A TAPHONOMIC ANALYSIS OF THE UNGULATE FAUNA FROM THE EARLY HOWIESONS POORT AT KLASIES RIVER SITE

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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 in any other University.

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Abstract

The Howiesons Poort (HP), a key Middle Stone Age techno-complex investigated by several recent studies in South Africa, is characterized by innovative lithic reduction techniques and projectile weapons hinting at human behavioural complexity in the Late Pleistocene. This complexity is also evident in the 1.8 metre HP sequence from Klasies River main site (KRM). The subsistence behaviours and occupational activity at KRM has received much less attention than the lithic technology, leading to an underdeveloped understanding of behavioural complexity of the HP at KRM. In this study taphonomic analyses, a crucial step in establishing subsistence strategies and site formation processes, have been undertaken for two layers from the lowermost HP deposits in Cave 1A, from square J51 layers YSx5 and CPx4. The relatively high incidence of acid etching, weathering, tooth marks and low degree of burning and cut marks suggest both human and carnivore accumulators in layer YSx5. Layer CPx4 on the other hand records relatively higher levels of burning, percussion marks and cut marks indicating human accumulators. The higher levels of trampling and abrasion in CPx4 indicates a period of higher occupational intensity while the lower levels of acid etching, tooth marks and weathering indicate lower carnivore activity as well post depositional exposure of bone. The abundance of the bovid size classes varies in the two layers with YSx5 exhibiting a prevalence of size 1(0-23kg) and CPx4 exhibiting size 2 (23-86kg). This most likely signifies variation in subsistence strategies with larger size classes showing higher degrees of human modification.

Keywords

●Klasies River ●Early Howiesons Poort ●Taphonomy ●Subsistence strategies

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CHAPTER 1

SITE BACKGROUND

The Klasies River landscape is a national monument and consists of a complex of five coastal caves located along a 2.5 km stretch along the Tsitsikamma Coast of South Africa approximately 130 km west of Port Elizabeth (Wurz *et al.* 2018) (Fig. 1). Caves 1,1A,1B and 2 constitute what is referred to as the main site (34° 06 S, 24°, 24 E) situated closest to the Klasies River mouth. Main site preserves 21m of deposits that are all part of the same build up process (Shackleton 1982; Deacon *et al.* 1988; Vogel 2001; Jacobs *et al.* 2008).

KRM was first excavated between 1967-1968 by Singer & Wymer and subsequently by Deacon (1984-1995) and Wurz (2013- current) (Wurz *et al.* 2018). The main site MSA deposits span from the MIS 5- MIS 3 (Deacon & Geleijnse 1988; Vogel 2001). A huge mass of these original deposits has been eroded away in the Holocene and the remaining sections illustrate the truncated nature of the layers left behind by this erosion.

The area surrounding KRM is generally associated with Fynbos vegetation of the Greater Cape Floristic region (CFR) (Mucina & Rutherford 2006; Verboom *et al.* 2015). However, a recent detailed analysis of the immediate environment around KRM shows that the vegetation is a complex mixture of thicket, forest and coastal species with some Fynbos elements (Van Wijk *et al.* 2017). The CFR today, as in the Holocene, supports mainly small bodied browsers as the dominant ungulates (Klein 1983; Boshoff *et al.* 2001; Faith 2011). Large mammal fauna is rather minimal owing to the restricted availability of grassy habitats (Boshoff *et al.* 2001; Faith 2013). The CFR however, supported many large grazers such as Quagga (*Equus quagga*), black wildebeest (*Connochaetes gnou*) and reedbuck (*Redunca arundinum*) during the Pleistocene (Klein 1976).

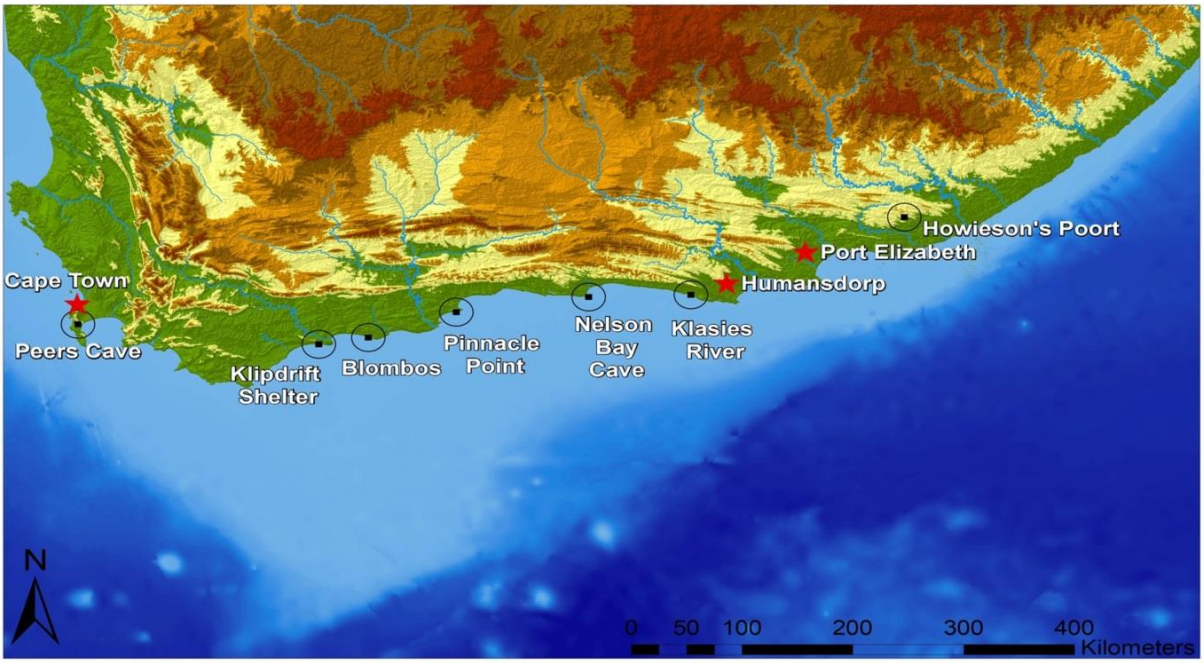


Figure 1. 1: Map denoting Southern Cape Late Pleistocene sites courtesy of Kuni Mosweu (2019).

1.1 Research problem statement

Faunal studies in the Howiesons Poort in Southern Africa have been characterised by the focus on subsistence strategies and whether and how this relates to paleoenvironmental and technological change. Some (e.g. Thompson 2010; Reynard *et al.* 2016a, b) of these studies included taphonomy which has enabled the inference of agents of accumulation, technological influence and site formation processes. However, taphonomic studies of faunal assemblages from the HP layers at KRM have not been undertaken. This is the focus of this project and it is investigated whether changes in site formation processes and subsistence strategies occurred within the early layers of the Howiesons Poort at KRM.

The study investigated three hypotheses;

H^1 The main bone accumulator for YSx5 and CPx4 were humans.

H^2 YSx5 and CPx4 taphonomic analysis, reflect different subsistence strategies.

H^3 CPx4 reflects a period of high occupation density than YSx5.

1.2 Research Question

Which subsistence strategies and site formation processes occurred during the earlier layers of the Howiesons Poort at KRM?

1.3 Aim and Objectives

The aim of this project is to conduct a taphonomic analysis on the large mammal faunal remains from the lower layers of the Howiesons Poort from square J51, layers YSx5 and CPx4 at KRM, cave 1A. The objectives of the project are as follows:

- To conduct bone surface modifications analyses and assess fracture patterns of a sample from the faunal assemblage.
- To use taphonomic data to identify the agent(s) of bone accumulation within selected layers.
- To use taphonomic data to infer the dominant site formation processes in the lower layers of the Howiesons Poort at KRM.

1.4 Rationale

Taphonomy is a key method used to determine both site formation processes and to understand the human subsistence strategies. Taphonomic analysis of the HP KRM faunal remains has not been undertaken as previous studies have focused on paleoenvironmental change (Klein 1976; Van Pletzen 2000). In order to fully utilize information from large mammal fauna fine-scale taphonomic analyses are necessary to fully interpret different aspects of behaviour in which Pleistocene hominins are the suspected bone accumulators (Pickering *et al.* 2013). Furthermore, a comprehensive taphonomic study may aid in not only inferring processing activities but also documenting site formation processes during the HP at KRM. Two layers of a seemingly different taphonomic context from square J51 from the Deacon excavations are selected for analysis. Layer CPx4 is a carbonized parting associated with burnt material, whereas YSx5, a layer below this, is dominated by yellow sand and perhaps lesser occupational intensity with no visible burning (Deacon 1995).

Organization of the dissertation

This dissertation is divided into six chapters including this introduction which makes up chapter one. The next chapter (chapter two) is the literature review which discusses the Howiesons Poort techno-complex (HP) at KRM and in wider context. Chapter three discusses the methodology applied in this study and the sample used. The results of the analyses are

discussed in Chapter four. Chapter five comprises the discussion and the conclusions of this project are presented in Chapter six. The appendix of this study is found in chapter seven.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the Howiesons Poort techno-complex in Southern Africa and provides the rationale and context for this study. It highlights the previous studies undertaken in the HP including the paleoenvironmental context, behavioural complexity and faunal studies then delves specifically into studies undertaken at KRM.

2.1 The Howiesons Poort techno-complex

The Howiesons Poort (HP) is one of the better-known industries from Southern Africa and has featured prominently in discussions regarding technological and behavioural complexity associated with Anatomically Modern Humans (AMH) (Mackay 2011). The HP industry has been recorded all over South Africa, and in the Southern Cape at Pinnacle Point, Boomplaas Cave, Klipdrift Shelter, Nelson Bay Cave and KRM (Fig. 1) (Wurz 2013; Reynard *et al.* 2016a, b). The lithic typological marker in the HP is geometric backed artefacts (Wurz 1999; De la Peña 2015) in association with irregularly notched artefacts, scrapers, unifacial and bifacial points as well as blade and flake technology (Wurz 2013). Experimental and use-wear analysis of some backed artefacts from Sibudu Cave artefacts indicate that they may have been used in projectile weapons (Wadley & Mohapi 2008; Lombard 2011). There is also an increased frequency in the use of fine-grained raw material such as silcrete and quartz (Villa *et al.* 2010). Such aspects of HP lithic technology have been linked to behavioural "modernity" (Henshilwood 2012) and are also discussed for the KRM HP (Wurz 2000; 2013).

The use of dating methods such as Thermoluminescence (TL), Optically Stimulated Luminescence (OSL), Electron Spin Resonance (ESR) and Amino Acid Racemization (AAR) have aided in refining dates for the MSA as a whole, but especially for the HP. The initial dates from radiocarbon dating were thousands of years too young for sites such as the Howiesons Poort type site (Deacon 1995) and Boomplaas (Vogel 2001). Recent ages obtained from OSL and TL dating (Tribolo *et al.* 2013) give a variety of dates for different Cape HP sites, and most date to around 65ka. However, the dates from Diepkloof Rock Shelter estimate that the HP ranged there between 100-50ka. It has been argued that an earlier

phase of the HP occurred at Diepkloof but is absent at other HP sites (Tribolo *et al.* 2013, Porraz *et al.* 2013).

2.2 Palaeoenvironment and residential patterns during the HP

Taxonomic studies of faunal assemblages from the MSA has been used as a proxy for paleoenvironmental reconstruction (Klein 1976; Van Pletzen 2000). Palaeo-ecological studies of Southern African MSA sites reflect a period of changing environmental conditions (Klein 1976; Van Andel 1989, Chase 2010; Faith 2013). Research shows a range of taxa reflecting these changing conditions during the MSA at for example, KRM (Klein 1976; Van Pletzen 2000) record an increase in *Raphicerus* and *Tragelaphus* during MSA stage II reflecting the shift to more closed environments. At Die Kelders (Klein & Cruz-Uribe 2000) data from micromammal species such as the dune mole rat are indicative of relatively lower humidity conditions during the MSA occupation of the site (Avery 1982) whilst macromammal species indicate cool moist conditions. At Pinnacle Point faunal studies indicate warmer climates during MIS 5 based on the presence of small fauna such as grysbok and steenbok (*Raphicerus*) and cooler conditions during MIS 6 favouring habitats inhabited by grazing ungulates (Thompson 2008; Thompson 2010). At Blombos Cave faunal studies indicate cooler and drier conditions during the MIS5a/4 (Thompson 2008; Thompson & Henshilwood 2011; Reynard & Henshilwood 2017) based on the increase of grazers such as wildebeest (*Connochaetes gnou)* and hartebeest (*Alcelaphus buselaphus*).

In the Southern Cape HP assemblages occur within the Marine Isotope Stage (MIS) 4, which is dated to 74-59 ka (Chase 2010; McCall & Thomas 2012). MIS 4 was a period of sea level regression during which sea levels were between -50m and -72m lower relative to the current sea levels (Langejans *et al.*2012:13). The distance to the shore during the HP at KRM was estimated to be about 4.79 km (Langejans *et al*. 2012: 12) but Dor (2017) recently modelled a distance of 13.64 km from the coast at 65 ka. Glacial MIS 4 is also associated with cooler temperatures (Langejans *et al.* 2012).

One hypothesis is that the colder climate during MIS 4 was associated with aridity in the Southern Cape (McCall 2007). However, Chase (2010) suggests that MIS 4 in the Southern Cape may have been characterized by more humid climates resulting from the northward movement of the westerlies. Microfaunal evidence from KRM, as those from Rose Cottage and Border Cave, indicate that this period was characterized by moister and colder conditions

(Avery 1987: 414). At KRM cave 1A Avery (1987) sampled across the HP squares E50, H51 & J51 and inferred more open vegetation during the HP matching suggestions by Klein (1976) based on his large mammal fauna studies from the HP period at KRM. Majority of the ungulates from the HP at KRM are grazers, but browsers are common in the earlier phases of this period (Klein 1976; Van Pletzen 2000). This shift may be associated with climate shift during the Marine Isotope Stage 4 (Van Andel 1989; Chase 2010).

The HP in Southern Africa, also according to Ambrose and Lorenz (1990:6-7), was characterized by cooler, humid and moister climates with a shift towards open environments. However, mosaics of open and closed environments may have existed. Taxonomic studies at Sibudu indicate the prevalence of semi closed and closed environments during the HP in MIS 4 (Clark & Plug 2008; Lombard & Clark 2008; Clark 2011) as well instances of open grasslands or savannah. Klipdrift shelter, in the Southern Cape, is characterized by a change from a mosaic environment with prevalent browsers during the early Howiesons Poort to open grasslands in the mid to later Howiesons Poort (Reynard *et al.* 2016a).

Ambrose and Lorenz (1990) described the Howiesons Poort as an explicit adaptation to environmental changes during glacial MIS 4. They hypothesized that during MIS 4 resources were less predictable and scarce based on paleoenvironmental data from sites such as Boomplaas Cave, Nelson Bay Cave, and KRM. Ambrose and Lorenz (1990: 16-17) further suggested that foragers during this time period generally had higher mobility facilitating exchange of information and trade as evidenced by presence of "exotic" raw materials such as silcrete. The foragers would have maintained smaller groups, relocated sites frequently and sustained formal reciprocal arrangements with adjacent groups. Some though, argue for decreased mobility (Mackay *et al*. 2018) and base their arguments on the relative higher abundance of artefacts in Howiesons Poort assemblages and seeming humidity of that time (Chase 2010).

McCall (2007) suggests that the backed artefacts during the HP were mechanisms of dependable, specialised toolkits developed as a means of safeguarding against risk during a phase in which resources were scarce but predictable. His argument differs with Ambrose and Lorenz's (1990) model who suggest less predictable environments and resources in the Howiesons Poort. McCall further argues that, given the amount of labour invested in the production of composite toolkits, an approach considered costly (2007:1746), the HP humans anticipated maximum gain. This is attributed to their planned resource exploitation strategies

as well as information of the environment which are benefits of specialized toolkits (McCall 2007:1747). Bousman (1993:70) used optimal foraging theory to argue that "*reliable weapons reflect a great degree of advanced planning, and the initial development of reliable tools in the Pleistocene reflects an increasing mental ability for forethought*". Bousman argues that it is difficult to identify the earliest production and use of dependable tools, but maybe they are represented by Howiesons Poort backed segments. Studies from foraging societies indicate that they have specialised toolkits in seasonal environments characterized by periods of low productivity (Binford 1976). Binford's studies show that foragers during low productivity periods increase the number of tools taken on a single trip depending on the amount of expected incremental uses on the trip; hunting, fishing & processing of resources (Binford 1976).

Based on their study of the HP at Pinnacle Point caves 5-6 Wilkins *et al.* (2017) argue that shifts in resource accessibility and distribution resulted from reduced sea-levels and the exposure of the Agulhas Bank during MIS 4. They argue that resources, though scarce, were predictable especially in the form of small mammals (2017:3-4). This may have led to reduced residential mobility and increased sedentariness. Their findings are also inconsistent with those from Ambrose and Lorenz (1990) who argue for increased mobility, but similar to that of Mackay *et al*. (2018). Wilkins *et al.* (2017:7) further argue that effective local raw material availability was possibly lower in MIS 4 due to groups inhabiting the site for longer periods and incessantly manipulating the nearest sources. In the MIS 4, silcrete was knapped using more competent lithic technology, for example through increased blade production, a phenomenon Wilkins *et al.* (2017) attribute to sedentariness. At PP5-6 foragers responded to changing climates through increased population sizes occupying sites for longer periods of time, creating home bases and ensuring that these occupation locations were stocked with the needed stone resources, a phenomenon known as place provisioning (Wilkins *et al.* 2017). Kuhn (1995) who coined the term "place provisioning" distinguishes two types of provisioning: provisioning of individuals and provisioning of places. The former comprises foragers equipping themselves with adequate tools to perform tasks they come across before the next knapping event whilst the latter involves equipping landscapes with raw materials and turning them into sources to facilitate knapping and tool making.

Optimum Foraging Theory (OFT) models adopt that foragers aim to maximise the energetic gain of their foraging activities with regards to hominin foraging strategies (Langejans *et al.* 2012). In terms of optimal foraging, it is clear that much time and effort was put into making the hafted projectile weapons in terms of handling costs (Bird & O'Connell 2006), and

therefore it can be assumed that they would have expended as much effort into ensuring gains from the targeted resources (Langejans *et al.* 2012).

Clark & Kandel (2013) note an increase in the exploitation of small grazers during the MIS 4 in their comparison studies of 8 sites spanning from MIS 6-3 (~170–40 ka); Blombos Cave (BBC), Die Kelders 1(DK1), Diepkloof Rock Shelter (DRS), KRM, Pinnacle Point Cave 13B, (PP13B) and Sibudu (SIB), a phenomenon they attribute to increased dietary breadth. However, in this study the Howiesons Poort and Still Bay were grouped together.

Generally, there is a reported increase in the frequency of small bovids, small mammals and suids in the HP sequences across Southern African sites (Clark 2011; Dusseldorp 2012; Faith 2013; Clark & Kandel 2013) and a decline in the frequency of these small bovids post-HP. They are replaced by a focus on large and very large bovids during the post-HP (Wadley *et al*. 2011; Clark 2009; Dusseldorp 2014). At Sibudu, fauna during MIS 4 HP is dominated by small ungulates (size 1) indicating an increase in not only their exploitation but also the dietary breadth of HP populations as well. Dusseldorp (2010) states, that an increase in dietary breadth in the form of suids at Sibudu may have been influenced by technology such as snaring. Exploitation of marine resources evident at Klipdrift shelter (Reynard *et al.* 2016a) and KRM (Voigt 1982) during HP further supports dietary breadth expansion.

At Klipdrift Shelter taphonomic analysis indicate the exploitation of small fauna such as hyrax and tortoise during the HP (Reynard *et al.* 2016a). Percussion marks present on the long bone fragments of lower ranked prey indicate marrow processing which may be evidence of increased dietary breadth as an adaptation to changing climatic conditions (Henshilwood *et al.* 2014; Reynard *et al.* 2016a; Reynard & Henshilwood 2017).

Reynard *et al*. (2016a) infer occupational intensity during the HP from molluscan and bone density volumetric data. They record fluctuating levels of occupation during the HP based on shifts in assemblage density suggesting higher occupational intensity during the middle layers of the HP. Reynard *et al*. (2016a), based on their studies of Klipdrift shelter (KDS) fauna, argue that intensified subsistence was influenced not only by paleoecological and nutritional stress but also advanced technology linked with the progression of complex behaviour during the MSA. Such studies have not yet been undertaken for the HP at KRM.

2.3 Complexity of behaviour in the HP

The HP is a well-known time period associated with what has been termed variously as innovative behaviours, modern behaviours and complex behaviours (Henshilwood 2012; Wadley 2015). Klein (2000) argues that a genetic mutation took place between 50-40ka

causing cognitive reorganization in the MSA humans. From this perspective HP populations would not have been modern. Klein (2000:17) bases his argument on the lack of living structures, and what he refers to as "informal artefacts" as well as a lack of standardization of artefacts across MSA sites as well as "…their failure to produce unequivocal art or ornaments". According to Klein MSA and by extension HP hunters were less adept than their Later Stone Age counter parts. He (2000:17) comments on "*their relatively limited ability to hunt and gather".* Klein (1976:83-84) infers from the studies he conducted on the fauna from KRM that MSA humans focused on docile prey such as eland (*Taurotragus oryx)* as they were not capable of hunting more aggressive prey such as Cape buffaloes *(Syncerus caffer).* In instances where dangerous prey is present in the record he attributes this to juveniles or vulnerable dangerous prey such as female *Syncerus caffer* after giving birth (Klein 1976; 1989). One major limitation of Klein's (2000) argument is that the genetic mutation theory cannot be tested from fossil human remains to infer when exactly the biological mutation occurred.

Behavioural complexity during the Southern African MSA has been linked with the hunting capability with regards to large or aggressive ungulates (Klein, 1976, 1989; Binford 1984; Milo 1998; Marean *et al.* 2000; Clark & Plug 2008; Faith 2008), the capacity to exploit marine resources (Klein 1976; Fisher *et al.* 2010) and the ability to use remote capture techniques to hunt small and difficult-to-catch prey (Stiner *et al*. 2000; Wadley 2010; Reynard & Henshilwood 2017). At Sibudu Cave taxonomic studies show the increased presence of animals such as the blue duiker which prefer forested environments, monkeys, rodents and small carnivores suggesting that they may have been captured using traps and snares (Wadley 2010; Lombard 2011). Wadley (2010) argues that the use of such remote capture technologies signifies a fundamentally modern perception.

The capacity to repair compound tools through replacements of various parts that is a feature associated with the LSA is also present in the HP (Wadley *et al.* 2009; Henshilwood 2012). Micro residue analysis carried out on 53 samples from Sibudu Cave indicate the presence of organic remnants such as bone and animal tissue on the blades of the Howiesons Poort segments (Lombard & Pargeter 2008: 2529). This evidence may suggest that they were used as changeable inserts in hunting tools.

Variability in hafting configurations is evidenced by patterns of the micro-residues associated with hafting traces (Lombard 2011) suggesting that the various backed artefacts may have been used for hunting; for example, based on the spear points inferred from segments hafted

longitudinally, transversely, diagonally and back-to-back (Villa & Soriano 2010; Lombard 2011; Wadley 2013). Bow and arrow technology is inferred at Sibudu Cave based on microtraces that imply the use of transversely hafted quartz artefacts (Wadley & Mohapi 2008; Lombard 2011). 13 crystal quartz backed tools from Sibudu that were recorded as averagely smaller than backed tools made from other materials also give evidence of hafting from micro residue presence on eight of them (Lombard 2011:1919).

Forethought is also involved in the process of hafting the weapons as the humans would have had to picture the positioning that would result in an efficient tool. Wadley *et al.* (2009) undertook an experimental study of HP artefacts with residues from Sibudu that might have been hafted. They experimentally produced adhesives that consisted of red ochre, beeswax and iron oxide and heated the hafted implement over the fire. Abstract ideas of the properties of components used such as ochre, tree gum and honey show the ability of HP humans to utilize and manipulate the available resources. Based on their results, they infer that cognitive fluidity was present in HP humans because they possessed the ability to intentionally alter the mechanical properties of the adhesive components. The ability of HP humans to discern which adhesive components to use and modify ingredients from experience may indicate increased mental architecture (Wadley *et al.* 2009). These concepts when put together imply not only flexibility and fluidity in the mental process of HP humans but also the ability to multi task (Wadley *et al.* 2009). Behavioural complexity in this context implies logical reasoning, innovative & abstract thought problem solving skills as well as the ability to plan over time (Wadley 2013).

Wadley (2015:155) argues that creative lithic technology employing pressure flaking and heat treatment occurred during the MSA. HP humans had information on properties of materials used for tool making and weaponry, were aware of edible and medicinal plants (Sievers 2006; Wadley *et al.* 2011) and knew which type of wood they could use to fuel hearths (Cartwright 2013). At Diepkloof processing of animal resources evident from trace and use wear analysis of backed HP artefacts from Diepkloof Rock Shelter suggest cutting (Igreja & Porraz 2013). These various traces of evidence suggest increased perception and complexity present in the HP that equals that seen in LSA humans (Henshilwood *et al.* 2014).

Bone tools obtained from Sibudu with an age of 64-61*ka* have been interpreted as a potential arrow head and a needle (Wadley 2006). d'Errico *et al.* (2012) give a detailed report of the

recovery of 3 scaled pieces (*pieces esquillees*), 2 pressure flakers (bone), a potential projectile bone point, 3 awls and 2 wedges from the HP layers at Sibudu cave. At KRM a bone fragment recovered from Singer & Wymer's HP layer 20 exhibits 4 parallel incised lines which indicate some form of symbolic marking as well as a bone point (d'Errico & Henshilwood 2007). Similarly, at Sibudu a layer dated to 60*ka* produced a rib fragment with ten consistently placed notches. These traces point to the presence and continuity of symbolic behaviour across HP sites in Southern Africa. This is further supported by the fact that engraved ostrich eggshells from Diepkloof are similar to engraved OES from Klipdrift Cave (Henshilwood 2012; Henshilwood *et al.* 2014).

Uniform technological adaptation over South Africa during the HP may have been influenced by the interactions between the various groups as argued by Mackay *et al*. (2014). The HP is characterised by inter-regional similarities in flaking systems on non-local fine-grained materials across South Africa (2014: 21). These phases of inter-regional inhabitant interaction compare with phases in which ornaments and symbolic items become prevalent in the archaeological record (Mackay *et al.* 2014). The occurrence of symbolic behaviour and complex cognition can be traced earlier than MIS 4 through evidence such as the ochre tool kits from Blombos cave dated to 100,000 years (Henshilwood *et al.* 2011) and bone tools at 100,000 years from KRM as well (Wurz 2000). This evidence implies that the cognition witnessed during the HP along the Southern Cape may have begun much earlier and developed into the innovativeness associated with the HP. The HP innovativeness may be a result of incremental modifications by generations over a period of time resulting in the complexity of subsistence systems, innovations and material culture (Henshilwood 2008:10). Evidence from Southern Cape HP sites may suggest evolution of the local populations rather than technology introduced by new populations as suggested by Singer & Wymer (1982). The differences or disparities recorded between the MSA and periods such as the Still Bay and HP may be explained in terms of adaptive technology. Simply put some of the tools used during earlier or later periods such as the LSA may not have been suited for the HP due to the climatic shifts recorded (Henshilwood 2012). These innovations however enabled the HP humans to thrive in a period when some populations in Europe were devastated; volcanic glass shards linked with the Mt. Toba eruptions recorded at approximately 74ka have been recovered at Pinnacle point and Vleesbaai, This eruption brought about volcanic winter which devastated populations in Europe however populations in the Southern Cape seem to have been thriving during this period (Smith *et al.* 2018).

2.4 Faunal Studies from the MSA

Faunal studies from MSA assemblages have often been conducted with the aim of understanding subsistence strategies (McBrearty & Brooks 2000; Reynard *et al.* 2016a) and its link with behavioural complexity (Clark & Ligouis 2010; Clark 2011) as well as reconstructing palaeoenvironments (Klein 1976; Van Pletzen 2000). Subsistence and procurement strategies have been an area of interest in the MSA due to the association of the MSA with behaviourally complex humans (Stiner 1993; Marean & Assefa 1999; McBrearty & Brooks 2000; Thompson 2008; Clark & Kandel 2013). Research suggests that the MSA is associated with variability in faunal procurement (De Menocal 2004; Bobe & Leakey 2009; Thompson 2010; Faith 2011; Clark 2011; Dusseldorp 2012). This variability is based on the different arguments of procurement strategies such as hunting vs scavenging (Klein 1976; Binford 1984), the types of animal species (docile vs dangerous) and size classes found in various MSA sites. Klein (1976) conducted faunal analyses of KRM MSA fauna focusing on the skeletal part frequency and distribution. Based, in part, on the KRM fauna, he argues that MSA humans were less adept hunters than their LSA counterparts (Klein 1976). Klein supported his argument with the fauna present from MSA sites showing abundant representation of smaller size classes and docile animals such as eland (*Taurotragus oryx)* when larger size classes were present. On the other hand, faunal studies at Pinnacle Point cave 13B (PP13B) indicate that animals larger than 24kg falling within Brain's size classes 2-5 were accumulated by MSA hominins (Thompson 2010) a phenomenon that differs from other MSA sites. This accompanied by the technological adaptation present during the MSA may be used to argue for the competency of the MSA humans as hunters.

Binford (1984) studied fauna from KRM to investigate the concept of scavenging among MSA humans. His studies focused on skeletal part representation (which has been a major area of study especially in the MSA) from the MSA assemblage represented in cave 1 (Klein 1976; Marean & Kim 1998; Van Pletzen 2000). Assemblages dominated by cranial and foot bones, an occurrence nicknamed the Klasies pattern (Marean & Kim 1998), were interpreted as representing scavenging (Binford 1984). Binford analysed the relative element abundance, intensity and placement of cut marks on bones as well frequency of carnivore tooth marks on the KRM assemblages. According to Binford (1984) the absence of 'fleshy' limbs in MSA assemblages implies the late access to carcasses by hominins and is thus direct evidence for opportunistic scavenging.

2.5 Faunal studies at KRM

In previous decades the interpretation of the Klasies River Mouth mammal faunal assemblage was a point of major controversy (Binford 1984; Turner 1989; Thackeray 1990; Marean & Assefa 1999; Outram 2001). Much debate took place as to whether the inhabitants of Klasies River were scavengers or hunters (Klein 1976; Binford 1984; Blumenschine 1986). This debate was fuelled by the dominance of cranial and foot bones which is usually a key indicator of scavenging and a pattern that was referred to as 'The Klasies pattern' (Marean & Kim 1998; Bartram & Marean 1999; Klein *et al*. 1999). Turner (1989) attributed the Klasies pattern to excavator bias whereby unidentifiable and rather fragmentary bones were discarded during the 1967-68 excavation by Singer and Wymer. Klein (1976) argued that pre-excavation differential transport and differential destruction processes were responsible for the Klasies pattern. Klein (1976) introduced a theory called the 'schlepp effect' based on studies of Neolithic hunters at Suberde site in Turkey by Perkins and Daly (1968). According to Klein's (1976) schlepp effect, the skeletal part representation was caused by the practice of bringing small animals back to the site whole while larger animals were brought back in pieces with the feet left attached to the skins and used as handles. Binford (1984) argued that the Klasies pattern was due to the differential import of carcass parts. He further argued that KRM MSA hominins, despite being anatomically modern, were behaviourally archaic as they were less competent hunters than their LSA counterparts. Based on actualistic studies from the Nunamiut he concluded that the MSA hominins at Klasies River site occasionally killed small bovids and juvenile larger bovids transporting the meat yielding parts back to the site. Based on his marrow utility index, he concluded that they were scavengers utilizing marrow from the lower limb bones of larger bovid carcasses from carnivore kills hence marginal utility such as lower long bones and cranial elements dominated the assemblage (Binford 1984; Outram 2001). Blumenschine & Madrigal (1993) research on marrow variability in ungulates in East Africa related to resource stress and seasonality showed that stressed animals were much more fat depleted in the upper limbs than in the lower ones. As such it would be cost effective for a scavenger to utilize the upper limb bones before the lower. Bartram & Marean (1999) compare the Klasies pattern to actualistic studies of the Kua from the Kalahari Desert and conclude that the Klasies pattern is not unique to Klasies River and can be found across archaeological sites. Comparative studies with fauna from the Die Kelders cave 1, level 10 shows that it mimics the Klasies pattern if large bovid limb bones are systematically excluded from the sample (Bartram & Marean 1999).

2.6 The HP at Klasies River

The HP at KRM is represented in cave 1A by Singer & Wymer's layers 10-21 and in cave 2 by layers 1-5 (Singer & Wymer 1982; Wurz 1999). Deacon's excavations of the HP in these layers were undertaken in squares E50, H51 and J51 occurring in his Upper member (Deacon & Geleijnse 1988) and containing approximately 1.8m of HP deposits.

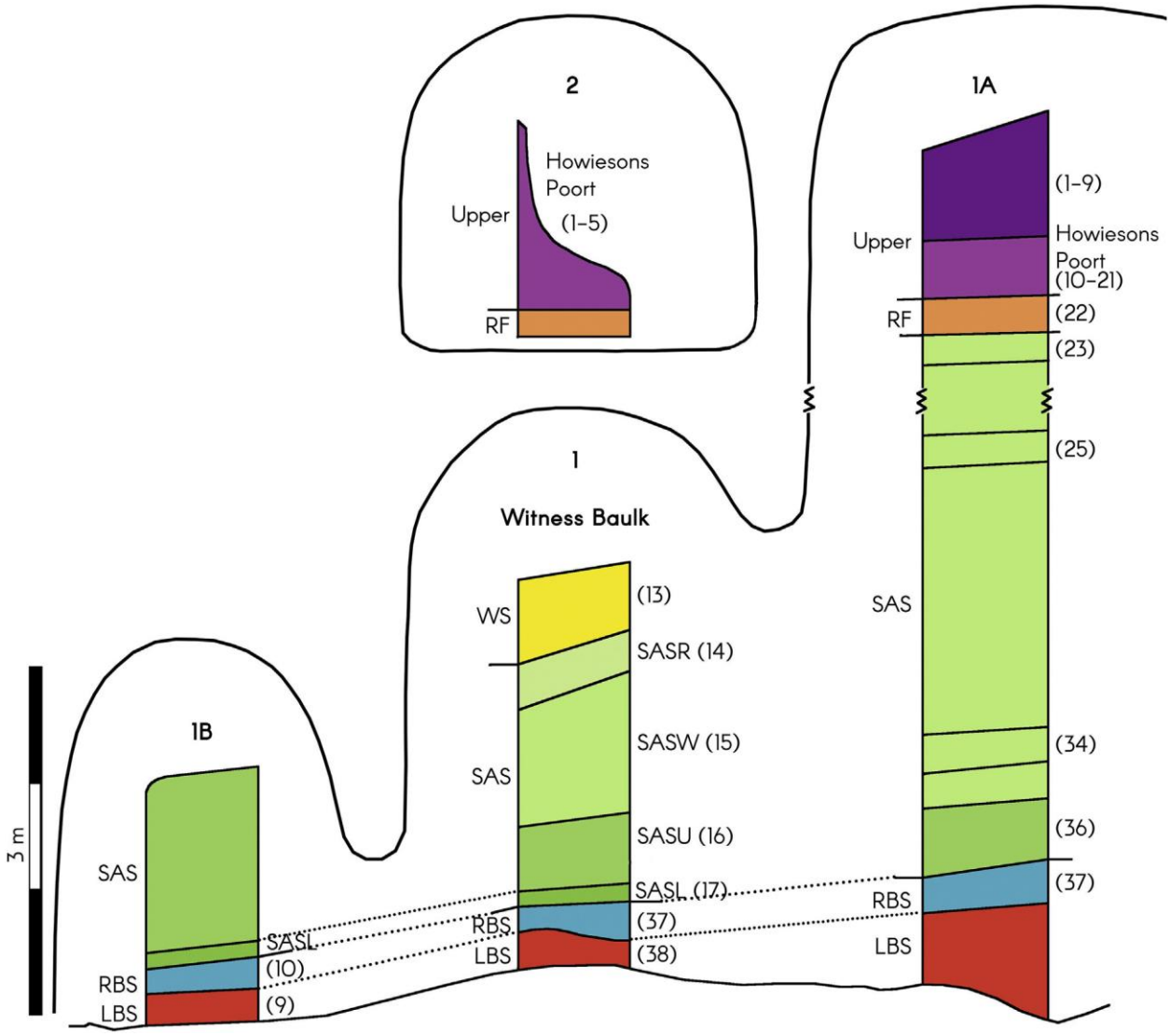


Figure 2. 1: Showing the HP layers at KRM in light purple and the corresponding members (Courtesy of Wurz *et al.* 2018).

At KRM, as at most sites in South Africa, the HP occurred during Marine Isotope Stage (MIS) 4. At KRM there is a wide range of dates for this period (Table 2.1) from various methods. Vogel (2001) and Jacobs *et al*. (2008) both obtained a date of 65.6 ka for the HP at KRM.

Table 2. 1: Showing various HP dates obtained for KRM (Adapted from Wadley 2015).

KRM	HP DATES	Dating Method	Excavation	REFERENCE
Cave 2	52.4ka	OSL/ISRL	Layer 1&2 (Singer & Wymer)	Feathers (2002)
Cave 2	63.4ka, 65.5ka,	OSL single grain	Layer 1&2 (Singer & Wymer)	Jacobs *et al*. (2008a),
Cave 2	63.4 2.6	OSL single grain	ZKR9 (Singer & Wymer layer not known)	Jacobs & Roberts 2017
Cave 2	65.5 2.3	OSL single grain	ZKR10 (Singer & Wymer layer not known)	Jacobs & Roberts 2017
Cave 1A	64.1 2.6	OSL single grain	ZKR6 (Singer & Wymer layer not known)	Jacobs & Roberts 2017
Cave 1A	65.6ka	U series	Layer 14 (Singer &Wymer)	Vogel (2001)
Cave 1A	64.1ka	OSL single grain	Upper member (Deacon, E50, ca. Layer 18),	Jacobs *et al*. (2008a)
Cave 1A	46.7ka	OSL/ ISRL	Layer 15 (Singer & Wymer)	Feathers (2002)
Cave 1A	55ka	TL	Square E50; CP18 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	54ka	TL	Square E50; YS4 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	53ka	TL	Square E50; CP7 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	52ka	TL	Square E50; CP8 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	50ka	TL	Square E50; CP18	Tribolo *et al*. (2013)
Cave 1A	58ka	TL	Square H51; CP4C (Deacon)	Tribolo *et al*. (2013)
Cave 1A	56ka	TL	Square H51; CP10 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	55ka	TL	Square H51; CP4C (Deacon)	Tribolo *et al*. (2013)
Cave 1A	54ka	TL	Square H51; CP7 (Deacon)	Tribolo *et al*. (2013)
Cave 1A	52ka	TL	Square H51; CP7AF2 (Deacon)	Tribolo *et al*. (2013)

Cave 1A	48ka	TL	Square H51; CP7AF2 (Deacon)	Tribolo *et al*. (2013)

Generally, periods of sea level regression seem to be registered at KRM by an increase in grazers (Klein 1976, 1983; Van Pletzen 2000). Klein (1976) described the fauna from the MSA obtained from the Singer & Wymer KRM excavations, with a focus on skeletal frequency distribution and difference in size classes. He included the bovids identified to species based on complete elements and identified the rest to size class. His study of the HP fauna shows a relative increase in fauna belonging to Brain's 1974 size class one (1976: 83-84). Van Pletzen's (2000) study of the fauna from the Deacon excavations also reflects an increase in the small bovids which fall within Brain's size classes 1, when the assemblage is considered as a whole. The only identifiable small bovid in the HP is the *Raphicerus* (cape grysbok, steenbok) which is a highly adaptable browser, thus unidentifiable bones may also belong to this species (Klein 1976; Van Pletzen 2000).

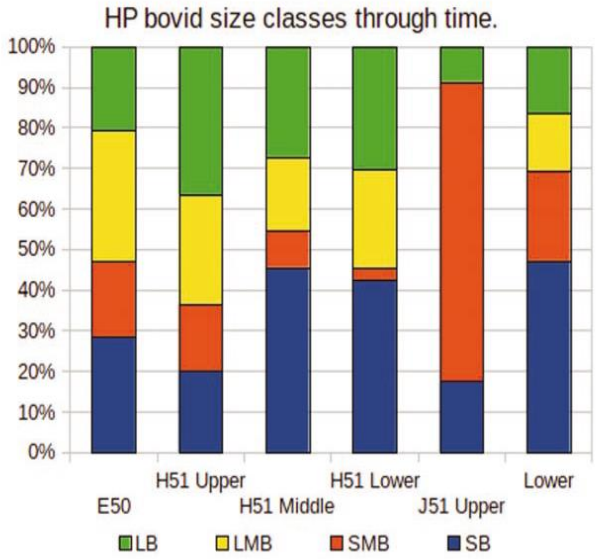


Figure 2. 2: HP bovid size data (Klein 1976, Van Pletzen 2000) obtained from the Deacon excavation data (Image by Van Pletzen-Vos & Wurz 2014).

Figure. 2.2 shows that when the layers are subdivided there are differences in the bovid size classes through time. In the lowermost layers of J51, size 1 bovids dominate, but in the upper layers of J51 small medium bovids dominate. The Deacon data indicate that the increase in size 1 bovids is most prominent in square H51. In the latest phases of the HP from squares H51 Upper and E50 there is some increase in large medium and large bovids phase.

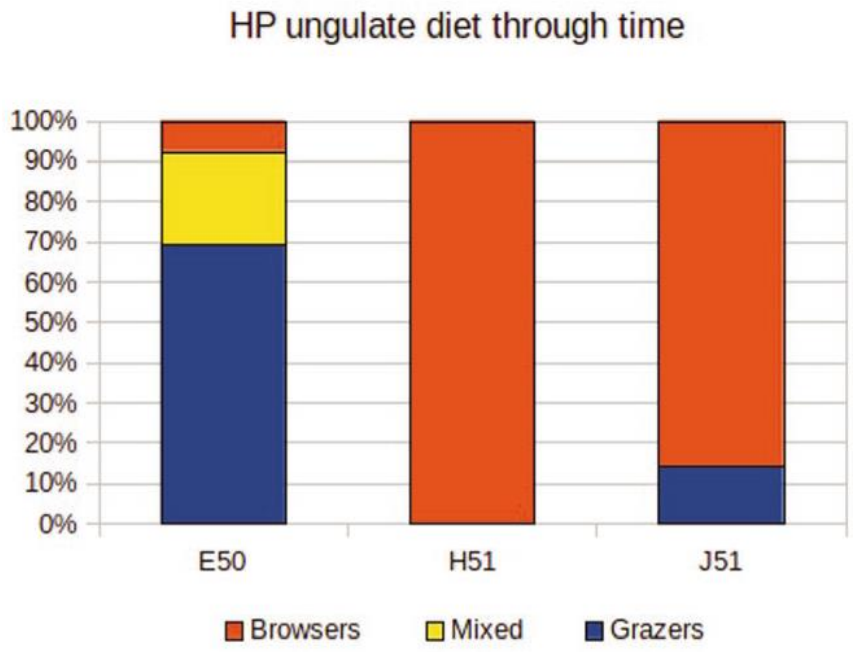


Figure 2. 3: HP ungulate diet data obtained from the Deacon excavations (Image by Van Pletzen-Vos & Wurz 2014).

Van Pletzen-Vos & Wurz (2014) show that from the Deacon data the dominant ungulate species in the lower part of the HP, in square J51 at KRM are browsers occurring with minimal grazers. The trend shifts to a browser dominated assemblage during the middle part of the HP in square H51, whereas the upper part of the HP in square E50 is characterised by mixed feeders, browsers and mainly grazers. In Figure 2.3 the inference can be made that environments were most closed during H51 and most open during E50 as it is dominated by grazers. It can be inferred that the environment was not open throughout the whole of the HP, and that there was a shift from somewhat open environments to closed environments then back to open environments.

Taphonomic studies have not been carried out for the HP at KRM and therefore it is not possible to discuss subsistence strategies within the HP with other sites such as KDS. A comprehensive taphonomic analysis of the faunal remains for KRM is therefore necessary in order to explore subsistence activities. This study is focused on a taphonomic study of two layers from J51 namely YSX5 & CPX4, and the species composition from Van Pletzen's (2000) study will be discussed in combination with the taphonomic results to further elaborate on the site formation processes and subsistence strategies in the lowermost HP at KRM.

2.7 Taphonomy

One of the major approaches used in zooarchaeology is taphonomy: the study of the transition of organisms from the biosphere to the lithosphere (Efremov 1940; Behrensmeyer 1978; Reitz & Wing 1999). The term taphonomy has its origins in 1940 coined by Efremov loosely translating to the laws of burial and mostly involves studying the processes affecting an organism from burial to fossilization. Taphonomy generally focuses on the post mortem, pre-& post burial histories of faunal remains (Lyman 1994). The chronology of agents and processes affecting animal remains at an assemblage make up a taphonomic history/pathway.

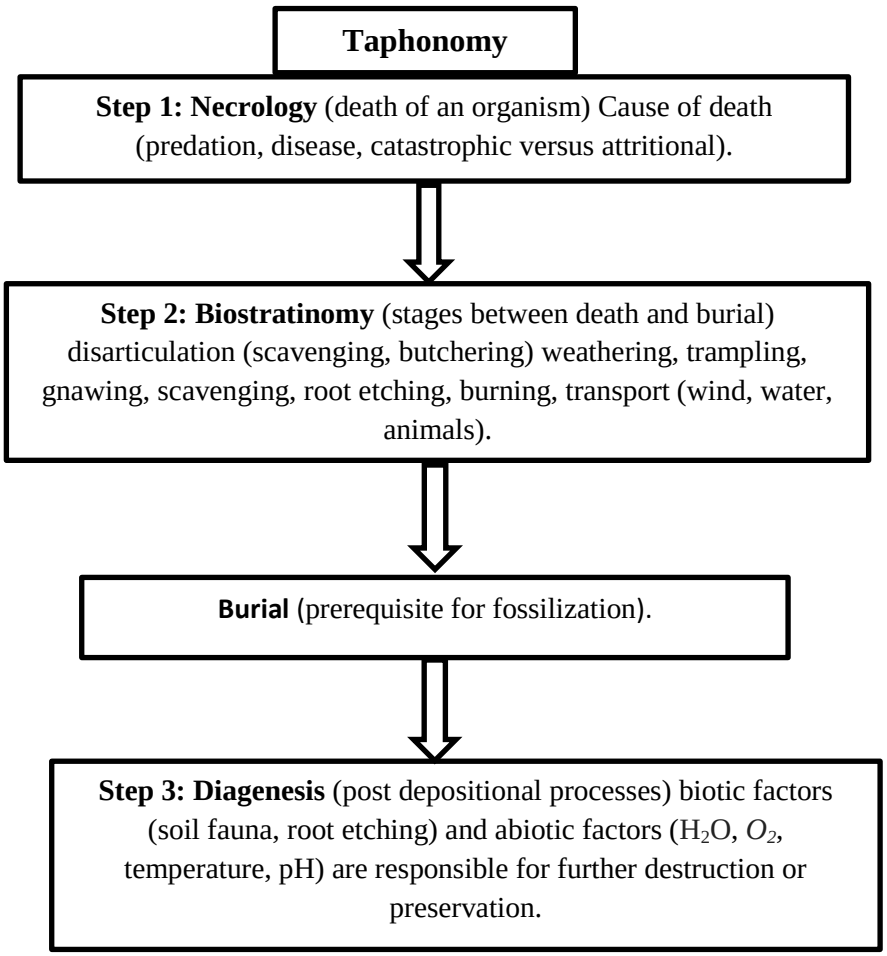


Figure 2. 4: Taphonomic history & chronology of agents acting on an assemblage (adapted from Grupe & Harbeck 2013:242).

The establishment of taphonomic principles in research has enabled the study of different processes contributing to the accumulation of a single assemblage (Gifford 1981; Noe-Nygaard 1987). A taphonomic history consists of various aspects and processes; taphonomic agents include the physical cause of modification to animal remains and consist of both natural forces such as gravity and source of force applied to bones by primary or secondary

predators such as carnivores or humans (Gifford-Gonzalez 1991; Lyman 1994). The actions of the primary and secondary predators on assemblages for example in the form of gnawing, fracturing or even movement make up part of the taphonomic process (Lyman 1994). These taphonomic processes leave traces on components of an assemblage and only through the study of these traces can zooarchaeologists aim to understand the fossil assemblage and its implications (Schiffer 1987; Grayson 1984). Quantitative measures such as taxonomic abundances and skeletal element frequencies are affected by taphonomic processes (Grayson 1984) resulting in instances of better preservation of specific elements compared to others. Both intrinsic (size of organism, bone density and porosity) and extrinsic (presence of water in the site, chemical composition of the soil where the assemblage is preserved) factors play a role in this (Grayson 1984; Lyman 1994; Reitz & Wing 1999). Diagenesis which herein refers to alteration after burial (Lyman 1994:417) varies from site to site and may account for the preservation of certain elements in abundance for instance, cranial elements and distal limbs. (Klein 1976; Binford 1984;1989; Turner 1989; Marean & Kim 1998; Bartram & Marean 1999; Van Pletzen 2000).

Another challenge facing taphonomic studies is that distributional contexts may be obscured and in the process elements that are unrelated may become spatially associated while related elements may lose their association thus skewing the interpretation of distribution of faunal remains (Lyman 1994). A fossil assemblage is considered to be representative of the biotic community however this is not always the case. Determining the reason why the faunal remains contrast with the biotic community is one of the challenges that occur in taphonomic studies. Based on the identification of elements and their categorization, age or mortality profiles for a site can be recreated (Stiner 1991a, 1991b). It is imperative therefore to record the age at death of specimens of assemblages usually undertaken through categorizing specimens as juveniles or adults. This is done through the study of the state of fusion of long bones, tooth eruption and more recently the texture of cortical bone surface.

2.8 Taphonomic studies in Southern Africa

Dart's (1957a, 1957b) study of the Makapansgat fossils was the first representation of analysis and interpretation of a bone assemblage from an African cave. Makapansgat is dated to about 3 *ma* and is one of the oldest South African sites associated with the *Australopithecines* (Brain 1981; Deacon & Deacon 1999). Dart devised the 'Osteodontokeratic (bone, tooth & horn) culture' hypothesis to explain the differential preservation and representation of skeletal elements at Makapansgat. He hypothesized that

the site may have functioned as a hominin home-base based on the differential faunal skeletal part representation. Dart argued that the less abundant skeletal elements were tools and weapons made by *Australopithecines* (Dart 1958). He based this argument not only on the dense abundance of mandibular elements but also on the presence of depressed cranial vaults of *Australopithecines* as well as baboons which he considered damage from violent predatory behaviour from the *Australopithecines* (Dart 1949a, 1949b). This study is considered a pilot study in the taphonomic field due to the methodology applied as Dart (1957a) identified the 4560 elements by body parts and taxon from a total of 7159 bone fragments.

C.K Brain in the 1960's undertook actualistic and ethnographic studies in the Namib to test Dart's Osteodontokeratic hypothesis. Brain (1967, 1969) collected, analysed and quantified goat bones from a *Topnaar Khoekhoen* settlement focusing on the butchery, cooking and disposal of the bones. Brain observed that these bones had been butchered, prepared and consumed on site. Whatever was left was consumed by dogs, gnawed by rats, ravaged by scavengers and weathered by the sun and other elements. This process represented the processes a bone in the fossil record undergoes from death, consumption and inclusion in an archaeological record. Brain's studies reflected an abundant preservation of dense bones such as the mandible in the *Topnaar* settlement, findings which resembled the Makapansgat assemblage studied by Dart. Brain's studies were the first to indicate density mediated attrition as a biasing fact in preservation in the fossil record. His findings were also key in showing not only the importance of understanding the process of taphonomy but also conducting comprehensive taphonomic analysis of fauna with regards to the Osteodontokeratic culture hypothesis.

Taphonomic analyses are a vital step in establishing subsistence strategies at sites and site formation processes that frame behavioural complexity. The understanding of hominin subsistence activities in Plio-Pleistocene sites for instance Olduvai Gorge and Koobi Fora (Harris 1983; Isaac 1984; Bunn & Kroll 1986) has elucidated the importance of taphonomic studies with relation to arguments of scavenging versus hunting. Equifinality from a range of processes mimicking anthropogenic activities, for example the Dikika cut marks, has necessitated the inclusion of actualistic taphonomic studies in understanding hominin sites. Southern African site Swartkrans Member 3 is known for its preservation of *Australopithecus robustus* remains as well as mammalian taxa fossils (Lee-Thorp *et al.* 1989). Taphonomic analysis of mammalian fauna at Swartkrans has identified hominins and carnivores as agents of bone accumulation at member 3 (Pickering *et al.* 2005). This is based on the presence of

both fracture patterns from hammer stone percussions as well as carnivore tooth marks (Pickering *et al.* 2005) burnt bone and cut marks (Brain 1993). Brain and Shipman's (1993) study of probable tools from Swartkrans members 1-3 dated to about 1.8 million years indicated that the tools were used by australopithecines to dig up tubers. These tools were re-examined by d'Errico and Backwell (2003) to establish their validity due to the fact that non-anthropogenic processes can lead to bones and stones mimicking hominin produced tools. d'Errico's and Backwell's (2003) study indicated that the tools were indeed anthropogenic tools used for termite foraging.

In MSA sites analysing taphonomic processes affecting fauna is an important area of study due to its association with Anatomically Modern Humans (AMH) (Reynard 2014). Faunal analyses enable the understanding of subsistence strategies and prey selection in the MSA (Reynard *et al.* 2016a). Yet, except for Blombos Cave (Thompson & Henshilwood 2011; Reynard & Henshilwood 2018), Boomplaas Cave (Faith 2013), Pinnacle Point 13B (Thompson 2010), Klipdrift Shelter (Reynard *et al*. 2016a; Reynard & Henshilwood 2017), few taphonomic studies have been conducted on MSA faunal assemblages. Through inclusive taphonomic analyses of terrestrial and marine mammals as well as other faunal components of fossil assemblages MSA faunal exploitation by AMH can be understood (Thompson 2010). Investigations of bone preservation, fragmentation and differential destruction as well modifications on bone cortex enable the reconstruction of the taphonomic processes undergone by various faunal species (Marean *et al.* 2001; Thompson 2010). The analyses also provide a means for inferring the agents of accumulation and modification as well as the function of various faunal components in MSA diet thus enabling inferences about hominin behavioural complexity (Marean 1998; Milo 1998).

2.9 Taphonomic studies at KRM

Milo's (1998) detailed analysis of the KRM fauna comprises the only taphonomic study conducted at KRM. Milo analysed fauna from Cave 1 representative of the MSA. His findings include the recording of abundant butchery marks present on the bones, a factor that contributed to his conclusion that the KRM MSA humans had early access to kills and were adept hunters (Milo 1998; McBrearty & Brooks 2000; Outram 2001). Some scholars (Shipman 1986; Bunn & Ezzo 1993) have argued that early access to carcasses by hominins could reflect active hunting or very aggressive scavenging. However, Milo's argument based on his analysis of the KRM MSA fauna is that it is improbable for hominins to locate fresh

carnivore kills regularly to the degree that carnivore traces would be absent on the bones. Therefore, the most likely scenario would be hunting (Milo 1998; Outram 2001). Further evidence supporting the capability of the KRM MSA as not only as capable hunters but also behaviourally complex is the presence of an embedded quartz point in the vertebrae of a *Pelorovis antiquus* a 2000kg giant buffalo (Milo 1998).

Milo's analysis indicated the presence of butchery marks on both high utility parts of large animals as well as distal elements which would be considered low utility parts (Outram 2001). Elements of animals belonging to size classes III & V showed the highest proportion of butchery and axial elements of size class IV (specifically eland) were cut at remarkably high rates. Milo concluded that the patterning of these frequencies reflected concentration on highly ranked portions (Milo 1998). Eland (*Taurotragus oryx*) at KRM exhibits a catastrophic mortality rate inferring hunting methods such as driving the animals off a cliff (Klein 1976). Milo's 1998 analysis of the butchering patterns of Eland show its consistency with Klein's 1976 conclusion i.e. mass drives. Based on actualistic studies carried out by Frison (1974) butchery patterns of the eland at KRM mimic those carried out by Native Americans while processing bison killed in mass drives. Milo infers from these studies that the KRM hominins designed task groups within which they shared out processing tasks when dealing with numerous carcasses (Milo 1998;125) thus cuts were more consistent and fewer marks left behind on the bone. The ability to form and organise such task groups has been argued as an indicator for behavioural complexity (Reynolds 1993; Milo 1998).

However, taphonomic analysis have not been carried out on the HP at KRM thus there are no comparative studies of the HP vs the HP at other sites. The HP being a time period associated with behavioural and technological complexity at KRM has only had studies focusing on skeletal part representation as well paleoenvironmental recreation (Klein 1976; Van Pletzen 2000) conducted. It is of importance to conduct comprehensive taphonomic analysis on any given assemblage due to the fact that inferences on subsistence behaviour and complexity cannot be based solely on skeletal part representation but must be complimented by modifications present on bone (Lyman 1994; Milo 1998).

Summary

This chapter presented an overview of MIS4 in Southern Africa discussing change in climates, subsistence strategies as well as technological adaptations. Increased dietary breadth associated with the climate change and technological adaptations (Wadley *et al.* 2011) has

been one of the areas of study in the MIS4 and MSA as a whole. This section provided background on taphonomic studies from MIS4 sites representative of the HP outlining the importance of the time period as well as taphonomy in faunal studies. This dissertation focuses on taphonomic analyses of two sampled layers from the Howiesons Poort at KRM to infer subsistence strategies, site formation processes and agents of accumulation. This study will enable the comparison of results obtained with those from other HP sites in Southern Africa

CHAPTER 3

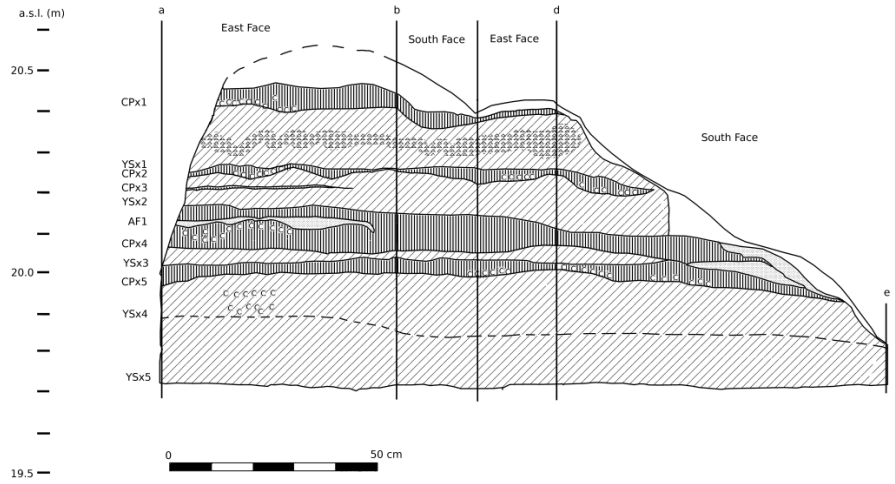
Materials and Methods

This chapter discusses the materials sampled for this study as well as the methodology applied to conduct taphonomic analysis on the specimens. It provides descriptions of terminology used in faunal studies and various approaches listing their advantages and biases. The final section of the chapter deals with issues of faunal counts and quantification describing the main approaches.

3.0 Materials

The main focus of this project is the faunal materials from Square J51, layers CPX4 and YSX5 in cave 1A from Klasies River main site recovered during the 1984-1995 excavations by Deacon. These layers are broadly equivalent to layer 19-20 of the initial cutting of the Singer & Wymer (1982) excavation. Both identifiable and unidentifiable bone fragments larger than 2cm were included in this study. Only unidentifiable fragments larger than 20 mm were analysed. These materials are currently housed at the University of Witwatersrand in the Geography, Archaeology and Environmental Studies laboratory and will be taken to the Iziko Museums Archaeology division once it is reopened.

KRM 1A 2D section of J51



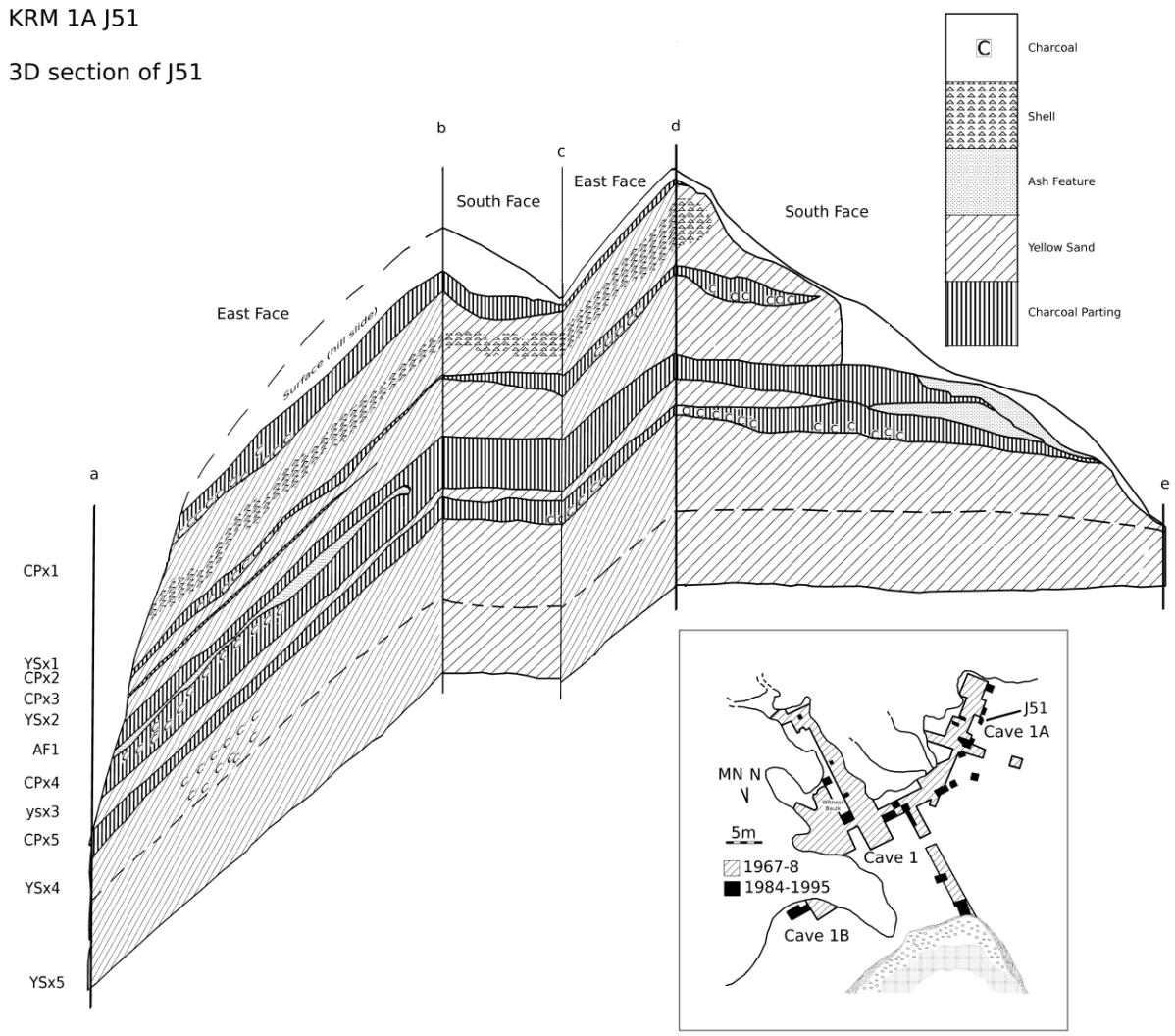


Figure 3. 1 Stratigraphy section courtesy of Wurz.

3.1 Methodology

Though it is impossible to record every bit of information that comes from a site and some evidence may be lost, the use of three- dimensional representation of data is quite advantageous. This not only ensures the collection of large amounts of data but also its accurate representation thus resulting in a probable representation of predator-prey interactions and subsistence strategies (Grayson 1984). Sieves with screen mesh sizes ranging from 2-10mm (Van Pletzen 2000) were used in the Deacon excavations as screen mesh size can invalidate some interpretations and introduce biases especially towards the small fauna (Grayson 1984; Shaffer & Sanchez 1994).

3.2 Bone identification

Attempts were first made to identify specimens to element. Identifiable elements were classified as such based on the presence of articular surfaces, tuberosities and other diagnostic features. Some unidentifiable specimens could be identified to long bone and these were included in the analysis. This project focused on taphonomy of the specimens and as such no higher order taxonomic identifications (such as genus, species or family) were attempted. Specimens identified as bovid were grouped into size classes (Table 3.1) based on Brain 1974 (see also Klein 1976; Milo 1998; Van Pletzen 2000). Specimens that could only be identified to mammal were grouped into small, medium and large size class mammals as in Klein (1976), Milo (1998) and Van Pletzen (2000) to maintain consistency of Klasies River site faunal analysis. The comparative collection housed in the Evolutionary Studies Institute at the University of Witwatersrand and the Ditsong Natural Museum of Natural History (former Transvaal Museum) were used to identify the elements and size classes for the entire sample.

Table 3. 1: Klasies River bovid size classes after Brain (1974,1981) and Klein (1976).

Size class	**Live-weight range**	**Examples**
I	0 – 23 kg	*Oreotragus oreotragus* (klipspringer), *Raphicerus campestris* (steenbok), *Sylvicapra grimmia* (common duiker)
II	23 – 84kg	*Antidorcas marsupialis* (springbok), *Redunca arundinum* (southern reedbuck), *Pelea capreolus* (vaalribok)
III	84 – 296kg	*Tragelaphus strepsiceros* (kudu), *Oryx gazella* (gemsbok), *Connochaetes gnou* (black wildebeest)
IV	296 – 1000kg	*Syncerus caffer* (buffalo), *Tragelaphus oryx* (eland)
V	Above 1000kg	*Pelorovis antiquus* Giant buffalo (Klein 1976)

3.3 Quantification

Of major significance in any faunal study is the number of individuals or species represented in an assemblage. This can be achieved by employing various methods including counting of bone or bone fragments and considering the mass of bones and fragments (Chase & Hagaman 1987). Use of relative frequencies permits the exploration and understanding of population

successions, environmental fluctuations, recovery and sampling biases as well as taphonomy (Reitz & Wing 2008). Relative frequencies are used to determine relative abundance of species (Lyman 1994; Davis 2005) which can help to understand the role of different species in diets of early humans and link this to various subsistence strategies (Grayson 1973; Reitz & Wing 1999). The most commonly applied methods are those that involve counting and estimating the number of bones in any given individual (Grayson 1973; 1984; Lyman 1994; Van Pletzen 2000).

3.3.1 Number of Identifiable Specimen (NISP)

This is a key metric in estimating frequency per taxon in a given assemblage (Grayson 1973; Ringrose 1993). All the identifiable specimens are tallied resulting in an estimation of the taxonomic abundance of the deposited or death assemblage (Ringrose 1993; Reitz & Wing 1999). Even though NISP or specimen count is primary data it has been used to estimate relative frequency of taxa and as an analytical product this has caused criticism (White 1953; Grayson 1973; 1979). A biasing factor in NISP calculations is the differential preservation and fragmentation of elements (Chaplin 1971; Lyman 1994) for instance middens at some sites are dominated by molluscs because their shells preserve much better than some mammal bones and teeth (Reitz & Wing 2008). NISP also does not take into account practices of transportation, butchery and processing and thus elements such as long bone shafts/shaft fragments may often skew the results (Bunn *et al*. 1988; Mateos 2005). The difference in the numbers of elements in species is another biasing factor as some species have more bones/elements than others (Grayson 1984:21). The use of NISP does not consider this and thus may sometimes offer misleading results of species/individuals in an assemblage (Grayson 1984; Ringrose 1993). Identifiability of elements may also cause a bias as some elements, for instance vertebrae, are easily identified and occur in large numbers thus may have a higher NISP as compared to other elements (Reitz & Wing 2008). However, despite the limitations of NISP stated, it is the preferred method for this study due to the sample size as in Van Pletzen (2000).

3.3.2 normed Number of Identifiable Specimen (nNISP)

nNISP refers to the number of elements (NISP values) divided by the number of times the elements occur in a skeleton (Faith 2007; Reynard *et al.* 2016b). In calculating skeletal element consistency, it is essential that elements be normalized by their occurrence in the skeleton (Faith 2007). Normed NISP values are comparable to patterns from derived

measures of element abundance such as MNE and MAU however, nNISP lacks aggregation effects (Grayson 1984).
The Skeletal parts profile will be calculated using the normed NISP (nNISP) for each layer. The sum of the nNISP for each anatomical region; skull, forelimbs, hindlimbs and distal limbs will be used to create stacked charts.

3.3.2 Minimum Number of Elements (MNE)

This method is key in showing the body units of each taxa represented in an assemblage. MNE refers to the minimum number of whole skeletal elements necessary to account for all observed specimens (Bunn 1993; Lyman 1994; Morlan 1994). MNE is obtained by calculating the number of elements represented by the fragmentary remains based on landmark features (Binford 1984; Bunn 1983; Ringrose 1993).

The two most common methods of determining MNE are the fraction summation and the overlap approach. The fraction summation method entails the estimation of the fraction of a defined zone of a specimen that is preserved, and the sum of those fractions to attain the MNE (Klein & Cruz-Uribe 1984). The overlap approach involves getting MNE estimates through comparison of specimens in each size category and limb. This approach counts areas of overlapping features and zones (Bunn & Kroll 1986).

One of the issues contributing to biased MNE values is the varying definitions and methods used by different scholars (White 1953; Binford 1978; 1984; Bunn 1986; Marean & Spencer 1991; Morlan 1994; Lyman 1994; Marean *et al.* 2001). MNE being an analytical unit is biased by the same factors as MNI (Lyman 1994). For example, the lack of a clear distinction between the specimens (SP) in NISP and skeletal elements in MNE hinders actualistic research on frequency distributions of skeletal parts in an assemblage (Grayson 1973; 1984; Lyman 1994). Measures to account for such problems have been proposed such as NISP: MNE ratios (Klein & Cruz-Uribe 1984) but as the intensity of fragmentation increases, the differences between NISP and MNE are exacerbated. Simply put as fragments become smaller they are unlikely to be indicated as independent of one another (Lyman 1994), thus limiting this approach. To control the effects of differential fragmentation one could include only the fragmentary or incomplete specimens because such fragmentation appears to characterize some bone-accumulating agents (human bone marrow processing activities). Moreover, the analyst could calculate an NISP: MNE ratio using only incomplete specimens, and in conjunction with the percentage of whole bones, derive an index of fragmentation for

particular bone-accumulating agents. Currently, however, the proportion of whole bones provides insights to one aspect of fragmentation whereas NISP: MNE ratios based solely on broken bones provide insights to a different aspect of fragmentation, as such both should be calculated (Klein & Cruz-Uribe 1984; Lyman 1994). In this analysis, the fraction summation approach will be used to determine MNE values.

3.4 Fragments and Fractures

Fragmentation and fracture patterns of all the specimens were also documented. Fragment size is a measure of the intensity of fragmentation and can suggest animal or human activity (Lyman 1994). The length of each fragment was measured using digital callipers and recorded according to Driver (1999) coding scale (Table 3.2).

Table 3. 2: Classification of fragment length.

Code	**Length**
1	Less than 1cm
2	1 to 1.99cm
3	2 to 2.99cm
4	3 to 3.99cm
5	4 to 4.99cm

The width or cortical thickness for identified and unidentified long bone was measured as cortical thickness varies on individual bone and can be used to infer size classes (Alexander 1977; Currey & Alexander 1985). Therefore, the thickest portion of the cortex was measured to the nearest millimetre and categorised according to Driver's 1999 coding scale. (Table 3.3) The cortical thickness codes were used to classify the unidentified long bone fragment specimens (see also Reynard *et al.* 2014) into various classes adapted from Brain (1981). Size class 1 < 2mm, size classes 2 & 3 ranged between 4-5.99mm and size classes 4 & 5 were denoted by cortical thickness codes of 6mm and above.

Table 3. 3: Classification of Cortical thickness.

Code	**Cortical Thickness**
1	Less than 2mm
2	2 to 3.99mm
3	4 to 5.99mm
4	6 to 7.99mm
5	8 to 9.99mm

3.4.1 Fractures

A fracture in this study refers to a localized mechanical failure (Currey 1984; Johnson 1985). Following previous taphonomic studies (Marean *et al.* 2000; Thompson 2010; Reynard *et al.* 2016a,b) fractures present were classified as spiral, transverse, irregular or eroded fractures.

Spiral fractures are defined as curved fractures in a semi or completely helical pattern around the circumference of the shaft (Johnson 1985; Gifford-Gonzalez 1989; Lyman 1994; Drivers 1999). A long bone in Haynes (1983) is defined as spirally fractured if the fracture outline '*curves as a semi helix, helix, or mixture of helixes around the shaft'*, and the fracture occurs in the part of the shaft containing marrow.

Transverse or Perpendicular fractures are defined as fractures that are at a right angle to the long axis of the bone (Johnson 1985; Gifford-Gonzalez 1989; Lyman 1994; Drivers 1999).

Irregular fractures are defined as fractures exhibiting scallops; a series of semicircles or curves along the edge (Johnson 1985). Breaks and fractures were noted as transverse, spiral or longitudinal as in Drivers (1999) coding manual.

Eroded fractures are defined as fractures resulting in the end of the bone damaged smoothly by natural processes such as sand or water abrasion. Eroded fractures may result in the exhibition of cancellous bone on a smooth surface (Driver 1999).

3.5 Modifications

All faunal specimens were examined using a hand lens with 10x magnification upon which bone surface modification such as cut marks, gnaw marks from rodents, carnivore tooth marks and bone breakage patterns were noted (following Blumenschine *et al.*, 1996; Fisher

1995; Fernandez-Jalvo & Andrews 2016). Specimens with modifications were studied further under an Olympus SZ61 binocular microscope with up to 30x magnification. The definitions applied for the modifications were as follows:

Cut marks occur as fine V-shaped incisions on the bone surface and are highly indicative of butchery activity (Bunn 1981; Noe-Nygaard 1989; Fisher 1995). Shipman (1981a, b) further describes cut marks made by stone tools as ranging from V to U shaped in cross section, elongate in nature, exhibiting multiple fine parallel striations and what she termed as shoulder effects (small striae parallel to the main striations). These definitions of cut marks were applied in the study however other factors such as depth of striations as well as anatomical location and orientation as in Lyman (1987) and Noe-Nygaard (1989) were considered.

Percussion marks are characterized by scars or 'notches' as well as pits and associated micro-striations (Blumenschine & Selvaggio 1988; Noe-Nygaard 1989; Lyman 1994; Pickering & Egeland 2006). Blumenschine & Selvaggio (1988) classified two types of percussion marks; '*isolated striae fields and pits with micro-striations'*. The former were defined as being the result of anvil impact on a bone (Turner 1983) whereas direct impacts during hammer stone bone breakage, was identified as the main cause of pits with associated micro-striations (Blumenschine & Selvaggio 1988; Pickering & Egeland 2006). Isolated striae could however be caused by trampling as well (Prendergast & Dominguez-Rodrigo 2008). Due to matters concerning equifinality percussion marks for this study were only recorded in instances of micro striations associated with a pit or where clear notches were left behind in association with bulbs of percussion from impact.

Abrasion is characterised as degree of rounding or polishing on bones (Fernandez-Jalvo & Andrews 2016). It can occur on complete bone or broken ends of the bone and at varying intensities such as slight, moderate or extreme abrasion. The rate and degree of abrasion on bone depends on the condition of the bone as well as the agent causing the abrasion (Fernandez-Jalvo & Andrews 2003). Transportation of bones by sediments, wind erosion (Fernandez-Jalvo & Andrews 2016) as well as trampling (Brain 1967a) may result in abrasion on a bone. Morphology of abrasion between different agents does not vary greatly as such abrasion is described in terms of degree or polish/sheen (Fernandez-Jalvo & Andrews 2016). As such in this study polish or abrasion was recorded only if the surface of the bone exhibits a glossy sheen (Reynard *et al.*2016b).

Tooth marks here are defined as U-shaped furrows or localized 'holes' on the surface while gnaw marks generally affect the edges of bone surfaces and are characterized by small, shallow parallel markings (Lyman 1994; Reitz & Wing 2008; Fernandez-Jalvo & Andrews 2016). Carnivore tooth marks on the specimens were classified as pits or punctures. Tooth pits refer to superficial marks that are the result of animal chewing and may appear as roughly circular marks lacking a long axis usually due to scarring of the bone without breaking of the cortex (Pickering *et al*. 2003; Andrews & Fernandez-Jalvo 1997). Punctures were classified as deep pits that pierce the cortical bone, along the edges of complete or broken bone (Andrews & Fernandez-Jalvo 1997).

The above modifications were noted as either 'present' or 'absent' on each bone fragment. If noted as present a number from 1-3 was assigned for marks based on their frequency on a single specimen. (1=mild modification, 2=moderate markings, 3=severe modifications). Mild modification was assigned when less than a third of the surface displayed markings. Moderate modification occurs when between a third and 60% of the surface is marked, and severe modification occurs when over 60% of the surface displays markings.

Burnt bone in this project is defined as the result of excessive heat that modifies and damages the surface of the bone (Shipman *et al.* 1984; Stiner *et al.* 1995). The colour of the burnt bones was recorded as brown, grey or black and a code for each colour assigned where 0=dark brown, 1=partial burning, 2=mostly black, 3=mostly grey & 4=mostly white (cf. Reynard *et al.* 2016a).

Weathering noted on any specimen was classified according to Behrensmeyer's (1978) stages as shown in Table 3.4.

Table 3. 4: Weathering stages based on Behrensmeyer's (1978).

STAGE	**DESCRIPTION**
0	No cracking of flaking on bone surface.
1	Longitudinal and/or mosaic cracking present on surface.
2	Longitudinal cracks, exfoliation on surface.
3	Fibrous texture, extensive exfoliation, cracked edges are rounded.
4	Coarsely fibrous texture, splinters of bone loose on the surface, open cracks.

5	Bone crumbling, large splinters.

Statistical tests such as chi-square tests, Spearman's Rho and Mann-U Whitney were conducted to test the significance of relationships observed in the data as well as correlation.

Summary

The methods used in this study are similar to those used in other taphonomic studies in Southern Africa (Reynard *et al.* 2014, 2016a) as using standardised methods ensures reliable comparisons between sites. The use of standardised coding manuals such as Driver (1999) and Fernandez-Jalvo & Andrews (2016) was employed in this study as well. The basic quantification method used in this study was NISP as despite its shortcomings it is the most widely used method of quantification in faunal studies. MNE will be determined using the fraction summation approach.

CHAPTER FOUR

RESULTS

4.1 Introduction

In this chapter I present the results and highlight the trends observed in the 2261.4g of specimens analysed from layers YSx5 and CPx4, Square J51 in cave 1A. The taphonomic analysis involved the identification and quantification of specimens using NSP, NISP, normed NISP and MNE. Skeletal and mortality profiles as well as size classes of the specimens analysed are presented in sections 4.2 and 4.3. Fragmentation and fracture patterns of bone were noted along with the bone surface modifications presented in section 4.4. Significance tests like Chi square, Spearman's Rho correlation and Mann-Whitney U were employed to investigate the extent of relationships between various attributes of the samples from YSx5 and CPx4.

4.2 Sample

4.2.1. Sample size

This study was undertaken on a sample of specimens larger than 2cm from the two layers. Layer YSx5 (Yellow Sand X5) (see Fig 3.1) consists mainly of yellow sand with a significant proportion of microfauna, but bone, shell and stone tools also occur. The volume excavated in YSx5 is 0.105m³. In contrast, CPx4 (Carbonised parting X4) consists of less deposit (0.04025 m³) and is a black-brown layer that consist of hearth material, some burnt bone as well as lithics. The total mass of bone excavated from YSx5 is 2279.5g, and from CPx4 is 1004.3g (Table 4.1) (Wurz & Deacon excavation notes). YSx5 is therefore a more extensive unit than CPx4. The faunal density for layer YSx5 is 21.709g/ m³ while CPx4 is 24.952g/ m³. Layers CPx4 generally had a relatively higher amount of smaller material that was excluded from this study as it was under 2cm long. Material from both layers without a cortex was excluded as no surface modification studies could be conducted on them.

Table 4. 1: Mass of bone in layers YSx5 and CPx4.

Layer	**Total weight* (g)**	**Weight analysed** †(g)	**Percentage (%)**	**Volume excavated**	**Faunal density**
YSx5	2279.5	1429.5	62.71	0.105m³.	21.709g/ m³
CPx4	1004.3	831.9	82.83	0.04025 m³	24.952g/ m³

Total	3283.8	2261.4	68.87	0.14525 m^3	22608g/ m^3

***=** Total weight of the specimens from both layers including specimens under 2cm that were not included in the study.

ŧ= Weight of all specimens above 2cm which were analysed.

4.2.2 Number of specimens (NSP)

Like most other MSA sites (Marean *et al.* 2000; Reynard *et al.* 2016b), layers YSx5 and CPx4 have a much higher proportion of unidentifiable than identifiable bones (Table 4.2). For the YSx5 layer the number of non-identifiable bones (82.51%; the number of specimens [n]=1005) exceeds the identifiable bones (17.49%; n=213). Layer CPx4 also exhibits a higher number of non-identifiable bone (84.73%; n=405) than identifiable bone (15.27%; n=73).

Table 4. 2: Identified specimens in YSx5 and CPx4.

Element	**YSx5 (n*)**	**Percentage (%)**	**CPx4 (n*)**	**Percentage (%)**
Identifiable Bone	213	17.49%	73	15.27%
Non-Identifiable Bone	1005	82.51%	405	84.73%
Total count (N)	1218	100%	478	100%

*Total number of Specimens (NSP).

A chi square test indicates that there is no significant difference in the proportion of ID and non-ID specimens between layers YSx5 and CPx4 (χ^2=1.20; df=1; p=0.27).

Table 4. 3: Chi square test of identifiable versus non-identifiable bone between layers YSx5 and layer CPx4.

	Identifiable bone	**Non-identifiable bone**	**Marginal row totals**
Layer YSx5	213	1005	1218
Layer CPx4	73	405	478
Marginal column totals	286	1410	1696

4.2.3 Number of Identified Specimens (NISP)

The number of identified specimens (NISP) for layer CPx4 is 67 with the most abundant element being ribs (n=27). Most of the ribs (n=21) were categorized as medium mammal.

Table 4. 4: Representation of elements and respective size classes in layer CPx4.

ELEMENT	SIZE 1	SIZE 2	SIZE 3	SIZE 4	SIZE 5	NISP
Petrossa	—	—	1	—	—	1
Premolar	—	—	—	—	1	1
Tooth	—	2	1	—	—	3
Hyoid	—	1	—	—	—	1
Vertebrae*	2	9		—		11
Ribs*	4	21		2		27
Ossified cartilage	1	—		—		1
RADIUS Proximal Shaft Distal	1	—	—	—	—	1
ULNA Proximal Shaft Distal	—	1	—	—	—	1
Innominate	—	1	—	—	—	1
TIBIA Proximal Shaft Distal	— 1	2 —				3
Calcaneus			1			1
Metapodial	1	1	4	1		7
Tarsal			1			1
Phalanges Proximal Medial Distal Indet phalanx	1 1	 1		 1		 4
Sesamoid	2		1	—	—	3
Total	14	29	19	4	1	67

*Ribs, vertebrae and ossified cartilage were classified as small mammal (equivalent to size 1 bovid), medium mammal (equivalent to size 2 and 3 bovid), and large mammal (equivalent to size 4 and 5 bovid).

Layer YSx5 (n=195) has a higher NISP than layer CPx4 with the most abundant elements being vertebrae (n=54), phalanges (n=31) and ribs (n=21). The size class with the highest representation in layer YSx5 with 97 elements is size class 1 (0-23kg). However, 30 of these specimens were vertebrae and classified as small mammal.

Table 4. 5: Representation of elements and respective size classes in layer YSx5.

ELEMENT	SIZE 1	SIZE 2	SIZE 3	SIZE 4	SIZE 5	NISP
Cranial	—	3	—	—	—	3
Petrosa		—	1	—	—	1
Incisor	1	—	—	—	—	1
Deciduous premolar		1		—	—	1
Premolar	—	1	—	—	—	1
Molar	1	3		—	—	4
Tooth		1	1	—	—	2
Hyoid		2		—	—	2
Vertebrae*	30	24		—		54
Sternum*	1	1		—		2
Ribs*	7	13		1		21
Ossified cartilage*	—	1	—	—		1
HUMERUS				—	—	9
Proximal	4	1	1			
Shaft						
Distal	3					
RADIUS						
Proximal	1		1	1		4
Shaft						
Distal	1					
ULNA						2
Proximal	1					
Shaft						
Distal		1				
Carpal	3	2	1	—	—	6
Metacarpal			1	—	—	1
Innominate	2	2	1	—	—	5
FEMUR						6
Proximal	2	1				
Shaft						
Distal	3					
TIBIA						5
Proximal		1			1	
Shaft		1	1		1	
Distal						
Astragalus	—	1	—	—	—	1
Tarsal	—	1	—	—	—	1
Metapodial	11	3	2	2		18
Metatarsal	1	2	1			4
Phalanges						31
Proximal	1	1				
Medial	2	1				
Distal	4	1				
Indet phalanx	14	6	1			

Sesamoid	4	3	2			9
Total	97	68	24	4	2	195

*Ribs, vertebrae, sternum and ossified cartilage were classified as small mammal (equivalent to size 1), medium mammal (equivalent to size 2 and 3), and large mammal (equivalent to size 4 and 5).

4.2.4 Minimum Number of Elements (MNE)

The minimum number of elements (MNE**)** was obtained using the fraction summation approach (Klein & Cruz- Uribe 1984). The MNE values were calculated for long bones from each layer. The data were however grouped due to small sample sizes with size classes 1 and 2 as a smaller group, and size class 3, 4 and 5 as a larger group.

Table 4. 6: MNE in relation to size classes for long bones.

	LAYER YSx5				**LAYER CPx4**			
Element	NISP (1&2	MNE (1&2)	NISP (3&4)	MNE (3&4)	NISP (1&2	MNE (1&2)	NISP (3&4)	MNE (3&4)
HUMERUS								
Proximal	4	4	1	1				
Shaft								
Distal	3	3						
RADIUS								
Proximal	1	1	1	1	1	1		
Shaft								
Distal	1	1						
ULNA								
Proximal	1	1			1	1		
Shaft								
Distal								
METACARPAL								
Proximal			1	1			1	1
Shaft								
Distal								
FEMUR								
Proximal	3	3						
Shaft								
Distal	3	3						
TIBIA								
Proximal	1	1	1	1	2	2		
Shaft	1	1	2	2				
Distal					1	1		
METAPODIAL								

Proximal								
Shaft	14	7	4	2	2	1	5	2.5
Distal								
METATARSAL								
Proximal	2	2	1	1	3	1.5	1	1
Shaft								
Distal	1	1						
TOTAL	**35**	**28**	**11**	**9**	**10**	**7.5**	**7**	**4.5**

The MNE for layer YSx5 is 28 for smaller bovids (size 1 and 2) while larger bovids (size 3, 4 and 5) have an MNE of nine. Layer CPx4 has an MNE of 7.5 for sizes 1 and 2 whereas for sizes 3, 4 and 5 the MNE is 4.5.

4.2.5 Skeletal parts profile

Skeletal parts profile is a useful measure to assess transport and subsistence patterns. Tables A1, A2 and A3 in the Appendix shows the skeletal parts profile in normed NISP.

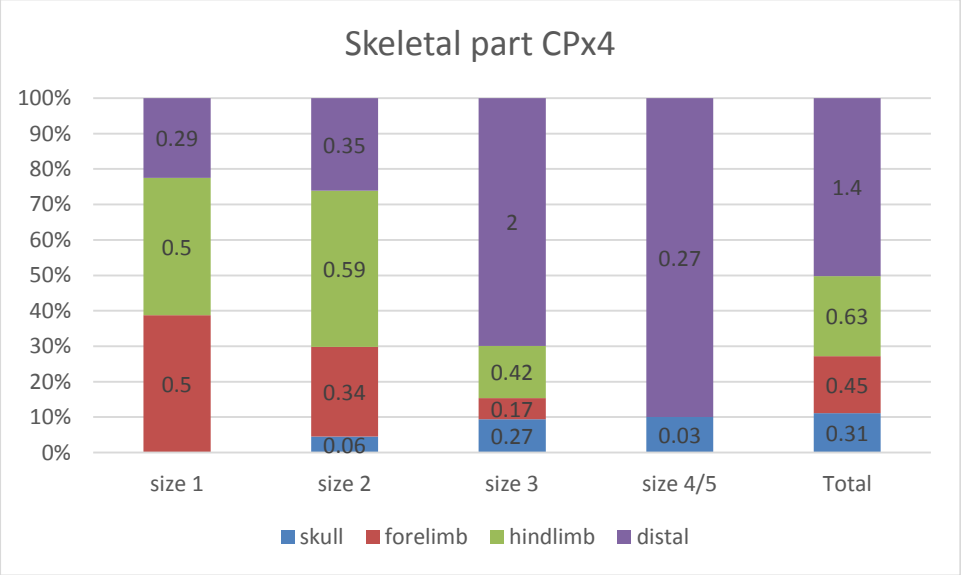


Figure 4. 1: Bovid skeletal profile of CPx4 (normed NISP indicated in columns).

There are proportionally more distal limbs for larger bovids (size 3, 4/5) and hind limbs are more common in sizes 1 and 2. Skull elements are less common in the samples (Fig 4.1). When the skeletal parts profile data are combined there is more equitability amongst skeletal elements representation, although distal elements are still relatively more abundant.

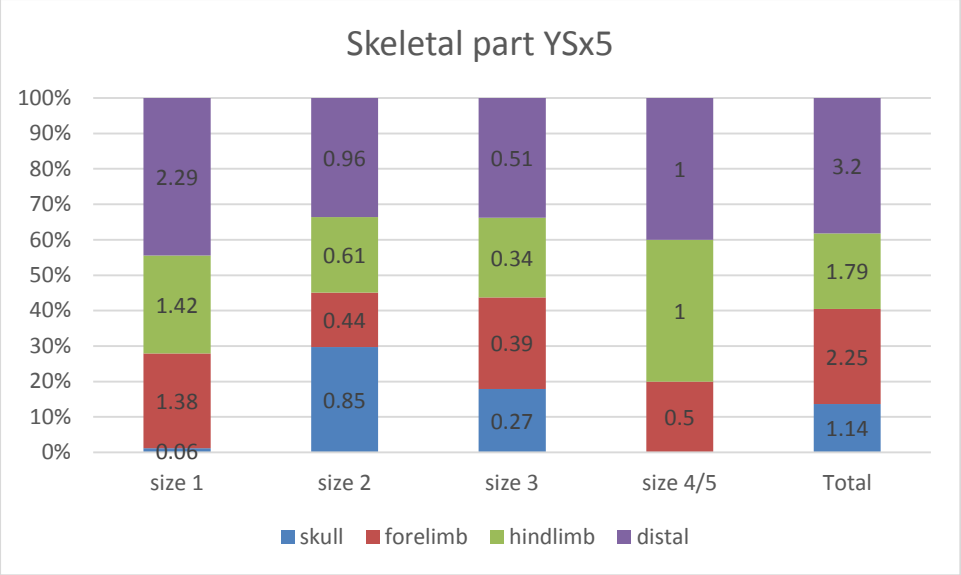


Figure 4. 2: Bovid skeletal profile of YSx5 (normed NISP indicated in columns).

Layer YSx5 records a relatively greater abundance of distal limbs across all the size classes. Size class 2 exhibits more skull elements while size classes 1 and 4/5 record relatively higher abundances of hind limbs. When size classes are clustered there is also a more equal representation of elements in layer YSx5, and the relatively larger abundance of distal limbs is reflected as well. Skull elements have a higher representation in YSx5 as compared to CPx4 (Fig 4.2).

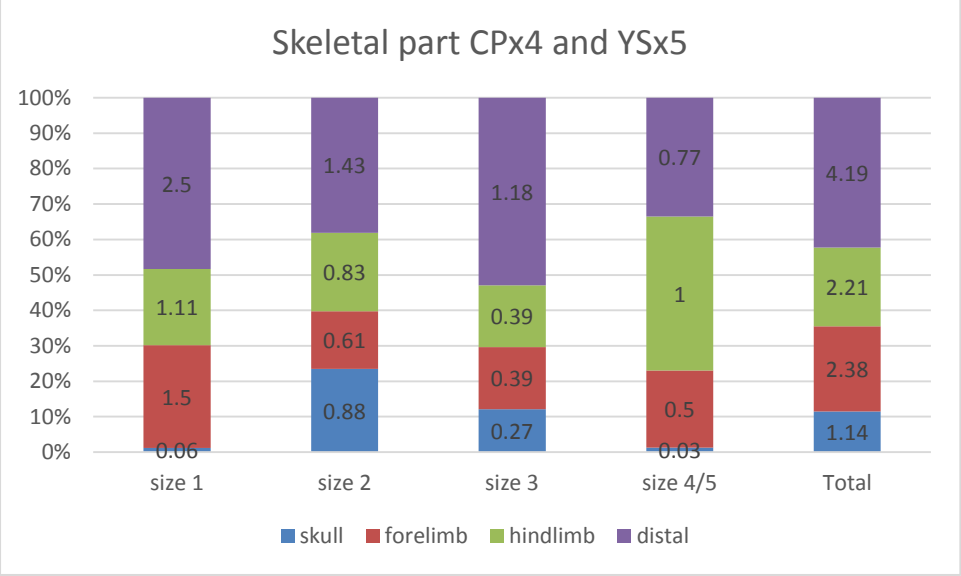


Figure 4. 3: Bovid skeletal profile of CPx4 and YSx5 combined (normed nNISP indicated in columns).

When nNISP data from layers YSx5 and CPx4 are combined (Fig. 4.3) all size classes show an abundance of distal limbs. However, size classes 2 and 3 reflect a relative representation of all elements, in contrast to size classes 1 and 4/5 which exhibit an abundance of distal and hind limbs respectively. Skull elements have a relatively lower abundance than other elements across the sizes in both layers.

Spearman's Rho tests indicate that there is no correlation between bone density and skeletal representation in YSx5 and CPx4. *Rangifer tarandus (*Reindeer/Caribou) artiodactyl portion density values from Lam *et al.* (1999) were used as the comparative density values for this ungulate study. These values were compared against the nNISP of combined bovids because sample sizes for each bovid size class were too small (Table A6). The results indicate no correlation between bone density and skeletal abundance in either of the layers (CPx4 r_s = -0.08584, p= 0.79081, YSx5 r_s = -0.08354, p=0.71883). When the layers are combined there is still no correlation (r_s= -0.1087, p=0.63015).

4.3 Mortality profiles and size classes

4.3.1 Mortality profile

Mortality was inferred from the state of fusion of the bones. In layer YSx5 adult specimens (9.11%; n=111) outnumber the juvenile remains (8.37%; n=102). This is also the case in layer CPx4 where there is a higher abundance of adult specimens (8.79%; n=42) with juveniles having a lower representation (6.49% n=31). However, specimens of unknown age are relatively abundant in both YSx5 (82.51% n=1005) and CPx4 (84.72% n=405) therefore either the adult or juvenile representation may be higher than estimated by the study (Table 4.7).

Table 4. 7: Mortality representation in YSx5 and CPx4.

AGE	**YSx5 (n*)**	**Percentage (%)**	**CPx4 (n*)**	**Percentage (%)**
Adults	111	9.11	42	8.79
Juveniles	102	8.37	31	6.49
Unknown	1005	82.51	405	84.72
Total count (N)	1218	100	478	100

*n=Number of identified specimens (NISP)

A chi square test indicates that there is no significant difference in the quantity of adult and juveniles in YSx5 and CPx4 (χ^2=0.64; df=1; p=0.42).

Table 4. 8: Chi square test of the proportion of adults and juveniles in YSx5 and CPx4

	Adults	**Juvenile**	**Row totals**
Layer YSx5	111	102	213
Layer CPx4	42	31	73
Column totals	153	133	286

4.3.2 Size classes

The most abundant size class from the identifiable elements (49.74% n=97) in YSx5 is size class 1 (Table 4.9). This refers to species such as Cape grysbok (*Raphicerus melanotis)* and steenbok *(Raphicerus campestris*). Table 4.9 also shows that the most abundant size class for layer CPX4 is size class 2 (43.28%, n=29). Size class 2 is represented by for instance *Pelea capreolus* (vaalribok) (Klein 1976; Van Pletzen 2000).

Table 4. 9: The number of identified specimens (NISP) for Bovid size classes in Layers YSx5 and CPx4.

SIZE CLASS	**YSx5 (n)**	**PERCENTAGE (%)**	**CPx4 (n)**	**PERCENTAGE (%)**
1	97	49.74	14	20.90
2	68	34.87	29	43.28
3	24	12.31	19	28.36
4	4	2.05	4	5.97
5	2	1.03	1	1.49
Total (N)	195	100	67	100

A chi square test indicates a significant difference in the proportion of size classes in the two layers YSx5 and Cpx4 (χ^2=21.18; df=4; *p=0*.00).

Table 4. 10: Size classes represented by the number of identified specimens (NISP) in Layers YSx5 and CPx4.

Layer	**Size 1**	**Size 2**	**Size 3**	**Size 4**	**Size 5**	**Row totals**
YSx5	97	68	24	4	2	195
CPx4	14	29	19	4	1	67
Column totals	111	97	43	8	3	262

4.4 Taphonomy

4.4.1 Fragmentation

Fragmentation of long bone can be used to investigate processing intensity (Thackeray 1979). Scatter plots were used to demonstrate the level of fragmentation as represented by the length and cortical thickness of the long bone fragments from layers YSx5 and CPx4 (Figure 4.4).

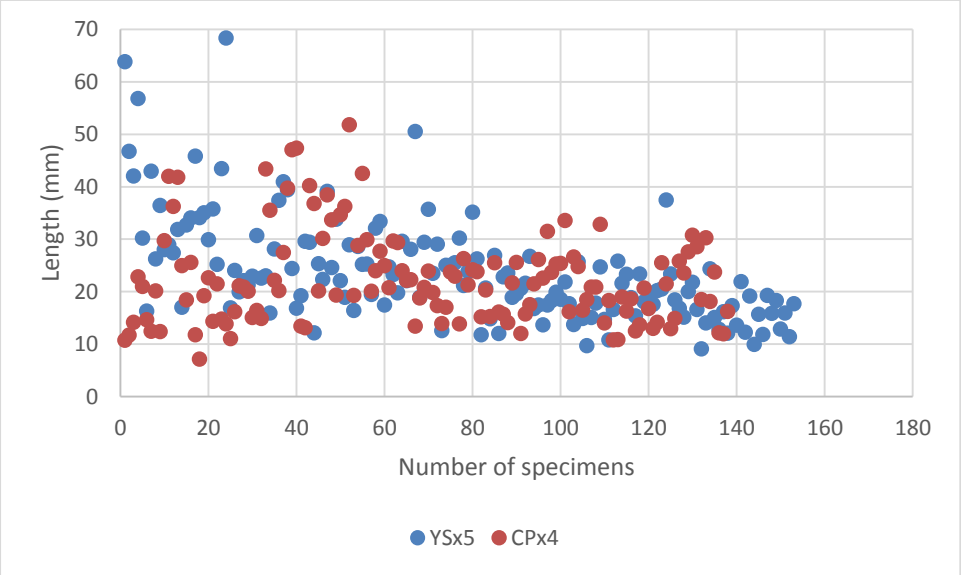


Figure 4. 4: Length of long bone fragments from YSx5 and CPx4 in mm.

Fragments from YSx5 were somewhat longer than those from CPx4. The average length of long bone fragments from layer YSx5 is 23.80 mm while that of layer CPx4 is 22.29mm.

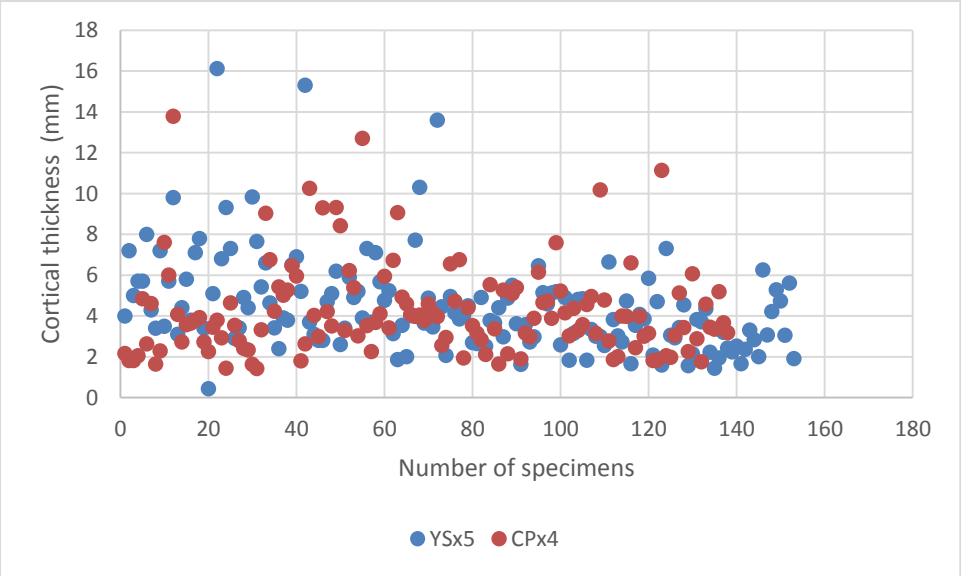


Figure 4. 5: Cortical thickness of long bone fragments from YSx5 and CPx4 in mm.

The long bone fragments from YSx5 were also slightly thicker than those from CPx4. The average thickness for long bone fragments from YSx5 is 4.47mm while that of CPx4 is 4.24mm. Mann Whitney U two-tailed tests were conducted to assess statistical differences of lengths and widths in the two layers. Results from the lengths of the two layers (U value= 9678.5, Z score is 1.22492, p value= 0.22246) and widths (U value = 9714.5, Z score is 1.1747, p value is 0.242) indicate no significant statistical difference.

4.4.2 Fracture Patterns

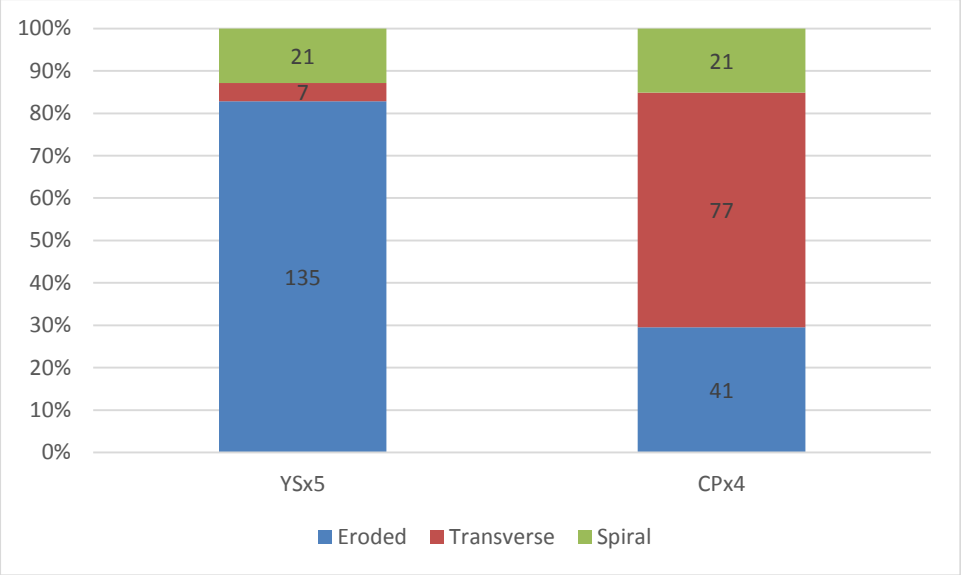


Figure 4. 6: Fracture patterns in YSx5 and CPx4.

The ends of the long bone fragments (LBFs) were analysed for breakage patterns. The most abundant breakage type for LBFs in layer YSx5 is eroded breaks 82.82% (n=135), while the most abundant breakage pattern for the long bone fragments from layer CPx4 is transverse breaks 55.40% (n=77).

Table 4. 11: Fracture patterns of LBFs in Layers YSx5 and CPx4.

Fracture pattern	**YSx5**	**Percentage (%)**	**CPx4**	**Percentage (%)**
Eroded	135	82.82	41	29.50
Transverse	7	4.29	77	55.40
Spiral	21	12.88	21	15.11
Total	163	100	139	100

A chi-square test indicates that there is a significant difference in the proportions of fracture patterns of long bones in layers YSx5 and CPx4 (χ^2=107.31; df= 2, p< 0.00).

Table 4. 12: Chi-square test on long bone fracture proportions in Layer YSx5 and CPx4.

Layer	**Eroded fractures**	**Transverse fractures**	**Spiral fractures**	**Row totals**
YSx5	135	7	21	163
CPx4	41	77	21	139
Column totals	176	84	42	302

4.4.3 Bone surface modifications

4.4.3.1 Anthropogenic

Burning

For layer YSx5, 15.35% (n=187 of a total of 1218 specimens) is burnt while (84.65%, n=1031) of the total assemblage is unburnt. Of the total burning the majority of specimens (n=75) are burnt grey indicating a relatively high degree of burning (Table 4.13).

Table 4. 13: Degree of burning for Identifiable Bone and Non- Identifiable bone in Layer YSx5.

Burning	**ID Bone (n=213)**	**Percentage (%) ID burning**	**Non-ID bone (n=1005)**	**Percentage (%) non-ID burning**	**Total burning**	**Total percentage (%)**
Brown	1	6.67	0	0	1	0.53
Localised	11	73.33	45	26.16	56	29.95
Black	1	6.67	48	27.91	49	26.20
Grey	2	13.33	73	42.44	75	40.11
White	0	0	6	3.49	6	3.21
Total burning	15	100	172	100	187	100

N*= total number of specimens (1218)

The indications of burning from Layer CPx4 are different from Layer YSx5 as a much larger proportion of the bone is burnt. Layer CPx4 has 79.71% (n=381 of a total of 478) burnt bones while (20.08%, n=96) bones of the total assemblage are unburnt. Here too most of the burnt bones (41.73%, n=159) are burnt grey.

Table 4. 14: Burning in identifiable bone and non- identifiable bone CPx4.

Burning	**ID Bone (n=73)**	**Percentage (%)**	**Non-ID bone**	**Percentage (%)**	**Total Burning**	**Percentage (%)**

			(n=405)			
Brown	5	11.11	54	16.07	59	15.49
Localised	10	22.22	66	19.64	76	19.95
Black	6	13.33	25	7.44	31	8.14
Grey	15	33.33	144	42.86	159	41.73
White	9	20.00	47	13.99	56	14.70
Total burning	45	100.00	336	100.00	381	100.00

N*= total number of specimens 478

A chi square test for burning was conducted using data from three burning categories: black, grey and white. Data from two categories of burning (brown and localised burning) were excluded. This was undertaken to avoid inflation of the results by factors such as staining which also turn bone brown. There is significant difference in the prevalence of burning in layers YSx5 and CPx4 (χ^2=331.03; df=1; $p < .05$).

Table 4. 15: Chi-square test comparing burning in LayersYSx5 and CPx4.

	Burning	**No burning**	**Row totals**
Layer YSx5	130	1088	1218
Layer CPx4	246	232	478
Column totals	376	1320	1696

Cut marks

The total number of cut marked bones recorded in Layer YSx5 is 17 (1.40%) with 11 occurring on identifiable bone. When cut marks are considered in relation to size classes, size classes 1and 2 have the most cut marks (n=4 each) while size class 3 has a higher intensity of cut marks with two bones indicating 2 and 3 cut marks respectively in layer YSx5.

Table 4. 16: Size classes and cut mark intensity in Layer YSx5.

SIZE CLASS	**Mild**	**%**	**Moderate**	**%**	**Severe**	**%**	**Total size classes ***	**Total cut mark %**
1	4	4.12	—		—		97	4.12
2	4	5.88	—		—		68	5.88
3	1	4.16	1	4.16	1	4.16	24	12.50

4	—		—		—		4	—
5	—		—		—		2	—
Total cut marks	9	4.62	1	0.51	1	0.51	195	5.64

*=Total number of specimens in each size class

The total number of cut marked bones recorded in Layer CPx4 is 12 (2.51%). The number of identifiable specimens from layer CPx4 with cut marks are relatively few (n=4). Cut marks are recorded most frequently in size class 3 (n=3) with two specimens recording three cut marks and one specimen having a single cut mark.

Table 4. 17: Size classes and cut mark intensity in Layer CPx4.

SIZE CLASS	**Mild**	**%**	**Moderate**	**%**	**Severe**	**%**	**Total size classes***	**Total cut mark %**
1	—		—	—	—	—	14	—
2	—		—	—	—	—	29	—
3	1	5.26	—	—	2	10.53	19	15.79
4	1	25	—	—	—	—	4	25
5	—	—	—	—	—	—	1	—
Total cut marks	2	2.99	—	—	2	2.99	67	5.97

*=Total number of specimens in each size class

The unidentifiable specimens exhibiting cut marks in both layers are presented in Table 4.18. In layer CPx4, eight of the non-identifiable bones exhibit cut marks with seven of these having one cut mark each and one specimen recording severe cut marks. In layer YSx5 6 non-identifiable bones exhibit mild cut marks.

Table 4. 18: Cut marks in ID vs Non-ID bone in YSx5 and CPx4.

CPx4				**YSx5**				
Element	**Mild**	**moderate**	**Severe**	**Total***	**Mild**	**moderate**	**severe**	**Total***
ID bone	2	—	2	73	9	1	1	213
Non -ID bone	7	—	1	405	6	—	—	1005
Total	9		3	478	15	1	1	1218

*Total number of specimens (NSP)

There is a marginal difference in the number of cut marks exhibited between the two layers. However, a chi-square test shows that there is no significant difference in cut marks between layer YSx5 and CPx4 (χ^2=2.54; df=1; p= 0.11).

Table 4. 19: Chi-square test comparing cut marks in Layers YSx5 and CPx4.

	CM*	**No CM**	**Row totals**
Layer YSx5	17	1201	1218
Layer CPx4	12	466	478
Column totals	29	1667	1696

***CM=** Cut marks

Percussion marks

When identifiable bone is considered, Layer YSx5 exhibits more percussion marks (4.23%, n=9) than Layer CPx4 (2.74%, n=2). Table 4.20 shows that there were three percussion marks for size class 1, 4 for size class 2 and two for size class 3. Layer CPx4 exhibits percussion marks only for size class 2 (n=2).

Table 4. 20: Percussion marks in size classes YSX5 and CPx4.

Layer YSx5				**Layer Cpx4**		
Size class	**PM***	**%**	**Total (NISP)**	**PM***	**%**	**Total (NISP)**
1	3	3.09	97	—	—	14
2	4	5.88	68	2	6.90	29
3	2	8.33	24	—	—	19
4	—	—	4	—	—	4
5	—	—	2	—	—	1
Total	9	4.62	195	2	2.99	67

***PM=percussion mark**

Percussion mark occurrence on identifiable and non-identifiable bone was compared between the two layers. Percussion marks are more abundant in non-identifiable than identifiable bones in both layers. In contrast to the ID bone, for non-identifiable bone Layer CPx4 has more percussion marks (12.59%, n=51) than YSx5 (3.28%, n=33). For the total assemblage as well Layer CPx4 records a higher number of percussion marks (11.09%, n=53) than YSx5 (3.45%, n=42).

Table 4. 21: Percussion marks for Identifiable vs Non-Identifiable bone in Layers YSx5 and CPx4 combined.

Layer YSx5				**Layer CPx4**		
Element	**PM***	**%**	**Total (N)**	**PM***	**%**	**Total**
Id bone	9	4.23	213	2	2.74	73
Non-Id bone	33	3.28	1005	51	12.59	405
Total	42	3.45	1218	53	11.09	478

***PM=percussion mark**

A chi-square test shows that there is a significant difference in percussion marks between layer YSx5 and CPx4 (χ^2= 37.90; df=1; p< .05). Layer CPx4 records more percussion marks than YSx5.

Table 4. 22: Chi-square test comparing percussion marks in YSx5 and CPx4.

	PM*	**No PM***	**Row totals**
Layer YSx5	42	1176	1218
Layer CPx4	53	425	478
Column totals	95	1601	1696

***PM=** Percussion marks

Table 4.23 represents a summary of the anthropogenic modifications in both the ID and non-id bone discussed in layers YSx5 and CPx4. This table clearly shows that Layer CPx4 exhibits a higher percentage of anthropogenic modifications than YSx5.

Table 4. 23: Anthropogenic modifications summary table.

Modifications	**YSx5**	**Percentage (%)**	**CPx4**	**Percentage (%)**
Cut marks	17	1.40	12	2.51
Burning	187	15.35	382	79.71
Percussion marks	42	3.45	53	11.09
Total (N)	1218		478	

4.4.3.2 Zoogenic modifications

Zoogenic marks such as acid etching, tooth marks and gnaw marks which can be associated with predators/carnivores were used as one of the proxies to record difference in accumulation agents within the layers.

Acid etching

Acid etching in YSx5 is relatively prevalent with 224 (18.39%) of the total bones reflecting acid etching (Table 4.24). In Layer CPx4 acid etching is less prevalent (6.07%, n=29). Some of these bones (1.67%, n=8) from CPx4 exhibited burning as well. The level of porous bones in YSx5 which also exhibits high intensities of acid etching (Fig A9) was higher compared to CPx4.

Table 4. 24: Acid etching in YSX5 and CPx4.

Gastric Acid Etching	**YSx5 (n)**	**PERCENTAGE (%)**	**CPx4 (n)**	**Percentage (%)**
Present	224	18.39	29	6.07
Total (N)	1218	100	478	100

There is a significant difference in the occurrence of acid etching between layers YSx5 and CPx4 (χ^2=41.08; df=1; $p < .05$). Layer YSx5 has a significantly higher number of specimens with acid etching than CPx4.

Table 4. 25: Chi-square comparing acid etching in layers YSx5 and CPx4.

	Acid etching	**No acid etching**	**Row totals**
Layer YSx5	224	994	1218*
Layer CPx4	29	449	478*
Column totals	253	1443	1696

*Number of Specimens (NSP)

Table 4.26 reflects the degree of acid etching compared to the frequency of carnivore tooth marks in the YSx5 assemblage. 6.25% (n=14) of specimens that displayed acid etching (n=224) also exhibit carnivore tooth marks in the form of pits and punctures. In 6.48% (n=79) of the 994 specimens without acid etching, tooth marks are present.

Table 4. 26: Comparing acid etching and tooth mark frequency in Layer YSx5.

Acid Etching	**Tooth Marks**	**PERCENTAGE (%)**	**TOTAL (NSP)**
Present	14	6.25	224
None	79	7.95	994
Total	93	7.64	1218

***TM**=Tooth marks

Table 4.27 indicates that in layer CPx4, for bones with acid etching (n=29) (37.93%, n=11) also have tooth marks. However, the highest number of tooth marks (3.34%, n=15) is recorded on the bones with no acid etching (n=449).

Table 4. 27: Comparing acid etching and tooth mark frequency in Layer CPx4.

Acid Etching	**TM***	**Percentage (%)**	**Total (NSP)**
Present	11	37.93	29
None	15	3.34	449
Total	26	5.44	478

***TM**=Tooth marks

Tooth marks

The frequency of tooth marks on the sample studied is shown in Table 4.28. The frequency of tooth marks for both assemblages is relatively similar. In Layer YSx5, 7.64% (n=93) and in Layer CPx4, 5.44% (n=26) of the bones show tooth marks.

Table 4. 28: Comparing tooth marks in Layer YSx5 and CPx4.

Element	**YSx5**	**Total***	**Percentage (%)**	**CPx4**	**Total***	**Percentage (%)**
ID bone	50	213	23.47	6	73	8.22
Non-ID bone	43	1005	4.28	20	405	4.94
Total	93	1218	7.64	26	478	5.44

*Total number of specimens

There is no significant difference in carnivore tooth marks between layer YSx5 and CPx4 (χ^2=2.54; df=1; p=0.11).

Table 4. 29: Chi-square test of the frequency of tooth marks in Layers YSx5 and CPx4.

	TM*	**No TM***	**Row totals**
Layer YSx5	93	1125	1218
Layer CPx4	26	452	478
Column totals	119	1577	1696

***TM=** Tooth marks

Table 4.30 presents a summary of the zoogenic modifications from both layers. Layer YSx5 presents higher percentages of zoogenic modifications than CPx4.

Table 4. 30: Zoogenic modifications summary.

Modifications	**YSx5**	**Percentage (%)**	**CPx4**	**Percentage (%)**
Tooth marks	93	7.64	26	5.44
Gnaw marks	11	0.90	1	0.21
Acid etching	224	18.39	29	6.07
Total (NSP)	1218	100	478	100

4.4.3.3 Natural modifications

The natural modifications noted such as weathering, root etching and staining may be associated with site formation processes. Table 4.31 indicates that weathering is more common in YSx5, (50.25% n=612), than in CPx4, (4.39% n=21). Root etching is also more prevalent in YSx5 (22.23% n=272) than in CPx4 (11.92% n=57). Levels of staining are relatively similar in both layers with YSx5 exhibiting (10.02%, n=122) and CPx4 (8.58%,

n=41). Encrustation also occurs in relatively similar percentages in both layers with YSx5 recording (5.91%, n=72) and CPx4 (3.35%, n=16).

Table 4. 31: Natural modifications summary.

Modifications	**YSx5**	**Percentage (%)**	**CPx4**	**Percentage (%)**
Weathering	612	50.25	21	4.39
Root etching	272	22.33	57	11.92
Staining	122	10.02	41	8.58
Encrustation	72	5.91	16	3.35
Total (NSP)	1218		478	

There is a significant difference in weathering between layer YSx5 and CPx4 (χ^2=308.53; df=1; $p < .05$). Layer YSx5 has an abundance of specimens exhibiting different stages of weathering as compared to layer CPx4.

Table 4. 32: Chi-square of the prevalence of weathering in YSx5 and CPx4.

	Weathering	**No weathering**	**Row totals**
Layer YSx5	612	606	1218
Layer CPx4	21	457	478
Column totals	633	1063	1696

4.4.3.4 Trampling

Trampling was recorded on bones based on striations and pits (Reynard 2014). Table 4.33 indicates that trampling occurs much more frequently in Layer CPx4 than in Layer YSx5.

Table 4. 33: Showing percentages of trampling in YSx5 and CPx4.

Layer	**Trampling**	**Percentage (%)**	**Trampling with sheen**	**Percentage (%)**
YSx5	100	8.21	181	14.86
CPx4	107	22.38	142	29.71
Total	**207**		**323**	

There is significant difference in trampling between layer YSx5 and CPx4 (χ^2=64.37; df=1; $p < .05$). In some studies abrasion/sheen has been taken to indicate trampling of specimens (Reynard 2014). Two chi-square tests were thus conducted: one including the data of specimens with sheen added to the trampling and one solely with trampled specimens.

Table 4. 34: Chi-square of the prevalence of trampling (without sheen) in Layers YSx5 and CPx4.

	Trampling	**No trampling**	**Row totals**
Layer YSx5	100	1118	1218
Layer CPx4	107	371	478
Column totals	207	1489	1696

When abrasion/sheen data is added to the trampling data there is still a significant difference between layers YSx5 and CPx4 (χ^2= 49.08; df=1; $p < .05$).

Table 4. 35: Chi-square of the prevalence of trampling (with sheen) in Layers YSx5 and CPx4.

	Trampling + sheen	**Trampling/sheen absent**	**Row totals**
Layer YSx5	181	1037	1218
Layer CPx4	142	336	478
Column totals	323	1373	1696

In this study, as in Reynard & Henshilwood (2018) abrasion/sheen refers to the condition of the bone and not the cause. As noted in chapter 3, sheen can be caused by burning, trampling and anthropogenic activities such as bone working. Chi-square test for abrasion excluded all burnt material and when abrasion/sheen solely is considered there is no significant difference between layer YSx5 and CPx4 (χ^2=0.24; df=1 p=0 .61).

Table 4. 36: Chi-square test for sheen in YSx5 and CPx4.

	Sheen present	**Sheen absent**	**Row totals**
Layer YSx5	81	1137	1218
Layer CPx4	35	443	478
Column totals	116	1580	1696

4.4 Summary

Table 4.37 summarises surface modification on bones from both layers. Many of the bones sampled carried multiple modifications (Table 4.37, see also Appendix Fig A3) such as percussion marks, trampling, abrasion, root etching, tooth marks, burning and cut marks.

Table 4. 37: All bone surface modifications in Layers YSx5 and CPx4.

Modifications	**YSx5**	**Percentage (%)**	**CPx4**	**Percentage (%)**
Burn (total)	187	15.35	381	79.71
PM*	42	3.45	53	11.09
CM*	17	1.40	12	2.51
TM*	93	7.64	26	5.44
GM*	11	0.90	1	0.21
Root etching	272	22.33	57	11.92
Abrasion/sheen	86	7.06	207	43.31
Trampling	100	8.21	107	22.38
Weathering	612	50.25	21	4.39
Acid etching	224	18.40	29	6.07
Encrustation	72	5.91	16	3.35
Manganese	122	10.02	41	8.58
Total number of specimens (NSP)	1218		478	

***PM=** Percussion marks, ***CM=** Cut marks, ***TM=** Tooth marks, ***GM=** Gnaw marks

4.5 Conclusion**:**

In this chapter I presented the results from the analysis of the large mammal fauna from square J51 Layers YSx5 and CPx4 at KRM 1A. The data presented included the identifiable specimens, relative counts such as NSP, NISP, normed NISP and MNE. Skeletal part profiles were calculated, and Spearman's Rho tests conducted showed no correlation between the density and skeletal part representation in both layers. Mortality profiles from YSx5 and

CPx4 indicated that the difference between the adult and juvenile representation was not pronounced. Size class data was obtained from the identifiable elements with Layer YSx5 exhibiting a dominance of size 1 and CPx4 showing more size class 2 and 3 bovids.

Fragmentation and fracture patterns data from long bone fragments was also presented and three dominant types of fractures – eroded, transverse and spiral fractures – occurred in both layers, indicating perhaps a similar agent at work. YSx5 records more eroded fractures indicating more natural processes at work on the bone, whereas CPx4 exhibited more transverse and spiral fractures indicating perhaps more human processing activity. Mann-Whitney U tests conducted on the lengths and widths of long bone fragments indicated no significant statistical difference. Bone surface modifications were discussed, and this analysis demonstrated that numerous processes contributed to the site formation of KRM 1A layers YSx5 and CPx4 faunal assemblage. These agents and processes include anthropogenic marks, such as burning, cut marks and percussion marks, as well as zoogenic modifications in the form of acid etching, tooth marks and natural processes such as weathering, root etching and staining. Trampling which may be indicative of occupational intensity is present and was more prevalent in CPx4. Significant differences in the two assemblages include the degree of burning, percussion marks, acid etching, weathering and trampling. Cut marks and tooth marks however, were not significantly different between the two layers.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

In this chapter I discuss the results of the taphonomic study conducted on two layers, YSx5 and CPx4 from Square J51, Cave 1A, Klasies River main site. In section 5.1 the agents of accumulation are discussed and subsistence strategies are deliberated in Section 5.2. Section 5.3 discusses the site formation processes evidenced by the bone surface modifications on the fauna from the two layers. Occupation density and these layers link to other HP sites are also discussed.

5.1 Agents of accumulation

The two layers sampled for this study provide evidence for different agents of accumulation. Size classes of fauna may be associated with different agents. While smaller fauna may be associated with raptors (Marean *et al.* 2000), carnivores (Thompson 2010) or human accumulators (Wadley 2010), larger fauna are mostly associated with human activity (Milo 1998). My results indicate that there is a significant difference in size classes between the two layers at KRM. Layer YSx5 has an abundance of size class 1 while Layer CPx4 is characterized by a dominance of larger size class 2 and 3 bovids. This aligns with Van Pletzen's (2000) study of KRM HP that also indicates a dominance of small bovids (size 1 in this study) in layer YSx5 and small medium bovids (size 2) in layer CPx4 (Table 5.1).

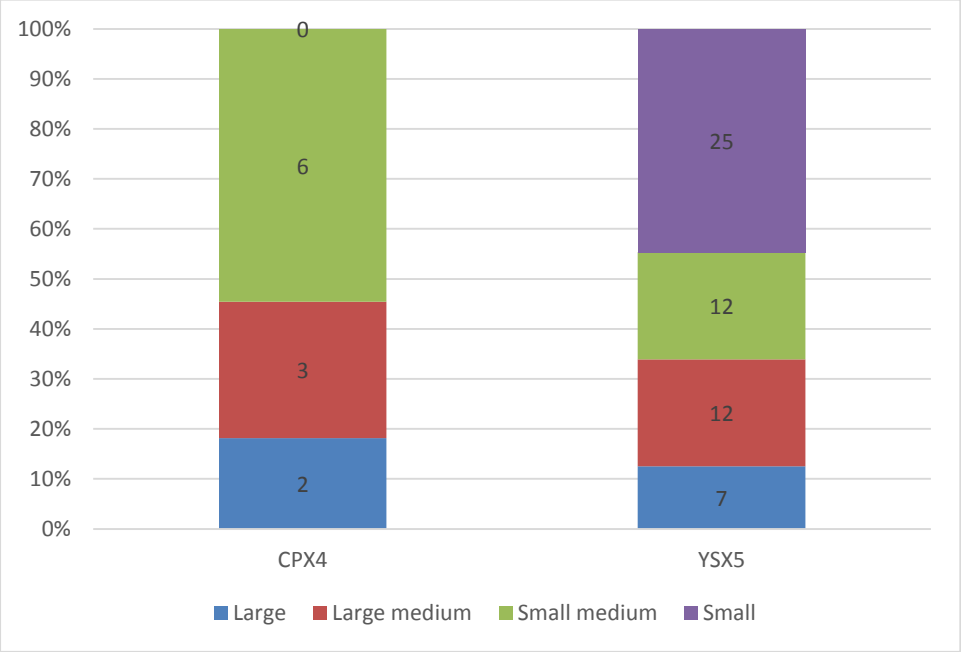


Figure 5. 1: Representation of bovid size classes across the HP layers at KRM; NISP values indicated in columns. (adapted from Van Pletzen's 2000 data).

This trend of dominance of small mammals has been noted for other HP sites for instance at Klipdrift Shelter (KDS). Here the top HP layers, PAY and PAZ are dominated by size 1 bovids, hyrax and tortoise (Reynard *et al.* 2014). The CPx4 type of occurrence, dominated by larger bovids, is also sometimes recorded at KDS as well with Layer PBA/PBB exhibiting a prevalence of size 2 bovids as compared to other size classes. Layer PCA, the lowermost HP unit that dates to about 65.5*ka.* also records a prevalence of size 2 and 3 bovids (Reynard *et al.*2016b). At Sibudu a prevalence of size 1 bovids is recorded in layer PGS dating to about 65ka while layer GS (62-62ka) records a higher occurrence of size 2 bovids (Clark 2017). At De Kelders 1 MIS 4 Layer 10 records a prevalence of size 3 bovids while in Layer 11 size 1 bovids are relatively more prevalent than other size classes (Marean *et al.* 2000). At Boomplaas (BPA) there is a prevalence of size 2 bovids in the HP layer OCH (Faith 2013). This suggests that larger size mammals are more prevalent in some HP Layers. It may be, as will be discussed below, associated with higher human occupation suggesting that layer CPx4 was primarily accumulated by humans.

Animal-induced marks such as tooth marks, gnaw marks and acid etching are taken as direct evidence of carnivore accumulation (Andrés *et al.* 2012). The two layers investigated here show similar percentages of tooth marks with no significant difference between the two layers. Gnaw marks occur in very low proportions in both layers suggesting very minimal rodent activity in these two layers. It is therefore unlikely that porcupines or rodents were significant accumulators. A comparison between the occurrence of tooth marks in specimens exhibiting etching and those lacking etching were made in an attempt to infer agents of accumulation as there is little morphological distinction between carnivore and human teeth (Landt 2007) on small mammal elements.

Acid etching was significantly more common in YSx5 than in CPx4. A small percentage of the specimens with acid etching from layer YSx5 also show carnivore tooth marks. A majority of the tooth marks recorded are on specimens with no acid etching (Table 4.26). In layer CPx4 over a third of bones with acid etching exhibit tooth marks, however, specimens without acid etching record a higher number of tooth marks (Table 4.27). It may be inferred that the specimens exhibiting both gastric etching and tooth marks may have been accumulated by carnivores. The bones without etching may be a result of carnivores chewing bones after humans collected and discarded them suggesting perhaps the site was used by

both humans and carnivores at different intervals (as in Marean *et al.* 1992). Tooth marks may have originally been more prevalent in the collection however, acid deteriorates the bone (Fig.A9) and may have destroyed some of the modifications present on the bone cortex. This applies more toYSx5 which exhibits a higher degree of acid etching.

A taphonomic analysis by Marean *et al.* (2000) for the MIS 4 layers at De Kelders 1(DK1) dating between 65-80ka, show a relatively high degree of gastric/acid etching of size 1 mammals from layer 10 (13%) and 11 (10.1%). Marean *et al.* (2000) attribute the acid etching at DK1 to raptors due to the discrepancy in gastric etching frequencies between size 1 and other sizes. The gastric etching exhibited at De Kelders 1 layers 10 and 11 is similar to that reported by Andrews & Cook (1990) caused by raptors. Reynard *et al.* (2016b) in their study of KDS also report a total of 3.4 % acid etching however it occurred in different degrees from layer to layer, with layer PAZ exhibiting the highest proportion of acid-etching (8.3%). PAZ was also a low occupation layer with less evidence of human activity. Faith (2013) at Boomplaas (BPA) reports a prevalence of acid etching from layer OCH (49-66ka) in bovid size 1. Faith attributes the etching to raptors as he argues carnivores are just as likely to ingest larger bovids thus a carnivore accumulation would show etching prevalence across most size classes (2013:721). In YSx5, acid etching is recorded more in size class 2 in the identifiable bone. Size class 2 at KRM is mostly represented by *Pelea capreolus* (Van Pletzen 2000) which as prey are too large for raptors (Thompson 2010) however Armstrong and Avery's (2014) study indicate raptors such as *Aquila verreauxii* accumulate and cause etching in bovid sizes 1 and 2 in the CFR in South Africa. This suggests that the assemblage at KRM layer YSx5 may have been accumulated by both carnivores and raptors.

The ratio of carnivores relative to ungulates in a faunal assemblage has been used as a method for distinguishing carnivore accumulations from human occupation sites (Brain 1981; Thackeray 1990). Sites with higher numbers of ungulates relative to carnivores represented in the faunal assemblage are considered as human accumulations whereas as those with smaller numbers of ungulates are taken to infer carnivore accumulations (Klein 1976). No carnivore-ungulate index ratio calculations could be conducted for this study because sample sizes are too small. However, Thackeray (1990) calculated the carnivore-ungulate index ratio of KRM, the values obtained for the lower HP layers 17-21 was 9,09 and his findings indicate that there is "*considerable*" variability throughout the assemblage (1990:103). His findings also indicate that sites with relatively high carnivore-ungulate index potentially associated with carnivore activity are characterised by higher percentage occurrence of *Raphicerus.*

Thackeray concludes that perhaps KRM has variable results because it may have been occupied by both humans and carnivores but at different times. In fact, the remains of carnivores such as brown hyaena and other indeterminate carnivores have been found in the Upper member at KRM (Van Pletzen 2000: 34). The level of acid etching recorded in layer YSx5 may suggest that KRM may have been used as a carnivore den during certain periods of the layer's formation. In layer CPx4, burnt bones exhibiting acid etching suggest that carnivores were more than likely scavenging off human food remains. The proportion of percussion marks relative to tooth marks specimens was calculated following Thompson *et al.* (2017) with results indicating that percussion marks in CPx4 relative to tooth marks outnumber those in YSx5, supporting that humans were the main accumulators in layer CPx4.

Table 5. 1: Proportions of percussion marks (PM) relative to tooth marked (TM) bone in YSx5 and CPx4.

Layers	**Total specimens**	**Fragments with PM**	**Fragments with TM**	**PM/(PM +TM)**
YSX5	163	25	93	21.19%
CPX4	139	19	26	42.22%

PM=Percussion marks, TM=Tooth marks

5.2 Subsistence strategies

Although the presence of cut marks in both layers infers human activity, cut marks occur in relatively low frequencies and chi-square tests show no statistical difference between the two layers. This may suggest similar subsistence strategies in the two layers based on cut marks. Size class 3 in both layers shows the highest intensity of cut marks. Reynard *et al.* (2016b) note that larger ungulates display more cut marks and percussion marks than smaller ungulates, and this result is consistent with this finding. The cut marks from this study in layer CPx4 mostly occurred on the long bone fragments which is a trend that may be associated with filleting (Domínguez-Rodrigo 1999; Galán *et al.* 2009). There were no chop marks recorded from the samples used in this study and as such no inference on disarticulation can be made from this data. However, both layers YSx5 and CPx4 record cut marks on the vertebrae and dorsal rib of size 1 and 2 bovids suggesting some form of disarticulation as well as phalanges and sesamoids suggesting skinning (Reynard *et al.*2016a). Frequencies with which cut marks occur on bone, however, can vary based on

factors such as the material a cutting tool is made of, skill of the butcher, size/ taxon of the mammal as well the amount of flesh present on a specific element (Thompson 2010). Perhaps one of these factors may have contributed to the low number of cut marks recorded at KRM in this study.

Percussion marks are taken as indicators of marrow processing (Galán *et al.* 2009). Layer CPx4 shows a significantly higher frequency of percussion marks (Table 4.21) which mostly occur on long bone and rib shaft fragments. The unidentifiable burnt bones also exhibit percussion marks with only two identifiable bovid size 2 elements recording percussion marks. In layer YSx5 over half of the percussion marks are recorded on long bone fragments as well. This may reflect periods of higher processing intensity in layer CPx4 which preserved less long bone fragments but reflects more percussion marks. The frequency of percussion marked long bone fragments has been considered a good quantitative measure of human contribution to an assemblage (Blumenschine *et al.* 1996; Marean *et al.* 2000). This may infer that CPx4 represents a period of intensive processing by humans at KRM however since majority of the elements with percussion marks are non-identifiable inferences with regards to size class processing cannot be made.

Both spiral and transverse fractures are more common on long bone fragments in CPx4 while YSx5 recorded a higher number of eroded fractures. Eroded fractures result from natural post depositional processes such as wind, water and soil erosion acting on a bone (Table 4.11) and may be used to indicate low intensity of processing activities and occupation (Schmitt & Juell 1994; Esteban-Nadal *et al.* 2010). The prevalence of eroded fractures and rounded edges in Layer YSx5 may suggest water action or logging in this layer. Studies indicate that eroded breaks on bone may also be caused by digestion by carnivores (Esteban-Nadal *et al.* 2010). This indicates that layer YSx5 may have been characterised by less human activity as bones from this layer also exhibit the highest degree of rounding (Table A4). Spiral fractures may reflect marrow processing activities in CPx4. Burning is also more prevalent in that layer. The predominance of both burning and spiral fractures in CPx4 may infer bone grease extraction in this layer. 80% of vertebrae remains in Layer CPx4 are centrums and this may be used to infer marrow fracturing (cf. Noe-Nygaard 1977) to obtain the medulla spinalis.

Skeletal part profiles in both layers indicate a relative abundance of hindlimbs and distal limbs as compared to cranial/skull elements across all the size classes (Fig. 4.3). In both layers size classes 1, 2 and 3 reflect more equitability in skeletal element distribution (Fig

4.3) which may imply that at least size classes 1 and 2 were transported whole to the site. Size class 3 records the highest intensity of cut marks and this may suggest equitable transport of elements. Size 1 and 4/5 in both layers reflect a low representation of skull elements. This is surprising as skull elements in general preserve better than other elements due to their density and thick cortical walls (Lyman 1994; Marean & Cleghorn 2003). There may be several reasons for the relative lack of skull elements. The low representation may have to do with the small sample size, but it may also be the result of transport and processing decisions of human accumulators, especially in the size class 4/5 sample. Bunn (1986: 680) states that selective transport of appendicular parts may result in low representation of cranial elements. Bunn further states that cranial elements of animals are more likely to be present at kill sites than appendicular elements. Size class 1 skull elements may be low in number due to differential destruction. Thus, when cranial elements are fragmented they may be difficult to identify due to reduced diagnostic features. In contrast to the skull elements, distal elements exhibit a high abundance across all size classes in both layers. This abundance of distal elements contrasts to studies from other sites for instance, at KDS a prevalence of skull/cranial elements are noted (Reynard *et al.* 2016a). However, as discussed in Chapter two, KRM faunal assemblages have been shown to exhibit the 'Klasies pattern' characterised by a dominance of head and/or foot bones (Marean & Kim1998). The sample from my study also exhibits the Klasies pattern with a representation of relatively complete skeletal elements for size class 1 &2. Bartram and Marean's (1999) studies from DK1 show that other sites exhibit the Klasies pattern as well when certain factors such as systematic exclusion of large bovid limbs from a sample occur. Marean *et al.* (1992) state that the lack of or exclusion of long bone shafts from a sample may also cause such a skew of head and foot bones. Pickering *et al.* (2003) also state that long bone shafts are important when determining skeletal part profiles. In my study there was a relatively low representation of shafts as most long bones were too fragmented to be identified to element. This may have played a role in the resulting skew towards foot bones/distal limbs resulting in the Klasies pattern. The processing of long bones for marrow by Pleistocene hominins resulting in their fragmentary recorded in most sites may be considered as an underlying Pleistocene behavioural cause of the Klasies pattern. Distal limbs such as phalanges, carpals and tarsals are considered low survival elements and generally have lower representations than skull elements (Lyman 1994; Marean & Cleghorn 2003). Marean *et al.* (1992) state that from experimental studies on hyena scavenging tarsals survive better when still attached to limbs compared to when they are not articulated. Marean *et al.* (1992) further state that abundance

in limb bones may be due to factors such as scavenging of hominin kills by carnivores such as hyenas and not necessarily due to selective human transport. In my study the sample had a prevalence of distal elements such as phalanges represented. They may have preserved better due to their smaller surface area and would be easier to identify due to their distinct morphology. Transport decisions may also have influenced the abundance of distal limbs as distal elements would be relatively easy to carry back to the site as compared to skull elements especially of larger size classes.

CPx4 is a carbon parting layer that is associated with a burning feature and exhibits significantly more burnt specimens with majority of the specimens burnt grey. This suggests burning from human activities and not natural phenomena such as bush fires (Cain 2005). It is inferred that layer CPx4 has a relatively smaller number of identifiable elements due to the high number of burnt bone. The 172.4g of specimens from layer CPx4 not included in the study was not only fragmentary but burnt as well. Burning has been recorded as occurring in high frequencies at other HP sites as well such as KDS (Reynard *et al.* 2016b), Sibudu where over a half of the non-identifiable bone and a third of identifiable bone (Clark & Ligouis 2010) are burnt. Burning appears to be very prominent in HP sites and may be a result of processing, site maintenance or even use of bones as fuel (Cain 2005). A sample of the non-identifiable burnt bones in Layer CPx4 exhibit cut marks while 96% of percussion marks occur in burnt bone suggesting human processing. This may also account for their unidentifiability. Scrape marks are also recorded in Layer CPx4 in the burnt bone suggesting access to marrow after cooking of bone. Though burning is minimal in layer YSx5 the highest number of bones burnt is burnt grey suggesting occasional human activity though no burning features are preserved in the layer perhaps due to taphonomic processes.

5.3 Site formation

Site formation processes can be inferred from factors such as trampling, abrasion, weathering and root etching (Reynard *et al.* 2016b). Trampling can also indicate the changing occupational intensities at a site (Reynard 2014). Abrasion is present in both layers but not significantly different between the two layers. As noted in chapter 3, there is high equifinality in terms of abrasion/sheen as it can be caused by burning, trampling and anthropogenic activities such as bone working. Burnt bones with sheen (Fig A8) were not included when calculating chi-square tests as burning has been shown to result in sheen (Reynard 2014). At KDS (Reynard *et al.* 2016b) (20%, n=604) of the assemblage exhibits abrasion however only

(n=4) of these specimens record trampling marks. As such abrasion solely cannot be used to infer trampling/occupational intensity.

Trampling has been associated with periods of higher occupational intensity at sites. Trampling is significantly more prevalent in CPx4 than in YSx5, as discussed in chapter 4. Although it is difficult to distinguish animal from human trampling, the trampling exhibited in layer CPx4 may perhaps indicate a period of higher human occupational intensity. CPx4 also exhibits a higher number of fragmented bone and specimens smaller than 2cm a factor which may be attributed to trampling. The most frequent fracture type on long bone fragments from layer CPX4 are transverse fractures that are sometimes attributed to compaction in sediments (Villa & Mahieu 1991) which may be as a result of natural processes such as rockfalls. However, Reynard *et al.* 2016a argue this may be as a result of human occupation at a site as such the prevalence of transverse fractures in Layer CPX4 may be an indicator of high occupational intensity (Reynard & Henshilwood 2018). At KDS the middle layers PBA/PBB have recorded a higher prevalence of abrasion suggesting higher occupational intensities (Reynard *et al.* 2016a). At KDS bone fragmentation was also attributed to factors such as trampling (Reynard et al. 2016b:16).

Weathering was recorded in both layers however YSx5 exhibits a significantly higher number of bones with different stages of weathering. Specimens from YSx5 also exhibit a higher degree of rounding than CPx4 (see Table A4 in appendix) with instances of waterlogging. This weathering may be as a result of carnivore accumulations of bone in the areas surrounding the cave before exposure to sub-aerial weathering. Water action may have been the final taphonomic sequence resulting in the deposition of the bone in the cave and the rounding recorded in the sample as well. Layer YSx5 exhibits quite a high number of weathering (50.25%) as compared to other sites such as KDS which records the highest percentage of weathering 0.8% in Layer PBA/PBB (Reynard *et al.* 2016b). These results from KRM may infer that layer YSx5 represents a period of low occupational intensity as compared to CPx4.

Root etching was more prevalent in layer YSx5 where it occurs in 11.92% of the specimens. At KDS root etching occurs in the most in layer PBA/PBB at 16.7% (Reynard *et al.* 2016b:7). The middle layers PBA/PBB differ from YSx5 however, in that they represent higher occupational intensities whereas YSx5 is representative of low occupational intensity. Another way to infer to presence of vegetation at sites, is through the occurrence of seeds.

Zwane (2015) reports a higher abundance of seed fragments in square J51 as compared to other HP squares at KRM. In her study Zwane found an occurrence of more seeds, and also more burnt seeds in Layer CPx4 than YSx5 indicating perhaps more human activity in this layer. The seeds of CPx4 are also more fragmentary. Layer YSx5 was characterized by less fragmented and unburnt seeds suggesting less activity by humans at the site. The root etching present on the bone in Layer YSX5 may also be indicative of a carnivore bone accumulation in areas surrounding the cave before deposition into the cave by other taphonomic agents such as water as suggested above.

Staining in layers YSx5 and CPx4 occurs in relatively similar percentages. Specimens burnt black and grey may also record incidences of staining however this was difficult to distinguish due to the burning. Therefore, incidences of staining may be higher than recorded in the sample. Staining at KRM may be due to the sediment present and not other factors such as digestion based on the similar occurrence in the two layers especially with regard to large fauna.

Layer YSx5 recorded the highest abundance of eroded fractures which come about as a result of natural processes such as water action acting on a bone (Lyman 1994; Driver 1999). This layer also has a high number of rounded bones as compared to CPx4 suggesting perhaps that the bones from YSx5 are water logged. This may infer less human activity on the site during layer YSx5 and more natural processes acting upon the site. Eroded breaks may also be the result of digestion by carnivores.

5.4 Conclusion

The results indicate that layer YSx5 and CPx4 may represent different agents of accumulation. Layer YSx5 exhibits a prevalence of size 1 bovids whereas Layer CPx4 records size 2 and 3 bovids. Layer YSx5 also exhibits higher incidences of acid etching and tooth marks suggesting more carnivore activity. The low levels of cut marks, percussion marks and burning insinuate lower human occupational intensity by humans as compared to CPx4. Layer CPx4 records a higher abundance in burning and percussion marks suggesting processing intensity during this time period. The abundance of spiral and transverse fractures in addition to burning may infer marrow and bone grease processing by humans. Trampling evidence indicates higher occupational intensity of the site in layer CPx4 however, the low incidences of acid etching and tooth marks suggest human rather than carnivore activity. Weathering and root etching data indicate a prevalence of more natural processes on bone

during YSx5 further supported by the high incidences of eroded breaks on the long bone fragments and general rounding of specimens found in YSx5.

CHAPTER 6

In this concluding chapter I summarize the outcomes of the study and conclusions in 6.1. Section 6.2 addresses some of the limitations of the study such as the small sample size in both layers. The final section 6.3 deals with future avenues of taphonomic study of the HP layers at KRM.

6.1 Conclusion

This study investigated three main hypotheses.

Hypothesis 1: The main bone accumulator for YSx5 and CPx4 were humans.

This study indicates that the layers sampled from square J51, YSx5 and CPx4 were accumulated by the same agents but at different intensities. Layer YSx5 has a prevalence of size 1 bovids whereas CPx4 exhibited size 2 and 3 bovids. This may indicate CPx4 representing a human accumulation based on studies from other HP sites which show a prevalence of larger bovids in high occupational intensity layers (Reynard *et al.* 2016 a, 2016b). There is very minimal rodent activity suggested by the low proportions of gnaw marks in the sampled assemblages. Tooth marks occur in similar percentages in the two layers. The proportion of percussion marks to tooth marks indicate percussion marks to be relatively higher in CPx4, suggesting humans as the main accumulators in this layer. The high incidences of acid etching in Layer YSx5 indicate more carnivore activity in this layer as compared to CPx4. This suggests Layer YSx5 represents a period of higher carnivore activity than CPx4. The results affirm the set hypothesis suggesting that the main bone accumulator for Layer YSx5 and CPx4 were humans with more carnivore action present in YSx5.

Hypothesis 2: YSx5 and CPx4 taphonomic analysis, reflect different subsistence strategies.

The presence of cut marks, percussion marks and burning signifies human activity in Layer YSx5. The statement relating to CPx4. YSx5 records percussion marks but at lower frequencies than CPx4 suggesting less marrow processing. Most of the percussion marks are recorded on the long bone fragments in this layer suggesting human processing activity. Cut marks recorded in this layer occur in distal elements such as phalanges and sesamoids as well as other appendicular elements such as vertebrae and ribs indicating some form of disarticulation in Layer YSx5. Layer CPx4 on the other hand exhibits an abundance of

percussion marks as compared to YSx5. CPx4 records prevalent cut marks on the long bone fragments perhaps indicating filleting as a form of processing in the layer. In both layers size class 3 has the highest intensity of cut marks, a trend that is recorded in other HP sites as well such Klipdrift shelter (Reynard *et al.* 2016a, 2016b). Burning is present and more prevalent in CPx4. CPx4 which is associated with a burning feature exhibits more burning with over 70% of specimens from the layer burnt. Many of the percussion marks in CPx4 occur on burnt bone. Layer CPx4 also records a prevalence of transverse and spiral fractures indicating marrow processing as compared with YSx5 which records an abundance of eroded fractures. The abundance of percussion marks in Layer CPx4 along with transverse and spiral fractures infers bone grease processing. This suggests that the two layers exhibit different subsistence strategies confirming the set hypothesis.

Hypothesis 3: CPx4 reflects a period of higher occupation density than YSx5

The abundance of trampling marks and abrasion indicate that Layer CPx4 may represent a period of high occupational intensity. Layer YSx5 on the other hand represents a period of low human occupational intensity with minimal trampling and abrasion as well as high levels of weathering, eroded fractures and rounding. The rounding of specimens and eroded fractures in YSx5 suggests animal activity and perhaps more natural processes such as water action present in this layer. Over half of the specimens from the layer YSx5 exhibit different degrees of weathering suggesting prolonged post depositional exposure (perhaps sub aerial weathering after carnivore accumulation before deposition in the cave complex by water action). CPx4 exhibits less weathering and rounding of specimens. Different degrees of root etching are recorded in the two layers as well with YSx5 recording more root etching. This suggests more plant action in YSx5 than CPx4 with previous studies at KRM (Zwane 2015) indicating more fragmentary and burnt seeds in CPx4 than YSx5. These results suggest that a period of higher occupational density is represented in layer CPx4 than YSx5, confirming this hypothesis.

6.2 Challenges

This study's limitations are related to the relatively small sample size from the two layers. Fragmentation of elements especially from layer CPx4 resulting in an abundance of elements under 20 mm also contributed to the small sample size. There was a relatively small number of shafts represented due to the fragmentary nature of the sample especially in layer CPx4.

This made inferences such as processing activities by humans difficult and may have caused the skew towards distal elements in the skeletal parts profile.

6.3 Future studies

The sample size in this study was relatively small so future taphonomic studies should analyse the entire sample from square J51. This would not only increase the sample size but also enable comparison and observation of trends between the layers and other sites with comprehensive taphonomic studies such as Klipdrift Shelter, Boomplaas and Sibudu. Perhaps looking at all the layers in square J51 would also affect the presence of cranial elements and expand information on adult and juvenile representation and give a better idea of factors such as transport decisions and mortality profiles.

The use of methods such as zooarchaeology by mass spectrometry (ZooMS) would aid in identifying bone in layers such as YSx5 to family level. As this layer exhibits minimal burning the collagen may be relatively well preserved as such use of ZooMS would be possible in this and other layers which exhibit the same properties.

Comparison of tooth mark occurrence in relation to acid etching could prove to be a potential proxy in determining agents of accumulation such as carnivores. Though, as seen in this study, bones with high frequencies of acid etching (Fig 4.9) may not preserve modifications such as tooth marks. However, it would be interesting to see if there is a pattern between the acid etching and tooth mark occurrence on bones from other HP sites as well. Future studies should incorporate a coding system with regards to acid etching based on actualistic studies recording the level of etching in modern carnivores and raptors, potentially narrowing down the responsible agent of accumulation in archaeological assemblages.

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APPENDIX

Fragmentation and Fracture patterns

Breakage patterns for Long Bone Fractures were analysed for both layers. The results were recorded based on Driver's 1999 manual where A= made into and artefact, C= chewed by carnivores, D= eroded break, E= broken during excavation, I= intact, P= splintered, R= gnawed by rodents, S= spiral, T= transverse, V= Irregular break.

Quantification

Normed number of identified numbers was calculated by dividing the NISP by the number of times the specific element occurs in a vertebrate skeleton.

Table A. 1: normed Number of Identified Specimen (nNisp) for layer CPx4.

Element	Size 1		Size 2		Size 3		Size 4/5		Total	
	NISP	nNISP	NISP	nNISP	NISP	nNISP	NISP	Nnisp	NISP	nNISP
Cranium*					1	0.5			1	0.5
Hyoid		--	1	--		--		--	1	
Teeth		--	2	0.06	1	0.03	1	0.03	4	0.12
Skull			**3**	**0.06**	**2**	**0.27**	**1**	**0.03**	**6**	**0.31**
Radius P	1								1 1	
Radius S	1	0.5								0.5
Radius D										
Ulna P			1						1 1	
Ulna S			1	0.5						0.5
Ulna D										
Carpal			1	0.17	1	0.17			2	0.34

Forelimb	**1**	**0.5**	**2**	**0.34**	**1**	**0.17**			**4**	**0.45**
Pelvis			1	0.17					1	0.17
Femur P					1				1	
Femur S						0.5				0.5
Femur D					1				1	
Tibia P			2						2 3	
Tibia S	1	0.5	2	1						1.5
Tibia D	1								1	
Tarsal		--			2	0.33		--	2	0.33
Hindlimb	**1**	**0.5**	**4**	**0.59**	**3**	**0.42**			**7**	**0.63**
Metatarsal P			1						1 1	
Metatarsal S			1	0.5						0.5
Metatarsal D										
Metapodia P					4*		1*		7*	
Metapodia S	1 1*	0.5	1 1*	0.5	4	2	1	0.5	7	3.5
Metapodia D										
Phalanx	2	0.08	1	0.04			1	0.04	4	0.21
Distal	**3**	**0.29**	**3**	**0.35**	**4**	**2**	**2**	**0.27**	**12**	**1.40**

Cranium*= Includes mandible, maxilla & audiobuillae

Table A. 2: normed Number of Identified Specimen (nNisp) for layer YSx5.

Element	Size 1		Size 2		Size 3		Size 4/5		Total	
	NISP	nNISP	NISP	nNISP	NISP	nNISP	NISP	nNISP	NISP	nNISP
Cranium*			3	1.5	1	0.5			4	2
Hyoid		--	2	--		--		--		
Teeth	2	0.06	6	0.19	1	0.03		--	9	0.28

Skull	**2**		0.06	**11**		**0.85**	**2**		**0.27**				**15**		**1.14**	
Humerus P	4	7		1	1		1	1					6	9		
Humerus S			3.5			0.5			0.5						4.5	
Humerus D	3												3			
Radius P	1	2					1	1		1	1		4	5		
Radius S			1						0.5			0.5			2.5	
Radius D	1												1			
Ulna P	1	1			1								1	2		
Ulna S			0.5			0.5									1	
Ulna D				1									1			
Carpal	3		0.5	2		0.33	1		0.17				6		1	
Forelimb	**13**		**1.38**	**4**		**0.44**	**3**		**0.39**	**1**		**0.5**	**22**		**2.25**	
Pelvis	2		0.33	2		0.33	1		0.17				5		0.83	
Femur P	2	5		1	1								3	6		
Femur S			2.5			0.5									3.5	
Femur D	3												3			
Tibia P				1	2			1		1	2		2	5		
Tibia S				1		1	1		0.5	1		1	3		2.5	
Tibia D																
Tarsal			--	2		0.33			--			--	2		0.33	
Hindlimb	**8**		**1.42**	**7**		**0.61**	**2**		**0.34**	**2**		**1**	**18**		**1.79**	
Metacarpal P							1	1					1	1		
Metacarpal S									0.5						0.5	
Metacarpal D																
Metatarsal		1	0.5	2	2	1	1	1	0.5				3	4	2	

P										
Metatarsal S	1								1	
Metatarsal D										
Metapodia P	11*		3*		2*		2*		18*	
Metapodia S	11	5.5	3	1.5	2	1	2	1	18	9
Metapodia D										
Phalanx	21	0.88	9	0.38	1	0.04		--	31	1.29
Distal	**33**	**2.29**	**14**	**0.96**	**5**	**0.51**	**2**	**1**	**54**	**3.20**

Cranium*= includes mandibles, maxilla, audio bullae.

Normed NISP was calculated for both layers combined in order to look at skeletal parts profile of the HP.

Table A. 3: normed Number of Identified Specimen (nNisp) for layer YSX5 and CPX4.

Element			Size 2		Size 3		Size 4/5		Total	
	NISP	nNISP	NISP	nNISP	NISP	nNISP	NISP	nNISP	NISP	nNISP
Cranium*			3	1.5	2	0.5			5	2.5
Hyoid		--	3	--		--		--	3	
Teeth	2	0.06	8	0.25	1	0.03	1	0.03	12	0.28
Skull	**2**	0.06	**14**	**0.88**	**3**	**0.27**	**1**	**0.03**	**20**	**1.14**
Humerus P	4 7	3.5	1 1	0.5	1 1	0.5			6 9	4.5

Humerus S										
Humerus D	3								3	
Radius P	2	3			1	1		1	1		4	5	
Radius S			1.5				0.5			0.5			2.5
Radius D	1										1		
Ulna P	1	1		1	2						1	3	
Ulna S			0.5			1							1.5
Ulna D				1							1		
Carpal	3		0.5	2		0.33	1		0.17			6		1
Forelimb	**14**		**1.5**	**5**		**0.61**	**3**		**0.39**	**1**		**0.5**	**26**		**2.38**
Pelvis	2		0.33	3		0.5	1		0.17			6		1
Femur P	2	5		1	1							3	7	
Femur S			2.5			0.5		1	0.5					3.5
Femur D	3						1					4		
Tibia P				3	4			1		1	2		4	8	
Tibia S		1	0.5	1		2	1		0.5	1		1	3		4
Tibia D	1												1		

Tarsal		--	2	0.33		--		--	2	0.33
Hindlimb	**9**	**1.11**	**10**	**0.83**	**3**	**0.39**	**2**	**1**	**24**	**2.21**
Metacarpal P					1 1				1 1	
Metacarpal S						0.5				0.5
Metacarpal D										
Metatarsal P	1		3 3						4 4	
Metatarsal S	1	0.5		1.5						2
Metatarsal D										
Metapodia P	12*		4*		6*		3*		25*	
Metapodia S	12	6	4	2	6	3	3	1.5	25	12.5
Metapodia D										
Phalanx	23	1	10	0.79	1	0.04	1	0.04	47	1.75
Distal	**37**	**2.5**	**26**	**1.43**	**14**	**1.18**	**4**	**0.77**	**81**	**4.19**

Cranium*=Cranium includes mandibles, maxilla & audiobuillae

Bone density and skeletal part profile

Table A. 4: Density values and normed NISP values for YSX5.

Total ungulate	**Density**	**nNISP**
Humerus P	0.26	3
Humerus D	0.48	1.5
Radius P	0.53	1.5
Radius D	0.49	0.5
Ulna P	0.68	0.5
Ulna D	0.38	0.5
Metacarpals P	0.63	0.5
Femur P	0.39	1.5
Femur D	0.32	1.5
Tibia P	0.35	1
Tibia M	0.71	1.5
Metatarsals P	0.58	1.5
Metatarsals M	0.65	0.5
Metapodia M	0.72	9
Crania	0.99	2
Carpals	0.67	1
Innominate 91 blade	0.43	0.33
Innominate 93 isc + pub	0.67	0.17
Innominate 95 ac frag	0.65	0.33
Tarsals	0.71	0.33
Phalanges	0.56	1.29

Table A. 5: Density values and normed NISP values for CPx4.

Total ungulate	**Density**	**NNISP**
Radius P	0.53	0.5
Ulna P	0.68	0.5
Femur D	0.32	0.5
Tibia P	0.35	1
Tibia D	0.39	0.5
Metatarsals P	0.58	0.5
Metapodia M	0.72	3.5
Crania	0.99	0.5
Carpals	0.67	0.34
Innominate 95 ac frag	0.65	0.17
Tarsals	0.71	0.33
Phalanges	0.56	0.21

Table A. 6: Density and normed NISP values for YSx5 and CPx4.

Total ungulate	**Density**	**nNISP**
Humerus P	0.26	3
Humerus D	0.48	1.5
Radius P	0.53	2
Radius D	0.49	0.5
Ulna P	0.68	1
Ulna D	0.38	0.5
Metacarpals P	0.63	0.5
Femur P	0.39	1.5
Femur D	0.32	2
Tibia P	0.35	2
Tibia M	0.71	1.5
Tibia D	0.39	0.5
Metatarsals P	0.58	1.5
Metatarsals M	0.65	0.5
Metapodia M	0.72	12.5
Crania	0.99	2.5
Carpals	0.67	1
Innominate 91 blade	0.43	0.33
Innominate 93 isc + pub	0.67	0.17
Innominate 95 ac frag	0.65	0.5
Tarsals	0.71	0.33
Phalanges	0.56	1.75

Rounding of specimens

Rounding was recorded based on (Dischamps lab analysis notes). A number was assigned based on degree of rounding where N=none, 1 = ¼ of edges rounded/ slightly smoothed on tips of edges; 2 = abrasion/rounding of the entire edge; 3 = RE expanded in area beyond the edge margin; 4 = most of edge abraded, either side of edges margin significantly rounded; 5 = whole specimen affected/deformed.

Table A. 7**:** Rounding of specimens in YSx5 and CPx4.

Rounding degree	**YSx5**	**Percentage %**	**CPx4**	**Percentage %**	**Total (n)**
1	**1029**	84.48	**449**	93.93	**1478**
2	**127**	10.43	**25**	5.23	**152**
3	**10**	0.82	**1**	0.21	**11**
4	**1**	0.08	**0**	0	**1**
5	**4**	0.33	**0**	0	**4**
Total	**1218**	100	**478**	**100**	

Modification images

Figure A. 1: Rounding of specimens in YSx5.

Figure A. 2: An example of root etching and encrustation on bone.

Figure A. 3: A display of trampling and abrasion on bone.

Figure A. 4: Multiple root etching marks on bone from layer YSx5.

Figure A. 5: A demonstration of weathering on bone from layer YSx5.

Figure A. 6: A burnt bone from layer CPx4.

Figure A. 7: A transverse break on bone.

Figure A. 8: Displaying sheen as a result of burning.

Figure A. 9: Acid etching resulting in the destruction of cortex in layer YSx5.