

# Of Buffalo and Butchers: Coupling Traditional Procurement Studies with Taphonomic Analyses to Explore Intensive Wild Animal Processing Patterns at Two Early Iron Age Sites in the Kruger National Park

Evin Grody, <sup>1,\*</sup>

Email [evin.f.grody@gmail.com](mailto:evin.f.grody@gmail.com)

<sup>1</sup> Department of Anthropology and Archaeology, University of Pretoria, Pretoria, South Africa

---

## Abstract

Located in northeastern South Africa in the Kruger National Park, the wild-dominated faunal assemblages at Le6 and Le7 allow for a site-level examination of the treatment of wild species within the highly variable spectra of Early Iron Age animal use. Looking at hunting beyond pure subsistence choices, this paper couples traditional morphological analysis with taphonomic analysis and theoretical frameworks of intensification to ask new socially focused zooarchaeological questions of these assemblages. Through this, both the procurement and processing methods utilized at Le6 and Le7 are identified and the significance of these choices is discussed. In so doing, the paper addresses possible specialization in both the hunting and the processing of large wild mammals. The socio-economic implications and potential drivers of these faunal choices are then considered within the broader context of the southern African Early Iron Age, and a potentially new faunal use strategy and site type are

introduced.

---

Les sites archéologiques Le6 et Le7 sont localisés dans le Parc National Kruger, au nord-est de l’Afrique du Sud. Les assemblages, qui sont dominés par des espèces sauvages, permettent une analyse intra-site du traitement spécifique des espèces sauvages au sein du large spectre des pratiques d’utilisation des ressources animales qui existent pour l’Age du Fer ancien. Dans cet article, la sphère cynégétique n’est pas abordée seulement sous l’angle des choix de subsistance. Il présente une approche plus large, qui recoupe les analyses morphologiques traditionnelles, les résultats taphonomiques ainsi que les cadres des théories d’intensification afin d’aborder des questions archéozoologiques novatrices, abordant l’aspect social des accumulateurs des ensembles fauniques. Ces méthodes d’analyse permettent d’identifier les stratégies d’acquisition et de traitement des ressources animales à Le6 et Le7 et de discuter l’importance des choix effectués. Parmi ces choix, nous discutons de la possibilité que les assemblages fauniques reflètent une spécialisation de la chasse et du traitement de grands mammifères sauvages. Les implications socio-économiques et les facteurs potentiels ayant mené à ces choix fauniques sont considérés dans le contexte de l’Age du Fer ancien d’Afrique australe. Enfin, sont introduits un nouveau type de stratégie d’utilisation des ressources animales et un nouveau type de site archéologique qui lui est associé.

---

## Keywords

South Africa  
Zooarchaeology  
Intensification  
Taphonomy  
Butchery  
Wild fauna

---

## Introduction

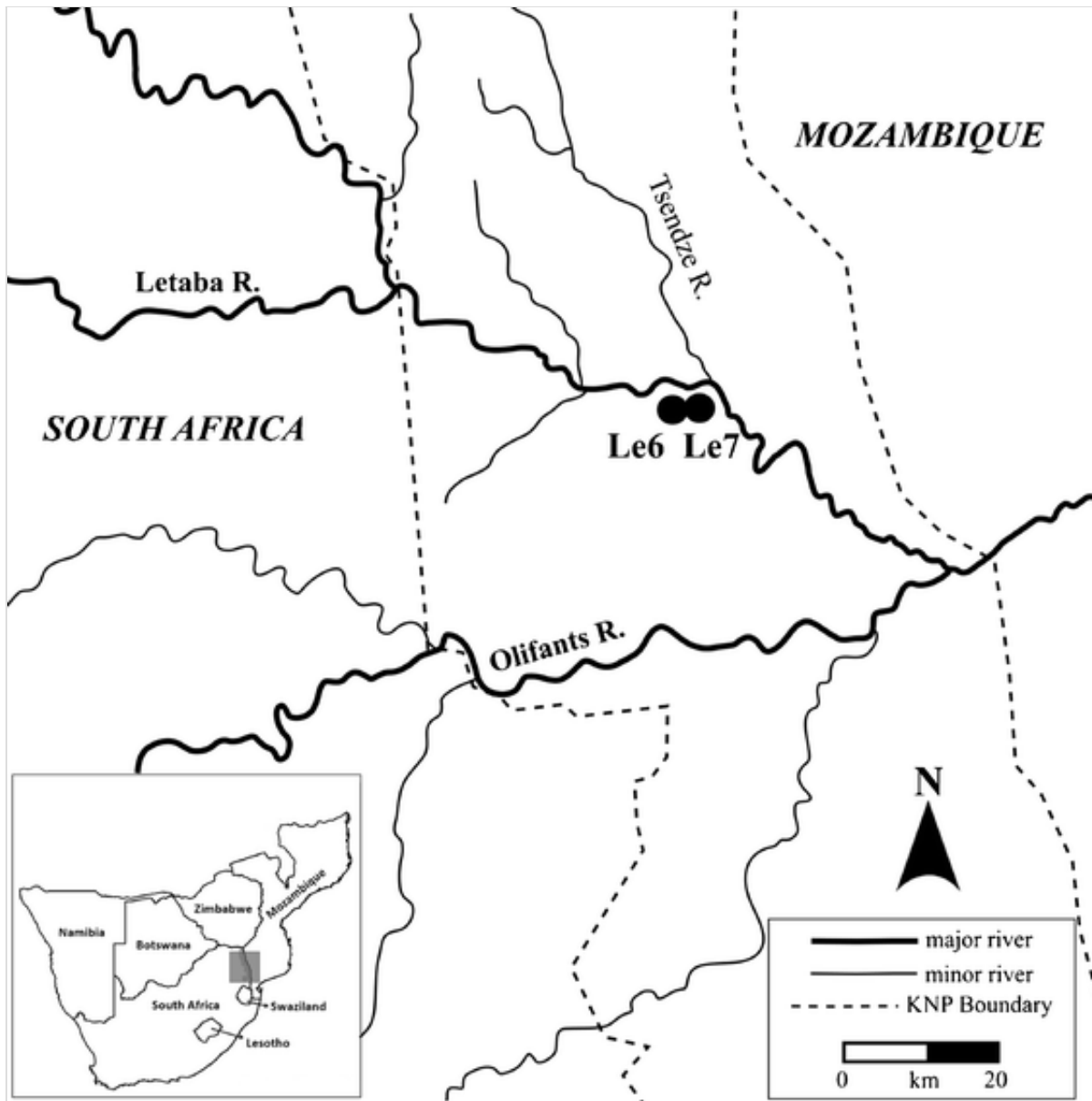
Animals have played intrinsic roles in human history from time immemorial. Whether as simple dietary contributions, markers of cultural identity, or symbols of wealth and ritual importance, animals are a key part of society in any time or place. Within archaeology, there has been increasing recognition both of these myriad roles and of the type of questions zooarchaeologists can ask and answer (e.g., Russell 2011; Sykes 2014). Moving beyond simple species lists, expanded zooarchaeological questions not only aid in understanding the human-animal relationship but also allow for better application and fuller integration with broader archaeological questions (e.g., deFrance 2009; Russell 2011; Sykes 2014; Twiss 2012). By acknowledging this potential, zooarchaeology offers promising new avenues for exploring both the spectrum of Early Iron Age (EIA) animal exploitation in southern Africa, as well as the broader socio-economic implications therein.

Previously unanalyzed assemblages from Letaba 6 (Le6) and Letaba 7 (Le7), two neighbouring EIA sites located at the Kruger National Park (KNP) in northeastern South Africa (Meyer 1986, p. 149; Plug 1989a) (Fig. 1), offer the opportunity to closely engage with faunal use and move beyond simple “wild vs. domestic” and “hunting vs. herding” designations. Moreover, coupling traditional zooarchaeological methods with taphonomic analysis and new theoretical frameworks (specifically intensification) allows for the exploration of both the procurement and processing patterns at these two sites, as well as an examination of the *intent* behind the use strategies involved. In so doing, this paper presents an example of intensive, and potentially specialized, hunting and processing of large wild mammals, which introduces a potentially new faunal use strategy for the southern African EIA.

### **Fig. 1**

Location of Le6 and Le7 within the KNP: these two sites are less than 100 m apart on the west bank of the Letaba River (the eastern boundary of the KNP marks the border between South Africa and Mozambique)

---



## Animal Use in Context: Zooarchaeology of the Southern African EIA

The southern African EIA (200–900 AD) (Huffman 2007, pp. xi, 331) is a time of great transitions and a multiplicity of economic modes. As Bantu speakers moved into and spread throughout the region during this period, they brought with them new production methods and technology (e.g., domesticated flora and fauna, metal tools), sundry-associated ceramic styles, and distinctive settlement characteristics that have come to serve as defining factors for the identification of Iron Age (IA) peoples within the southern African archaeological record (e.g., Huffman 2007, p.

xi). Rather than a uniform presentation of material culture and subsistence strategies, southern African IA sites express a great deal of variation in the manifestation of these elements (e.g., Huffman 2007; Maggs and Whitelaw 1991; Plug 2000; Voigt 1986). This diversity is evident in both ceramic industries and food use.

In terms of faunal presence, EIA sites across southern Africa range from domesticated dominated (e.g., Turner 1987b; Plug 1979, 1999; Voigt 1983; Voigt and Von den Driesch 1984), a balance of wild and domestic animals (e.g., Antonites et al. 2014; Maggs and Michael 1976; Turner 1987a, 1987b), to almost wholly wild (e.g., Plug 1979, 1989a; Turner 1987b). However, what causes this variable animal presence and use remains unclear (e.g., Voigt 1986). Speculations about the roots of this diversity include suggestions that status or cultural tradition created differential access to certain species (i.e., domesticates), meaning more wild species mark lower status settlements (e.g., Plug 2000; Turner 1987a; Voigt 1983). Ritual activity (e.g., Brunton et al. 2013; Plug 2000; Schoeman 2009), elite hunting (Voigt 1983), “symbiotic relationships with hunter-gatherers” (e.g., Voigt 1986: 17; Plug and Pistorius 1999), and population pressures or environmental constraints (e.g., Turner 1987b; Plug 2000; Voigt 1986) have also been proposed as reasons for the presence of wild species in agro-pastoralist assemblages. Yet, the extreme variation in species presence follows neither clear spatial or temporal patterns—nor clear correlation with ceramic variability—during the EIA. Therefore, these often vague explanations of wild animal presence at a site are not always wholly satisfactory.

Part of this continued ambiguity is due to the general trend to use the species list as the main, if not only, data utilized in faunal investigation, as well as an almost exclusive focus on the presence and importance of domesticates in southern African EIA zooarchaeology. This domesticate-centred research has been an intrinsic part of EIA studies. For example, the presence of these (new) domestic species (i.e., cattle, sheep, and goat) has been used as a cultural proxy with which archaeologists can track the IA agro-pastoralist peoples into and across the southern African landscape (e.g., Voigt 1986). Domesticated studies have also explored agro-pastoralist interactions with autochthonous foragers (e.g., Denbow

1990; Sadr and Plug 2001; Sadr et al. 2003; Sampson 1984; Smith 1986; Thorp 1997) and the varying developments between and within the agro-pastoralist groups (e.g., Huffman 2007; Kinahan 1986; Maggs and Whitelaw 1991). This zooarchaeological information has been crucial in understanding settlement patterns within groups and the socio-cultural implications of those patterns (e.g., Central Cattle Pattern, see Kuper 1982; Huffman 2001). It also addresses the role domesticates have played, both as wealth and in the accumulation thereof, in increasing political complexity (e.g., Fraser and Badenhorst 2014; Huffman 2000; Plug 2000; Voigt 1983). Given the potential links between economic strategies (i.e., herding) and tradition or cultural complexes (e.g., Plug 1988, p. 354), domesticates can be an archaeologically valuable tool for identifying socio-cultural distinctions that have been a key focus of IA studies in southern Africa (e.g., Huffman 2007, p. 97).

While valuable, this narrow focus on domesticates has left lacunae in our understanding of the full spectrum of the human-animal relationship during the EIA of southern Africa. Archaeologists have considered the role of wild animals in EIA agro-pastoralist societies to some degree (e.g., Badenhorst 2008; Maggs 1980; Plug 1997; Plug and Pistorius 1999; Schoeman 2009; Turner 1987b; Voigt 1986). However, for all of the presented interpretations of wild presence—be they ritual, status, or pure environmental determinism—the variety in wild use that is expressed across southern African EIA sites is rarely addressed. Indeed, some suggestions, such as trade in meat (e.g., Badenhorst 2008; Denbow et al. 2008; Plug and Pistorius 1999), have never been entirely substantiated in the southern African context. Therefore, there is arguably still a good deal of ambiguity in our understanding of the variety of ways wild animals may have been used by EIA agro-pastoralists. There is also relatively little known about how both wild and domestic species were processed and prepared during this period. These gaps are consequential for our understanding of EIA animal use and the variations within it.

## **Theoretical Frameworks and Interdisciplinary Methods: Expanded Zooarchaeological Questions**

With the rapid expansion of theoretical frameworks and multidisciplinary analyses in the field, new realms of socially focussed questions have opened up within

zooarchaeology (e.g., Crabtree 1990; deFrance 2009; Russell 2011; Sykes 2014; Twiss 2012). In light of this, this paper uses theories of intensification (Morrison 1994) to examine Le6 and Le7 faunal use beyond its basic nutritive value and move into the driving forces behind peoples' choices. Discussion of intensification and specialization deals largely with themes of production, such as craft (e.g., Costin 1991), and agriculture (e.g., Morrison 1994). However, intensification and specialization are still applicable to zooarchaeological material and animal-based food choices (e.g., Betts and Friesen 2004; Cannon and Meltzer 2004; Morgan 2015; Spielmann 2002).

Zooarchaeologically, "intensification" has been used to describe many different situations (e.g., Betts and Friesen 2004; Lupo et al. 2013; Morgan 2015), but Morrison's (1994) definitions serve to encompass most of them. She (Morrison 1994, pp. 142–144) lists three main components to intensification: "intensification proper" specialization, and diversification. The first is described as "increased labor and/or capital inputs" (Morrison 1994, p. 142) into a given mode of production. This may also include "increased investment" (Morrison 1994, p. 142) in certain practices associated with production. Betts and Friesen (2004, p. 357) clarify this as "the development of new technologies and procurement strategies." Archaeologically, this could manifest in the development of specific hunting strategies or processing tools.

Specialization, or "the reduction of diversity" (Morrison 1994, p. 143), is characterized by a focus on a type of production or product. This could be seen in a predilection for hunting and consistent targeting of a specific type of animal or the use of selective processing patterns. It comprises, therefore, concentration on a narrow range or specific type of resource. Diversification, on the other hand, is marked by an "increase in the number of components of a productive system" (Morrison 1994, p. 144). In other words, this would be a concerted effort to utilize an expanded number or type of resources. This could come across archaeologically as a broad mix of taxa types and/or complete use of all available animal products within the carcass. For example, Lupo et al. (2013) use this type of diversification to explore intensifying efforts to utilize a wider range of resources during times of resource scarcity. Specialization and diversification may thus appear to be

opposites, but both present processes through which intensification may occur.

The potential drivers of intensification are numerous: from environmental issues (e.g., Lupo et al. 2013) to social and ritual activities (e.g., Spielmann 2002), population growth (e.g., Morrison 1994), and changing social complexity (e.g., Costin 1991). As for methods through which intensity and human choices may be assessed archaeologically, species identifications offer the ability to discern either narrow focus or diversified selection in the procurement strategies. Different strategies may also be discernible in processing choices, making taphonomy another route through which to identify intensification.

## Taphonomy

Taphonomy is the study of the various processes that affect animal remains from the moment of death, through burial, and up to the recovery of those remains during excavations, as well as any damage incurred in storage or curation (e.g., Efremov 1940; Lyman 1994, pp. 1–4). These include human actions (e.g., cooking, butchery, and disposal) as well as carnivore damage, weathering, and other diagenetic processes (e.g., Lyman 1994; Orton 2012). Taphonomic studies, although not widely applied in southern African EIA zooarchaeology, may help elucidate the intra-site relationships (and variations) that remain unclear in the period, through an analysis of site-specific processing patterns.

In addition to the identification of the various processes that influence and shape an assemblage (e.g., Gifford-González 1993; Lyman 1994; Orton 2012) and even the differentiation of different site types—such as permanent settlements vs. acquisition and processing sites (e.g., Bamforth 2011; Byerly et al. 2005, 2007; Driver 1990)—taphonomy can also clarify what was being “procured” beyond the meat, as in the traces of cut marks made during skinning (e.g., Binford 1981), breakage patterns indicative of marrow and bone grease extraction (e.g., Byers 2002; Karr et al. 2014; Outram 2001), the variation in processing seen between different meat preservation methods (e.g., Friesen 2001; Friesen and Stewart 2013), and even the speed and skill of the butchers doing the processing (e.g., Seetah 2006b, 2008). All of these add detail to our understanding of faunal use habits that extend far beyond initial procurement choices.



## Background

Both Le6 and Le7 have been studied previously as part of broader projects. Meyer (Meyer et al. 1984, Meyer 1986) focused on establishing the cultural history of the park through ceramic studies. Within that KNP-wide framework, the majority of Le6 and Le7 ceramics belong to some variant or phase of the Mzonjani faces, with a few features containing possible Malapati wares (Alexander Antonites, personal communication; Meyer 1986, pp. 223–224, 227; but see Huffman 2007, p. 239; Plug 1988, pp. 139,142 for contrasting interpretations). Meyer (1986, pp. 102–106, 149–155, 223, 226) identified Le6 and Le7 as residential EIA sites created by shifting re-occupation of the same area, resulting in an amorphous, palimpsest-like distribution of ash-filled pits, ash heaps, two hut floors, and surface concentrations (likely eroded pits) across the two sites. Meyer (1986, p. 223, 226) believed that Le7a marked the first occupation of the area, with a gap in use after which Le6 was occupied, and then a final shift back to Le7b after a relatively short time. There is some variation in radiocarbon dates yielded by these features, but it appears that all occupations at the sites occurred between ca. AD 300–700. It should be noted that the two occupations at Le7 were not distinguished through stratified, overlapping deposits, as all features excavated were interpreted as single depositional events (Meyer 1986, pp. 102–106, 149–155). Instead, features relating to either Le7a or Le7b were differentiated by their ceramic contents (Meyer 1986, p. 223).

In another study, Plug (1984a, 1988, 1989a, 1989b) used zooarchaeology to identify regional economic activities and environmental conditions during the IA. These included assessments of the subsistence strategies employed in this period (Plug 1988, pp. 302–326, 1989a), as well as the use of archaeological animal distributions to identify the state of the natural environment during the IA in the KNP region (Plug 1988, pp. 288–298, 1989b).

While the KNP boasts a wealth of wild floral and faunal species (Joubert 1986), it has generally been classified as “a hostile environment” for both domestic plant and animal species (Meyer 1984, p. 217; Plug 1989a). Soil types, low annual

rainfall, erratic droughts, and low grazing-carrying capacities for domestic herbivores combine to inhibit agro-pastoral potential in most of the park (Gertenbach 1980; Meyer 1984; Plug 1989a). A variety of diseases are endemic to the region—including foot-and-mouth disease and periodic presence of Tsetse fly—that have little impact on wild species, but often prove lethal for domestic animals (Plug 1989a; Titoy 1994).

Despite environmental constraints, domesticates (cattle, sheep, and/or goats) are present at most EIA sites in the KNP (Plug 1989a). However, they are typically rare in these assemblages when compared to the far more domesticate-rich sites outside of the park (e.g., Plug 1984a, 2000). As a result, KNP EIA sites have been classified as not only “hunting reliant” but also as “peripheral” (Plug 1988, p. 357) or “marginal” (Meyer 1984, p. 225, 1986, p. viii). This scarcity of domestic species has also been used to suggest that KNP EIA faunal patterns were dictated by environmentally forced subsistence choices (Plug 1989a). While the expected disease limitations were likely severe for the domestic stock, these sites display no signs of resource scarcity nor environmental pressure. In her studies of the KNP, Plug (1988, p. 359) found neither evidence of famine foods, a degraded environment, nor resource depression, nor was there any “evidence that game supplies dwindled” (1989a, p. 63).

Therefore, new research on faunal use at Le6 and Le7 utilizes previous unanalyzed faunal material (from later excavations of the sites by J. F. Eloff in the late 1980s [Ina Plug, personal communication]), to re-engage with these interpretations. This new study reassesses the implication of “wild-dominated” faunal assemblages: Were they truly shaped by environmental parameters, or rather, might they suggest socially motivated choices? Do more wild species within a site’s assemblage necessarily indicate a marginal or peripheral situation (e.g., Meyer 1984; Plug 1989a), or may there be broader significance in wild use? How were animals prepared and used at these EIA sites? What do the use strategies indicate, in terms of intensity or scale of activity, and imply about the skill or priorities of those undertaking them?

Plug (1988) also discussed some taphonomic aspects of the assemblages.

However, because her aim was not the exploration of processing patterns (1988, pp. 56, 71, 277), her analyses focused mostly on problems associated with differential destruction of skeletal elements. This type of attrition can substantially impact species identification, and these identifications were the most fundamental element of analysis in that type of subsistence study. The butchery and burning data that Plug (1988, pp. 330-338) recorded from the KNP sites was collated into a single set and synthesized to produce an IA-wide model of butchery and preparation habits in the park.

Building on previous regional research (e.g., Meyer 1986; Plug 1988), the questions above form the underlying framework through which I use a finely scaled study of procurement and processing to explore site-level faunal-use patterns, what they may mean for the nature of Le6 and Le7, and their place within the broader landscape of the southern African EIA.

## Methods and Materials

The faunal material employed here stems from 13 features on Le6 and Le7. Although the features may each represent separate deposition events, as all are unstratified and generally small deposits (Meyer 1986, pp. 102–106, 149–155), probably used only for “a few weeks, or months at most” (Plug 1988, p. 337). Here I follow Meyer (1986) in grouping the features into phases. These phases, and the interpretation of continuous occupation, will be revisited in the “Conclusions” section. It should be noted that on the whole and where samples were not very small, procurement and processing patterns within individual features mirrored those seen at the phase level.

Excavation was carried out by trowel, and faunal material was hand collected (Plug 1988 and personal communication). All other excavated soil was sieved first through large screens, then a 5- $\times$ -5-mm screen, and finally through a mosquito mesh of 2  $\times$  2 mm. No matter how small, all faunal material was collected, and a faunal specialist was always on-site; this material may be considered to have minimal excavation and collection biases.

All material was sorted and identified by the author. While primarily studied at the

University of Pretoria, all taxonomic identifications took place at the Ditsong National Museum of Natural History (formerly the Transvaal Museum) in Pretoria. A number of identification guides were also used to distinguish between closely related species (Balasse and Ambrose 2005; Boessneck 1969; Halstead et al. 2002; Peters 1988; Prummel and Frisch 1986; Zeder and Lapham 2010; Zeder and Pilaar 2010). Brain's (1974) bovid size-classes are employed for less determinate bovid specimens. I also, at times, group specimens by mammal size-classes. Bov. I species and other mammals of comparable weights are "Small/Medium", Bov. II species and similar size non-bovids are "Medium", Bov. III and IV and similar mammals are classified as "Large". Small includes species such as hares, and "Very Large" consists of giraffe, rhinoceros, hippopotamus, and elephant. These size classes provided a simple method for exploring the data.

---

The taxonomic names are those used in Skinner and Chimimba (2005) and listed in the order given by Meester et al. (1986). Additionally, specimens classified as "cf." (e.g., cf. *Bos taurus*) are combined with their confirmed counterparts (e.g., *B. taurus*) in analyses and discussion (apart from Table 2). This was done to simplify the data presented. Number of identified specimens (NISP) is the only quantification unit presented here.

Taphonomic data were recorded from all identifiable and unidentifiable remains. I broadly followed Orton's (2012) framework for taphonomic analysis, apart from an expansion in the butchery section based on select elements of Seetah's (2006a) analytical methods. This expansion was primarily to include the type of butchery mark (e.g., chop, cut, and scoop; see Seetah 2006a, pp. 125–129 for descriptions) to tie the presence of marks back to the actual function and intentions of the butcher (e.g., Seetah 2006b). This approach also addresses issues with butchery mark quantification, as that affects the quantification of butchery intensity.

The number of butchered specimens has been suggested as a better indicator of processing intensity than the frequency and number of butchery marks (e.g., Egeland 2003; Lyman 2005). However, Seetah (2006a, p. 98, 2006b) points out that tool damage on a bone may have more to do with a butcher's skills, goals, and tools, than intensity. Therefore, I examined both the number of butchered specimens and the propensity with which types of marks occur in certain areas of certain elements, to identify consistent, repetitive patterns in butchered portions (see Seetah 2006a, pp. 135–169). In this way, specific processing patterns can be identified, and aspects such as the function of the butcher's choices, repetitiveness, expediency, and speed of butchery can be addressed. The skills, if not specialization, of the butchers themselves may also be evident in processing choices made (e.g., Seetah 2006a, b).

In terms of quantification and simplifying the data, the taphonomic data presented here are grouped by mammal size class rather than taxa. When the data are discussed only at a species or genus level, key datasets are lost, as certain elements or portions (ribs, long-bone shafts, skulls) are far more likely to be consigned to either family or basic mammal-size class level. Excluding those pieces by virtue of taxonomic precision not only causes those parts to be severely underrepresented in the data, but their associated taphonomic information is also lost, affecting the scope and quality of interpretations and discussions.

Using only mammal size class levels groups a variety of taxa together that may have been treated and processed in different manners, such as the ungulates and the non-ungulates. However, given the scarcity of non-ungulates, it is hard to draw confidently any interpretations from the processing data, as samples are too small. As a result, they are not presented here, but are discussed in a forthcoming Masters thesis by the author

Although there were small quantities of fish, tortoise, and mollusks (freshwater and terrestrial) found at Le6 and Le7, this paper will only discuss mammalian remains (apart from Table 1). This is due to the differences in skeletal fragmentation and taphonomy for non-mammals (Behrensmeyer 1978; Gifford-González 1989; Lyman 1994, pp. 434–450). Moreover, while some of the other

non-mammal species were quite common (e.g., tortoise in nearly every feature) or are notably unusual (such as the anomalous numbers of fish [Whitelaw 2009] and the ostrich bones), these non-mammals played only a minor role in terms of species use and foodways at these sites, compared to the importance of mammals present.

**Table 1**

Total faunal sample from Le6 and Le7 in this study: Identifiable (ID) and unidentifiable (non-ID) material per phase (NISP, weight) (includes non-mammal remains)

	<b>ID</b>	<b>Non-ID</b>	<b>ID</b>	<b>Non-ID</b>
Site and phase	NISP	NISP	Weight (g)	Weight (g)
Le6	1,714	3,192	21,242	5,646
Le7b	348	1,609	3,480	1,696
Le7a	2,803	9,807	21,521	12,746
Total	4,865	14,608	46,243	20,088

## Results

### Assemblage Composition

The combination of ash and alkaline soils means that the Le6 and Le7 faunal remains are well preserved. This, combined with the lack of intensive processing and the prolific hunting (see below), contributed to the sizable assemblages recovered (Table 1). The overall preservation is evident in the high proportion of identifiable remains—54 % at Le6, 22 % at Le7b, and 29 % at Le7a.

### Species

Table 2 presents the mammalian species list for the material identified in this study. To facilitate reading, only the common names of species are in the discussion; see Table 2 for scientific names.

**Table 2**

## Mammalian species list for Le6 and Le7 per phase [NISP]

<b>Taxon (common name)</b>	<b>Le6</b>	<b>Le7b</b>	<b>Le7a</b>	<b>Total</b>
<i>Papio hamadryas</i> (chacma baboon)	13	1	1	15
cf. <i>Papio hamadryas</i>		1		1
<i>Cercopithecus pygerythrus</i> (vervet monkey)	3		2	5
Primate, small/medium	2			2
<i>Civettictis civetta</i> (civet)		1	1	2
<i>Crocuta crocuta</i> (spotted hyena)			2	2
<i>Panthera leo</i> (lion)	4	1		5
Felid, medium			1	1
Felid, medium/large			2	2
Carnivore, small/medium			1	1
Carnivore, medium	3	4	1	8
Carnivore, medium/large		1	1	2
Carnivore, large	1		5	6
<i>Loxodonta africanus</i> (elephant–ivory only)	1			1
Unidet. ivory (hippo. or elephant)			2	2
<i>Rhinocerotidae</i> sp. (rhinoceros)	11	2	2	15
cf. <i>Rhinocerotidae</i> sp.	3		1	4
<i>Diceros bicornis</i> (black rhinoceros)	8			8
cf. <i>Diceros bicornis</i>		1		1
<i>Equus quagga</i> (plains zebra)	88	22	93	203
cf. <i>Equus quagga</i>	11	3	18	32
<i>Phacochoerus africanus</i> (warthog)	2		3	5
cf. <i>Phacochoerus africanus</i>	1			1
<i>Potamochoerus larvatus</i> (bushpig)			2	2

<i>cf. Potamochoerus larvatus</i>			1	1
Suid-wild			3	3
<i>Hippopotamus amphibius</i> (hippopotamus)			1	1
<i>cf. Hippopotamus amphibius</i>			1	1
Hippopotamus or Rhinoceros	4		1	5
<i>Giraffa camelopardalis</i> (giraffe)	21	1	15	37
<i>cf. Giraffa camelopardalis</i>	5	1	4	10
<i>Bos taurus</i> (cattle)	21		7	28
<i>cf. Bos taurus</i>	6		1	7
<i>Ovis aries</i> (sheep)			3	3
<i>cf. Ovis aries</i>			2	2
Ovicaprine (sheep/goat)			6	6
<i>cf. Ovicaprine</i>			2	2
<i>Connochaetes taurinus</i> (blue wildebeest)	41	11	135	187
<i>cf. Connochaetes taurinus</i>	3	6	43	52
<i>Alcelaphine sp.</i> (wildebeest/hartebeest)	2		9	11
<i>cf. Alcelaphine sp.</i>	1		3	4
<i>Sylvicapra grimmia</i> (common duiker)	2		12	14
<i>cf. Sylvicapra grimmia</i>		1	3	4
<i>Raphicerus campestris</i> (steenbok)			3	3
<i>cf. Raphicerus campestris</i>			1	1
<i>Raphicerus sharpei</i> (Sharpe's grysbok)			2	2
<i>cf. Raphicerus sharpei</i>			1	1
<i>Aepyceros melampus</i> (impala)	26	2	7	35
<i>cf. Aepyceros melampus</i>	4	4	3	11
<i>Hippotragus equinus</i> (roan)		3		3



<i>cf. Hippotragus equinus</i>	1		2	3
<i>Hippotragus niger</i> (sable)	4		11	15
<i>cf. Hippotragus niger</i>	1		8	9
<i>Hippotragus sp.</i> (roan/sable)	1		2	3
<i>cf. Hippotragus sp.</i>			2	2
<i>Syncerus caffer</i> (buffalo)	35	5	12	52
<i>cf. Syncerus caffer</i>	3	1	6	10
Bovini sp. (cattle or buffalo)	46	2	10	58
<i>cf. Bovini sp.</i>			10	10
<i>Tragelaphus strepsiceros</i> (kudu)	2		2	4
<i>cf. Tragelaphus strepsiceros</i>		1	2	3
<i>Tragelaphus oryx</i> (eland)	11	1	2	14
<i>cf. Tragelaphus oryx</i>	1	3	1	5
<i>Tragelaphus sp.</i> (eland/kudu)			3	3
<i>Kobus ellipsiprymnus</i> (waterbuck)	2	5	11	18
<i>cf. Kobus ellipsiprymnus</i>		4	8	12
Bovid, small (Bov I)	1	1	17	19
Bovid, small/medium (Bov I/II)	2	1	18	21
Bovid, small/medium (Bov I/II–wild)			4	4
Bovid, medium (Bov II)	77	5	38	120
Bovid, medium (Bov II–wild)	9		13	22
Bovid, medium/large (Bov II/III)	15	4	25	44
Bovid, medium/large (Bov II/III–wild)			2	2
Bovid, large (Bov III)	112	13	237	362
Bovid, large (Bov III–wild)	24	10	40	74

Bovid, large/very large (Bov III/IV)	100	17	118	235
Bovid, large/very large (Bov III/IV–wild)	2	1	4	7
Bovid, very large (Bov IV)	117	5	41	163
Bovid, very large (Bov IV–wild)	1	1	2	4
Bovid, indeterminate	1		4	5
<i>Pedetes capensis</i> (springhare)			1	1
<i>Hystrix africaeaustralis</i> (porcupine)	1			1
cf. <i>Hystrix africaeaustralis</i>			1	1
Rodent, small	63	6	15	84
Rodent, medium		2	4	6
Rodent, large	1		1	2
<i>Lepus saxatilis</i> (scrub hare)	1		3	4
<i>Lagomorph</i> sp. (hare)			4	4
cf. <i>Lagomorph</i> sp.			1	1
Mammal, small		4	7	11
Mammal, small/medium	5		4	9
Mammal, medium	6	1	28	35
Mammal, medium–bovid or suid	4	1	4	9
Mammal, medium/large	19		36	55
Mammal, large	23	6	72	101
Mammal, large–bovid or equid	50	13	80	143
Mammal, large/very large	11	4	55	70
Mammal, large/very large–bovid or giraffe	19	4	30	53
Mammal, very large	5	2	16	23
Total	1,063	189	1,424	2,676

Le6 and Le7 display a diverse variety of taxa, including upland foragers (eland), open grassland grazers (zebra, wildebeest, buffalo), and forest dwellers (black rhino, kudu). While certain taxa are found in great numbers in all phases (as well as virtually all features)—e.g., zebra, wildebeest, and buffalo—others are notably less ubiquitous. Cattle were identified in only a few Le6 and Le7a features, and ovicaprines appeared in a single Le7a feature in this study. When the faunal assemblage is considered as a whole, domesticates make up only 1.6 % (by %NISP) of the identifiable sample from Le6, and 0.8 % of the Le7a sample. No domesticates were identified in Le7b features in this study. As Plug (1989a) originally found, wild animals predominate in the Le6 and Le7 assemblages. Wild ungulate species (i.e., hoofed mammals, including all wild bovid, equid, suid, giraffe, hippopotamus, elephant, and rhinoceros species) have a far more frequent and numerous presence than the domesticate, carnivore, and rodent taxa. This is particularly clear when the species are grouped into taxa types (Table 3), following Raath’s (2014, pp. 180-181) groupings. The wild bovids, equids, and suids group dominates in every phase, followed by the very large mammals. This demonstrates the first significant species-use pattern at Le6 and Le7: a strong preference for the wild ungulate species, as they were clearly the most commonly targeted and procured animal type.

**Table 3**

Taxa type present per phase [NISP] (\*excludes small rodents [e.g., rats, mice])

<b>Taxa group</b>	<b>Le6</b>	<b>Le7b</b>	<b>Le7a</b>	<b>Total</b>
Very large mammals	57	8	41	106
Wild bovids, equids, and suids	279	82	496	857
Domesticates	27		21	48
Carnivores and primates	23	9	17	49
Small snared/gathered mammals*	3	6	22	31
Total grouping NISP	389	105	597	1,091

Large mammals outnumber all other categories in all Le6 and Le7 phases (Table 4). As with the dominance of wild ungulates, a clear preference (this time for larger animals) is evident. The datasets in Tables 3 and 4 are also linked: the majority of the ungulate taxa listed above (Table 2), which contribute to the populous “wild bovids, equids, and suids” group (Table 3), are large. Although there are a few smaller species present—such as the occasional duiker, steenbok, and Sharpe’s grysbok, and the slightly more common impala—most of the ungulate species listed are large or very large. They are also far more numerous than these smaller animals. The indeterminate bovid and mammal remains (Table 2) exhibit the same pattern: the larger size classes express the largest samples (excepting the hybrid categories; Large/Very Large and similar).

**Table 4**

Mammal size classes\* present per phase [NISP] (\*excludes small rodents [e.g., “very small”])

Size classes	Le6	Le7b	Le7a	Total
Very large	57	8	41	106
Large/very large	30	8	85	123
Large	713	132	998	1,843
Medium/large	35	7	70	112
Medium	144	14	116	274
Small/medium	14	8	70	92
Small	4	4	18	26
Total	997	181	1,398	2,576

The size trend clarifies and develops the taxa type preference identified above. It is not just wild ungulates, but *large* wild ungulates that were clearly the preferred hunting targets at Le6 and Le7. This size-based selection is further corroborated by the ageing data. There are juvenile and neonate remains present, but they account for only a small fraction of the total identifiable assemblage. The scarcity of very

young individuals may mean two things. It could indicate that this hunting did not take place during the calving season, or it may simply be that young individuals were not captured and killed and/or were not brought back to the site (e.g., Plug 1993). However, the evident targeting of adults, rather than younger (and smaller) individuals, again points to a strong size preference. Even the ubiquity of gregarious ungulates (e.g., zebra, wildebeest, and buffalo—the most common ungulate species) may align with this focus on large animals. As gregarious species congregate in larger groups, this allows for the acquisition of multiple (large) animals at once.

Therefore, the acquisition of numerous large, adult, wild ungulates appears to be the main focus of procurement activities at these sites. This pattern holds through feature level, phase level, and even by weight of specimens in the assemblage. This is the case at the species level and within the bovid size classes too. This type of taxa is always the most numerous and highly populated mammal type.

## Taphonomy

### Diagenetic Processes

Both human and non-human (e.g., carnivore) activities can greatly influence the taphonomic characteristics of an assemblage (e.g., Lyman 1994; Orton 2012). Therefore, if one wishes to explore the social factors of taphonomy (e.g., butchery), the more diagenetic elements must also be examined to ensure that the taphonomic patterns present stem from human activities (e.g., Lyman 1994; Orton 2012).

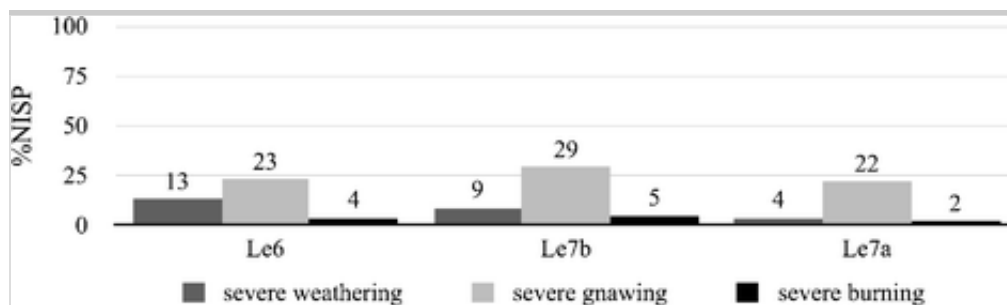
Diagenetic processes such as weathering, gnawing, and density-mediated attrition (e.g., Lyman 1994; Orton 2012) seem to have had little impact on the Le6 and Le7 assemblages. There is scant evidence of density-mediated attrition. Both robust elements and many other less dense elements display similar levels of completeness and preservation. For example, in addition to a great number of complete sesamoids, carpals, and tarsals and well-preserved ribs and vertebrae, there are also a wide variety of delicate remains present. These include fish bones,

sternae, dew claws, neonate remains, and even rib cartilage. This points to low density-mediated attrition at these sites (cf. Marean 1991 ; Orton 2012).

Rodent gnawing had a negligible effect on the material (never appearing on more than 2 % of the total assemblage at the phase level). Carnivore gnawing (33–50 %) and surface weathering (41–71 %) are far more frequent. In spite of this common presence, the weathering and gnawing is usually light, and severe damage is rare (Fig. 2). The majority of gnawing and weathering present is very superficial, often manifest as light fine-line weathering and scattered, shallow carnivore tooth marks. Only minor structural and/or cortical damage has been imparted by these processes (e.g., Behrensmeyer 1978 ; Marean and Spencer 1991 ; Phoca-Cosmetatou 2005). This means weathering and gnawing also have not had a substantial impact on the assemblages (although they may shed light on disposal practices, discussed below). Although burning is often associated with cooking and food preparation methods, it may also stem from peri- or post-depositional events and can have a more diagenetic-type effect on an assemblage (e.g., Stiner et al. 1995). Yet burning at Le6 (15 %), Le7b (19 %), and Le7a (8 %) is rare. Moreover, as with weathering and gnawing, the type of burning likely to induce or promote structural damage (e.g., severe burning, calcination) (Stiner et al. 1995) is scarce at these sites (Fig. 2).

**Fig. 2**

Incidence of severe weathering, gnawing, and burning per phase (%NISP)



On the whole, there is little severe weathering and gnawing, burning is rare, and there are few signs of density-mediated attrition in the Le6 and Le7 assemblages. This means that one can more confidently assign the taphonomic patterns present

to human actions and choices, rather than chance post-depositional events and processes (e.g., Lyman 1994; Orton 2012; Phoca-Cosmetatou 2005). It is also indicative of the exceptional level of preservation in this material. This is true for bones themselves, and for butchery marks, a situation which allows for a more in-depth study of butchery patterns than usually possible on more poorly preserved material (e.g., Phoca-Cosmetatou 2005).

The Le6 and Le7 material is composed of remarkably complete skeletal profiles as well. Due to space restraints, the details of these are not included here. However, it should be noted that every region of the skeleton, and virtually every element, is well represented across the Le6 and Le7 features and phases, particularly for large (even very large) ungulates. This is not only significant in the discussion of carcass transport and energy expended in carrying, e.g., almost an entire giraffe to site, but it also directly affects how taphonomic patterns may be interpreted. As essentially every region of the skeleton is commonly present, any selective patterns evident in the taphonomy are due not to the mere presence or absence of certain elements, but to truly differentiated practices in how carcasses were processed.

### Processing Patterns: Butchery and Breakage

Butchery is similar to weathering in terms of overall frequency (Table 5). There are also comparable levels of butchery (and proportions of the various mark types) between the ungulates species, size classes, features, and phases. Chopping dominates in all features, phases, taxa types, and size classes; cuts and scoops have a more variable presence. Local comparative data are scarce, but the observable butchery at Le6 and Le7 does seem to be far more frequent than that reported at most other sites (e.g., Turner 1987a, b).

**Table 5**

Identifiable and unidentifiable butchered specimens per phase, bones only [NISP]

	Identifiable bones									Unidentifiable bones	
	Total sample	Total butchered		Chopped		Cut		Scooped		Total sample	Total butchered
Phase	NISP	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	NISP	<i>n</i>

Le6	937	448	47.8	324	34.6	215	22.9	22	4.9	2,914	213
Le7b	157	94	59.9	90	57.3	19	12.1	13	13.8	1,547	86
Le7a	1,288	645	50.1	586	45.5	151	11.7	52	8.1	9,254	509
Totals	2,382	1,187	49.8	1,000	42.0	385	16.2	87	3.7	13,715	808

While these patterns are largely driven by the butchery evident on ungulate remains, it is harder to confirm the butchery patterns within the non-ungulate taxa given their small sample sizes (Table 3). However rare, the carnivore and rodent taxa were also butchered: deep chops are present on lion and baboon specimens, among others, along with more delicate butchery within other Le6 and Le7 non-ungulate specimens. Although butchery is common throughout this material, the first signs of differentiated processing appear when the butchery is examined between the skeletal regions and elements.

The grouped skeletal regions (Table 6) are adapted from Stiner (1991) and modified to allow for the inclusion of unidentifiable material. For example, “Limb” includes unidentifiable long bone shaft fragments, which are otherwise often underrepresented in zooarchaeological discussions (e.g., Outram 2001; Pickering et al. 2003; Marean et al. 2004). With the potential exceptions of the foot regions of Le7b, the various skeletal regions within each phase display largely comparable rates of butchery overall. These relatively even rates may be indicative of differentiated processing efforts, an argument explained in the discussion below.

**Table 6**

Butchered specimens per skeletal region by phase [NISP] (the axial region includes both vertebrae and pelvis; \*includes unidentifiable material)

		<b>Total sample</b>	<b>Total butchered</b>		<b>Chop</b>		<b>Cut</b>		<b>Scoop</b>	
Phase	Skeletal region	NISP	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
	Head*	146	31	21.2	29	19.9	8	5.5	1	0.7
	Axial*	257	88	34.2	75	29.2	22	8.6	3	1.2



Le6	Rib*	144	43	29.9	33	22.9	13	9.0		0
	Limb*	975	337	34.6	246	25.2	165	16.9	17	1.7
	Foot	260	80	30.8	45	17.3	41	15.8	1	0.4
	Total	1,782	579		428		249		22	
Le7b	Head*	51	9	17.6	7	13.7	3	5.9	1	2.0
	Axial*	42	15	35.7	12	28.6	3	7.1		0
	Rib*	18	3	16.7	3	16.7	1	5.6		0
	Limb*	404	94	23.3	79	19.6	28	6.9	12	3.0
	Foot	30	15	50.0	14	46.7	3	10.0		0
	Total	545	136		115		38		13	
Le7a	Head*	690	78	11.3	64	9.3	25	3.6	5	0.7
	Axial*	476	171	35.9	153	32.1	34	7.1	6	1.3
	Rib*	465	91	19.6	75	16.1	22	4.7	5	1.1
	Limb*	1,933	482	24.9	416	21.5	129	6.7	36	1.9
	Foot	223	59	26.5	48	21.5	17	7.6		0
	Total	3,787	881		756		227		52	

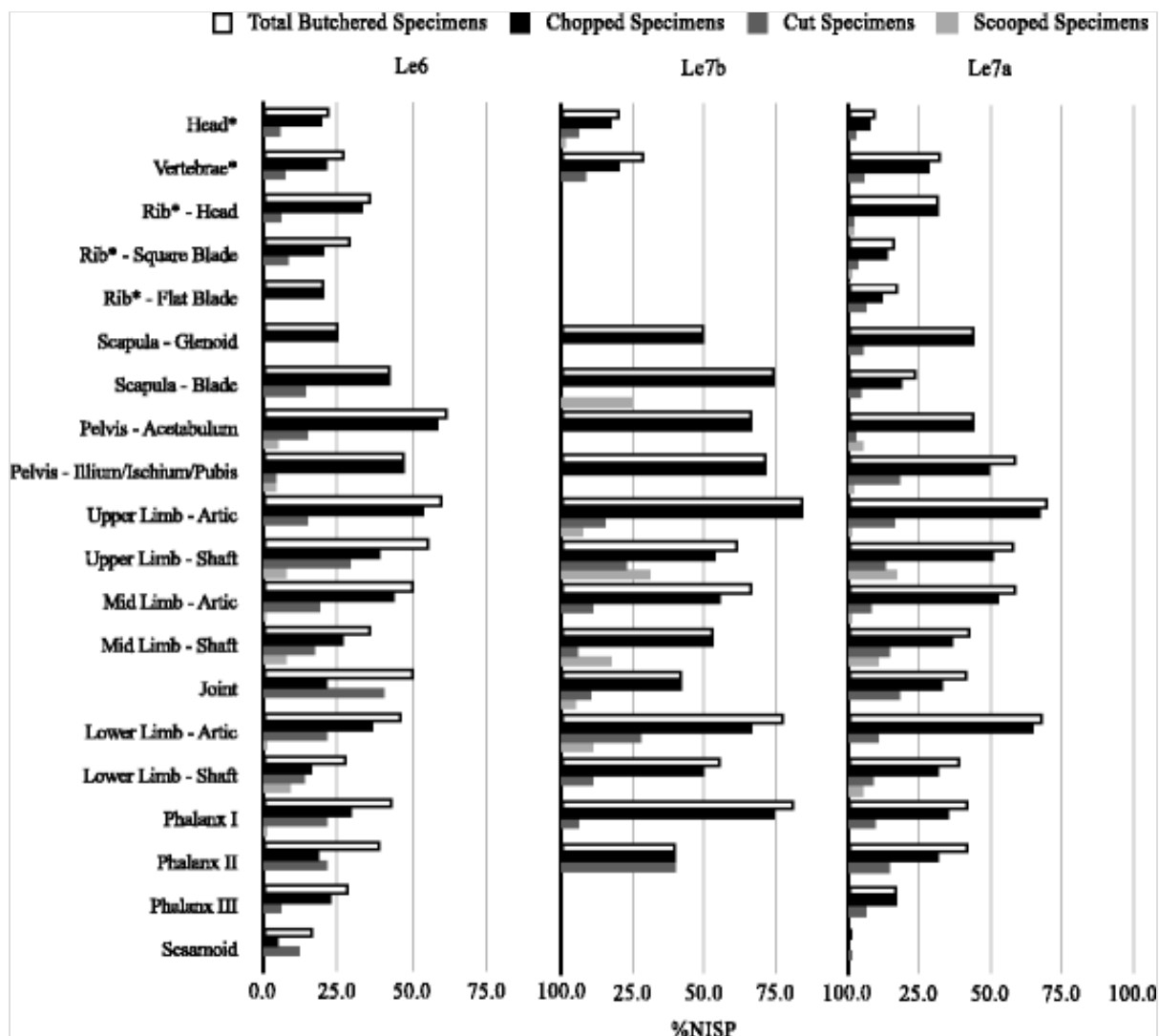
At a finer intra- and inter-element level (Fig. 3), there is a distinctive peak in the total butchered specimens and chopped specimens that begins around the scapula and pelvis, and centres over the limbs in all three phases. The highest concentrations of cut specimens are also found in this region. Together, this mirrors the implications of differential processing efforts suggested for the coarser skeletal regions (Table 6). While chopping is prevalent throughout the skeletal regions and elements, the finer cut and scoop marks are concentrated around the limbs. Specifically, the long bone articulations (and the scapula glenoid and pelvis acetabulum in certain features) tend to exhibit the highest number of cut and scooped specimens. As most muscle groups attach around the articulation facets and joints (e.g., Schaller 2007, pp. 85–87, 95–119, 127), these types of butchery

mark concentrations are to be expected if the aim was to remove the large muscle groups that exist in these regions. In contrast, it appears that chopping was the main butchering action employed in the axial regions. This often manifests as deep chops perpendicular across and through the rib heads and vertebral processes (i.e., just to the side of the vertebral column). Rixson (1989) describes such chopping as a quick method for separating the major muscle groups and more meat-heavy rib blades from the vertebral column. However, there is still a lack of the additional fine-scale cuts that would have been needed to fully strip the meat present along the spine (e.g., Bunn et al. 1988; Frison 1970; Lupo 2006). Therefore, there seem to be distinctly differential efforts in the butchering of these carcasses. A similarly selective pattern is seen within the bone breakage on-site.

**Fig. 3**

Butchered specimens present per element and portion by phase (%NISP) (\*includes unidentifiable material)

---



Acknowledging not only the differing levels of meat associated with certain regions, but also the variable fats available in skeletal elements, can aid in distinguishing the intent behind processing choices (e.g., Outram 2001, 2002; Janzen et al. 2014; Karr 2015). Therefore, the Le6 and Le7 elements were grouped into four main bone fat sources (long bone shafts, long bone epiphyses, appendicular cancellous bones, and cancellous axial elements) to assess patterns of breakage and fragmentation that may have been driven by fat exploitation (Table 7).

**Table 7**

Skeletal elements assigned to their fat source groups (\*includes only bovid and giraffe metapodia and equid third metapodia)

<b>Long bones: shafts and epiphyses</b>	<b>Appendicular cancellous bones</b>	<b>Axial cancellous</b>
Femur	Carpal	Pelvis
Humerus	Tarsal	Rib
Metapodial*	Os malleolar	Vertebra
Radius	Astragalus	Sacrum
Ulna	Calcaneum	
Tibia	Sesamoid	
	Patella	
	Dew claw	

To quantify the fragmentation seen within these groups, Morlan's (1994) formula was used to calculate completeness scores. Following Orton (2012), Dobney and Rielly's (1988) zones were employed as the portions in Morlan's (1994) equation. In this equation, a score of 1 would denote a complete element, and scores approaching 0 indicate progressively less complete specimens. Table 8 presents these results, which are separated into the major size classes. This was done given the significant difference involved in fracturing, e.g., the bones of a giraffe (Very Large) versus those of a duiker (Small/Medium).

**Table 8**

Completeness (\*averages per category) by fat type grouping per mammal size class and phase

		<b>Long bone shaft %C*</b>	<b>Long bone epiphyses %C*</b>	<b>Appendicular cancellous %C*</b>	<b>Axial cancellous %C*</b>
Le6	Very large	0.121	0.448	0.856	0.118
	Large	0.101	0.322	0.775	0.163
	Medium	0.135	0.313	0.778	0.081
	Small/medium	0.367	0.378	0.25	

	Small	1	0.365		
Le7b	Very large	0.125		0.575	0.261
	Large	0.137	0.292	0.811	0.067
	Medium	0.109	0.402	0.25	0.531
	Small/medium	0.125	0.125	0.5	
	Small	0.2			
Le7a	Very large	0.12	0.115	0.917	0.03
	Large	0.126	0.276	0.74	0.168
	Medium	0.163	0.371	0.811	0.13
	Small/medium	0.104	0.422	0.75	0.104
	Small	0.417	0.719		0.667

The smallest taxa commonly have the highest rates of completeness across the skeletal types. Their low numbers complicate interpretation, but they may simply have been less heavily or thoroughly exploited for their fats than the large species (e.g., Yellen 1991). Across all other mammals, the long bone shafts consistently display the lowest completeness scores within their size class categories. In these completeness scores, there is an almost inverse relationship between quality of fat and completeness: the higher the quality of the fat and the easier to extract, the lower the completeness of the element or type. Long bone shafts house the richest fats (marrow) that are the easiest to access via shaft fracturing (e.g., Outram 2001, 2002; Karr 2015), yet exhibit the lowest completeness scores. Alternately, the appendicular elements, with their quality bone grease but dense cancellous structure that necessitates boiling for fat extraction (e.g., Janzen et al. 2014; Karr 2015), remain far more complete.

The axial elements, which also contain bone grease (although of lower quality than the appendicular elements) (e.g., Janzen et al. 2014; Karr 2015), are the only outliers in terms of a relationship between breakage and fat quality. However, this breakage is likely related to structure, rather than fragmentation incurred from

grease extraction (Karr 2015). One way to address structural weakness versus use breakage is by comparing the completeness of vertebral spines versus bodies. Although not wholly complete, the Le6 and Le7 vertebral bodies are generally around 50 % complete, compared to roughly 10 % for the spines. Moreover, much of this breakage in the vertebral bodies is very clean: the centrums are neatly halved and often display remnants of the chops that cleaved them in two. This type of breakage (and butchery) points more to dismemberment (e.g., Seetah 2006a, pp. 204–205, 207–208) than to grease extraction.

If the results from the vertebrae are taken as indicative of the broader axial class (where much of the fragmentation is likely due to structural weakness and/or portioning breakage, not fat exploitation), then the axial results support the above findings. In other words, just as with the muscle groups and butchery, there was selective use of fats rather than intensive (i.e., diversified) exploitation of all possible resources. As this speaks to a distinct set of priorities and conditions, the discussion now turns to the implications of these patterns of use evident in the Le6 and Le7 data.

## Discussion

Before discussing the specific patterns of procurement and processing, the broader parameters of faunal use at Le6 and Le7 must be addressed. The Le6 and Le7 data do not suggest patterns shaped wholly by environmentally constrained conditions or diagenetic assemblage formation processes. Instead, these assemblages point to distinct and significant social choices and human actions guiding both the procurement and processing strategies. Primarily, this manifests in the highly selective and focussed use patterns.

### Selective Use

The hunting choices (Table 2) present one such sign of selective use. There are a variety of taxa present at these sites, indicating that a mix of habitats were exploited as the occupants of Le6 and Le7 gathered, herded, and hunted. However, this does not necessarily imply that they were simply acquiring whatever presented itself in the environment. In all Le6 and Le7 features and phases, there is a

pronounced focus not only on hunting, but the hunting of large adult wild ungulates specifically. Beyond confirming that Le6 and Le7 are indeed wild-dominated (Plug 1989a), this focus raises questions of intensity.

If specialization is defined as “the economic focus on a narrow range of resources” (Betts and Friesen 2004, p. 357 after Morrison 1994), then the pronounced targeting of large wild ungulates at Le6 and Le7 may qualify as “specialization”. The number of different taxa within this category does not negate this interpretation of a narrow hunting focus: the aim was evidently simply “large ungulate” rather than a particular species. There were also smaller mammals and non-mammals in the assemblages, but these appear to be more occasional captures than regular targets. The predominance of large wild ungulates also points to significant quantities of time and energy being focussed on the hunting of these particular taxa types. Therefore, not only do these types of species indicate a suitably narrow focus on a particular type of resource, but the number of individuals from these species present (and thus the time and effort invested in their acquisition) further displays an intensified (i.e., specialized; following Morrison [1994]) focus in the Le6 and Le7 procurement strategies. In fact, the investment of energy in this particular strategy may also approach a second component of intensification: “intensification proper” (Morrison 1994).

One must also consider the hunting skill necessary to consistently capture and kill species such as buffalo, rhinoceros, and large groups of wildebeest. Many of these species are known to be dangerous to hunt, particularly buffalo, black rhinoceros, and hippopotamus (e.g., Skinner and Chimimba 2005, pp. 535, 559, 624). In the taxa present at Le6 and Le7, the inhabitants of these sites demonstrate their distinct hunting prowess. Plug (1999, p. 194) also concluded that “the variety of species [at KNP EIA sites], including large and dangerous animals, prove that hunting expeditions were well coordinated and that hunting techniques were advanced.” Therefore, the consistency with which these large wild ungulates appear attests to very particular skills and choices on the part of the human hunters. As the taxonomic patterns visible in these assemblages are unlikely to have developed by mere incidental encounters while out hunting, they point to deliberate selection. It is unlikely these animals were sought simply for the risk

involved, as the species and individuals represent prime targets: adult animals of great size. Altogether, this indicates that instead of ensuring ease or safety in acquisition, the aim of this hunting centred on maximizing the meat (and/or other animal products) produced per animal procured. The riverside location of Le6 and Le7 (Fig. 1) may have also aided in this aim, increasing the chance of encountering animals in close proximity to the sites. This in turn may have played a role in the prevalence of nearly complete skeletons, as carcasses would not have to be carried far for processing.

While the issue of diseases in the KNP may have curtailed herding (e.g., Plug 1989a), the pervasive prevalence of prime hunting targets again negates suggestions that environmental stress or resource scarcity essentially forced hunting choices. Rather than utilizing the wide range of taxa available (e.g., Joubert 1986; Plug 1989a, b), there is an explicit procurement focus on prime species—who were evidently plentiful in number—within this rich environment. The processing strategies point to an equally bountiful situation, as the carcasses in these features are far from being fully utilized. This selective, if not wasteful, use does not suggest resource scarcity or stress. The narrow focus in the Le6 and Le7 hunting patterns is mirrored in the processing of the selectively procured large wild ungulates. Rather than a diversified use of skeletal resources, the brunt of the taphonomic modification evident in the assemblages appears to be linked to distinct carcass products, such as certain meat portions and fats. This selectivity is seen in both the butchery and breakage patterns at the two sites, which in turn shed light on the specific strategies and priorities that guided the processing patterns.

## Processing Function and Strategies

To assess selective processing via butchery damage, the actual function of the chop, cut, and scoop marks present must be discussed. Although there is significant variety in how terms such as “chop” and “cut” are employed in the literature (e.g., Seetah 2006b, 2008), they derive from very different actions.

A chop stems from the titular chopping (or splitting) action with a butchery tool, usually a cleaver or similar instrument (Seetah 2006a, p. 125, 2006b). On the other hand, cutting is a more finely scaled movement, usually with a knife or



comparable tool (Seetah 2006a, pp. 125–127, 2006b). In cutting, the aim is usually slicing something through or off (Seetah 2006a, pp. 125–127, 2006b). It tends to be a less energetic or powerful action than chopping, and so the nature of the resulting butchery mark is different. A “scoop” mark, which appears as a shallow scoop taken out of the bone (described elsewhere as a “chisel mark” [Plug 1988, p. 57]), may occur when an implement is run along the surface of a bone to remove meat (Seetah 2006a, pp. 128–129). Therefore, these specific marks—with their associated actions—demonstrate distinct intents on the part of the butchers creating them. In assessing these marks, is this butcher trying to carefully de-flesh a foreleg by using slow, careful cuts to separate elements and slice off every sliver of meat (e.g., Lupo et al. 2013; Seetah 2006b)? Or do we see the deep, powerful chops of a butcher experienced in processing large quantities quickly (e.g., Seetah 2006b)?

It is true that both chopping and cutting may be used to disarticulate elements (e.g., Seetah 2006b). However, I do not believe disarticulation was the main purpose of the cuts seen at Le6 and Le7. If cuts were used rather than chops for dismemberment—as slicing through ligaments takes less energy and strength than chopping through a joint (e.g., Seetah 2006b)—one would expect cut marks to essentially replace chop marks in the breakdown of butchery marks present. Instead, cuts are essentially “added” to the chops at Le6 and Le7: in the features, phases, and elements with greater numbers of cut specimens, there is not an accompanying decrease in the prevalence of chopping (Fig. 3, with the Le6 joint category being the only potential exception to this). Moreover, while cutting can be used for multiple purposes, it is simply not practical to utilize chopping as a main de-fleshing tactic (see Seetah 2006a, p. 20). It therefore seems that chopping was used primarily to separate the skeletal elements, as can be expected with the type of processing undertaken at these sites (e.g., Frison 1970; Bamforth 2011; Seetah 2006b). Such dismemberment may have occurred at a variety of different stages in the processing sequence. Some chopping may have been part of the original portioning of the carcass to facilitate transport to site (e.g., Bunn et al. 1988; Lupo 2006). There would have been additional disarticulation during preparation sequences as well, when bones and regions are first separated from one another and then de-fleshed and/or broken open for their marrow (e.g., Seetah

2006a, b). Overall, given the overwhelming ubiquity of chop marks, disarticulation was clearly one of the most frequent processing actions at Le6 and Le7.

The function of the cuts and scoops is relatively straightforward: these marks occurred while stripping meat from the bones and possibly (in the case of the cuts on elements such as phalanges and metapodials) from skinning (e.g., Yellen 1991). Some of the chop marks might have also been incurred during quick meat removal (e.g., Rixson 1989). Nevertheless, the majority of chops likely stem from dismemberment and portioning, as discussed above, while cuts and scoops relate to de-fleshing and finer processing. In contrast to the consistently present dismemberment, there appears to be selective patterns of use in the further processing of these carcasses.

As presented in Table 6, the even rates of butchery at the coarser skeletal-region scale may actually indicate differential use, as seen in Fig. 2. Explaining this assertion requires consideration of the different physiological structures of skeletal regions. The appendicular regions (i.e., limbs) of the carcass can be wholly stripped of meat quickly and with relatively few strokes (e.g., Lupo 2006). Conversely, had the axial elements been similarly—and thoroughly—de-fleshed, one could expect far more butchery damage, as the complex shape of the elements necessitate both greater time and processing effort (e.g., Bunn et al. 1988; Lupo 2006). Yet this is not the case here: cutting (a main de-fleshing mark) in particular is either no more frequent in the axial elements than the limbs (as in Le7a and Le7b) or is far less frequent in the axial elements (Le6).

It is possible that the axial elements could have been cooked, as that would have served to loosen the meat on them, rendering less butchery necessary (e.g., Bunn et al. 1988; Gifford-González 1993; Henrikson 2003; Halstead 2007). However, although vertebral spines and processes are occasionally broken, the vertebrae remain relatively complete and—given the size of many of these animals—large, neither of which conditions are particularly indicative of “pot-sizing” nor conducive for boiling (e.g., Janzen et al. 2014). There are also few, if any, signs of roasting within the axial elements; thus, cooking was not usually employed to

facilitate the butchering of these elements. It therefore seems that the axial elements simply underwent less butchery, particularly de-fleshing, as there are fewer marks in that region than one would expect to see if these element types had been thoroughly processed. Figure 3 reinforces this interpretation, as the butchery marks (and the de-fleshing marks in particular) are concentrated around the limb regions and the major muscular groups (e.g., the shoulder and hindquarters: scapula, pelvis, and upper limb).

The disparate pattern of butchery damage and processing effort is also visible in the fat exploitation. That the long bones were particularly targeted for their marrow is not only evident in the varying completeness scores (Table 8), but in the butchery and fracture patterns as well. More than 90 % of the long bones in each phase exhibited the markers of marrow extractions. These include spiral fractures (e.g., Johnson 1985; Outram 2001, 2002), as well as a distinct method of longitudinal splitting. Studies of marrow utilization are often based on the premise of percussive methods being used to fracture the shafts (e.g., Johnson 1985; Outram 2001, 2002). However, both Rixson (1989) and Seetah (2006a, p. 103) note that it is (relatively) easy to longitudinally split long bone shafts by chopping down through an epiphysis (it being cancellous and therefore less dense), which provides access to the marrow. This type of chopping would account not only for the great number of longitudinally split elements but also the large number of epiphyses that have been cleanly sheared through, in addition to the high frequency of chop marks noted on the limbs (Fig. 3). This method then ties into the level of completeness seen above. The longitudinally split shafts are more incomplete, but the more complete values of the epiphyses may well be driven by this splitting.

In fact, if modified to include this preference for longitudinal splitting rather than hammerstone use, the Le6 and Le7 assemblages correspond largely to an exclusive focus on the extraction of marrow only (see Outram 2001). In such cases, one would expect to find: bones left complete or nearly complete, long bone shaft fragments bearing evidence of percussive damage, epiphyses deposited whole, and axial elements left complete (Outram 2001). Where not subject to structural weakness (i.e., vertebral spines and processes), the Le6 and Le7 axial elements and

the non-marrow bearing elements (e.g., carpals, tarsals) do display higher completeness (Table 8). In fact, these assemblages are characterized by a great number of perfectly complete—and often still articulating—sets of carpals, tarsals, and phalanges. The use of longitudinal splitting means there is little evidence of percussive damage (although a few Le7 shaft fragments possess percussive damage). Longitudinal splitting also damages the epiphyses, and the Le6 and Le7 epiphyses were often longitudinally split or sheared through, but there is no great comminution beyond that. Therefore, they may not be whole, but these epiphyses are not as fragmented one would expect with grease processing (e.g., Janzen et al. 2014).

The breakage and fragmentation patterns, therefore, suggest that marrow may have been the main focus in fat utilization at these sites. Some in-bone fat was exploited, but it cannot be said that fat use was “intensive” in the sense of all possible fats being used. The “easy” and rich marrow sources (e.g., long bones) were utilized, but there are no signs of more concerted or systemic efforts to extract skeletal fats. This pattern, once again, suggests highly selective processing priorities, with a focus on the biggest and most easily removed meat cuts and richest and most easily accessed marrow sources.

A selective processing pattern ties to the same component of intensification as the species selection (Morrison 1994): specialization, with a narrow focus on particular “products”. Thus, the occupants of Le6 and Le7 seem to be employing not only intensified (i.e., specialized) hunting strategies but also intensified processing strategies. Simply identifying and defining these patterns leaves one question unanswered: why is there such wastefulness apparent in the processing at these sites?

It is hard to unequivocally define waste (e.g., Seetah 2006a, pp. 89–90, 2008; Halstead 2007). However, here it is employed heuristically to describe elements that butchers and other processors elected to not fully process. At Le6 and Le7, the presence of articulating elements, whole elements, and entire skeletal regions whose nutritional potential does not appear to have been fully exploited all point to “wastefulness”. In terms of subsistence, these types of highly selective use patterns

are typically described as “wasteful” (Halstead 2007, p. 36), in that not every dram of nutrition has been extracted from skeletal material. What may have driven this waste?

## Parameters of Use: Time Restraints?

Such choices could have been shaped by simple preferences for certain portions and products. However, that would seem somewhat arbitrary, especially in comparison to the thorough usage seen in many other EIA assemblages (e.g., Plug 1984b; Voigt 1984). It would seem that more concrete factors may have driven these choices. Time constraints could play a role in shaping these evidently wasteful decisions.

Time limitations could be imposed in a variety of ways. Large numbers of carcasses arriving on site in a short period of time means the meat would have to be processed rapidly to avoid spoilage (e.g., Friesen and Stewart 2013). In addition, if a site were occupied for only a limited time, it would also induce a similar need for carcass processing speed. In either or both cases, this type of situation might concentrate selection and utilization efforts on those elements or portions that proffered the best yield for time spent processing (e.g., Metcalfe and Jones 1988; Lupo 2006, p. 30; Lupo et al. 2013). Time-based selective use patterns would then be evident in the types of elements that were heavily and thoroughly exploited, as is seen at North American bison mass kill sites (e.g., Frison 1970; Widga 2004; Byerly et al. 2005; Bamforth 2011) and here in the Le6 and Le7 material. Therefore, selective use could be one strategy for dealing with limited processing time. There are also other signs of processing speed at these sites as well, such as the rate of deposition in the pits and ash heaps.

Rather than exhibiting the variable weathering types and severity associated with the gradual build-up of material (Behrensmeyer 1978), the rarity of severe weathering at these sites implies rapid burial (Fig. 2). Apart from scattered elements found at the surface of the features, there are no signs of significant exposure or gaps between deposition events in a single feature. The often complete, and un- or under-utilized skeletal remains in these features, display virtually identical weathering and overall taphonomic condition, indicating that

each faunal specimen (and the animals they came from) was captured and introduced to the deposits at the same relative times. There is no evidence of the kind of weathering, or layers of more extreme weathering, that one would expect if the pit fill had been slower. It seems that the occupants of Le6 and Le7 were obtaining essentially prodigious quantities of meat (evident in both the number and size of the species procured) for these 7–8 ha sites (Meyer 1986, p. 149) in some haste, which resulted in the rapid production of waste and subsequent discard and burial of the faunal remnants. The processing choices also display haste in action.

While it may take more time to de-flesh and fillet an uncooked element (Gifford-González 1993), chopping is faster than cutting when dismembering a carcass (Seetah 2006b). The presence of significant chops can indicate an interest in speed on the part of the butcher. Seetah (2006a, p. 100) specifically states that this type of deep and frequent chopping demonstrates a distinct “need to disarticulate the carcass rapidly,” and that if there were not a “need for fast ... dismemberment” such mark types and patterns would not be seen. Seetah (2006a, p. 223) goes on to list “chopped femoral heads [and] scoop marks” as two butchery points that can “point towards fast, economic methods of portioning” in archaeological assemblages. All of these aspects are found at Le6 and Le7. These butchering strategies also necessitate the use of the proper—if not specialized and task-specific—tools, a topic discussed in forthcoming work.

Even with the best tools, the butchery methods described above are not easy. While these techniques require less time, they require more effort in terms of physical strength and energy expenditure (Seetah 2006a, p. 223, 2006b). One may take for granted that butchery was a common activity in daily life during the EIA. However, it is far more difficult to execute some of these actions than others; chopping through a femoral head, as opposed to carefully cutting away the attaching ligaments, takes greater strength and a practiced hand. This ties back to the possibility of special skill on the part of the butcher (Seetah 2006b). In the Le6 and Le7 material, this experience is seen both in the types of butchery choices made and in the consistency present.

In other parts of the world, consistency in butchery patterns has been associated with the rise and development of professional butchers (Sykes 2014, p. 15). “Professionalism” and its many implications are not aspects I am in a position to address within the context of these sites and the EIA of southern Africa. Nevertheless, the similarities in the butchery between “professional” assemblages (e.g., Seetah 2006b) and those at Le6 and Le7 do speak to certain traits, qualities, and priorities on the part of those carrying out the processing. These similarities include the signs of speed and efficiency in utilizing the faunal remains, skill and practice in handling large mammals consistently, as well as a specific interest in certain products—as is apparent in the wasteful patterns at Le6 and Le7. It is essential to note that here waste or wastefulness does not relate to inexperience or sloppy practices on the part of the occupants at these sites (e.g., Seetah 2008). Rather, these patterns show waste in the sense that only particular products were consistently sought, selected, and utilized, with the remainder being discarded. These are highly conscious choices and signify specific value systems at work among the butchers and hunters at Le6 and Le7. In fact, returning to the concept of specialization, Seetah (2008, p. 141, emphasis added) states that practices where the bones are largely unprocessed and left unused “[are] highly wasteful and possible only within *specialized* societal situations.” Again, this means that these patterns point not to incidental actions nor accidental situations, but to intentional choices and strategies—in this case focussed around specialized (as in intensified) processing patterns.

Altogether, the signs of speed in processing, rapid refuse production, selective use, and even the targeting of the types of taxa that would maximize meat-yield for time spent hunting, all indicate that time was a significant factor in the strategies employed at Le6 and Le7. None of these or the other factors discussed above seem to comfortably align with the traditional interpretation of (and expected foodways at) typical small, full-time, residential EIA agro-pastoralist sites. Might Le6 and Le7 instead mark a new type of site for southern Africa, that is neither the classic full-time agro-pastoralist site (e.g., Meyer 1986; Huffman 2007, p. 3) nor a small-scale “temporary hunting camp” (Plug 1984a, p. 233)?

## Nature of the Sites

If Le6 and Le7 were, as originally interpreted, marginal but typical full-time EIA agro-pastoralist settlements, what would be the impetus to so selectively target large, “dangerous” species? Furthermore, the speed at which they were procured would be highly inconsistent with this type of site. If a site were occupied permanently, there would be no particular need to kill so many animals in such a short amount of time. In addition to these high-volume hunting choices, one would also not expect to see a focus on speed in processing nor, especially, significant portions of skeletal resources ignored at a continuously occupied site. These choices do not seem to correspond well with a small-scale residential site.

There is another possibility that seems to proffer the best fit with the given data: a high-intensity procurement and processing site, occupied for a shorter period of time. It should be noted that these processing sites are not necessarily a highly ephemeral, once-off hunting camp. As seen in the North American bison studies (e.g., Frison 1970; Logan 1998; Widga 2004; Byerly et al. 2005; Bamforth 2011), specialized kill and processing sites range from small sites where a handful of animals were processed once, to large-scale kill sites used again and again, and various combinations thereof. Therefore, this site type should not immediately be related to the small temporary hunting camps locally associated with Later Stone Age foragers (e.g., Huffman 2007, p. 3). Kill and processing sites may display a variety of characteristics (in terms of size, precise duration of occupation, or instances of repeated re-occupation). Despite that variation, there should be distinctive and identifiable patterning in the animal-use choices evident (i.e., intensified hunting and processing).

Le6 and Le7 are very similar to these types of specialized sites in terms of their main procurement and processing strategies. Everything from the distinct focus on the hunting of large wild ungulates, highly selective and systematic butchery patterns that emphasize speed, to even the almost wholesale discard of skeletal parts at the processing site (which produces a distinct skeletal element profile) evident in the Le6 and Le7 assemblages, is mirrored in the bison processing site assemblages (e.g., Frison 1970; Widga 2004; Byerly et al. 2005; Bamforth 2011). These are also not the only aspects Le6 and Le7 have in common with bison processing sites.



Given the nature of a shorter-term processing site, secondary travel and transport weight are introduced as additional parameters of use. As not all meat is being procured for immediate local consumption, decisions must be made about how that meat will be carried, not to mention preserved, to its final destination. Thus, if Le6, Le7, or any phase therein, was a kill site, there may be certain characteristics in preparation one would expect (e.g., Frison 1970; Gifford-González 1993; Widga 2004; Byerly et al. 2005; Bamforth 2011). For instance, there may be fewer signs of cooking, as not all meat procured was consumed on site (e.g., Gifford-González 1993). A similar dearth of usual cooking activities is evident at Le6 and Le7 in the burning. What burning that is present—most commonly manifest as scattered patches of brown or black burning on the long bones—may be indicative of occasional roasting and/or marrow warming (e.g., Gifford-González 1989; Kent 1993; Orton 2012). However, the scarcity of burning suggests that neither of these were activities regularly practised. The mostly uncooked, uneaten meat would then need to be preserved in some manner. As freezing was not an option for the southern African hunters of the EIA, smoking, salting, or drying are other ways by which to extend the usability of meat (see Rixson 1989; Friesen 2001; Henrikson 2003; Friesen and Stewart 2013).

Filleting is also a key part of certain preservation methods. This is particularly true for drying, during which meat must be removed from the fatty bones to facilitate proper dehydration and avoid putrefaction (Henrikson 2003). This presumably applies to salting and smoking too, as they also involve the removal of moisture from the meat. In the warm climate of the KNP, preservation processes would have to be started very quickly to prevent spoilage (Friesen and Stewart 2013).

Additionally, as long-distance transport may have been a crucial factor in decisions at such a kill site, it is also likely that meat would have been filleted from the bone simply because of weight issues (e.g., Bunn et al. 1988; Grayson 1989; Driver 1990; Gifford-González 1993; Kent 1993; Henrikson 2003; Lupo 2006).

This does not mean that there would have been no cooking at Le6 and Le7. Any portions that were eaten at the site during the larger processing activities may still display cooking damage. This type of low level, on-site consumption is highly likely, as the processing of the many large animals at Le6 and Le7 would have

taken considerable time (e.g., Kent 1993; Lupo 2006). There are examples of occasional cooking (particularly roasting, as it is faster than boiling [Kent 1993]) and long bone marrow extraction at processing sites (e.g., Frison 1970; Bunn et al. 1988; Kent 1993; Bamforth 2011), just as seen at Le6 and Le7.

Finally, it is not unknown for processing sites to be repeatedly re-used over time (e.g., Bamforth 2011; Frison 1970). A similar pattern of re-occupation could explain the amorphous medley of ash-filled pits and heaps that characterize Le6 and Le7. In fact, rather than Meyer's (1986, pp. 223, 226) interpretation of chronologically distinct longer-term occupation horizons, the lack of strata in the features, the palimpsest layout of the sites, the mostly Mzonjani ceramics with small-scale variations throughout (Alexander Antonites, personal communication; Jordaan 2011), and the scarcity of domestic debris (compared to the plethora of intensive hunting refuse) may suggest a shifting and more intermittent pattern of occupation. This would explain the ceramic variety between the features of a single purported occupation "phase". For example, if these re-occupations happened at relatively short intervals, perhaps yearly, there would likely only be slight changes in the ceramics, making the assemblage somewhat similar to that of a single continuous occupation but with more small-scale variation. Therefore, instead of a clearly defined progression from Le7(a) to Le6, and then back to Le7(b) (Meyer 1986: 223, 226), the suggestion here is of a more mixed and muddled sequence and use of space. It therefore seems these features may stem from repeated re-use and re-occupation of the area between the sites. However, over the whole period of use at Le6 and Le7, there always appears to have been the same intention and purpose behind the occupation of these sites: intensive (i.e., specialized) hunting and processing of large wild ungulates.

## Conclusions

If Le6 and Le7 are short-term, repeatedly occupied sites at which intensive procurement and processing strategies are employed, their place within the southern Africa EIA must be addressed. To the best of my knowledge, this would be a new use strategy and site type for this period and region. Having been identified, the drivers of such strategies should be considered as well.

Trade and long-distance provisioning are two possibilities (e.g., Alexander 1984; Driver 1990). Long-distance provisioning would involve a group from some community (likely located outside of the modern-day boundaries of the KNP and the pastoral-limiting factors therein), travelling to these sites to hunt and procure wild animal products. The meat and fat acquired from the large ungulates—along with skins, sinews, and other animal products intended for consumption, trade, tool production (e.g., bone sourced for bone tools), medicine, or various other purposes (Campbell 1822, p. 219; Stayt 1931, p. 70; van Warmelo 1932, p. 92; Perkins and Daly 1968; Emery 2009)—may have been acquired for community use and consumption back at a primary residential site (e.g., Driver 1990). This type of specialized activity pattern is coarsely comparable to those identified at the salt-production sites (e.g., Evers 1979; Plug 1999; Antonites 2005, 2013) and specialist metal smelting sites (e.g., Kiyaga-Mulindwa 1992; Plug and Pistorius 1999; Chirikure 2007) in this same region of southern Africa, where the archaeological sites were focussed around a single activity and occupations were both temporary and recurrent.

The situation, in terms of the identity of the occupants, might be the same if trade were the driver of this use. The difference would be that the products procured would not be for community consumption but for bartering or other exchange, likely beyond the community (e.g., Alexander 1984; Driver 1990). If these use patterns are instead trade-oriented, it also introduces the possibility of another aspect of specialization: that the Le6 and Le7 occupants are not just employing specialized strategies but are actually *specialists* in the hunting and processing of large wild mammals. This would mark the difference between Muller's (1984, p. 490, original emphasis) "*site* specialization and *producer* specialization." In terms of the latter type, there has been speculation about "professional hunters" (Plug and Pistorius 1999, 182) in the IA, though it has never been confirmed. Perhaps Le6 and Le7 indicate the existence of such specialists?

This possibility certainly requires further examination before any type of substantiation is possible, as does the question of why this type of intensification arose in this region of southern Africa. However, whether for long-distance provisioning or for trade, these sites appear to introduce a new use strategy for the

southern African EIA in their specialized practices. This not only sheds new light on one manifestation of wild-use within the widely varied spectrum of EIA faunal use but, hopefully, also exemplifies the broader social and archaeological questions that can be both asked and answered with faunal studies in southern Africa.

## Acknowledgments

First and foremost, all thanks go to my advisors, Annie Raath Antonites and Alexander Antonites—without whom none of this research would ever have happened. Alexander Antonites and the Department of Anthropology and Archaeology at the University of Pretoria provided financial support for the project. Permission was given by the University of Pretoria to analyse this material. Shaw Badenhorst and Wynand Van Zyl provided assistance and access to the Ditsong National Museum of Natural History collection, and Ina Plug assisted in distinguishing cattle from buffalo at these sites as well as in the discussion of this material. Catherine Schenck and Katja Douze aided in translating the French abstract. Tim Forssman assisted in the creation of Fig. 1. Karin Scott provided valuable comments on an earlier draft, and the anonymous reviewers also provided insightful commentary in honing this paper.

## References

Alexander, J. (1984). Early frontiers in southern Africa. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 12–23). Oxford: British Archaeological Series 207.

Antonites, A. (2005). *The salt of Baleni: An archaeological investigation into the organization of production during the Early Iron Age of South Africa*. M.A. Thesis, University of Pretoria.

Antonites, A. (2013). Archaeological salt production at the Baleni Spring,

northeastern South Africa. *South African Archaeological Bulletin*, 68(198), 105–118.

Antonites, A., Antonites, A. R., Kruger, N., & Roodt, F. (2014). Report on excavations at Penge, a first-millennium Doornkop settlement. *Southern African Humanities*, 26, 177–192.

Badenhorst, S. (2008). Subsistence change among farming communities in southern Africa during the last two millennia: A search for potential causes. In S. Badenhorst, P. Mitchell, & J. C. Driver (Eds.), *Animals and people: Archaeozoological papers in honour of Ina Plug* (pp. 215–228). Oxford: British Archaeological Series 1849.

Balasse, M., & Ambrose, S. H. (2005). Distinguishing sheep and goats using dental morphology and stable carbon isotopes in C4 grassland environments. *Journal of Archaeological Science*, 32, 691–702.

Bamforth, D. B. (2011). Origin stories, archaeological evidence, and Postclovis paleoindian bison hunting on the Great Plains. *American Antiquity*, 76(1), 24–40.

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

Betts, M. W., & Friesen, T. M. (2004). Quantifying hunter-gatherer intensification: A zooarchaeological case study from Arctic Canada. *Journal of Anthropological Archaeology*, 23, 357–384.

Boessneck, J. (1969). Osteological differences between sheep (*Ovis aries* Linné) and goat (*Capra hircus* Linné). In D. Brotherwell & E. Higgs (Eds.), *Science in archaeology: A survey of progress and research* (pp. 331–358). London: Thames and Hudson.

Brain, C. K. (1974). Some suggested procedures in the analysis of bone

accumulations from southern African Quaternary sites. *Annals of the Transvaal Museum*, 29, 1–7.

Brunton, S., Badenhorst, S., & Schoeman, M. H. (2013). Ritual fauna from Ratho Kroonkop: A second millennium AD rain control site in the Shashe-Limpopo confluence area of South Africa. *Azania: Archaeological Research in Africa*, 48(1), 111–132.

Bunn, H. T., Bartram, L. E., & Kroll, E. M. (1988). Variability in bone assemblage formation from Hadza hunting, scavenging, and carcass processing. *Journal of Anthropological Archaeology*, 7, 412–457.

Byerly, R. M., Cooper, J. R., Meltzer, D. J., Hill, M. E., & LaBelle, J. M. (2005). On Bonfire Shelter (Texas) as a Paleoindian bison jump: An assessment using GIS and zooarchaeology. *American Antiquity*, 70(4), 595–629.

Byerly, R. M., Cooper, J. R., Meltzer, D. J., Hill, M. E., & LaBelle, J. M. (2007). A further assessment of Paleoindian site-use at Bonfire Shelter. *American Antiquity*, 72(2), 373–381.

Byers, D. A. (2002). Paleoindian fat-seeking behaviour: Evidence from the Hell Gap Site, Locality II Agate Basin faunal assemblage. *Plains Anthropologist*, 47(183), 359–377.

Campbell, J. (1822). *Travels in South Africa, being a narrative of a second journey (1820)* (Vol. II). London: Westley.

Cannon, M. D., & Meltzer, D. J. (2004). Early Paleoindian foraging: Examining the faunal evidence for large mammal specialization and regional variability in prey choice. *Quaternary Science Reviews*, 23, 1955–1987.

Chirikure, S. (2007). Metals in society: Iron production and its position in Iron Age communities in southern Africa. *Journal of Social Archaeology*, 7(1), 72–100.

Costin, C. L. (1991). Craft specialization: Issues in defining, documenting, and explaining the organization of production. *Archaeological Method and Theory*, 3, 1–56.

Crabtree, P. J. (1990). Zooarchaeology and complex societies: Some uses of faunal analysis for the study of trade, social status, and ethnicity. *Archaeological Method and Theory*, 2, 155–205.

deFrance, S. D. (2009). Zooarchaeology in complex societies: Political economy, status, and ideology. *Journal of Archaeological Research*, 17, 105–168.

Denbow, J. (1990). Congo to Kalahari: Data and hypotheses about the political economy of the western stream of the Early Iron Age. *African Archaeological Review*, 8, 139–175.

Denbow, J., Smith, J., Ndobochani, N. M., Atwood, K., & Miller, D. (2008). Archaeological excavations at Bosutswe, Botswana: Cultural chronology, paleo-ecology and economy. *Journal of Archaeological Science*, 35, 459–480.

Dobney, K., & Rielly, K. (1988). A method for recording archaeological animal bones: The use of diagnostic zones. *Circaea*, 5(2), 79–96.

Driver, J. C. (1990). Bison assemblages from the Sierra Blanca Region, southeastern New Mexico. *Kiva*, 55(3), 245–263.

Efremov, I. A. (1940). Taphonomy: A new branch of paleontology. *Pan-American Geologist*, 74, 81–93.

Egeland, C. P. (2003). Carcass processing intensity and cutmark creation: An experimental approach. *Plains Anthropologist*, 48(184), 39–51.

Emery, K. F. (2009). Perspectives on ancient Maya bone crafting from a classic period bone-artifact manufacturing assemblage. *Journal of Anthropological*

*Archaeology*, 28(4), 458–470.

Evers, T. M. (1979). Salt and soapstone bowl factories at Harmony, Letaba District, Northeast Transvaal. *South African Archaeological Society Goodwin Series*, 3, 94–107.

Fraser, L. M., & Badenhorst, S. (2014). Livestock use in the Limpopo valley of southern Africa during the Iron Age. *South African Archaeological Bulletin*, 69(200), 192–198.

Friesen, T. M. (2001). A zooarcheological signature for meat storage: Re-thinking the drying utility index. *American Antiquity*, 66(2), 315–331.

Friesen, T. M., & Stewart, A. (2013). To freeze or to dry: Seasonal variability in caribou processing and storage in the barrenlands of Northern Canada. *Anthropozoologica*, 48(1), 89–109.

Frison, G. (1970). The Glenrock Buffalo Jump, 48CO304: Late Prehistoric period buffalo procurement and butchering. *Plains Anthropologist: Memoir 7: The Glenrock Buffalo Jump, 48CO304*, 15(50), 1–45.

Gertenbach, W. P. D. (1980). Rainfall patterns in the Kruger National Park. *Koedoe*, 23, 35–43.

Gifford-González, D. (1989). Ethnographic analogues for interpreting modified bones: Some cases from East Africa. In R. Bonnicksen & M. H. Sorg (Eds.), *Bone Modification* (pp. 179–246). Orono: Center for the Study of the First Americans.

Gifford-González, D. (1993). Gaps in zooarchaeological analyses of butchery: Is gender an issue? In J. Hudson (Ed.), *From bones to behaviour: Ethnoarchaeological and experimental contributions to the interpretation of faunal remains* (pp. 181–199). Carbondale: Southern Illinois University.



Grayson, D. (1989). Bone transport, bone destruction, and reverse utility curves. *Journal of Archaeological Science*, 16, 643–652.

Halstead, P. (2007). Carcasses and commensality: Investigating the social context of meat consumption in Neolithic and Early Bronze Age Greece. In C. Mee & J. Renard (Eds.), *Cooking up the past food and culinary practices in the Neolithic and Bronze Age Aegean* (pp. 25–48). Oxford: Oxbow Books.

Halstead, P., Collins, P., & Isaakidou, V. (2002). Sorting the sheep from the goats: Morphological distinctions between the mandibles and mandibular teeth of adult *Ovis* and *Capra*. *Journal of Archaeological Science*, 29, 545–553.

Henrikson, L. S. (2003). Bison freezers and hunter-gather mobility: Archaeological analysis of cold lava tube caves on Idaho's Snake River. *Plains Anthropologist*, 48(187), 263–285.

Huffman, T. N. (2000). Mapungubwe and the origins of Zimbabwe culture. *South African Archaeological Society Goodwin Series*, 8, 14–29.

Huffman, T. N. (2001). The central cattle pattern and interpreting the past. *Southern African Humanities*, 13, 19–35.

Huffman, T. N. (2007). *Handbook to the Iron Age, the archaeology of pre-colonial farming societies in Southern Africa*. Cape Town: University of Kwa-Zulu Natal Press.

Janzen, A., Reid, R. E. B., Vasquez, A., & Gifford-González, D. (2014). Smaller fragment size facilitates energy-efficient bone grease production. *Journal of Archaeological Science*, 49, 518–523.

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

Jordaan, G. (2011). Letaba: Between spaces; reanalysis of early farming settlements on the Letaba confluence. Honours dissertation. Pretoria: University of Pretoria.

Joubert, S. C. J. (1986). The Kruger National Park—An introduction. *Koedoe*, 29, 1–11.

Karr, L. P. (2015). Brewster site zooarchaeology reinterpreted: Understanding levels of animal exploitation and bone fat production at the Initial Middle Missouri type site. *Science and Technology of Archaeological Research*, 1(1), 1–13.

Karr, L. P., Short, A. E. G., Hannus, L. A., & Outram, A. K. (2014). A bone grease processing station at the Mitchell Prehistoric Indian village: Archaeological evidence for the exploitation of bone fats. *Environmental Archaeology*, 20(1), 1–12.

Kent, S. (1993). Variability in faunal assemblages: The influence of hunting skill, sharing, dogs, and mode of cooking on faunal remains at a sedentary Kalahari community. *Journal of Anthropological Archaeology*, 12, 323–385.

Kinahan, J. (1986). The archaeological structure of pastoral production in the central Namib desert. *South African Archaeological Society Goodwin Series*, 5, 69–82.

Kiyaga-Mulindwa, D. (1992). Iron-working at Makodu in eastern Botswana. In P. J. J. Sinclair & A. Juma (Eds.), *Urban origins in eastern Africa* (pp. 162–166). Upsala: Swedish Central Board of National Antiquities.

Kuper, A. (1982). *Wives for cattle: Bridewealth and marriage in Southern Africa*. London: Routledge & Kegan Paul.

- Logan, B. (1998). The fat of the land: White Rock phase bison hunting and grease production. *Plains Anthropologist*, 43(166), 346–366.
- Lupo, K. D. (2006). What explains the carcass field processing and transport decisions of contemporary hunter-gatherers? Measures of economic anatomy and zooarchaeological skeletal part representation. *Journal of Archaeological Method and Theory*, 13(1), 19–66.
- Lupo, K. D., Fancher, J. M., & Schmitt, D. N. (2013). The taphonomy of resource intensification: Zooarchaeological implications of resource scarcity among Bofi and Aka forest foragers. *Journal of Archaeological Method and Theory*, 20, 420–447.
- Lyman, R. L. (1994). *Vertebrate taphonomy*. Cambridge: Cambridge University Press.
- Lyman, R. L. (2005). Analyzing cut marks: Lessons from artiodactyl remains in the northwestern United States. *Journal of Archaeological Science*, 32, 1722–1732.
- Maggs, T. (1980). Mzonjani and the beginning of the Iron Age in Natal. *Annals of the Natal Museum*, 24(1), 71–96.
- Maggs, T., & Michael, M. (1976). Ntshekane: An Early Iron Age site in the Tugela Basin, Natal. *Annals of the Natal Museum*, 22(3), 705–740.
- Maggs, T., & Whitelaw, G. (1991). A review of recent archaeological research on food-producing communities in southern Africa. *Journal of African History*, 32(1), 3–24.
- Marean, C. W. (1991). Measuring the post-depositional destruction of bone in archaeological assemblages. *Journal of Archaeological Science*, 18, 677–694.
- Marean, C. W., & Spencer, L. M. (1991). Impact of carnivore ravaging on

zooarchaeological measures of element abundance. *American Antiquity*, 56(4), 645–658.

Marean, C. W., Domínguez-Rodrigo, M., & Pickering, T. R. (2004). Skeletal element equifinality in zooarchaeology begins with method: The evolution and status of the “shaft critique. *Journal of Taphonomy*, 2(2), 69–98.

Meester, J. A., Rautenbach, I. L., Dippenaar, N. . J., & Baker, C. M. (1986). Classification of southern African mammals. *Pretoria: Transvaal Museum Monograph*, 5.

Metcalf, D., & Jones, K. T. (1988). A reconsideration of animal body-part utility indexes. *American Antiquity*, 53(3), 486–504.

Meyer, A. (1986). *'n Kultuurhistoriese interpretasie van die Ystertydperk in die Nasionale Krugerwildtuin*. Ph.D. Dissertation, University of Pretoria.

Meyer, A. (1984). A profile of the Iron Age in the Kruger National Park, South Africa. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 215–227). Oxford: British Archaeological Series 207.

Morgan, C. (2015). Is it intensification yet? Current archaeological perspectives on the evolution of hunter-gatherer economies. *Journal of Archaeological Research*, 23, 163–213.

Morlan, R. E. (1994). Bison bone fragmentation and survivorship: A comparative method. *Journal of Archaeological Science*, 21, 797–807.

Morrison, K. D. (1994). The intensification of production: Archaeological approaches. *Journal of Archaeological Method and Theory*, 1(2), 111–159.

Muller, J. (1984). Mississippian specialization and salt. *American Antiquity*, 49(3), 489–507.

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

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

Outram, A. K. (2002). Bone fracture and within-bone nutrients: An experimentally based method for investigating levels of marrow extraction. In P. Miracle & N. Milner (Eds.), *Consuming passions and patterns of consumption* (pp. 51–63). Oxford: MacDonald Institute Monographs.

Perkins, D., & Daly, P. (1968). A hunter’s village in Neolithic Turkey. *Scientific American*, 219, 96–106.

Peters, J. (1988). Osteomorphological features of the appendicular skeleton of African buffalo, *Syncerus caffer* (Sparrman, 1779) and of domestic cattle, *Bos primigenius f. taurus* Bojanus 1827. *Z. Säugetierkunde*, 53, 108–123.

Phoca-Cosmetatou, N. (2005). Bone weathering and food procurement strategies: Assessing the reliability of our behavioural inferences. In T. O’Connor (Ed.), *Biosphere to lithosphere* (pp. 135–145). Oxford: Oxbow Books.

Pickering, T. R., Marean, C. W., & Domínguez-Rodrigo, M. (2003). Importance of limb bone shaft fragments in zooarchaeology: A response to ‘On in situ attrition and vertebrate body part profiles’ (2002), by M.C. Stiner. *Journal of Archaeological Science*, 30, 1469–1482.

Plug, I. (1979). Namakala and Nanga: Faunal report on two Early Iron Age sites, Zambia. *South African Archaeological Bulletin*, 34(140), 123–126.

Plug, I. (1984a). Man, animals and subsistence patterns during the Iron Age in the Kruger National Park. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 228–235). Oxford: British Archaeological Series 207.

Plug, I. (1984b). MNI counts, pits and features. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 357–362). Oxford: British Archaeological Series 207.

Plug, I. (1988). *Hunters and herders: An archaeozoological study of some prehistoric communities in the Kruger National Park*. Ph.D. Dissertation, University of Pretoria.

Plug, I. (1989a). Aspects of life in the Kruger National Park during the Early Iron Age. *South African Archaeological Society Goodwin Series*, 6, 62–68.

Plug, I. (1989b). Notes on distribution and relative abundances of some animal species, and on climate in the Kruger National Park during prehistoric times. *Koedoe*, 32(1), 101–119.

Plug, I. (1997). Early Iron Age buffalo hunters on the Kadzi River, Zimbabwe. *African Archaeological Review*, 14(2), 85–105.

Plug, I. (1999). Some Early Iron Age communities of the Eastern escarpment and lowveld, South Africa: A faunal perspective. *Archaeozoologia*, X, 189–200.

Plug, I. (2000). Overview of Iron Age fauna from the Limpopo Valley. *South African Archaeological Society Goodwin Series*, 8, 117–126.

Plug, I., & Pistorius, J. C. C. (1999). Animal remains from industrial Iron Age communities in Phalaborwa, South Africa. *African Archaeological Review*,

16(3), 155–184.

Prummel, W., & Frisch, H.-J. (1986). A guide for the distinction of species, sex and body side in bones of sheep and goat. *Journal of Archaeological Science*, 13, 567–577.

Raath, A. (2014). *An archaeological investigation of Zhizo/Leokwe foodways at Schroda and Pont Drift, Limpopo Valley, South Africa*. Ph.D. Dissertation, Yale University.

Rixson, D. (1989). Butchery evidence on animal bones. *Circaea*, 6(1), 49–62.

Russell, N. (2011). *Social zooarchaeology: Humans and animals*. Cambridge: Cambridge University Press.

Sadr, K., & Plug, I. (2001). Faunal remains in the transition from hunting to herding in southeastern Botswana. *South African Archaeological Bulletin*, 56(173/174), 76–82.

Sadr, K., Smith, A., Plug, I., Orton, J., & Mütti, B. (2003). Herders and foragers on Kasteelberg: interim report of excavations 1999-2002. *South African Archaeological Bulletin*, 58(177), 27–32.

Sampson, C. G. (1984). A prehistoric pastoralist frontier in the Upper Zeekoe Valley, South Africa. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 96–110). Oxford: British Archaeological Series 207.

Schaller, O. (Ed.) (2007). *Illustrated veterinary anatomical nomenclature* (2nd ed.). Stuttgart: Enke Verlag.

Schoeman, M. H. (2009). Excavating the ‘waterpits in the mountain’: The archaeology of Shashe-Limpopo Confluence Area rain-hill rock tanks. *Southern African Humanities*, 21, 275–298.

Seetah, K. (2006a). *Butchery as an analytical tool: A comparative study of the Romano-British and Medieval Periods*. Ph.D. Dissertation, University of Cambridge.

Seetah, K. (2006b). Multidisciplinary approach to Romano-British cattle butchery. In M. Maltby (Ed.), *Integrating zooarchaeology* (pp. 109–116). Oxford: Oxbow Books.

Seetah, K. (2008). Modern analogy, cultural theory and experimental replication: A merging point at the cutting edge of archaeology. *World Archaeology*, 40(1), 135–150.

Skinner, J. D., & Chimimba, C. T. (2005). *The mammals of the southern African sub-region*. Cambridge: Cambridge University Press.

Smith, A. B. (1986). Competition, conflict and clientship: Khoi and San relationships in the Western Cape. *South African Archaeological Society Goodwin Series*, 5, 36–41.

Spielmann, K. A. (2002). Feasting, craft specialization, and the ritual mode of production in small-scale societies. *American Anthropologist*, 104(1), 195–207.

Stayt, H. (1931). *The BaVenda*. London: Oxford University Press.

Stiner, M. C. (1991). Food procurement and transport by human and non-human predators. *Journal of Archaeological Science*, 18, 455–482.

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

Sykes, N. (2014). *Beastly questions: Animal answers to archaeological issues*.



London: Bloomsbury.

Thorp, C. (1997). Evidence for interactions from recent hunter-gatherer sites in the Caledon Valley. *African Archaeological Review*, 14(4), 231–256.

Titoy, G. A. P. (1994). Socio-economic impact of nagana. *Protozoology*, 10, 1–23.

Turner, G. (1987a). Early Iron Age herders in northwestern Botswana: The faunal evidence. *Botswana Notes and Records*, 19, 7–23.

Turner, G. (1987b). Hunters and herders of the Okavango Delta, northern Botswana. *Botswana Notes and Records*, 19, 25–40.

Twiss, K. (2012). The archaeology of food and social diversity. *Journal of Archaeological Research*, 20(4), 357–395.

Van Warmelo, N. J. (1932). *Contributions towards Venda history, religion, and tribal ritual. [Ethnological Publications Vol. III]*. Union of South Africa: Department of Native Affairs.

Voigt, E. A. (1983). *Mapungubwe: An archaeozoological interpretation of an Iron Age community*. Pretoria: Transvaal Museum Monograph No.1.

Voigt, E. A. (1984). Iron Age faunal analysis—Problems and possibilities. In M. Hall, G. Avery, D. M. Avery, M. L. Wilson, & A. J. B. Humphreys (Eds.), *Frontiers: Southern African archaeology today* (pp. 352–356). Oxford: British Archaeological Series 207.

Voigt, E. A. (1986). Iron Age herding: Archaeological and ethnoarchaeological approaches to pastoral problems. *South African Archaeological Society Goodwin Series*, 5, 13–21.

Voigt, E. A., & Von den Driesch, A. (1984). Preliminary report on the faunal

assemblage from Ndondondwane, Natal. *Annals of the Natal Museum*, 26(1), 95–104.

Whitelaw, G. (2009). An Iron Age fishing tale. *Southern African Humanities*, 21, 195–212.

Widga, C. (2004). Early Archaic subsistence in the Central Plains: The Spring Creek (25FT31) fauna. *Plains Anthropologist*, 49(189), 25–58.

Yellen, J. E. (1991). Small mammals: !Kung San utilization and the production of faunal assemblages. *Journal of Anthropological Archaeology*, 10, 1–26.

Zeder, M. A., & Lapham, H. A. (2010). Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science*, 37(11), 2887–2905.

Zeder, M. A., & Pilaar, S. E. (2010). Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science*, 37, 225–242.

Binford, L.R. (1981). *Bones: Ancient Men and Modern Myths*. New York: Academic Press.

Plug, I. (1993) The macrofaunal remains of wild animals from Abbot's Cave and Lame Sheep Shelter, Seacow Valley, Cape. *Koedoe*, 36(1), 15–26.