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The Middle Stone Age fauna from the DC member of Cave 1B at Klasies River main site, South Africa: Animal exploitation during the MSA II

Rialivhuwa Ratshinanga [a], Sarah Wurz [b,c], Shaw Badenhorst [d,*]

[a] School of Geosciences, University of the Witwatersrand, Private Bag 3, Wits, 2050, South Africa
[b] School of Geography, Archaeology and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits, 2050, South Africa
[c] Centre for Early Sapiens Behavior (SapienCE), University of Bergen, Bergen, Norway
[d] Evolutionary Studies Institute, University of the Witwatersrand, Private Bag 3, Wits, 2050, South Africa

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ABSTRACT

Klasies River main site (KRM) is a prominent Middle Stone Age (MSA) site located on the southern Cape coast in the Eastern Cape province of South Africa. This contribution discusses the animal remains from the DC member in Cave 1B not reported on before. These animals fall within MSA II (Mossel Bay) techno-complex that, at KRM, dates from before 110 to 78ka. Despite heavy fragmentation, the fauna from this period shows a variety of taxa, including mammals, birds, reptiles, amphibians, fish and molluscs. The most common taxa in the sample include indeterminate medium and small mammals, tortoises, indeterminate small birds, Cape fur seals, and indeterminate Bovid I and II's. The presence of several stacked hearths, shellfish, lithics and burnt and butchered bones all suggest that humans were the main agent of accumulation of the fauna. This is further supported by low values for the carnivore-ungulate ratio, the carnivore richness- and the leopard index, which measures the probabilities of brown hyena, leopard and human accumulations. However, the presence of chew marks presumably caused by carnivores suggests brown hyenas or leopards accumulated, or had access to some fauna. Assuming that humans accumulated most fauna, there is evidence of a summer occupation at KRM during the MSA II. People were exploiting a variety of environments during the MSA II, including coastal dunes, grasslands, savanna woodlands and closed, bush environments. During the MSA II at KRM, people focused on hunting ungulates.

1. Introduction

The Middle Stone Age (MSA) in southern Africa dates to between 300 and c. 22ka and is associated with anatomically modern humans (*Homo sapiens*) with complex behaviours. In particular, the Eastern and Western Cape provinces of South Africa host several deeply stratified and well-dated MSA sites (overviews in Wadley, 2015; Wurz, 2024). During the MSA, people exploited a variety of small, medium and large prey in this region. However, there were regional and temporal differences in game selection (Badenhorst et al., 2022a; also see Badenhorst and Plug, 2012). Nevertheless, people were effectively exploiting the environments around shelters (Badenhorst et al., 2022a). In general, faunal samples from the MSA in the (mainly) coastal Eastern and Western Cape of South Africa often contain ungulates, large dangerous prey (Badenhorst et al., 2021a) such as the extinct long-horned African buffalo (*Syncerus antiquus*, Milo, 1998), as well as tortoises (Thompson and Henshilwood, 2014) and birds (Val et al., 2016). A prominent MSA site from the Eastern and Western Cape region of South Africa is Klasies River main site (KRM). In this paper, we report the fauna from the DC member at KRM, as part of the MSA II techno-complex (Morrissey et al., 2023). This study aims to investigate the relationship between environmental conditions and human hunting strategies during the MSA at KRM, specifically focusing on the DC member of Cave 1B. This research seeks to understand how these factors influenced the selection and exploitation of various prey animals, providing insights into the subsistence practices of early modern humans and their adaptive responses to changing ecological contexts in the Eastern Cape of South Africa.

2. Klasies River main site

Klasies River main site is one of the prominent MSA sites in Africa owing to its extensive deposits and associated publications (Fig. 1, Wurz,

* Corresponding author.
E-mail address: shaw.badenhorst@wits.ac.za (S. Badenhorst).

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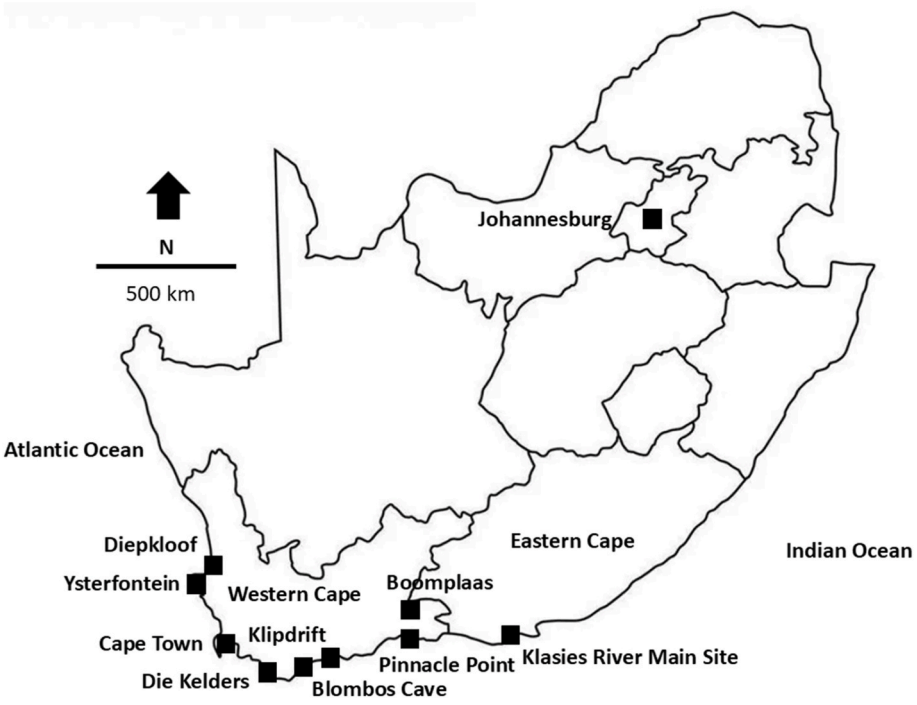


Fig. 1. Location of KRM in South Africa, and other sites mentioned in the text. The modern cities of Johannesburg and Cape Town are also shown.

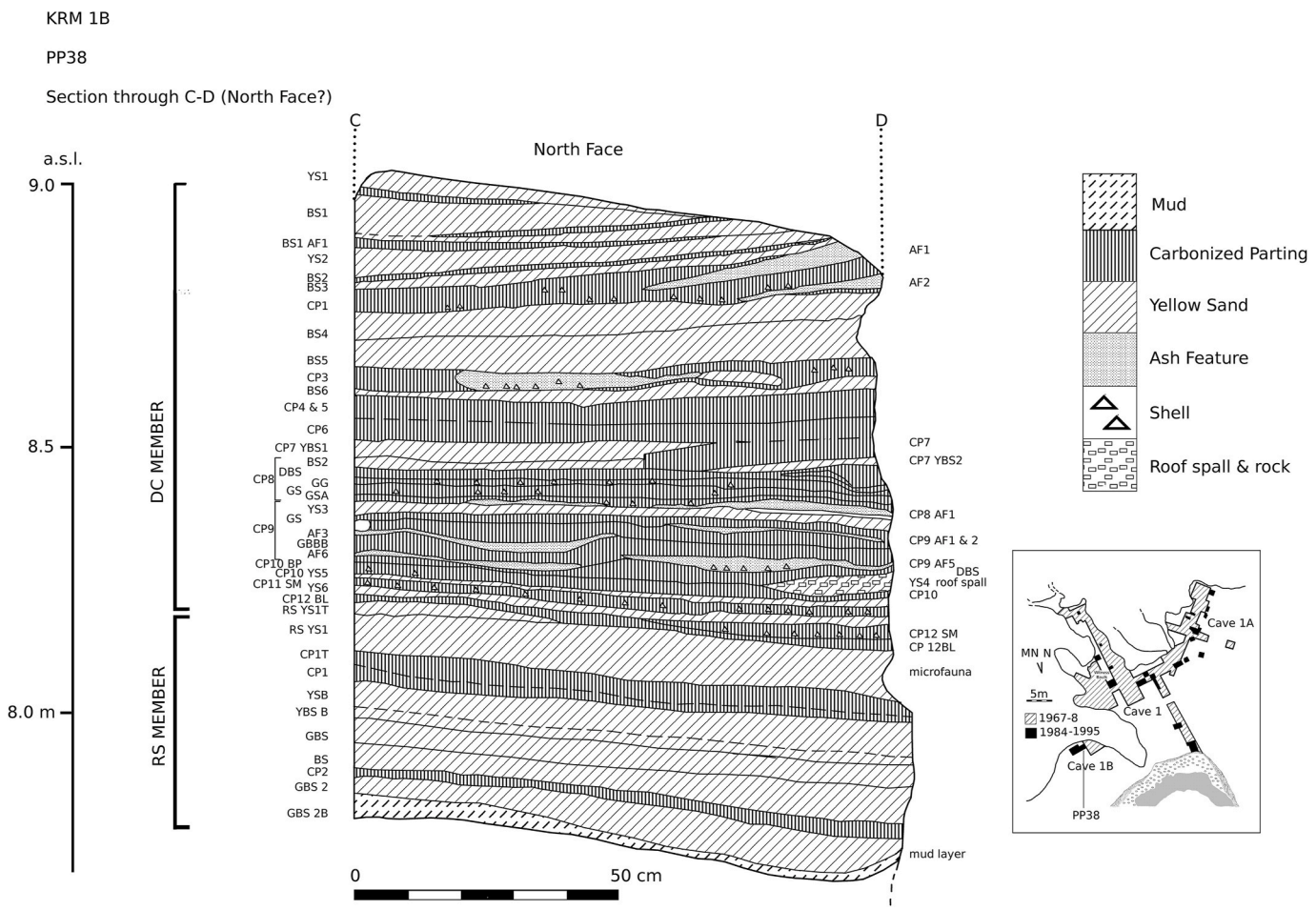


Fig. 2. The DC member from KRM Cave 1B, north face (stratigraphic drawing from the Deacon archive of field notes). Note that not all the layers appear on this drawing, see Morrissey et al. (2023) Table 3 for a full description of the layers of the DC member).

Table 1
Previous studies on MSA II mammal remains at KRM. The data are listed according to NISP/MNI. From Klein (1976)[a] and Van Pletzen-Vos et al. (2019)[b].

Taxa	Cave 1 MSA II[a]	Cave 1A MSA II[a]	Cave 1 & 1A MSA II Upper[b]	Cave 1 (SASW, SASR from Witness Baulk) MSA II Upper[b]	Cave 1 (SASU from Witness Baulk) MSA II Lower[b]	SM1-SCB2 MSA II Lower[b]
Orycteropus afer (aardvark)			6/-	6/-	21/-	
Procavia capensis (rock hyrax)	-/45	-/8	87/-	38/-	301/-	33/-
Loxodonta africana (elephant)	-/3					
Lepus capensis (Cape hare)	-/1			1/-		
Lepus sp. (hare)			1/-			
Bathyergus siullus (Cape dune molerat)			1/-	1/-	5/-	
Georychus capensis (mole rat)	-/7					
Hystrix africaeaustralis (porcupine)	-/18	-/2	2/-			
Homo sapiens (human)	-/6	-/1				
Papio ursinus (chacma baboon)	-/5				2/-	
Indeterminate Primate					1/-	
Parahyeana brunnea (brown hyena)	-/3				4/-	
Panthera pardus (leopard)	-/9					
Caracal cf. *caracal* (possibly caracal)	-/3					
Felis silvestris (wildcat)	-/1	-/1				
Herpestes ichneumon (Egyptian mongoose)	-/3					
Galarella pulverulenta (Cape grey mongoose)	-/5					
Atilax paludinosus (water mongoose)	-/1					
Lupulella mesomelas (black-backed jackal)	-/1					
Aonyx capensis (clawless otter)	-/7				2/-	
Mellivora capensis (honey badger)	-/2					
Arctocephalus pusillus (Cape fur seal)	-/50	-/23		39/-	211/-	
Arctocephalus sp. (seal)			110/-			29/-
Mirounga leonina (elephant seal)	-/1					
Indeterminate carnivore			18/-	8/-	7/-	
Diceros bicornis (black rhinoceros)	-/4					
Equus cf. *quagga* (quagga)	-/2					
Equus sp. (zebra)			1/-		2/-	3/-
Potamochoerus larvatus (bushpig)	-/2					
Phacochoerus africanus (warthog)	-/1					
Suid sp. (warthog/bushpig)			2/-	1/-	1/-	
Hippopotamus amphibius (hippopotamus)	-/10				6/-	
Cetacea sp. (whale/dolphin sp.)	-/1				1/-	
Delphinidae sp. (dolphin)	-/7					
Syncerus caffer (African buffalo)	-/29	-/5	8/-	3/-	23/-	1/-
Syncerus antiquus (long-horned African buffalo)	-/32	-/5			3/-	3/-
Tragelaphus strepsiceros (kudu)	-/10	-/3	1/-		16/-	1/-
Tragelaphus scriptus (bushbuck)	-/20		2/-	2/-	21/-	
Tragelaphus oryx (eland)	-/80	-/18	14/-	7/-	49/-	5/-
Tragelaphine (bushbuck/kudu)					2/-	
Connochaetes sp. (wildebeest)	-/8					
Alcelaphus/Connochaetes (Hartebeest/wildebeest)			6/-			
Damaliscus pygragus (bontebok/ blesbok)			1/-			
Damaliscus sp.	-/2					
cf. Alcelaphinae sp.				2/-	10/-	
Hippotragus leucophaeus (bluebuck)	-/32	-/11	1/-	1/-	12/-	5/-
Hippotragus sp. (roan/sable/ bluebuck)			2/-			4/-
Philantomba monticola (blue duiker)			1/-	1/-		
Sylvicapra grimmia (common duiker)					2/-	1/-
Redunca arundinum (southern reedbuck)			2/-			
Redunca cf. *arundinum* (possible southern reedbuck)	-/3	-/3				
Redunca fulvorufula (mountain reedbuck)	-/3					
Redunca sp. (reedbuck)					5/-	
cf. *Redunca* sp. (possible reedbuck)						1/-
Pelea capreolus (grey rhebok)	-/5	-/2			1/-	1/-
Antidorcas sp. (springbok)	-/4					
Ourebia ourebi (oribi)	-/2					
Raphicerus melanotis (Cape grysbok)	-/49	-/6		21/-	53/-	

(*continued on next page*)

Table 1 (*continued*)

Taxa	Cave 1 MSA II[a]	Cave 1A MSA II[a]	Cave 1 & 1A MSA II Upper[b]	Cave 1 (SASW, SASR from Witness Baulk) MSA II Upper[b]	Cave 1 (SASU from Witness Baulk) MSA II Lower[b]	SM1-SCB2 MSA II Lower[b]
Raphicerus sp. (Cape grysbok/ steenbok)			22/-			2/-
Bovidae I/Small			350/-	233/-	375/-	13/-
Bovidae I-II/Small-Medium			131/-	71/-	228/-	28/-
Bovidae II/III/Medium-Large			91/-	49/-	260/-	67/-
Bovidae III/Large			77/-			20/-
Bovidae III-IV/Large-Very Large				25/-	200/-	
Indeterminate Bovid			52/-	48/-	144/-	12/-
Indeterminate Mammal			189/-	167/-	436/-	33/-
Total	**-/477**	**-/88**	**1178/-**	**724/-**	**2404/-**	**262/-**

2023). The site consists of two caves, Caves 1 and 2, and two overhangs, Caves 1A and 1B and is situated on the Tsitsikamma coast, Eastern Cape of South Africa, about 0.5 km from the Klasies River (Deacon and Geleijnse, 1988; Deacon and Wurz, 2005; Wurz et al., 2018). KRM falls within the Greater Cape Floristic Region of the southern and south-western Cape of South Africa and fynbos, forest and thicket vegetation surround the site (Mucina and Rutherford, 2006; Van Wijk et al., 2017).

The site has a complex depositional history, with MSA deposits broadly dating between Marine Isotope Stages (MIS) 5 and 3 (Singer and Wymer, 1982; Deacon and Geleijnse, 1988). Ongoing work is refining the temporal extent of deposits at the site (e.g. Wurz et al., 2022). Wymer initially excavated the site in all the caves and identified from layer 40 at the base to layer 1 at the top (Singer and Wymer, 1982). Singer and Wymer (1982) divided the deposits into five cultural stages, from oldest to youngest, the MSA I, MSA II, Howiesons Poort, MSA III and MSA IV. Subsequent smaller-scale excavations by Deacon grouped the deposits into five members linked to the Singer & Wymer layers (Deacon and Geleijnse, 1988), sub-dividing the MSA II into the MSA II lower and MSA II upper (Wurz, 2002). From bottom to the top, the KRM members are Light Brown Sand (LBS, Caves 1, 1A, 1B); Rubble Brown Sand (RBS, Caves 1, 1B, 1A, but this member's designation is being revised, see Morrissey et al., 2023); Shell and Sand (SAS, Caves 1, 1A, 1B); Rock Fall (RF, Cave 1A), Upper (Cave 1A) and White Sand (WS, Cave 1) (Deacon and Geleijnse, 1988).

The faunal sample reported here is from the MSA II cultural phase from Cave 1B, square PP38, excavated by Deacon. The uppermost layers of the MSA II in Cave 1B to the west of square PP38 were excavated by Henderson (1992), but not included in this analysis. The analysed sample is part of the DC (Dark Carbonised) member (Fig. 2). The DC member is dominated by several stacked hearths containing shellfish, lithics and animal remains (Morrissey et al., 2023). The excavated material was sieved using a 3 × 2 mm mesh (Deacon and Geleijnse, 1988). There are no ages for the DC member itself, but it is associated with the SAS member in Caves 1 and 1A. The base of the SAS member is older than 110ka in Cave 1 (Wurz et al., 2022), whereas the youngest date for the MSA II upper in Cave 1A is 78ka (Wurz, 2023). The DC member in Cave 1B is underlain by the RS (Rubble Sand) member, associated with MSA I artefacts. Detailed information on how the RS member in Cave 1B relates to the LBS and RS members in Caves 1 and 1A is not available, as the contexts differ in the various caves, and there is no dating of the RS member itself. The LBS member in Cave 1/1A is older than 110ka, and possibly extends into MIS 6 (Reynard and Wurz, 2020; Wurz et al., 2022; Morrissey et al., 2023).

Several faunal samples have been studied from the MSA II techno-complex at KRM excavated by Wymer (Klein, 1976) and Deacon (Van Pletzen-Vos et al., 2019; Reynard and Wurz, 2020). These studies, which have large sample sizes (Badenhorst et al., 2022b), show a high taxa diversity, with primates, carnivores, small animals and ungulates represented. In particular, ungulates are particularly common, with lesser frequencies of small game (Table 1). The MSA II at KRM falls within Marine Isotope Stages 5d-5a, which included the interglacial period with cool conditions, as well as a warmer phase (Wadley, 2015) with the presence of extensive grasslands and fynbos in the southern parts of the GCFR (Reynard, 2021). This is supported by the presence of ungulate species such as wildebeest (*Connochaetes* sp.), buffalo (*Syncerus caffer*) and Cape grysbok (*Raphicerus melanotis*) in MSA II faunal samples (Table 1).

3. Agents of faunal accumulation in shelters

Before turning to the fauna from the DC member at KRM, the role of various agents of faunal accumulation must first be considered, since it influenced the methods used in the study. In shelters used during the MSA in the Eastern and Western Cape of South Africa such as KRM, there is often ambiguity as to the main agent of faunal accumulation, and the role of secondary agents. These agents of accumulation include humans, brown hyenas (*Parahyaena brunnea*), leopards (*Panthera pardus*), porcupines (*Hystrix africaeaustralis*) and birds of prey. Various criteria have been established to recognise these agents of accumulation. Raptors such as the Cape eagle owls (*Bubo capensis*) often feed on small game, including rock hyraxes (*Procavia capensis*), Cape dune molerats (*Bathyergus suillus*) and Cape grysbok/steenbok (*Raphicerus* sp.). Large quantities of these small mammals may indicate raptor activity. In addition, faunal samples of small animals accumulated by raptors are often dominated by maxillae detached from brain cases, mandibles, complete long bones and digested remains (Klein and Cruz-Uribe, 2000; Henshilwood et al., 2001; Steele and Klein, 2013).

Several MSA sites in the Eastern and Western Cape have evidence of some carnivore activity in accumulating animal remains such as (and at least some) small ungulates (e.g. Marean et al., 2000; Thompson, 2010; Thompson and Henshilwood, 2011; Faith, 2013; Reynard and Henshilwood, 2017, 2018, 2019). Samples accumulated by brown hyenas typically show chew marks (Blumenschine, 1988), evidence of juvenile hyenas (Kuhn et al., 2010), hyena coprolites (Cruz-Uribe, 1991) and a lack of cultural artefacts (Scott and Klein, 1981). Brown hyena samples tend to have a high diversity of carnivore species (e.g. Scott and Klein, 1981; Pickering, 2002; Kuhn et al., 2010; Badenhorst and Siteto, 2024), since brown hyenas frequently prey on other carnivores (Mills and Mills, 1977; De Ruiter et al., 2008; Fourvel et al., 2018; Badenhorst et al., 2021b). In particular, the presence of black-backed jackals (*Lupulella mesomelas*) may be a signal of brown hyena activity (Klein et al., 1999). Humans rarely made use of carnivores (but see Val et al., 2020) and while the dietary niches of humans overlapped with those of brown hyenas, the former was able to regularly bring down large and dangerous prey (e.g. Klein and Cruz-Uribe, 2000; Van Pletzen, 2000; Avery et al., 2008; Rector and Reed, 2010; Steele and Klein, 2013; Reynard et al., 2016a,b; Van Pletzen-Vos et al., 2019; Reynard and Wurz, 2020; Ezeimo et al., 2024). The Cape fur seal (*Arctocephalus pusillus*) is a regular prey of brown hyenas in coastal regions, and their vertebrae are often common in such samples, as well as a wide range of seal ages (Klein et al., 1999).

Leopards often prey on medium-sized ungulates, baboons (*Papio ursinus*) and rock hyraxes (Brain, 1981; Thackeray, 1990; Badenhorst et al., 2014, 2021b). The presence of these animals may be suggestive of leopard activity

(Thackeray, 1990), especially baboons (Badenhorst, 2022). However, some of these animals, such as medium-sized ungulates and rock hyraxes, were also favoured prey to humans (Badenhorst et al., 2014, 2021b).

The process of equifinality can mimic different agents of accumulation; for example, humans may also leave chew marks on bones (Brain, 1967; Romero et al., 2016). The size of the tooth marks caused by carnivores (Pobiner, 2008) overlaps between different taxa (Delaney-Rivera et al., 2009). While digested bones are usually considered to be the result of carnivore (or large raptor) activity, humans also often swallow skeletal remains (Brain, 1967; Dewar and Jerardino, 2007; Clark, 2019). All of this is further complicated by differential preservation of skeletal elements (Lyman, 1994).

Human occupations and faunal accumulations are usually recognised through material remains such as lithics, hearths, ornamentation, bone tools, shellfish, butchery marks, burnt bone and a high fragmentation of long bones (e.g. Brain, 1981; Thompson and Henshilwood, 2011; Thackeray, 2007). For smaller taxa, such as rock hyraxes and hares (*Lepus* sp.), forelimbs outnumber the hind-limbs, post-crania outnumber crania (Cruz-Uribe and Klein, 1998), and high fragmentation of long bones (Badenhorst et al., 2014) all indicate human consumption.

4. Materials and methods

The fauna from the DC member was analysed following Driver (2005), a frequently used method of analysis in South Africa (see references in Badenhorst et al., 2022b). According to this method, all specimens of which the element can be established, are considered identifiable. The remaining fauna are unidentifiable (also see Driver, 1982, 1991 for detailed motivation of this method). The identifications were done using the skeletal collections housed at the Evolutionary Studies Institute (University of the Witwatersrand, Johannesburg, South Africa) and the Ditsong National Museum of Natural History (Pretoria, South Africa). In addition to taxon and element, the following were recorded using a coding system during analysis (Driver, 2005): portion of the elements, side, maximum length, modification and cortical thickness. We used general age categories to access the state of long bone fusion (neonate, juvenile, sub-adult, adult), following Driver (2005). Juveniles were recognised by the presence of unfused diaphyses and epiphyses. In adults, all diaphyses and epiphyses are fully fused (also see Reitz and Wings, 2008). We distinguish between the following fracture patterns of long bones: intact, irregular, spiral or transverse (Driver, 2005; also see Marshall, 1989; Lyman, 1994). We distinguish between the different colours of burnt bone, notably brown, black, grey and white (see Gilchrist and Mytum, 1986). The indeterminate bovid size classes follow Brain (1974).

The fauna was quantified using the two most widely-used methods of quantification, the Number of Identified Specimens and the Minimum Number of Individuals (NISP, MNI, Perkins, 1973; Casteel, 1977; Grayson, 1984; Klein and Cruz-Uribe, 1984; Lyman, 2008; Plug and Plug, 1990; Reitz and Wings, 2008). A normed Number of Identified Specimens (nNISP) was used to calculate the skeletal part representation, as some elements (e.g. phalanges) occur in higher numbers compared to other elements (e.g. humeri). The nNISP is the number of elements recorded as NISP values divided by the number of times each element occurs in a bovid skeleton (e.g. Van Pletzen-Vos et al., 2019).

To infer the potential role of different agents of accumulation, we used several approaches. First, we recorded all visible modifications using macroscopic analysis. Second, we employed three indices that have been shown to reliably distinguish between human, brown hyena and leopard samples in the Eastern and Western Cape during the MSA (Badenhorst et al., 2021b), namely the leopard index (Thackeray, 1990), the carnivore-ungulate ratio (Klein, 1975), and the carnivore richness index (Badenhorst and Siteto, 2024) using NISPs. These indices, especially the carnivore-ungulate ratio have been widely used in Africa (e.g. Cruz-Uribe, 1991; Kuhn et al., 2010; Van Pletzen-Vos et al., 2019; Ezeimo et al., 2024), the Levant and Europe (e.g. Rabinovich et al., 2004; Dusseldorp, 2013; Orbach and Yeshurun, 2021). Some samples from KRM excavated by Wymer were reported using the Minimum Number of Individuals only (Klein, 1976). However, previous studies have shown that similar results using indices calculated by NISP and MNI can be obtained (Badenhorst et al., 2021b, also see Fraser and Badenhorst, 2014; Badenhorst, 2018).

Table 2
Sample size of the DC member.

Cultural Phase	Identified Specimens (NISP)	Unidentified Specimens	Total Sample	Percentage Identified
MSA II upper	352	2298	**2650**	13 %
MSA II lower	847	13 480	**14 327**	6 %
Total	**1199**	**15 778**	**16 977**	**7 %**

The leopard index measures the ratio between baboons and leopards against the total number of ungulates in samples (Thackeray, 1990; Badenhorst et al., 2021b). Baboons are frequent prey of leopards (Badenhorst, 2022). A high ratio indicates a sample with a high probability of leopard activity. The carnivore-ungulate ratio measures the ratio between carnivores and ungulates in samples. This index reflects the potential role of brown hyenas, who frequently consume other carnivores (Klein, 1975; Brain, 1981; Thackeray, 1990; Badenhorst et al., 2021b). Often, as is the case for many MSA coastal sites from the Eastern and Western Cape in South Africa, the Cape fur seal makes up a substantial proportion of the fauna (e.g. Klein, 1976; Grine and Klein, 1993; Klein and Cruz-Uribe, 2000; Van Pletzen, 2000; Avery et al., 2008; Rector and Reed, 2010; Badenhorst et al., 2016; Reynard and Wurz, 2020). Since the high frequencies of seals in samples can potentially mask the role of brown hyenas as agents of accumulation, Badenhorst et al. (2021b) excluded seals from their carnivore-ungulate calculations. We followed this convention in this paper. The carnivore richness index also reflects brown hyena activities, as it measures the ratio of the number of carnivore and ungulate taxa in samples. Higher values are associated with brown hyena accumulations (Badenhorst and Siteto, 2024). The effectiveness of using these ratios in inferring the role of humans, leopards and brown hyenas in samples from the Eastern and Western Cape from the MSA has been well established (Badenhorst et al., 2021b; Badenhorst and Siteto, 2024).

We also utilised the game index to investigate patterns of faunal exploitation during the MSA II at KRM. The game index measures the ratio between small game such as rock hyraxes and Cape dune molerats against the number of ungulates. Higher values indicate samples dominated by small game (Badenhorst, 2015; Badenhorst et al., 2022a). In addition, we calculated the modified degree of vegetation cover (MDVC) index (Greenacre and Vrba, 1984; Thackeray, 1990; Badenhorst et al., 2022a). This index compares the ratio of kudu (*Tragelaphus strepsiceros*), bushbuck (*Tragelaphus sylvaticus*) and Cape grysbok/-steenbok to the remaining number of ungulates in samples. Kudus, bushbuck and Cape grysbok/steenbok prefer closed, bush environments (Skinner and Chimimba, 2005). We excluded the indeterminate bovidae from the MDVC calculations. Higher values of the MDVC index reflect more closed environments, or that people hunted animals in such environments.

5. Results

5.1. Sample size and fragmentation

The faunal sample from the DC member contains 16, 977 specimens, of which 1199 (7 %) were identified, and 15, 778 (93 %) remains were unidentified (Table 2). Most specimens (identified + unidentified) are from the MSA II lower cultural phase. Based on the lengths of the identified specimens, most specimens are less than 3 cm in length (Fig. 3), indicating a highly fragmented sample. The species

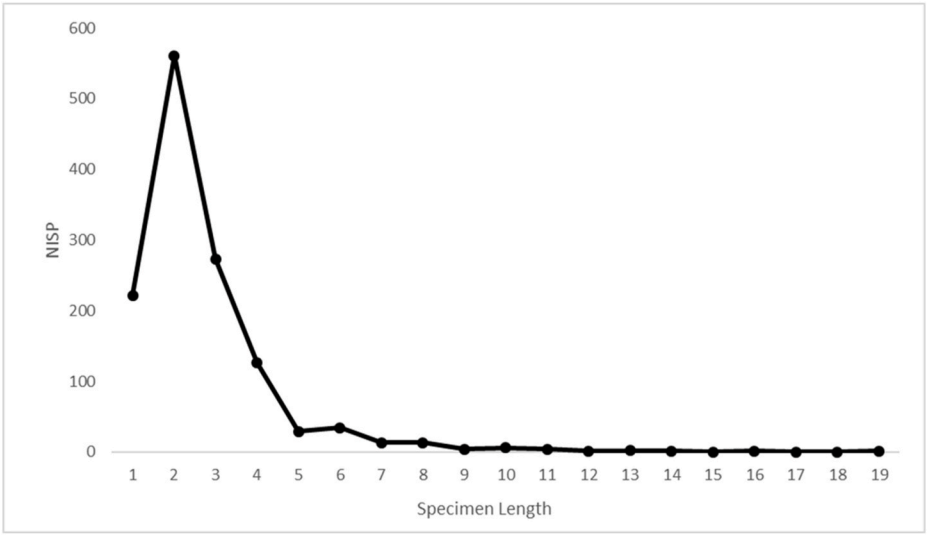


Fig. 3. The lengths of the identified specimens.

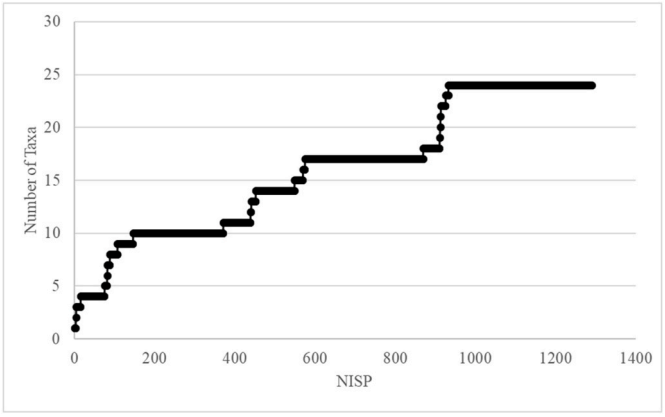


Fig. 4. Species accumulation curve of the DC member (based on the NISP and nTaxa, see Badenhorst et al., 2022b).

accumulation curve, based on the NISP and nTaxa, indicates that the sample is sufficiently large (Fig. 4, Badenhorst et al., 2022b).

5.2. Taxa present

The DC member contains mammals, birds, reptiles, amphibians, fish and molluscs (Table 3). Here, we combine all the layers due to the small sample size per individual layer, but the data are available for each layer (Ratshinanga, 2022). The most commonly identified taxa in the sample, based on NISP include indeterminate medium mammal, indeterminate small mammal, tortoise, indeterminate small bird, Cape fur seal, indeterminate Bovidae I and indeterminate Bovidae II. Many of the indeterminate medium mammals are possibly Cape fur seals, and many of the indeterminate small mammals and Bovidae I are likely species such as rock hyrax and Cape grysbok/steenbok (based on the relative abundance of these species in the sample). The Bovidae are represented by at least 13 species, but they all occur in very low numbers in the sample. Tortoise is represented by shell fragments only and fish by cranials and vertebrae.

The leopard index for the sample is 0.73 (Table 3), which is much lower than the leopard accumulations at Boomplaas Cave (ranging between 19.57 and 41.97 for layers LOH, OCH, BOL and OLP), which had significant leopard activity (Badenhorst et al., 2021b). This suggests that the role of leopards was not substantial in accumulating the DC member. The carnivore-ungulate ratio and the carnivore richness index are both low, 3.28 and 0.19, respectively, and similar to other largely anthropogenic accumulations in the Eastern and Western Cape during the MSA (Badenhorst et al., 2021b). These indices suggest a low probability of leopard and brown hyena activity in accumulating or accessing the fauna from the DC member.

5.3. Taphonomy

Considering the identified and unidentified specimens, burnt bone is very common in the DC member sample and present in most layers, amounting to 84 % of the total sample (Table 4). This is not surprising, considering the presence of several stacked hearths in the DC member (Morrissey et al., 2023). Most specimens are burnt brown and black. The high level of burning likely contributed to the heavy fragmentation of the sample. The presence of hearths and the high frequency of burnt bone all support the indices that the fauna from the DC member was accumulated by humans.

Butchery marks, including both cut and chop marks, occur on 313 specimens (identified using macroscopic analysis), representing 2 % of the overall sample size (Table 5). The presence of butchery marks supports the notion, along with the presence of several hearths, burnt bone and indices, that humans largely accumulated the faunal sample from the DC member.

Only 18 specimens, representing 0.1 % of the total sample, yielded carnivore chew marks (assuming that the marks were caused by carnivores, Table 6). Most of the specimens with chew marks (n = 14) are from unidentified specimens, whereas the identified specimens with chew marks include Cape grysbok/steenbok and indeterminate mammals. The presence of chew marks indicates at least some carnivore activity. Rodent gnaw marks are present on a total of 21 specimens.The rodent gnaw marks were caused by a small rodent.

5.4. Long bone breakage

The most common breakage pattern on long bones (humerus, radius, ulna, femur, tibia, metapodial, phalange) are dry breaks, *viz.* irregular and transverse breakage, accounting for 72 % of the long bone specimens (Table 7). Spiral breaks, which are common on fresh bone, are less common, and present on 28 % of the long bone specimens.

Table 3
Identified taxa per NISP and MNI for the DC member.

Taxa	MSA II Upper NISP	MSA II Lower NISP	Total NISP/ MNI
Papio ursinus (chacma baboon)	2	0	**2/1**
Aonyx capensis (clawless otter)	1	2	**3/1**
Arctocephalus pusillus (Cape fur seal)	17	38	**55/3**
Indeterminate small carnivore	1	2	**3/1**
Indeterminate small-medium carnivore	0	3	**3/1**
Otomys sp. (vlei rat)	8	2	**10/1**
Indeterminate rodent	16	19	**35/2**
Procavia capensis (rock hyrax)	6	16	**22/4**
Sylvicapra grimmia (common duiker)	0	4	**4/1**
Philantomba monticola (blue duiker)	0	3	**3/1**
Raphicerus melanotis (Cape grysbok)	1	2	**3/1**
Raphicerus campestris (steenbok)	0	6	**6/1**
Raphicerus sp. (Cape grysbok/ steenbok)	13	23	**36/3**
Redunca fulvorufula (mountain reedbuck)	2	4	**6/1**
Oreotragus oreotragus (klipspringer)	1	5	**6/1**
Ourebia ourebi (oribi)	0	2	**2/1**
Alcelaphus buselaphus (red hartebeest)	1	2	**3/1**
Connochaetes (wildebeest)	0	1	**1/1**
Tragelaphus scriptus (bushbuck)	3	2	**5/1**
Tragelaphine (bushbuck/kudu)	4	4	**8/-**
Tragelaphus oryx (eland)	0	3	**3/1**
Syncerus caffer (African buffalo)	0	2	**2/1**
Syncerus antiquus (long-horned African buffalo)	0	1	**1/1**
Bovidae I	15	48	**63/2**
Bovidae II	17	45	**62/4**
Bovidae III	6	39	**45/3**
Bovidae IV	5	10	**15/2**
Indeterminate small mammal	25	136	**161/4**
Indeterminate small-medium mammal	5	36	**41/2**
Indeterminate medium mammal	79	136	**215/4**
Indeterminate medium-large mammal	1	18	**19/2**
Indeterminate large mammal	3	23	**26/3**
Phalacrocorax capensis (Cape cormorant)	1	3	**4/2**
Spheniscus demersus (African penguin)	10	23	**33/4**
Indeterminate small bird	2	72	**74/7**
Indeterminate small-medium bird	7	14	**21/2**
Indeterminate medium bird	20	29	**49/1**
Indeterminate large bird	0	3	**3/1**
Chelonia (tortoise)	65	35	**100/1**
Indeterminate small reptile	10	11	**21/3**
Aura sp. (frog)	0	4	**4/1**
Sparidae sp. (mussel cracker)	0	6	**6/1**
Indeterminate small fish	2	9	**11/1**
Indeterminate medium fish	2	1	**3/1**
Indeterminate marine invertebrate (molluscs)	1	0	**1/1**
Total NISP	**352**	**847**	**1197**

5.5. Bovid skeletal part representation

The identified bovid skeletal part representation indicates that teeth, which are very dense elements and which preserve well, are also the most common (Table 8, Fig. 5). Overall, lower leg bones, especially of small bovids, are also common. The sample is dominated by small bovids, followed by medium-sized bovids, with very large bovids being the least represented. No pelvic remains were recovered, and these elements are not particularly dense.

Table 4
Burnt specimens from the DC member (number of specimens, including both identified and unidentified specimens).

Cultural Phase	Brown	Black	Grey	White	Total	% of Sample Burnt
MSA II upper	1606	611	221	165	**2603**	98 %
MSA II lower	4714	5177	1049	778	**11 718**	82 %
Total	**6320**	**5788**	**1270**	**943**	**14 321**	**84 %**
Percentage	**44**	**40**	**9**	**6**		

Table 5
Butchery marks on identified and unidentified specimens using macroscopic analysis from the DC member (number of specimens).

Cultural Phase	Cut	Chop	% with Butchery Marks
MSA II upper	35	9	2 %
MSA II lower	223	46	2 %
Total	**258**	**55**	**2 %**

Table 6
Carnivore chew and rodent gnaw marks (number of specimens).

Cultural Phase	Carnivore Chew Marks	Rodent Gnaw Marks	% with Chew & Gnaw Marks
MSA II upper	4	2	<1 %
MSA II lower	14	19	<1 %
Total	**18**	**21**	**<1 %**

Table 7
Long bone breakage (number of specimens).

Breakage Pattern	N	Percentage
Irregular	131	62
Transverse	20	10
Spiral	60	28
Total	**211**	**100**

Table 8
Bovid skeletal part representation (NISP and normed NISP). The normed NISP is rounded off.

Elements	Bov I	Bov II	Bov III	Bov IV	Total	Normed NISP
Cranium	6	5	3	1	**5**	**5**
Tooth	12	19	23	5	**59**	**3**
Scapula	3	2	1	0	**6**	**3**
Humerus	5	1	1	1	**8**	**4**
Radius	2	0	1	0	**3**	**2**
Ulna	1	4	1	0	**6**	**3**
Carpal	11	6	1	0	**18**	**3**
Femur	0	1	2	0	**3**	**2**
Patella	0	2	2	0	**4**	**2**
Tibia	5	4	4	4	**17**	**9**
Tarsal	8	6	3	1	**18**	**6**
Metapodial	20	11	8	1	**40**	**10**
Phalange	42	15	11	6	**74**	**3**
Total	**115**	**76**	**61**	**19**	**261**	
Percentage	**44**	**29**	**23**	**7**	**100**	

5.6. Ageing

The majority of teeth in the sample are from adult individuals (Ratshinanga, 2022) and do not provide evidence for the time of the year of death. However, long bones of several taxa are unfused, including penguin (n = 1), rock hyrax (n = 5), Cape fur seal (n = 15), klipspringer (*Oreotragus oreotragus*, n = 2), possibly steenbok (cf. *Raphicerus campestris*, n = 2) and Cape grysbok/steenbok (n = 1).

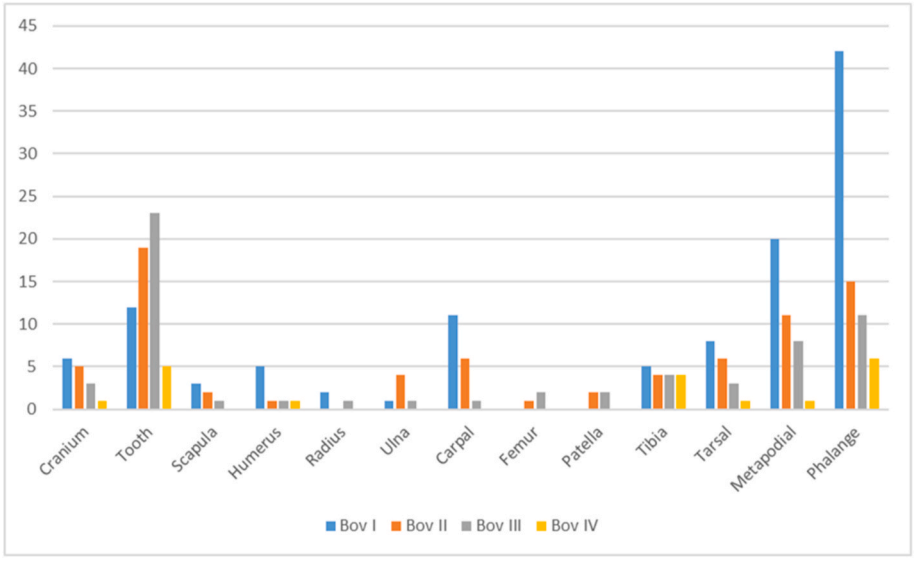


Fig. 5. Bovid skeletal part representation (NISP).

6. Discussion and conclusion

The faunal sample size from the DC member is sufficient (Badenhorst et al., 2022b) to allow for valid interpretations, and the high level of fragmentation is not unusual (e.g. Badenhorst and Plug, 2011). For example, the underlying RS member from Cave 1B (MSA I), which was studied using the same set of methods, had 6 % identified specimens (Ezeimo et al., 2024). The high incidence of burning likely contributed to the high level of fragmentation, in addition to post-depositional fracturing of bones, as reflected in the dominance of irregular and transverse breakage.

MSA faunas from KRM have been central to the 'Klasies Pattern' debate. According to this pattern, the upper and distal limb bones of large bovids are underrepresented, compared to more complete small bovids (Klein, 1976, 1989). This has been interpreted as evidence of inefficient hunting and scavenging, thus indicating that early modern humans in the MSA lacked fully developed cognitive and technological abilities (Klein, 2000). The Klasies Pattern is also present in the sample from the DC member. However, the Klasies Pattern has been widely debated. First, the older samples excavated by Wymer were handpicked during excavations, and as a result, smaller and fragile specimens were likely under-represented in samples, skewing transport and processing patterns. Carnivore activity and long bone fragmentation could also account for many aspects of the Klasies Pattern without invoking cognitive inferiority (Bartram and Marean, 1999). The high degree of burnt bone and fragmentation may also have resulted from deliberate processing for marrow and grease extraction rather than scavenging or inefficient hunting (Milo, 1998). Moreover, early humans likely transported high-utility skeletal elements to shelters while leaving low-utility portions behind, a pattern consistent with many ethnographically documented hunter-gatherer groups (Marean and Cleghorn, 2003).

Binford (1984) applied ethnoarchaeological and taphonomic models to the MSA fauna from KRM, arguing that early humans scavenged rather than actively hunted. He based this argument, in the main, on the dominance of low-yield skeletal elements and the presence of carnivore damage. His views have been widely criticized. Carnivore damage does not necessarily indicate primary scavenging but may reflect secondary access by carnivores after human processing (Bartram and Marean, 1999). Skeletal element distribution of small bovids at KRM aligns with high-utility transport decisions seen in ethnographic hunter-gatherer groups, indicating that people were selectively transporting high-value skeletal parts rather than opportunistically scavenging entire carcasses (Marean and Cleghorn, 2003). It is now widely accepted that early modern humans were skilled and effective hunters.

Table 9
The carnivore-ungulate ratio, carnivore richness index and leopard index for MSA II samples at KRM (based on Table 1). The carnivore-ungulate ratio excludes seals (following Badenhorst et al., 2021b) and is based on NISP. Klein (1976) did not report any indeterminate Bovidae, and only reported MNIs.

Sample	Carnivore – Ungulate Ratio	Carnivore Richness Index	Leopard Index
Cave 1 & 1A MSA II Upper (Van Pletzen Vos et al., 2019)	2.36	0.08	0.00
Cave 1 (SASW, SASR from Witness Baulk) MSA II Upper (Van Pletzen Vos et al., 2019)	1.72	0.11	0.00
Cave 1 (SASU from Witness Baulk) MSA II Lower (Van Pletzen Vos et al., 2019)	0.92	0.17	0.14
Cave 1/1A AA43/Z44, SM1-YS1B + SCB2-SCB2BCP MSA II (Van Pletzen Vos et al., 2019)	0.00	0.09	0.00
Cave 1 MSA II (Klein, 1976)	11.44	0.38	4.58
Cave 1A MSA II (Klein, 1976)	1.89	0.2	0.00
Cave 1B DC member MSA II (this study)	3.28	0.19	0.73

There are indications for several agents of accumulation of the fauna from the DC member. The presence of several stacked hearths, shellfish, lithics, butchered and burnt bone all point to repeated occupations by humans during the MSA II at KRM. In addition, the sample contains a very low leopard-index, carnivore-ungulate ratio and carnivore richness index values, further supporting the notion that humans were the main agent of bone accumulations of the DC member. Nevertheless, there are indications of carnivore involvement in accumulating the fauna from the DC member, or had secondary access to bone remains after human processing. The presence of carnivore chew marks suggests possible leopard or brown hyena activity. Moreover, leopards regularly feed on baboons (Badenhorst, 2022), rock hyraxes and small antelopes such as Cape grysbok and steenbok (Thackeray, 1990; Skinner and Chimimba, 2005; Badenhorst et al., 2021b), all of which are present in the DC member sample. It is therefore possible that at least some of these taxa were accumulated by leopards. However, brown hyenas cannot be excluded; these carnivores could also have used the shelter as temporary habitation, or scavenged bones following periods of human occupation. Nevertheless, humans were the main agents of accumulation of the DC member.

Table 10
The game index for MSA II samples at KRM (from Table 1, this study).

Sample	Total NISP	MDVC (NISP)	Game Index
Cave 1 & 1A MSA II Upper (Van Pletzen Vos et al., 2019)	1178	0.40	0.10
Cave 1 (SASW, SASR from Witness Baulk) MSA II Upper (Van Pletzen Vos et al., 2019)	724	0.61	0.08
Cave 1 (SASU from Witness Baulk) MSA II Lower (Van Pletzen Vos et al., 2019)	2404	0.43	0.18
Cave 1 SM1-YS1B + SCB2-SCB2BCP MSA II Lower (Van Pletzen Vos et al., 2019)	262	0.13	0.02
Cave 1 MSA II (Klein, 1976)	–	–	0.15
Cave 1A MSA II (Klein, 1976)	–	–	0.13
Cave 1B DC member MSA II (this study)	1199	0.56	0.07

The low probabilities of leopard and brown hyena activity in the DC member are also reflected in other MSA II samples from KRM (Table 9). Reynard's (2022) microscopic study of the MSA II L fauna from Cave 1 Witness Baulk (Wurz excavations), also confirms this view. However, the index values are elevated for the larger sample from Cave 1 MSA II excavated by Wymer (Klein, 1976), suggesting that carnivores were involved. However, not all the faunal specimens were retained in this particular case (Shipman, 1986; Bartram and Marean, 1999), and this may also have influenced the index values.

Having established that humans were the main accumulator of fauna during the MSA II at KRM, the game index indicates that people focused on hunting ungulates (Table 10, Fig. 6). In particular, small Cape grysbok/steenbok are common in faunal samples. Small, often fast-reproducing game animals, in particular rock hyraxes, Cape dune molerats and hares (*Lepus* sp.), played a smaller role in the subsistence practices of people during the MSA II at KRM. The focus on ungulates at KRM during the MSA II is in contrast to some other MSA sites in the Western Cape, such as Blombos Cave (M3 phase, which is broadly contemporaneous with the younger part of the MSA II at KRM) and Die Kelders (layers 6, 10, 12 and 14), where people focussed their efforts on obtaining these small animals (although Cape grysbok/steenbok are also common in these samples, Badenhorst et al., 2014; Armstrong, 2016; Badenhorst et al., 2016; Badenhorst et al., 2022a). The different focus in hunting strategy between sites such as KRM during the MSA II and other samples may relate to various social, technological, palaeoenvironmental and biological reasons. Viewed from a foraging theory perspective, it is expected that people would have exploited larger animals based on energetic returns (e.g. Marean and Cleghorn, 2003). However, when small game like rock hyraxes and Cape dune molerats is abundant and/or easy to capture, they become attractive prey that is obtained at a lower risk, despite their lower caloric return, thus becoming a more reliable and energetically efficient target than larger, more dangerous or rare prey (e.g. Blumenschine, 1991; O'Connell et al., 1991; Lupo and O'Connell, 2002; Lupo, 2007). The Cape dune molerats live in sandy substrates below 300 m in altitude (Skinner and Chimimba, 2005), and such suitable dune environments may not have been present close to KRM during the MSA II. Populations of rock hyraxes are often severely affected by droughts and diseases (Wimberger et al., 2009), which can easily cause local extinctions. However, the possibility cannot be excluded that people were not interested in obtaining and consuming these animals on a large scale at KRM during the MSA II due to other reasons.

Rhinoceros are not common at MSA sites in the Eastern and Western Cape of South Africa (summary in Badenhorst et al., 2021a). Klein (1976) identified some specimens from Cave 1 from the MSA II. Remains of these large mammals, as well as those of elephants and hippopotami, are usually represented by a few isolated specimens only. People likely camped at carcasses of such large mammals for several days, resulting in few bones returning to shelters (Badenhorst et al., 2021a). Wildebeest has not been recorded from the Western Cape of South Africa during the last few centuries, although the black wildebeest (*Connochaetes gnou*) was known historically from the northern parts of the Eastern Cape (Du Plessis, 1969). During the MSA however, several sites yielded evidence for black wildebeest in the Western Cape (Klein, 1983; Klein and Cruz-Uribe, 2000; Cruz-Uribe et al., 2003; Avery et al., 2008; Reynard et al., 2016a; Wurz et al., 2018), indicating a much wider distribution in the distant past.

Small, medium and large birds are present in the DC member sample, of which only the penguin (*Spheniscus demersus*) and Cape cormorant (*Phalacrocorax capensis*) were identified. Birds such as penguins fall prey to brown hyenas (Siegfried, 1984; Kuhn et al., 2008) and may have been introduced by these carnivores. However, humans could also have killed these birds (e.g. Avery, 1984). Some bird remains have evidence of burning (Ratshinanga, 2022), but these could have been burnt incidentally after people made fires in Cave 1B (e.g. De Graaff, 1961). Similarly, tortoises are prey to both humans and brown hyenas (Mills and Mills, 1977), and it is uncertain who accumulated these remains. The frog and indeterminate reptile remains could be self-introduced.

Mussel crackers, as intertidal fish, have previously been identified from the MSA II at KRM. Intertidal fish tend to move into crevices and under rocks (Von den Driesch, 2004), where they can easily be caught. However, penguins and cormorants could have nested inside KRM, and brown hyenas also feed on fish (Von den Driesch, 2004). It was previously suggested that the well-preserved fish from KRM lack any signs of digestion, and the presence of several large taxa that required considerable effort to hunt may mean that people actively obtained fish during the MSA (Von den Driesch, 2004, see also Van Niekerk, 2011).

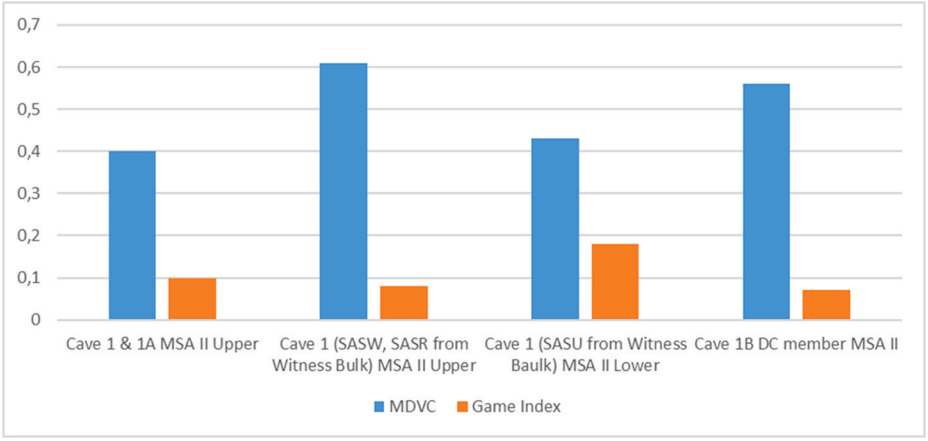


Fig. 6. The game index and modified degree of vegetation cover values for MSA II samples at KRM (NISP only, excluding the small sample from Cave 1 SM1-YS1B + SCB2-SCB2BCP MSA II).

Table 11
Peak birthing periods for taxa represented by young individuals in the DC member.

Taxon	Birth Peak	Reference
Cape penguin	Summer	Maclean (1984)
Rock hyrax	September–October	Millar (1971)
Cape fur seal	November–December	Skinner and Chimimba (2005)
Steenbok	November–December	Skinner and Chimimba (2005)
Cape grysbok	September–December	Skinner and Chimimba (2005)

The presence of young individuals of several taxa, including penguin, rock hyrax, Cape fur seal, steenbok and Cape grysbok shed light on the likely period of occupation of the DC member. Assuming that humans accumulated the vast majority of animal remains in the DC member, many of these taxa have birth peaks in the warmer summer months (Table 11).

Assuming that recent animal diets can be used as a proxy for past habitat preferences (but see Faith, 2011 for challenging this assumption), several animals suggest a varied environment during the MSA II at KRM that people were exploiting. The presence of shellfish, fish, penguins and Cape fur seals all indicate a shoreline close to KRM during MSA II to allow frequent visits. Several taxa are at home in coastal dune environments, apart from the Cape dune molerat, such as rock hyraxes, several ungulates and tortoises, and it was a rich niche that people exploited (Badenhorst et al., 2022a). Other animals, such as klipspringers, are at home in rocky environments, such as those found at KRM. Some ungulates from faunal samples from the MSA II at KRM are often associated with open, grassland environments (e.g. zebra [*Equus* sp.], extinct long-horned African buffalo, African buffalo, red hartebeest [*Alcelaphus buselaphus*], oribi [*Ourebia ourebi*]), with others preferring a savanna woodland setting (e.g. kudu, wildebeest, southern reedbuck [*Redunca arundinum*], mountain reedbuck [*Redunce fulvorufula*]), and others closed environments with bush cover (e.g. bushbuck, blue duiker [*Philantomba monticola*], common duiker [*Sylvicapra grimmia*], Cape grysbok, Skinner and Chimimba, 2005). The MDVC values are high for MSA II samples at KRM (only using NISPs, and excluding the small sample from Cave 1 SM1-YS1B + SCB2-SCB2BCP MSA II Lower), ranging between 0.40 and 0.61 (average: 0.50, Table 10). This all suggests people were exploiting the variety of environments that existed around KRM during the MSA II (see also Van Pletzen-Vos et al., 2019; Reynard and Wurz, 2020).

KRM has several faunal samples that pre- and postdate the MSA II (Table 12). In all cases, the carnivore-ungulate ratio (CU) and the carnivore richness index (CRI) are low, indicating that at KRM, brown hyenas played a very small to no role in accumulating or accessing faunal remains (apart from the MSA II sample in Cave 1 of Klein, 1976). However, Reynard et al. (2024) found evidence for a more intense role of carnivores in the post-Howiesons Poort (MSA III) in Cave 1A, where a high carnivore-ungulate ratio (9.52) and carnivore richness index (0.38), but low leopard index (0.0) suggest that brown hyenas were the responsible agents (this sub-sample is reported in Reynard and Wurz, (2020) and Van Pletzen-Vos et al., [2019]). Overall, the leopard index is low for all KRM samples, indicating that these carnivores had limited to no role in accumulating fauna at the site.

The MDVC values for the different cultural phases at KRM, excluding the small sample size from AA43/Z44 (MSA I), vary between 0.27 and 0.50. During MSA I and III at KRM, grazers outnumber browsers, and during MSA II, the proportion of browsers increased relative to grazers (Table 13). Taking cognizance that ungulates have preferential foods but may switch during times of scarcity (e.g. Plug, 2014), sample size affects the number of taxa present in a sample (Badenhorst et al., 2022b), and people may have targeted animals for a variety of reasons (e.g. Badenhorst and Plug, 2012), this all indicates that people at KRM had access to animals found in open grasslands, savanna woodlands and closed, bush environments, in additional to coastal dunes (Fig. 7).

The game index is highest for MSA I, then declines during MSA II and the Howiesons Poort, only to rise again during MSA III. The rises are caused almost exclusively by the relative increase in rock hyraxes compared to ungulates in the samples. The game index decreases to zero (or near zero) when rock hyraxes are removed from the calculations. At other MSA sites in the Western Cape, notably Blombos Cave (M3 phase), Die Kelders (layers 6, 10, 12 and 14), Diepkloof (MSA Mike, Lower MSA), Klipdrift (PCA/PCB, PAU-PAW) and Ysterfontein (Upper, Lower) (Avery et al., 2008; Steele and Klein, 2013; Armstrong, 2016; Badenhorst et al., 2016; Reynard et al., 2016b), the game index is also high with large quantities of rock hyraxes and Cape dune molerats. However, in some cases, other agents of accumulation may have contributed fauna to these samples (Badenhorst et al., 2022a). At other MSA sites in the

Table 13
Feeding preferences for ungulates at KRM (based on Plug, 2014).

Sample, Deacon member, cultural phase & reference	nTaxa Browsers	nTaxa Grazers	nTaxa Mixed Feeders
RS, Cave 1B, Ezeimo et al. (2024), AA43/Z44, Cave 1/1A, MSA I, Van Pletzen-Vos et al., 2019	4	8	3
SAS & DC, Caves 1,1A,1B, MSA II (Tables 9 and 10)	9	8	2
Upper, Cave 1A, HP, Reynard and Wurz, 2020; Van Pletzen-Vos et al. (2019)	3	3	3
Upper, Cave 1A, MSA III, Reynard and Wurz 2020, Van Pletzen-Vos et al. (2019)	4	6	5

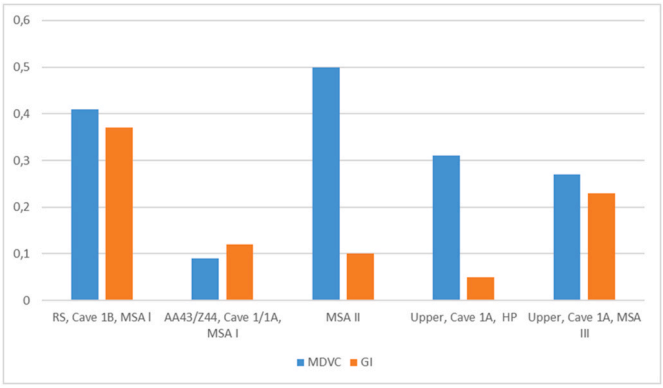


Fig. 7. The modified degree of vegetation cover and game index values from KRM.

Table 12
The MIS stages, the carnivore-ungulate, carnivore richness and leopard index, MDVC and game index values for KRM samples. For the MDVC, only samples with NISPs are used. For MSA II, ranges and averages are based on Tables 9-10.

Sample, Deacon member, cultural stage & reference	MIS	C-U	CRI	LI	MDVC (total NISP)	GI
RS, Cave 1B, MSA I, Ezeimo et al. (2024)	c. 5d-e	0.43	0.17	0.43	0.41 (1219)	0.37
AA43/Z44, Cave 1/1A, MSA I, Van Pletzen-Vos et al. (2019)	c. 5d-e	0.94	0.08	0.00	0.09 (282)	0.12
Collated, SAS & DC, Caves 1,1A,1B, MSA II (see Tables 9 and 10)	c. 5d-a	0.00–11.44	0.08–0.38	0.00–4.58	0.50 (5767)	0.10
Upper, Cave 1A, HP, Reynard and Wurz, 2020; Van Pletzen-Vos et al. (2019)	4–3	0.90	0.08	0.00	0.31 (418)	0.05
Upper, Cave 1A, MSA III, Reynard and Wurz 2020, Van Pletzen-Vos et al. (2019)	3	4.22	0.13	0.00	0.27 (595)	0.23

region, ungulates outnumber small game such as at Pinnacle Point (Rector and Reed, 2010), Klasies River Mouth (Table 12), and the remaining phases and layers at Blombos Cave, Diepkloof, Klipdrift and Ysterfontein (Badenhorst et al., 2022a).

In conclusion, this study of the faunal remains from the DC member of Cave 1B at KRM reveals insights into the subsistence strategies of early modern humans during the MSA. The evidence indicates that humans were the primary agent of faunal accumulation, as demonstrated by the presence of stacked hearths, burnt and butchered bones, and low carnivore-ungulate, carnivore richness and leopard indices. The diverse range of taxa identified, including ungulates and small mammals, reflects a complex and adaptive hunting strategy that was responsive to varying environmental conditions. People were effectively exploiting a variety of habitats close to KRM, including coastal dunes and grasslands, primarily focusing on larger game.

CRediT authorship contribution statement

Rialivhuwa Ratshinanga: Writing – original draft, Validation, Investigation, Formal analysis. **Sarah Wurz:** Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Shaw Badenhorst:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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