determine the impact of human and carnivore activity at the site during various periods. A more comprehensive analysis including raptor and rodent modifications can be useful to determine the impact of raptor and rodent involvement at the site.

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Appendix A

Table A.1: MSA III NISP and MNI values per layer

MSA III																				
			CP2		BSS1		BSS2 AF1		BSS2		CP3		BSS3		CP4		Total NISP	% of NISP total	Total MNI	% of MNI total
Order	**Taxa**	**Common Name**	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI				
Rodentia	*Bathyergus siullus*	Cape dune mole rat	..	..	..	..	..	..	..	..	..	..	..	..	1	1	**1**	**0.3**	**1**	**3.7**
Hyracoidea	*Procavia capensis*	Hyrax	6	1	3	1	1	1	9	2	8	1	9	2	3	1	**39**	**12.5**	**9**	**33.3**
Carnivora	*Arctocephalus pusillus*	Cape fur seal	3	1	1	1	1	1	4	1	1	1	1	1	1	1	**12**	**3.9**	**7**	**25.9**
	Carnivore: canid	Carnivore	..	..	..	..	..	..	2	1	..	..	..	..	..	..	**2**	**0.6**	**1**	**3.7**
	Carnivore: felid		1	1	..	..	..	..	3	1	..	..	..	..	..	..	**4**	**1.3**	**2**	**7.4**
	Carnivore: indet.		..	..	..	..	..	..	4	1	2	1	..	..	2	1	**8**	**2.6**	**3**	**11.1**
Ruminantia	Bovidae: BOV I	Bovid	6		2		2		15		7		20		10		**62**	**19.9**		**.**
	BOV II		1		3		..		4		..		6		6		**20**	**6.4**		**.**
	BOV II/III		1		..		..		..		1		..		1		**3**	**1.0**		**.**
	BOV III		4		6		..		5		2		4		13		**34**	**10.9**		**.**
	BOV III/IV		1		..		..		..		..		1		1		**3**	**1.0**		**.**
	BOV IV		1		3		..		2		2		..		2		**10**	**3.2**		**.**
	BOV IV/V		2		..		..		..		..		..		1		**3**	**1.0**		**.**
	Connochaetes sp.	Wildebeest	..	..	..	..	..	..	..	..	2	1	..	..	..	..	**2**	**0.6**	**1**	**3.7**
	Equid: indet.	Equid	..	..	..	..	..	..	..	..	1	1	..	..	..	..	**1**	**0.3**	**1**	**3.7**
	Syncerus caffer	African buffalo	5	1	..	..	..	..	..	..	..	..	..	..	4	1	**9**	**2.9**	**2**	**7.4**
Mammal: Indet	Small	Mammal	4		2		..		3		3		1		2		**15**	**4.8**		**.**
	Medium		17		2		2		7		9		14		15		**16**	**21.2**		**.**
	Large		1		2		..		5		2		5		2		**17**	**5.5**		**.**
Total NISP and MNI			**53 (17.0)**	**4 (14.8)**	**24 (7.7)**	**2 (7.4)**	**6 (1.9)**	**2 (7.4))**	**63 (20.3)**	**6 (22.2)**	**40 (12.9)**	**5 (18.5)**	**61 (19.6)**	**3 (11.1)**	**64 (20.6)**	**5 (18.5)**	**311**	**100**	**27 (100)**	**100**

Table A.2: HP NISP and MNI values per layer

HP																				
			CP5		YS5		CP6 (a)		CP6 (b)		CP9 (a)		CP9 (b)		CP9		Total NISP	% of NISP total	Total MNI	% of MNI total
Order	**Taxa**	**Common Name**	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI				
Rodentia	*Hystrix africaeaustralis*	Porcupine	..	..	..	..	..	..	1	1	..	..	..	..	..	..	**1**	**0.8**	**1**	**11.1**
Carnivora	*Arctocephalus pusillus*	Cape fur seal	..	..	3	1	1	1	..	..	..	..	..	..	..	..	**4**	**3.2**	**2**	**22.2**
	Carnivore: indet.	Carnivore	..	..	..	..	..	..	..	..	..	..	1	1	..	..	**1**	**0.8**	**1**	**11.1**
Ruminantia	*Alcelaphine* sp.	Hartebeest	..	..	..	..	..	..	..	..	..	..	10	1	..	..	**10**	**7.9**	**1**	**11.1**
	Antidorcas sp.	Springbok	..	..	..	..	..	..	..	..	..	..	1	1	..	..	**1**	**0.8**	**1**	**11.**
	Bovidae: BOV I	Bovid	2		5		..		1		..		..		..	..	**8**	**6.3**	**3**	**.**
	BOV II		1		..		2		2		..		2		..	..	**7**	**5.6**	**4**	**.**
	BOV III		4		1		1		7		..		3		..	..	**16**	**12.7**	**5**	**.**
	BOV III/IV		..		..		2		..		2		..		..	..	**4**	**4.0**	**2**	**.**
	BOV IV		..		..		4		3		2		2		..	..	**11**	**8.7**	**4**	**.**
	BOV IV/V		..		..		..		1		1		2		..	..	**4**	**3.2**	**3**	**.**
	Megalotragus sp.	Giant Hartebeest	..	…	..	..	..	..	..	..	..	..	1	1	..	..	**1**	**0.8**	**1**	**11.1**
	Syncerus antiquus	Long-horned buffalo	..	..	..	..	..	..	5	1	..	..	..	..	..	..	**5**	**4.0**	**1**	**11.1**
	Taurotragux oryx	Eland	..	..	..	..	..	..	..	..	..	..	3	1	..	..	**3**	**2.4**	**1**	**11.1**
Mammal: Indet	Small	Mammal	..	..	..		1		..	..	..		3		..	..	**4**	**3.2**	**2**	**.**
	Medium		4		1		9		8		4		3		..	..	**29**	**23.0**	**6**	**.**
	Large		1		..		5		8		..		..		1		**15**	**11.9**	**4**	**.**
Total NISP and MNI			**12 (9.5)**	**0)**	**12 (9.5)**	**1 (11.1)**	**25 (19.8)**	**1 (11.1))**	**36 (28.7)**	**2 (22.2)**	**9 (7.1)**	**0)**	**31 (24.6)**	**5 (55.6)**	**1 (0.8)**	**0**	**126 (100)**	**100**	**9 (100)**	

Table A.3: MSA III MNE and MAU values per layer

Skeletal part	Element	Anatomical region	MSA III															
			CP2		BSS1		BSS2 AF1		BSS2		CP3		BSS3		CP4			
			MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	Total MNE	Total MAU
Skull	**Cranial**	Fragment	2	1	1	0.5	..	..	2	1	2	1	1	0.5	1	0.5	**9**	**4.5**
	Mandible	Ramus	..	..	1	0.5	..	..	1	0.5	2	1	..	..	..	..	**4**	**2**
Upper Limbs	**Humerus**	Distal	..	..	..	..	..	..	..	..	..	..	..	..	1	0.5	**1**	**0.5**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Metacarpal	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	1	0.5	..	..	..	..	..	..	..	..	..	..	**1**	**0.5**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Radius	Distal	..	..	..	..	..	..	..	..	..	..	..	..	1	0.5	**1**	**0.5**
		Proximal	..	..	..	..	..	..	1	0.5	1	0.5	..	..	..	..	**2**	**1**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
Lower Limbs	**Femur**	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	1	0.5	..	..	..	..	1	0.5	..	..	..	..	..	..	**2**	**1**
		Shaft	2	1	..	..	..	..	..	..	..	..	..	..	..	..	**2**	**1**
	Metatarsal	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..	**1**	**0.5**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Tibia	Distal	..	..	..	..	..	..	1	0.5	..	..	..	..	2	1	**3**	**1.5**
		Proximal	1	0.5	..	..	..	..	..	..	..	..	1	0.5	..	..	**2**	**1**
		Shaft	..	..	..	..	..	..	..	..	1	0.5	..	..	2	1	**3**	**1.5**
Distal Limbs	**Metapodial**	Distal	1	0.3	..	..	1	0.3	1	0.3	..	..	1	0.3	3	0.8	**7**	**2**
		Proximal	1	0.3	1	0.3	..	..	..	..	..	..	..	..	..	..	**2**	**0.6**
		Shaft	2	0.5	..	..	..	..	1	0.3	1	0.3	..	..	9	2.3	**13**	**3.4**
	Phalanges	Complete	..	..	2	0.08	..	..	4	0.2	2	0.08	6	0.3	3	0.1	**17**	**0.8**
		Distal	1	0.04	2	0.08	1	0.04	2	0.08	1	0.04	2	0.08	1	0.04	**10**	**0.4**
		Proximal	2	0.08	1	0.04	..	..	1	0.04	..	..	5	0.2	2	0.08	**11**	**0.4**
		Shaft	..	..	..	..	..	..	1	0.04	..	..	2	0.08	..	..	**3**	**0.1**
Total MNE			**13**		**9**		**2**		**17**		**10**		**18**		**25**		**94**	**23.2**

Table A.4: HP MNE and MAU values per layer

Skeletal part	Element	Anatomical region	HP															
			CP5		YS4		CP6 (a)		CP6 (b)		CP9 (a)		CP9 (b)		CP9			
			MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU	Total MNE	Total MAU
Skull	**Cranial**	Fragment	1	0.5	..	..	..	..	1	0.5	..	..	..	..	..	..	**2**	**1**
	Mandible	Fragment	..	..	..	..	1	0.5	..	..	..	..	..	..	..	..	**1**	**0.5**
Upper Limbs	**Humerus**	Distal	..	..	..	..	..	..	..	..	..	..	1	0.5	..	..	**1**	**0.5**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Metacarpal	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	..	..	..	..	1	0.5	..	..	..	..	..	..	**1**	**0.5**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Radius	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	..	..	1	0.5	..	..	..	..	..	..	..	..	**1**	**0.5**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
	Ulna	Distal	..	..	..	..	1	0.5	..	..	..	..	..	..	..	..	**1**	**0.5**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
Lower Limbs	**Femur**	Distal	..	..	1	0.5	..	..	..	..	..	..	..	..	..	..	**1**	**0.5**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	1	0.5	..	..	..	..	..	..	..	..	..	..	..	..	**1**	**0.5**
	Metatarsal	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	1	0.5	..	..	..	..	..	..	..	..	..	..	..	..	**1**	**0.5**
	Tibia	Distal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	1	0.5	..	..	1	0.5	..	..	..	..	..	..	..	..	**2**	**1**
Distal Limbs	**Metapodial**	Distal	..	..	1	0.3	..	..	1	0.3	..	..	1	0.3	..	..	**3**	**0.9**
		Proximal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Shaft	..	..	..	..	2	0.5	..	..	2	0.5	..	..	..	..	**4**	**1**
	Phalanges	Complete	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**..**	**..**
		Distal	..	..	1	0.04	..	..	..	..	1	0.04	..	..	..	..	**2**	**0.08**
		Proximal	..	..	..	..	..	..	..	..	1	0.04	..	..	..	..	**1**	**0.04**
		Shaft	2	0.08	1	0.04	..	..	2	0.08	..	..	2	0.08	..	..	**7**	**0.28**
Total MNE			**6**		**4**		**6**		**5**		**4**		**4**		**0**		**29**	**8.3**

Table A.5: MSA III mammal size classes by unidentified long bone cortical thickness measurements

MSA III layers	Mammal size class by unidentified long bone cortical thickness measurements			Total N (%)	% of total
	Small mammal (<2 mm) n (%)	Medium mammal (2-5.9 mm) n (%)	Large mammal (6-19.9 mm) n (%)		
CP2	1 (6.7)	13 (86.6)	1 (6.7)	**15 (100)**	**32.6**
BSS1	0	2 (100)	0	**2 (100)**	**4.3**
BSS2 AF1	0	0	0	**0**	**0**
BSS2	1 (25.0)	1 (25.0)	2 (50.0)	**4 (100)**	**8.7**
CP3	0	4 (100)	0	**4 (100)**	**8.7**
BSS3	0	4 (66.7)	2 (33.3)	**6 (100)**	**13.0**
CP4	0	9 (60.0)	6 (40.0)	**15 (100)**	**32.6**
Total N (%)	**2 (4.4)**	**33 (71.7)**	**11 (23.9)**	**46 (100)**	**100**

Table A.6: HP mammal size classes by unidentified long bone cortical thickness measurements

HP layers	Mammal size class by unidentified long bone cortical thickness			Total N (%)	% of total
	Small mammal (<2 mm) n (%)	Medium mammal (2-5.9 mm) n (%)	Large mammal (6-19.9 mm) n (%)		
CP5	-	3 (60.0)	2 (40.0)	**5 (100)**	**6.0**
YS4	-	2 (100)	-	**2 (100)**	**2.4**
CP6 (a)	1 (4.5)	15 (68.2)	6 (27.3)	**22 (100)**	**26.5**
CP6 (b)	1 (4.0)	13 (52.0)	11 (44.0)	**25 (100)**	**30.1**
CP9 (a)	-	14 (82.4)	3 (17.6)	**17 (100)**	**20.5**
CP9 (b)	1 (9.1)	6 (54.5)	4 (36.4)	**11 (100)**	**13.3**
CP9	-	-	1 (100)	**1 (100)**	**1.2**
Total N (%)	**3 (3.6)**	**53 (63.9)**	**27 (32.5)**	**83 (100)**	**100**

Table A.7: MSA III burning patterns

MSA III Layers	Burning stages					No. of burnt remains n (%)	% of layer total	Total number of specimens N
	Brown (0) n (%)	Localised (1) n (%)	Black (2) n (%)	Grey (3) n (%)	White (4) n (%)			
CP2	32 (33.0)	49 (50.5)	14 (14.4)	2 (2.1)	0	**97 (100)**	**67.4**	**144**
BSS1	14 (23.7)	43 (72.9)	2 (3.4)	0	0	**59 (100)**	**72.8**	**81**
BSS2 AF1	2 (25.0)	3 (37.5)	3 (37.5)	0	0	**8 (100)**	**57.1**	**14**
BSS2	18 (39.2)	23 (50.0)	2 (4.3)	2 (4.3)	1 (2.2)	**46 (100)**	**26.7**	**172**
CP3	7 (23.3)	13 (43.3)	6 (20.0)	2 (6.7)	2 (6.7)	**30 (100)**	**13.6**	**220**
BSS3	2 (6.5)	20 (64.5)	5 (16.1)	4 (12.9)	0	**31 (100)**	**15.7**	**198**
CP4	51 (34.7)	40 (27.2)	32 (21.8)	20 (13.6)	4 (2.7)	**147 (100)**	**61.0**	**241**
Total N (%)	**126 (30.1)**	**191 (45.7)**	**64 (15.3)**	**30 (7.2)**	**7 (1.7)**	**418 (100)**	**37.1**	**1 070**

Table A.8: HP burning patterns

HP layers	Burning stages					No. of burnt remains n (%)	% of layer total	Total number of specimens (N)
	Brown (0) n (%)	Localised (1) n (%)	Black (2) n (%)	Grey (3) n (%)	White (4) n (%)			
CP5	15 (30.6)	10 (20.4)	19 (38.8)	5 (10.2)	0	**49 (100)**	**63.6**	**77**
YS4	5 (15.2)	7 (21.2)	10 (30.3)	11 (33.3)	0	**33 (100)**	**48.5**	**68**
CP6 (a)	40 (19.0)	27 (12.8)	79 (37.4)	53 (25.1)	12 (5.7)	**211 (100)**	**93.8**	**225**
CP6 (b)	38 (20.7)	14 (7.6)	45 (24.5)	71 (38.6)	16 (8.6)	**184 (100)**	**88.5**	**208**
CP9 (a)	37 (21.4)	5 (2.9)	57 (32.9)	65 (37.6)	9 (5.2)	**173 (100)**	**97.2**	**178**
CP9 (b)	69 (39.0)	5 (2.8)	55 (31.2)	42 (23.7)	6 (3.3)	**177 (100)**	**93.2**	**190**
CP9	5 (33.3)	1 (6.7)	2 (13.3)	7 (46.7)	0	**15 (100)**	**100**	**15**
Total N (%)	**209 (24.8)**	**69 (8.2)**	**267 (31.7)**	**254 (30.2)**	**43 (5.1)**	**842 (100)**	**87.6**	**961**

Table A.9: MSA III anthropogenic modifications by skeletal part

MSA III Layers	**Skeletal part with anthropogenic bone surface modifications**										**Remains with modifications n (%)**		**Total N (%)**	**% of total**
	Skull		**Axial**		**Upper Limbs**		**Lower Limbs**		**Distal Limbs**					
	CM n (%)	**PM n (%)**	**CM n (%)**	**PM n (%)**	**CM n (%)**	**PM n (%)**	**CM n (%)**	**PM n (%)**	**CM n (%)**	**PM n (%)**	**CM n (%)**	**PM n (%)**		
CP2	0	0	1 (2.3)	3 (6.8)	0	0	1 (2.3)	0	1 (2.3)	1 (2.3)	**3 (6.9)**	**4 (9.1)**	**44 (16.0)**	**16.0**
BSS1	0	0	1 (5.0)	0	0	0	0	0	2 (10.0)	0	**3 (15.0)**	**0**	**20 (15.0)**	**7.3**
BSS2 AF1	1 (16.7)	0	0	0	0	0	0	0	0	0	**1 (16.7)**	**0**	**6 (16.7)**	**2.2**
BSS2	0	0	0	0	0	0	0	0	1 (1.8)	3 (5.4)	**1 (1.8)**	**3 (5.4)**	**56 (7.2)**	**20.4**
CP3	0	4 (11.4)	0	4 (11.4)	0	0	0	1 (2.9)	0	1 (2.9)	**0**	**10 (28.6)**	**35 (28.6)**	**12.7**
BSS3	1 (1.8)	0	0	1 (1.8)	0	0	0	0	0	2 (3.5)	**1 (1.8)**	**3 (5.3)**	**57 (7.1)**	**20.7**
CP4	0	0	2 (3.5)	3 (5.3)	0	2 (3.5)	1 (1.8)	2 (3.5)	2 (3.5)	6 (10.5)	**5 (8.8)**	**13 (22.8)**	**57 (31.6)**	**20.7**
Remain with modification n (%)	**2 (4.3)**	**4 (8.5)**	**4 (8.5)**	**11 (23.4)**	**0**	**2 (4.3)**	**2 (4.3)**	**3 (6.4)**	**6 (12.8)**	**13 (27.7)**	**14 (29.8)**	**33 (70.2)**	**47 (100)**	**17.1**
Total N (%)	**33 (12.0)**		**91 (33.1)**		**19 (6.9)**		**37 (13.5)**		**95 (34.5)**				**275 (100)**	**100**

Table A.10: HP anthropogenic modifications by skeletal part

HP layers	Skeletal part with anthropogenic bone surface modifications										Remains with modifications n (%)		Total N (%)	% of total
	Skull		Axial		Upper limbs		Lower limbs		Distal limbs					
	CM n (%)	PM n (%)	CM n (%)	PM n (%)	CM n (%)	PM n (%)	CM n (%)	PM n (%)	CM n (%)	PM n (%)	CM n (%)	PM n (%)		
CP5	0	1 (8.3)	0	1 (8.3)	0	0	0	2 (16.7)	0	0	**0**	**4 (33.3)**	**12 (33.3)**	**12.4**
YS4	0	0	0	0	0	1 (10.0)	0	0	0	1 (10.0)	**0**	**2 (20.0)**	**10 (20.0)**	**10.3**
CP6 (a)	0	1 (4.0)	0	5 (20.0)	0	1 (4.0)	1 (4.0)	2 (8.0)	1 (4.0)	2 (8.0)	**2 (8.0)**	**11 (44.0)**	**25 (52.0)**	**25.8**
CP6 (b)	0	1 (4.2)	0	2 (8.3)	0	0	0	1 (4.2)	0	0	**0**	**4 (16.7)**	**24 (16.7)**	**24.7**
CP9 (a)	0	0	2 (22.2)	0	0	0	0	0	0	1 (11.1)	**2 (22.2)**	**1 (11.1)**	**9 (33.3)**	**9.3**
CP9 (b)	0	0	0	1 (6.3)	0	0	1 (6.3)	0	0	2 (12.5)	**1 (6.3)**	**3 (18.8)**	**16 (25.1)**	**16.5**
CP9	0	1 (100)	0	0	0	0	0	0	0	0	**0**	**1 (100)**	**1 (100)**	**1.0**
Remains with modifications n (%)	**0**	**4 (12.9)**	**2 (6.5)**	**9 (29.0)**	**0**	**2 (6.5)**	**2 (6.5)**	**5 (16.1)**	**1 (3.2)**	**6 (19.4)**	**5 (16.1)**	**26 (83.9)**	**31**	**32.0**
Total N (%)	**16 (16.5)**		**36 (37.1)**		**5 (5.2)**		**12 (12.4)**		**28 (28.8)**				**97 (100)**	**100**

Table A.11: MSA III zoogenic modifications by skeletal part

MSA III Layers	Skeletal part with zoogenic bone surface modifications										Remains with modifications n (%)		Total N (%)	% of total
	Skull		Axial		Upper Limbs		Lower Limbs		Distal Limbs					
	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)		
CP2	2 (4.5)	0	4 (9.1)	2 (4.5)	1 (2.3)	0	4 (9.1)	0	1 (2.3)	1 (2.3)	**12 (27.3)**	**3 (6.8)**	**44 (34.1)**	**16.0**
BSS1	2 (10.0)	0	1 (5.0)	0	1 (5.0)	0	1 (5.0)	0	2 (10.0)	0	**7 (35.0)**	**0**	**20 (35.0)**	**7.3**
BSS2 AF1	0	0	1 (16.7)	0	0	0	0	0	0	0	**1 (16.7)**	**0**	**6 (16.7)**	**2.2**
BSS2	3 (5.4)	2 (3.6)	5 (8.9)	1 (1.8)	2 (3.6)	1 (1.8)	4 (7.1)	0	6 (10.7)	2 (3.6)	**20 (35.7)**	**6 (10.8)**	**56 (46.5)**	**20.4**
CP3	0	0	1 (2.9)	1 (2.9)	0	0	0	0	0	1 (2.9)	**1 (2.9)**	**2 (5.8)**	**35 (8.7)**	**12.7**
BSS3	0	0	5 (8.8)	1 (1.8)	2 (3.5)	0	1 (1.8)	0	2 (3.5)	1 (1.8)	**10 (17.6)**	**2 (3.6)**	**57 (21.2)**	**20.7**
CP4	0	0	3 (5.3)	2 (3.5)	1 (1.8)	0	5 (8.8)	1 (1.8)	4 (7.0)	1 (1..8)	**13 (22.9)**	**4 (7.1)**	**57 (30.0)**	**20.7**
Remain with modification n (%)	**7 (8.6)**	**2 (2.5)**	**20 (24.7)**	**7 (8.6)**	**7 (8.6)**	**1 (1.3)**	**15 (18.5)**	**1 (1.3)**	**15 (18.5)**	**6 (7.4)**	**64 (78.9)**	**17 (21.1)**	**81 (100)**	**17.1**
Total N (%)	**33 (12.0)**		**91 (33.1)**		**19 (6.9)**		**37 (13.5)**		**95 (34.5)**				**275 (100)**	**100**

Table A.12: HP zoogenic modifications by skeletal part

HP layers	Skeletal part with zoogenic bone surface modifications										Remains with modifications n (%)		Total N (%)	% of total
	Skull		Axial		Upper limbs		Lower limbs		Distal limbs					
	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)	TM n (%)	GAE n (%)		
CP5	0	0	0	0	0	0	1 (8.3)	0	0	0	**1 (8.3)**	**0**	**12 (8.3)**	**12.4**
YS4	0	0	0	0	0	0	1 (10.0)	0	0	0	**1 (10.0)**	**0**	**10 (10.0)**	**10.3**
CP6 (a)	0	0	0	0	0	0	1 (4.0)	0	1 (4.0)	0	**2 (8.0)**	**0**	**25 (8.0)**	**25.8**
CP6 (b)	1 (4.2)	0	1 (4.2)	0	0	0	1 (4.2)	0	0	0	**3 (12.6)**	**0**	**24 (12.6)**	**24.7**
CP9 (a)	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**9**	**9.3**
CP9 (b)	0	0	0	0	1 (6.3)	0	0	0	1 (6.3)	0	**2 (12.6)**	**0**	**16 (12.6)**	**16.5**
CP9	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**1**	**1.0**
Remains with modifications n (%)	**1 (11.1)**	**0**	**1 (11.1)**	**0**	**1 (11.1)**	**0**	**4 (44.4)**	**0**	**2 (22.1)**	**0**	**9 (100)**	**0**	**9**	**9.3**
Total N (%)	**16 (16.5)**		**36 (37.1)**		**5 (5.2)**		**12 (12.4)**		**28 (28.8)**				**97 (100)**	**100**

Table A.13: MSA III trampling modifications

MSA III Layer	Trampling modifications				Remains with modifications n (%)	% of layer total	Layer total N (%)	% of total
	Lines n (%)	Scratches n (%)	Pits n (%)	Grooves n (%)				
CP2	8 (57.1)	2 (14.3)	3 (21.4)	1 (7.2)	**14 (100)**	**10.4**	**134**	**14.0**
BSS1	4 (100)	0	0	0	**4 (100)**	**5.6**	**72**	**7.4**
BSS2 AF1	1 (100)	0	0	0	**1 (100)**	**7.1**	**14**	**1.4**
BSS2	4 (100)	0	0	0	**4 (100)**	**2.5**	**161**	**16.8**
CP3	5 (83.3)	1 (16.7)	0	0	**6 (100)**	**3.2**	**185**	**19.3**
BSS3	4 (100)	0	0	0	**4 (100)**	**2.1**	**188**	**19.6**
CP4	14 (100)	0	0	0	**14 (100)**	**6.8**	**206**	**21.5**
Total N (%)	**40 (85.1)**	**3 (6.4)**	**3 (6.4)**	**1 (2.1)**	**47 (100)**	**4.9**	**960**	**100**

Table A.14: HP trampling modifications

HP layers	Trampling modifications				Remains with modifications n (%)	% of layer total	Layer total N (%)
	Lines n (%)	Scratches n (%)	Pits n (%)	Grooves n (%)			
CP5	3 (100)	0	0	0	**3 (100)**	**4.0**	**75**
YS4	6 (100)	0	0	0	**6 (100)**	**9.7**	**62**
CP6 (a)	84 (98.8)	0	0	1 (1.2)	**85 (100)**	**38.5**	**221**
CP6 (b)	82 (97.6)	1 (1.2)	1 (1.2)	0	**84 (100)**	**41.6**	**202**
CP9 (a)	44 (95.6)	1 (2.2)	1 (2.2)	0	**46 (100)**	**26.0**	**177**
CP9 (b)	52 (96.3)	0	2 (3.7)	0	**54 (100)**	**29.2**	**185**
CP9	7 (87.5)	0	1 (12.5)	0	**8 (100)**	**53.3**	**15**
Total N (%)	**278 (97.2)**	**2 (0.7)**	**5 (1.7)**	**1 (0.3)**	**286 (100)**	**30.5**	**937**

Appendix B

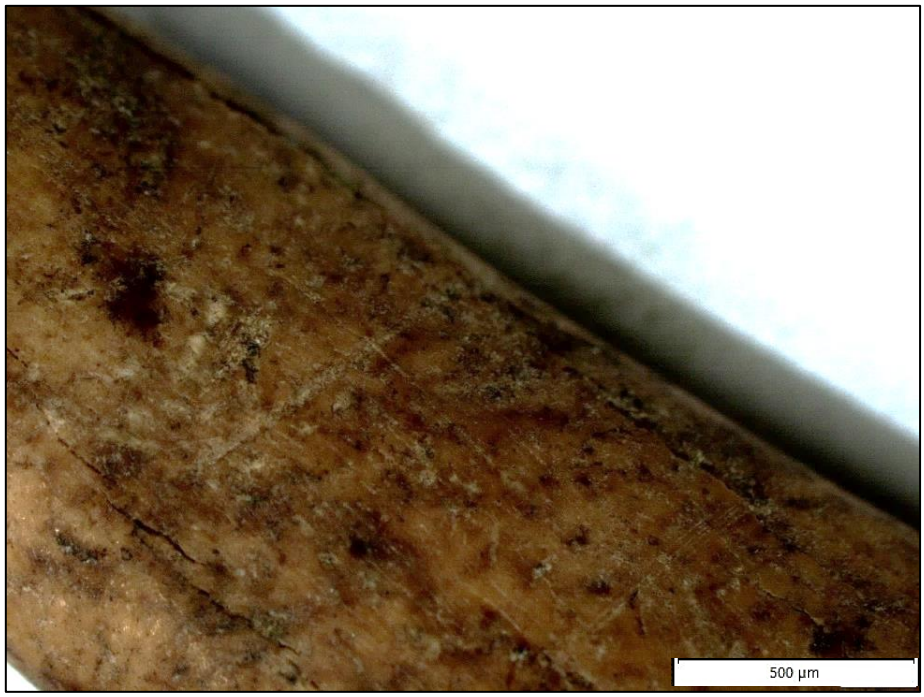

Figure B.1: Tooth mark on MSA III specimen

Figure B.2: Gastric acid etching on MSA III specimen

Figure B.3: Root etching on specimen from the HP

Figure B.4: Rounded specimen from the HP

Figure B.5: Burnt specimen from the HP

Figure B.6: Trampling modification on specimen from the HP