The use of faunal evidence to reconstruct site history at Hoedjiespunt 1 (HDP1), Western Cape.

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Abstract

Hoedjiespunt 1 (HDP1), is one of few later Middle Pleistocene to earlier Late Pleistocene African sites to yield well provenanced MSA hominid fossils, lending special significance to this site. The vertebrate fauna from this location, which consists of a palaeontological and an archaeological site, is described and analysed using both the taphonomic and controlled comparison approaches. The information obtained via this study allows for a better understanding of the context in which and the conditions under which these two sites were formed.

Stratigraphic evidence and spatial information, suggest that the bones in the palaeontological site were in all likelihood accumulated in a cavity, thus postdating the sediments in which they occur. Circumstantial evidence, in addition to Klein and Cruz-Uribe's (1984) criteria for distinguishing assemblages accumulated by hyaenas from those accumulated by people, points towards the brown hyaena as the most likely accumulator of this assemblage. It is also suspected that the bone in the archaeological assemblage, may postdate the sediments in which they occur. This is suggested by the presence at the site, of tools manufactured out of calcrete, similar to the calcrete carapace which caps the stratigraphic sequence.

Although density mediated destruction seems to have been the major cause of discrepancies in skeletal part abundance in the palaeontological site, it was found not to have been severe.

The composition of species represented in the two assemblages differ. It was found that, apart from containing a small percentage of marine animals, the palaeontological site is dominated by grazing ungulates and carnivores. This assemblage was accumulated during a period of lowered sea level, or “glacial”. On the other hand, the sample from the archaeological site contains proportionally fewer ungulates and carnivores, more small animals and more marine animals, reflecting a period of marine transgression, or “interglacial”.

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I would also like to thank the palaeontological department at the South African Museum for permission to examine the "Hoedjies punt" faunal sample which was collected by G. Avery and R. G. Klein. Thanks are also due to Margaret Avery of the palaeontological department at the South African Museum for identifying the microfauna bones from HDP1. The general help provided by the staff of the Archaeology department (SAM) is also much appreciated.

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CHAPTER ONE

INTRODUCTION

Hoedjiespunt 1 (HDP1) is a palaeontological and archaeological site, embedded in an aeolian sequence on the Hoedjiespunt Peninsula at Saldanha Bay, Western Cape. U series and luminescence analysis of the sediments at the site, as well as the composition of the foraminiferal assemblage from shelly sands at the bottom of the sequence, suggest that these sediments were deposited before 75 000 years B.P.

Surface collections done on the Hoedjiespunt hill and surrounding area in 1993, led to the discovery of several fragments of a human tooth associated with the palaeontological horizons at HDP1 (Berger and Parkington 1995). Since June 1994, these palaeontological horizons have been the main focus of excavations and as such, provided most of the HDP1 faunal material now housed in the South African museum. Excavations have also revealed more fragmented human fossils. These are currently housed in the Anatomy Department of the University of the Witwatersrand. The archaeological assemblage has only been sampled thus far, and as a result, the faunal sample from here is extremely small. This thesis presents a reconstruction of site history based mainly, but not exclusively on the faunal assemblage from the palaeontological horizons at HDP1. All material excavated at the site, from June 1994 to July 1996, will be dealt with in this analysis.

1.1: Previous research on sites in the immediate vicinity

In 1983, Klein (1983) reported on fossil bones found at a site called "Hoedjies Punt". These bones were collected as they weathered out of a sandstone cliff face, about 10 metres away from where excavations are currently being carried out at HDP1. This cliff has since been bevelled, and the material used to construct a road on the peninsula. According to Klein (1983) and Cruz-Uribe (1991), grazing faunas are abundant in this sample, as well as hyaena coprolites. Stone tools and marine shell are also absent. This suggests strongly that this fossil bone sample came mainly, but perhaps not exclusively from a palaeontological assemblage which was exposed by weathering. This fossil bone sample will be referred to as the Old Hoedjiespunt sample in this thesis.

Apart from HDP1, there are several other archaeological and palaeontological sites on the Hoedjiespunt Peninsula. So far, earthmoving and erosion have exposed two other sizable accumulations. At Hoedjiespunt 2 (HDP2), which is situated on the northern side of the peninsula (Fig. 3:1), there is another closely juxtaposed complex of human and hyaena occupations. Modest excavations at this site revealed thick occupation deposits, with ash, charcoal, bone, stone and ochre components which may reflect a talus slump from a former small overhang under a calcrete shelf (J. Parkington, pers. comm.). At Hoedjiespunt 3 (HDP3) (Fig. 3:1), limited section cleaning suggests that this site may only contain archaeological material. ESR analysis of marine shell from this site, suggests that it was deposited during the Last Interglacial (Yoshida 1996). This material is located in the context of burnt shell and ostrich eggshell fragments, and is associated with the lower part of the calcrete carapace.

The Hoedjiespunt Peninsula is not an isolated geological occurrence, but forms part of a larger fossil dune landscape that stretches into the Saldanha Naval Base. This section of the dune formation, houses the important Sea Harvest site (Grine and Klein 1993) (Fig. 3:1).

Fossils were sporadically collected at this site by Q. B. Hendey, R. G. Klein and G. Avery until 1980, when construction work restricted access to the cliff. In addition to yielding an extensive mammalian fauna, this site also yielded a human manual distal phalanx and a maxillary premolar. As is the case at HDP1, Sea Harvest also contains archaeological and palaeontological material, with a cemented shell midden, occurring at a higher stratigraphic level than the palaeontological material, which occur as bone pockets in the consolidated lower sediments of the cliff. Unlike the archaeological horizons, the palaeontological horizons contain no artefacts, but do contain abundant coprolites and gnawed bones. The human remains also came from these palaeontological horizons. Appart from the excavation of a particularly rich bone pocket by G. Avery and R. G. Klein in 1977, collection was generally focussed on fossils that had weathered naturally out of mainly the lower palaeontological horizons of the sandstone cliff face (Grine and Klein 1993).

Butzer (as quoted in Grine and Klein 1993) argued that, based on sand granulometry, the sediments in which the archaeological and palaeontological material occur, were probably deposited during a regressive phase, corresponding to one or more of the colder intervals within the Last Interglacial. Radiocarbon dates on ostrich eggshell fragments from the shell midden suggest that it was deposited before 40 000 years ago. Stratigraphic and sedimentological observations by Butzer (as quoted in Grine and Klein 1993) suggest that the most likely time of deposition was during "...the early part of the Last Glaciation (= global isotope stage 4), sometime between 74 000 and 60 000 years ago" (Grine and Klein 1993, p. 145). The fauna from the palaeontological horizon was thought to have been deposited sometime between the beginning of the Last Interglacial (± 128 000 years ago) and the minimum age (40 000 years ago) of the shell midden in the overlying deposits (Grine and Klein 1993). Grine and Klein (1993) favoured accumulation during the Last Interglacial (i.e. between ±128 000 years ago and ± 74 000 years ago). According to Butzer (as quoted in Klein 1983), the most likely time of deposition was probably during isotope substage 5b (± 92 000 years ago), one of two pronounced colder phases during the Last Interglacial.

1.2: The importance of these sites to our understanding of human evolution

These Saldanha Bay sites, in combination with an ever expanding number of other sites along the Cape West Coast, such as Duinefontein (Klein 1976a), Elandsfontein (Klein 1983) and Boegoeberg 1 (Klein and Cruz-Uribe 1996), have the potential to contribute substantially to our knowledge of the behaviour and anatomy of Middle to Upper Pleistocene hominids in Africa.

Having several penecontemporaneous sites dating from the Middle to Late Pleistocene, and including both palaeontological and human accumulations, may allow us to gain insight into an interesting, but little known time period in human evolution. Firstly, the abundant faunal remains will allow us to reconstruct past environments during this time period. Secondly, the presence of shell middens will allow us to compare faunal assemblages with and without human involvement and to compare human behaviour in this time period with that of the last 5000 years. Thirdly, because of the high diversity of species, there is always a chance that more human remains may be found in the palaeontological accumulations.

HDP1 in particular, provides a unique opportunity, in that all the human remains from here are provenanced. Not only have very few African sites yielded fossil human remains that date from the Middle and early Late Pleistocene (730 000 to 40 000 years B.P.), but still fewer have yielded provenanced remains. Although the human fossils at Sea Harvest are thought to have come from the palaeontological horizons, their exact positions are not known (Grine and Klein 1993). The Elandsfontein skull cap on the other hand, was found amongst mobile dune sands, along with the bones of bovids and carnivores, on one or more palaeosurfaces where they were being exposed by deflation (Deacon 1983; Klein 1983). Although the skull cap was found amongst a mainly Middle Pleistocene faunal assemblage, there is no way of knowing whether it was associated with these bones. Further afield at Border Cave, four human fossils were found in a dump created by a farmer who thought that the cave sediments could be used as fertilizer. Although many Middle Stone Age artefacts were found in the dump along with the human fossils, it cannot be shown whether these fossils originally came from the same levels as the artefacts. Because these bones contain insufficient collagen, accurate radiocarbon dates could not be obtained (Stringer and Gamble 1994). Every provenanced African MSA human fossil or archaeological assemblage accumulated by MSA people, therefore has the potential to contribute valuable information. This is especially pertinent if it is considered that the behaviour of humans during this period, as well as their anatomy, which lies at the centre of the debate concerning the origins of "anatomically modern humans" (Brauer 1984; Stringer 1984; Stringer and Andrews 1988; Stringer and McKie 1996), is not well understood.

1.3: The contribution that the study of the HDP1 fauna can make to current knowledge

By analysing the faunal remains from HDP1, we will be able to gain insight into how the site was formed and under what environmental conditions. This is especially important when it comes to dating the site. Firstly, because the stratigraphy is well understood at HDP1, it is possible to determine whether the palaeontological and archaeological assemblages were deposited in an already existing dune, or whether these assemblages and the sediments which surround them were deposited at the same time, as is presumed to have been the case at Sea Harvest (Grine and Klein 1993). This has important implications for whether or not dates obtained on the sediments, could be used to infer the ages of the assemblages contained within them. Secondly, this study provides an opportunity to determine whether the palaeontological assemblage in which the human fossils were found, is contemporary with the archaeological assemblage. If these two assemblages are found to be contemporary, HDP1 would provide a unique opportunity to study the anatomy, as well as the culture of a Middle to Late Pleistocene human population. The findings at HDP1 could also be used to evaluate Grine and Klein's (1993) interpretation of the manner in which, and the time when the archaeological and palaeontological assemblages at Sea Harvest were deposited. This could lead to new insights into the possible age of the Sea Harvest human fossils and their relationship to the archaeological horizons at the site.

The fauna also provides an opportunity to reconstruct the palaeoenvironmental and palaeoclimatic conditions that prevailed when the two assemblages were being accumulated, thus giving us an idea of the resources that were available to humans at the time.

The analysis of the HDP1 fauna can provide greater insight into palaeontological assemblages in general. These are extremely common in the aeolian sands along the Cape West Coast. Not only can this study confirm previous findings (Klein 1975, 1983; Cruz-Uribe 1991; Grine and Klein 1993), but it can also add to our current knowledge of what these accumulations are, and how they were formed. Because sites such as Sea Harvest (Grine and Klein 1993) and Swartklip 1 (Klein 1975) were not systematically excavated, mainly because they are situated in consolidated and partially consolidated material, it was difficult to determine whether the bones at these sites were non-randomely patterned. Since bones were plotted at HDP1 before they were removed, there is a chance to determine whether any behavioural information is present in the spatial patterning of bones in these palaeontological assemblages.

CHAPTER TWO

APPROACH AND METHODS

2.1: Approach

Two common approaches to interpreting fossil bone assemblages have developed in palaeontology and archaeology. These are interpretation based on taphonomy (Efremov 1940, as quoted in Behrensmeyer 1975; Lyman 1994) and interpretation based on controlled comparisons among fossil assemblages (Klein and Cruz-Uribe 1984).

Taphonomy is defined as "the study of the transition (in all its details) of animal remains from the biosphere into the lithosphere, i.e. the study of a process in the upshot of which organisms pass out of the different parts of the biosphere, and being fossilized, become part of the lithosphere" (Efremov 1940, as quoted in Gifford 1981). In other words, taphonomy is the study of those factors that cause a fossil assemblage to differ from the deposited, death and life assemblages that underlie it (Behrensmeyer and Hill 1980; Shipman 1981, as quoted in Klein and Cruz-Uribe 1984). A taphonomic study involves two distinct lines of investigation. The first involves the study of living processes, while the second concerns the application of such knowledge to the fossil record (Gifford 1981). In a taphonomic study, the investigator does not have to be confined to post-mortem factors only, as the character of the death assemblage is most often influenced by a combination of factors. These include animal behaviour, ecology and local environmental conditions, as well as post-mortem factors (Brink 1987).

According to Klein and Cruz-Uribe (1984), the composition of a fossil assemblage is determined by the ancient environment in which it accumulated, the agency that accumulated it and its postdepositional history. Further, Klein and Cruz-Uribe (1984) note that it is generally not possible to separate the effects of these three factors on a single assemblage. If several fossil assemblages are available, it may be possible to conduct comparisons in which two of the factors that shape assemblages are held constant. Differences that are observed between the assemblages may then be ascribed to the third factor. Thus, the two factors that are held constant are "controlled" to isolate the effects of the third (Klein and Cruz-Uribe 1984). Controlled comparisons among fossil bone assemblages (Lyman 1982; Klein and Cruz-Uribe 1984) provide different information to that provided by taphonomic studies. This method is useful for isolating common characteristics among fossil bone assemblages, as well as highlighting differences. Klein and Cruz-Uribe (1984) for example, used this method to determine whether assemblages share similar postdepositional histories, whether they were accumulated by the same agent of accumulation, or whether they were accumulated under similar environmental conditions. Controlled comparisons also made it possible for Klein and Cruz-Uribe (1984) and Cruz-Uribe (1991) to identify characteristics which distinguish assemblages accumulated by carnivores, from those accumulated by humans. These characteristics are now commonly used as criteria for distinguishing between bone assemblages accumulated by carnivores versus those accumulated by humans.

Klein and Cruz-Uribe (1984) argue that the taphonomic approach and the comparative approaches are complementary. The use of both methods in a faunal study can provide different types of information, which can only lead to a better understanding of an assemblage.

Information obtained via both these methods will be employed in this study. The taphonomic approach is primarily used to reconstruct the palaeoenvironment; to help determine the causes of the discrepancies in skeletal part frequencies; as well as to interpret the spatial distribution of bones in the accumulation. Observations on the behaviour of modern hyaenas; the causes of pre- and postdepositional bone destruction; as well as data on modern environments are required to address these issues. Criteria for distinguishing between assemblages accumulated by hyaenas versus those accumulated by humans (Klein and Cruz-Uribe 1984) were identified by carrying out controlled comparisons between carnivore and human accumulated assemblages. These will be applied to the HDP1 palaeontological fossil sample to lend support to the contextual evidence which suggest that the assemblage was accumulated by hyaenas.

2.2: Methods

2.2:1: Excavation

The majority of the fossils in the HDP1 sample were systematically excavated using dental picks, brushes and trowels. Cold glue was used to stabilise cracked bones. Before removal, the position of each bone was plotted with the aid of a theodolite, allowing each find to be three-dimensionally mapped. Although a system using a laser was used on one field trip, one using a prism was most often used. All deposits were screened with a fine sieve (3 mm), permitting recovery of even the smallest bones. The only unexcavated material is that recovered from surface scrapings done before excavation began. After recovery, fossils were wrapped in tissue-paper, placed in plastic bags, and numbered.

2.2:2: Preparation, sorting and identification

In the lab, all material were sorted and separated. To make the conservation of the bones easier, they were separated from stones, shellfish, terrestrial snail shell, ostrich eggshell and bird eggshell.

Many of the fossil bones exhibited salt crystal formation once they were exposed to air. This weakened the bones considerably, often causing untreated bones to crack. In an attempt to check the growth of salt crystals, bones were washed in de-ionized water and left to dry overnight in a drying cabinet in the Archaeology Department at the South African Museum.

Once dry, the bones were divided into identifiable and nonidentifiable classes. Nonidentifiable bones are defined as fragments that lack any "landmarks" which could be used to identify them as belonging to a particular bone. The identifiable bones were then divided into broad categories such as large mammals, which can loosely be defined as all mammalian species in which adults weigh at least 0,7-0,9 kg (after Klein 1980); micromammals, which generally include rats, mice, bats and insectivores; birds; fish and reptiles. The bones were then identified to species level using the South African Museum's comparative species collection. In cases where bones could not be identified to species level, bones were assigned to general categories. The microfaunal remains are extremely fragmented, consisting mostly of individual teeth which were difficult to identify to species level. D.M. Avery (pers. comm.) has however been able to identify a number of mandibles to species level and in so doing, provided a general idea of the species present in the assemblage. The bird bones were quite well preserved, and could easily be identified with the help of the comparative bird collection in the Archaeology Department at the South African Museum. Tortoise bones constitute the majority of the reptile remains from the site, and were also complete enough to identify to species level. The fish remains consist only of vertebrae and could not be identified to species level.

2.2:3: Counts

The frequencies of individuals in taxa, expressed as the number of identified specimens (NISP) and the minimum number of individuals (MNI), were calculated using the assumptions and computer programs described by Klein and Cruz-Uribe (1984) and Cruz-Uribe and Klein (1986). The minimum number of element (MNE) values were calculated using the method described by Lyman (1994). This method is similar to that which Klein and Cruz-Uribe (1984) employed to calculate MNI's. This entails the recording of the fraction by which an identifiable bone is represented using common and intuitively obvious fractions. The fractions are summed to produce MNE values for each skeletal portion (Klein and Cruz-Uribe 1984). The minimal animal unit (MAU) and percentage minimal animal unit (%MAU) values were calculated using the assumptions described by Binford (1978, 1981, 1984).

CHAPTER THREE

THE SETTING OF HOEDJIESPUNT 1

3.1: Geographical setting of HDP1

The Hoedjiespunt 1 (HDP1) site (33°01'45"S, 17°57'37"E) is located on the southern edge of the Hoedjiespunt Peninsula at Saldanha Bay on the west coast of South Africa (Fig. 3:1). This peninsula, which projects eastward into the northwest corner of Saldanha Bay, is part of a larger fossil dune formation that extends to the Sea Harvest site (Grine and Klein 1993) and into the Saldanha Naval Reserve. The fossil dune formation consists of partly cemented aeolian sands that rest on a wave cut platform of marine cobbles and boulders approximately 6m above sea level (asl) (Grine and Klein 1993).

3.2: Regional Geology

3.2:1: Solid geology

The underlying bedrock in the Saldanha-Langebaanweg area consists of deeply weathered rocks of the pre-Mesozoic Cape Granite Suite and the Malmesbury Group. The Cape Granite Suite dominates the coastal half of the Saldanha-Langebaanweg area (Fig. 3:2) and appears to occur in two bodies. The first extends from St Helena Bay through Vredenburg and Saldanha to Yzerfontein and Dassen Island. The second extends northwards from Mamre through Darling to Geelbek. Malmesbury bedrock is less common in the area, and exposures occur at the northern

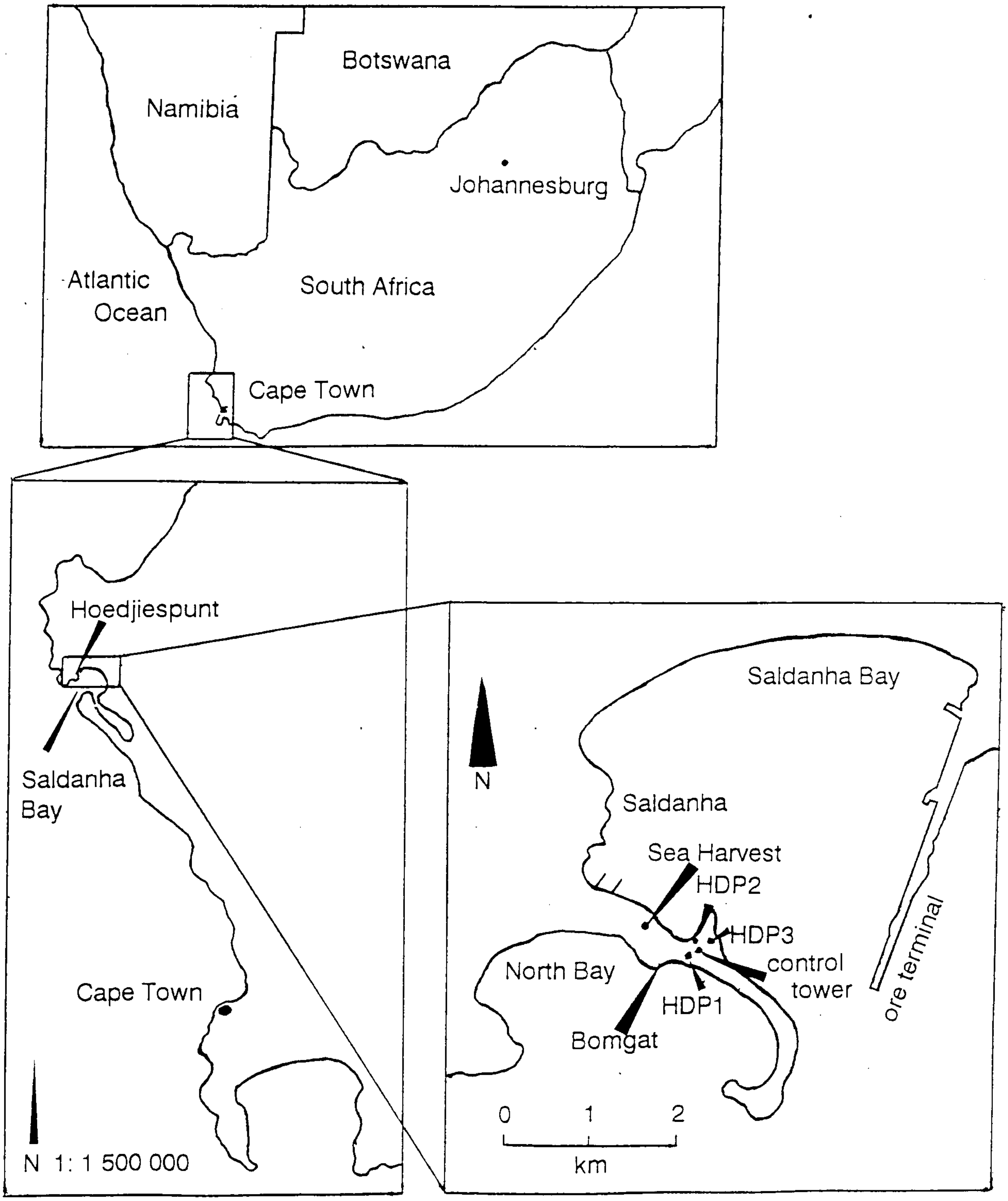


Figure 3:1 :
Map showing the approximate location of the Hoedjiespunt Peninsula and the HDP1, HDP2, HDP3 and Sea Harvest sites.

tip of the Langebaan Peninsula and south-west of Langebaanweg (Rogers 1980).

The deeply weathered state of the bedrock in this area is the result of a combination of downcutting of river systems and the effects of the tropical climate of the Late Cretaceous and Early Tertiary. This in addition to variations in bedrock geology gave rise to the undulating bedrock topography (Fig. 3:3) present in the area today (Rogers *et al.* 1990).

3.2:2: Surficial geology

The pre-Miocene period

There is no firm terrestrial evidence in the Saldanha-Langebaanweg area for any deposits dating back to the Early Tertiary (Hendey 1981b). Early Tertiary sediments however did occur in the area, as demonstrated by their presence on the submerged middle shelf (Dingle 1973). Siesser and Dingle (1981) also recorded two marine transgressions, one at 70m and the other at 163m, on the west coast of the southern Namib Desert. Both dated back to the Eocene. The implication is that during the Eocene transgression, much of the south-western Cape, including the Saldanha-Langebaanweg area would have been below sea level. The Early Tertiary deposits would have been deposited during this period.

Siesser and Dingle (1981) also recognised a major regression following on this transgression which spanned the entire Oligocene and part of the Early Miocene. During this regression, sea levels reached several hundred metres below that of the present. According to Hendey (1981b) this is likely to have been the period of major continental erosion during which

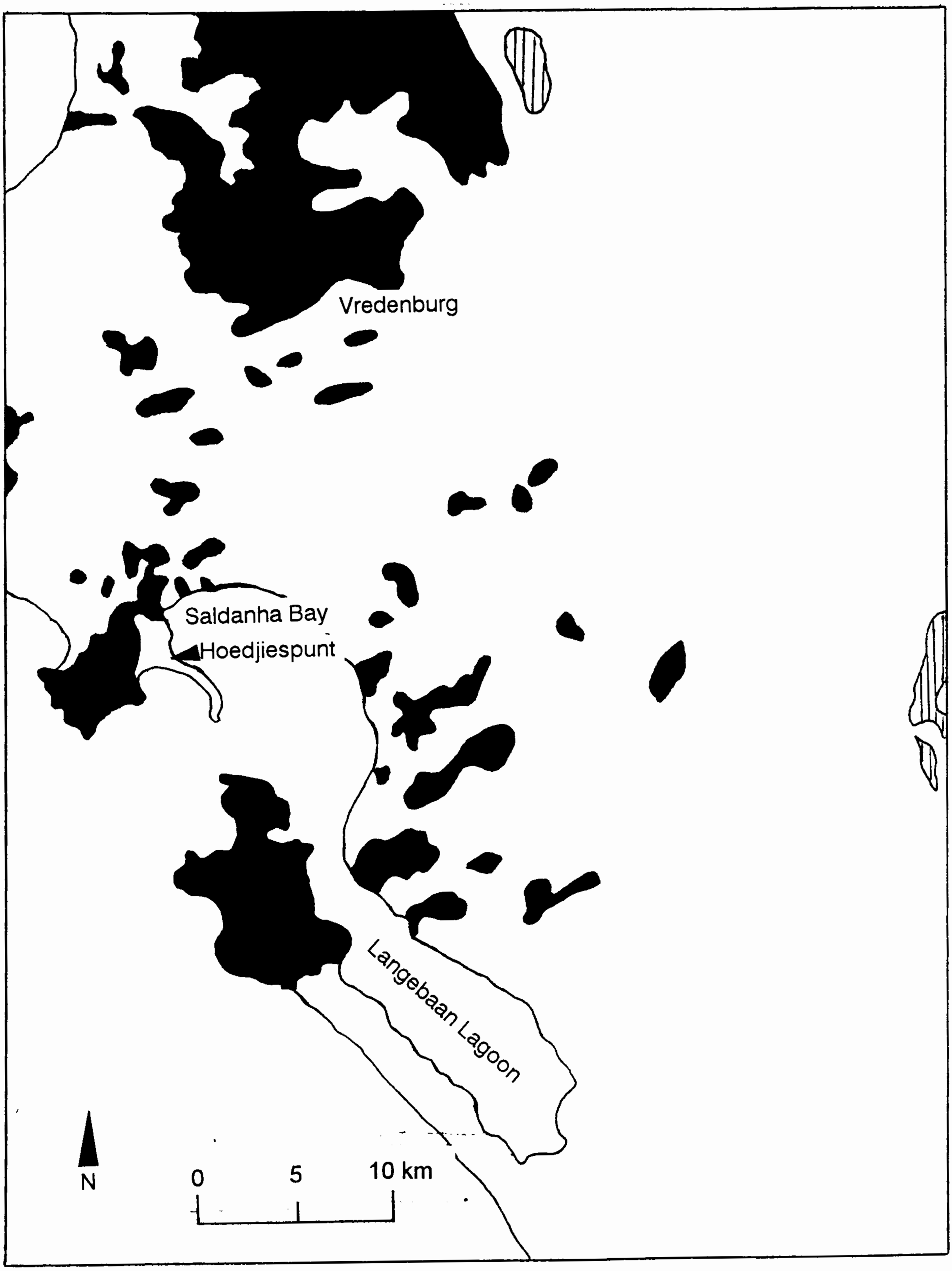


Figure 3:2 :

The regional geology: Langebaan - Saldanha Bay area.

■ Cape Granite Suite

□ Cenozoic

▥ Malmesbury Group

(After Rogers 1980)

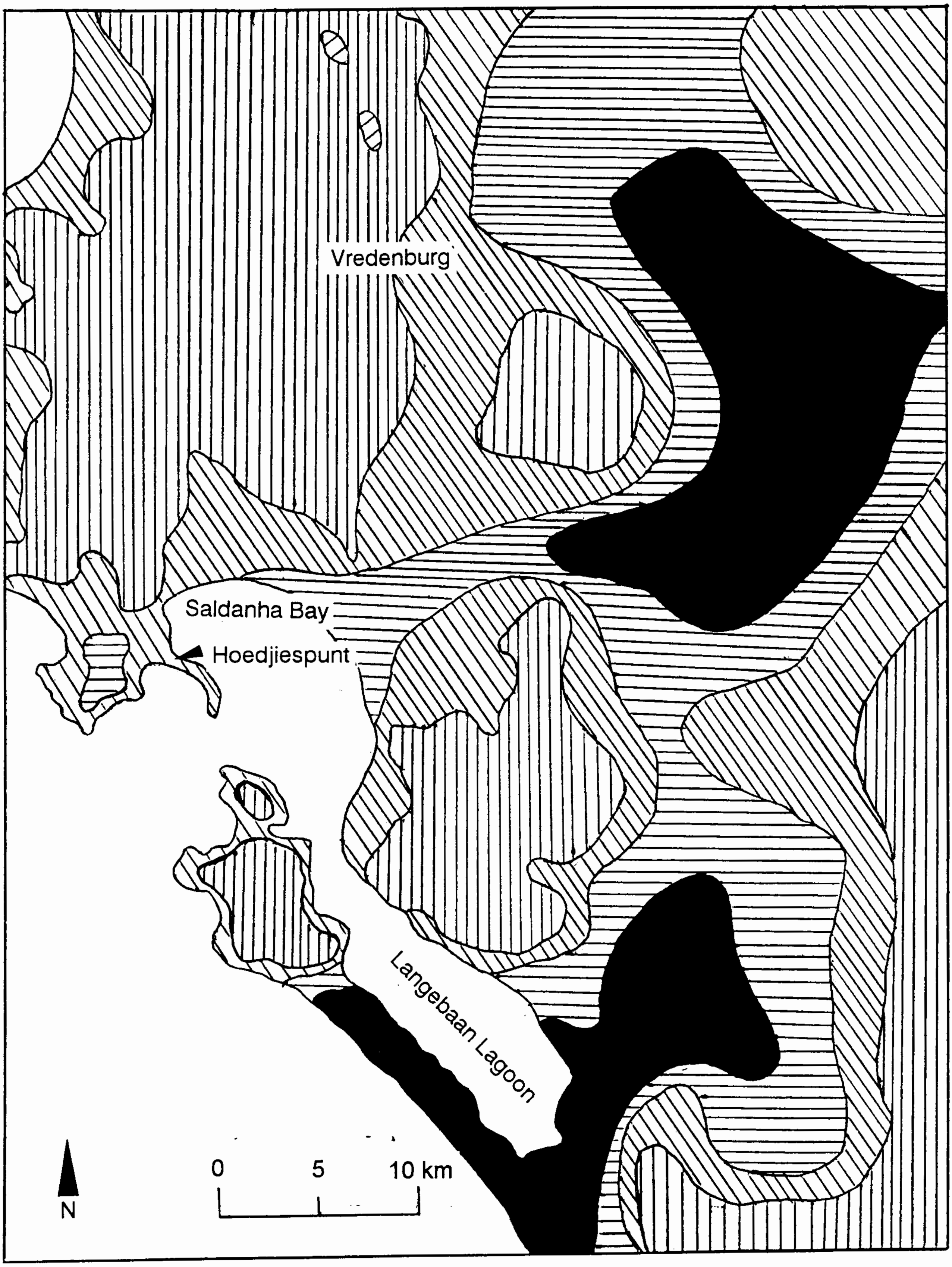


Figure 3:3 :

The bedrock topography:

Langebaan - Saldanha Bay area.

(After Rogers 1980)

all traces of Early Tertiary sediments in the Saldanha-Langebaanweg area, as well as elsewhere along the south-west coast, were removed. What remained was weathered bedrock.

The Miocene and post Miocene period

The Miocene aged formations of the Saldanha-Langebaanweg area

The Elandsfontyn Formation

The Elandsfontyn Formation unconformably overlies the Malmesbury Group or Cape Granite Suite (bedrock) and is overlain by the Varswater, Springfontyn or Saldanha Formations (SACS 1994). The formation is characterised by a subsurface unit of fining upward cycles of angular quartzose sands ranging from coarse, often gravelly, to fine sands. Overlying this unit are silts as well as clays of various colours. This formation occurs over a large part of the south-western Cape, ranging from north-east of Saldanha Bay to Noordhoek, south of Cape Town (Coetzee and Rogers 1982; Rogers *et al.* 1990; SACS 1994).

Dingle *et al.* (1983) argue that the fossil evidence for an accurate date on the Elandsfontyn Formation is scant. Hendey (1981b) identified the remains of a Miocene Hipparion, *Hipparion cf. primigenium* as well as warm water molluscs and shark teeth in the Gravel Member of the Saldanha Formation directly overlying the Elandsfontyn Formation. The remains of the molluscs as well as those of the Hipparion suggest a Late Miocene age for the Gravel Member of the Saldanha Formation and presumably a Middle or even Early Miocene date for the oldest parts of the Elandsfontyn Formation (Hendey 1981a).

The Saldanha Formation

The Saldanha Formation unconformably overlies the Elandsfontyn Formation in places, as well as other older rocks and is in turn overlain by the Varswater and Springfontyn Formations (Dingle *et al.* 1983; Rogers *et al.* 1990; SACS 1994). The type section for this formation is the Bomgat exposure in the Saldanha Bay Naval Base (Tankard 1975). This formation consists of an indurated 1 to 1,5m thick layer of conglomeratic quartzose phosphorite with gravel and marine molluscs present in places. It occurs sporadically between Cape Town and Port Nolloth (Rogers *et al.* 1990; SACS 1994).

Rogers *et al.* (1990) suggest that the Saldanha Formation was formed during the Middle Miocene transgression and the following Middle to Late Miocene regression. The shark teeth, warm water molluscs and the teeth of the Miocene Hipparion found in the Gravel Member of this formation suggests to Hendey (1981a) that at least this part has a Late Miocene age.

The Pliocene aged formation of the Saldanha-Langebaanweg area

The Varswater Formation

The Varswater Formation overlies the two older Miocene beds or granite and is unconformably overlain by Quaternary river channel sediments and aeolian sands (SACS 1994). The New Varswater Quarry or "E" Quarry near Langebaan serves as the type section of the Varswater Formation (Tankard 1974). It is composed of quartzose sand, pelletal phosphorite, gravel, sandy silt, black-grey carbonaceous kaolinitic clay and peat.

Although several authors have attempted a subdivision of this formation, the subdivisions proposed by Hendey (1981a, 1982) and Rogers *et al.* (1990) have received the widest acceptance. Hendey (1981a, 1982) divided the Varswater Formation into a Quartzose Sand Member (QSM) which occurs mainly on the northern side of the quarry; the regionally widespread Pelletal Phosphorite Member (PPM); and the Calcareous Sand Member (CSM). Rogers *et al.* (1990) provided a two-fold subdivision of the Varswater sediment members occurring north of Melkbosstrand. Firstly a Silwerstroom Member is recognised. This member is the same as the (Shelly) Gravel Member of Rogers (1980). Secondly, a Duynefontein Member is recognised. This is the same as Hendey's (1981a, 1982) Pelletal Phosphorite Member.

The Gravel Member: This member consists of consolidated quartzose sand with well rounded beach cobbles and gravelly sand layers. It, overlies the kaolinitic clay of the Varswater Formation, the Saldanha Formation or the Elandsfontyn Formation and is overlain by the Quartzose Sand Member. In the Cape Flats area, it is termed the Strandfontein Member and north of Melkbosstrand, it is termed the Silwerstroom Member (Rogers 1980, 1982; Rogers *et al.* 1990). Marine invertebrate fossils are present (SACS 1994).

The Quartzose Sand Member (QSM): This member comprises (1) estuarine sand silt grading laterally into carbonaceous sand, clays and peat, and (2) fluvial coarse and fine sand up to 7m thick. It conformably overlies the Gravel Member and is conformably overlain by the Pelletal Phosphorite Member (Dingle *et al.* 1983; SACS 1994). According to Hendey and Deacon (1977), the character of the deposits from this member varies considerably and reflects a variety of depositional environments, including fluvial, estuarine, floodplain, marsh, tidal mud-flat and pond. Hendey and Deacon (1977), as well as Hendey (1981b) suggested that accumulation of deposits occurred in and adjacent to a river estuary (probably related to a proto-Berg River) which was separated from the sea by a sandbar. This river estuary was formed during the Early Pliocene +90m transgression which allowed the sea to invade the hinterland via the Geelbek Gap, and thus facilitated the deposition of the Varswater Formation (Rogers *et al.* 1990).

The Pelletal Phosphorite Member (PPM): This member contains fine, phosphatic, quartzose sands with subspherical pelletal phosphorite in addition to lenses and concretions of phosphatic sandstone (SACS 1994). It is deposited on the Gravel Member, Quartzose Sand Member or older strata and overlain by the Calcareous Sand Member or Quaternary aeolian sand or river-channel sediments. Rogers (1980, 1982) used the terms Duynefontein and Bookram Members for occurrences north of Cape Town and St Helena Bay respectively. According to Hendey and Deacon (1977), this member was deposited between a barrier-bar and a beach near the mouth of a river during the +90m Early Pliocene transgression. The deposits are highly fossiliferous only in those areas which are adjacent to, or stood in the path of a river (Hendey and Deacon 1977).

Calcareous Sand Member (CSM): This member consists of up to 20m of phosphate-poor calcretized sand overlying the Pelletal Phosphorite Member on Anyskop, east of Saldanha Bay (Hendey 1981a; Rogers 1982, 1983). According to Hendey (1981b) the CSM could, in part, have been accumulated in a marine environment of deeper water than the PPM, and also in part on a beach or adjacent terrestrial environment. This combination of circumstances exists on a submerged barrier or barrier island. Anyskop hill could therefore be the remains of a barrier island or submerged barrier which formed during the Early Pliocene +90m transgression. Addressing this question, Hendey (1981b) states that the Early Pliocene transgression reached a height of 90m south-east of Langebaanweg while marine deposits from the same transgression is recorded at an elevation of 80m on the farm Elandsfontyn. According to Hendey (1981b) this is 10-20m above the maximum height of Anyskop.Thus, while Anyskop could have been reduced in height by post-Early Pliocene erosion, it might also never have been as high as 90m and formed, during the latter stages of the transgression, as part of a submerged barrier rather than a barrier island.

The Quaternary aged formations of the Saldanha-Langebaanweg area

The Uyekraal (Shelly Sand) Formation

The Uyekraal (Shelly Sand) Formation is the informal name given by Rogers (1983) to green-hued, shelly, muddy, quartzose sand containing phosphorite particles and capped with hardpan calcrete and leached soil which overlie the Elandsfontyn and Varswater Formations west of Anyskop, Saldanha Bay. This formation which is only known from boreholes, has a maximum thickness of 25m.

According to Rogers *et al.* (1990), the Uyekraal (Shelly Sand) Formation was deposited west of Anyskop, following a combination of a Late Pliocene +50m transgression and an Early Pleistocene +30m transgression which almost destroyed the mainly unconsolidated Varswater Formation deposited during the Early Pliocene.

The Springfontyn Formation

The Springfontyn Formation consists of unconsolidated (decalcified) aeolian quartzose sand which is peaty in places (Rogers *et al.* 1990). With a maximum thickness of 65m, this formation generally overlies the Varswater or Elandsfontyn Formations and is normally unconformably overlain by the Witzand Formation (SACS 1994). It generally extends from south of Cape Town to the Elandsbay area.

According to Rogers *et al.* (1990), the Springfontyn Formation dates from the Early Pleistocene. It consists mainly of the aeolian facies of a regressive sequence deposited after a major transgression, possibly the Early Pleistocene +30m Transgression. This regression exposed the sediments, formally covered up by the ocean, to strong glacial winds. This resulted in the formation of extensive dunefields, namely the Springfontyn Formation (Rogers *et al.* 1990).

Proof that the Springfontyn Formation has an aeolian origin, is provided by granulometry. This test revealed that the Springfontyn Formation demonstrated identical cumulative curves to those of the Witzand and Langebaan Formations, which are of aeolian origin (Rogers *et al.* 1990). What emerged was that all three formations demonstrated well-sorted fine to medium sand with little or no mud present.

Although the Springfontyn Formation was proved to be aeolian by displaying identical cumulative curves to those of the Witzand and Langebaan Formations, it lacks the shell fragments found in the latter two. Rogers (1982) contributed this to the possibility that the Springfontyn Formation was leached of its original shell fragments by acidic ground water, causing it to become unconsolidated and thus cohesionless. It therefore lacks the calcrete contained in the Langebaan Formation.

The Velddrif Formation

The Velddrif Formation consists of shell, limestone and sandstone and is cobble-bearing and calcrete-capped in places (SACS 1994). This formation which can be up to 17m thick, is stratigraphically located between the Springfontyn Formation (below) and the Langebaan Formation (above) (Rogers *et al.* 1990; SACS 1994). In the past it was referred to as the Velddrif

Shelly Sand Member (Bredasdorp Formation) by SACS (1980) and Rogers (1983) with southern occurrences termed the Milnerton (Beach) member by Rogers (1982).

The Velddrif Formation was formally assigned an age of about 100 000 years by Tankard (1976) and Flemming (1977), however this date was pushed back into the Middle Pleistocene by Hendey and Cooke (1985), who studied elephant teeth from the Velddrif Formation at Churchhaven. Of the two species that were found, one was identified as *Elephas iolensis*, an extinct Middle Pleistocene elephant, while the other remains unidentified.

According to Rogers *et al.* (1990), this formation was deposited in a littoral to estuarine environment. They postulate that a Middle Pleistocene interglacial formed an extensive proto-Langebaan Lagoon during which the intertidal deposits of the Velddrif formation were deposited (Rogers *et al.* 1990). The thermophilic molluscs contained in this formation, indicates higher sea temperatures than the present, at that time. According to Rogers *et al.* (1990), calcretization of the Velddrif formation occurred during the Last Glacial regression.

The Langebaan Formation

According to SACS (1994), the Langebaan Formation is an aeolian deposit consisting of fine to medium grained calcretized shelly sand and calcarenite with numerous terrestrial gastropod shells. It overlies various older units, and is overlain by unconsolidated dune sands of the Witzand Formation (Rogers *et al.* 1990; SACS 1994). This formation extends from False Bay to Elands Bay, south-western Cape Province. Middle Stone Age sites are commonly found buried and often cemented in the Langebaan Formation.

Rogers *et al.* (1990) argue that the Langebaan Formation was deposited during the Late Pleistocene. The Middle Pleistocene interglacial during which the Velddrif Formation was deposited, was followed by a subsequent glacial-period regression which exposed well-sorted intertidal sand to strong glacial winds. Subsequently, extensive dunefields of calcareous sand were formed which consolidated to form the Langebaan Formation that became extensively calcretized in places (Rogers *et al.* 1990). However, dates on the Langebaan Formation sediments on the Hoedjiespunt Peninsula (Woodborne and Vogel, pers. comm.) suggest that this formation could be much older and could date from the Early to Middle Pleistocene.

Witzand Formation

According to Rogers *et al.* (1990), the partly calcretized Langebaan Formation is overlain, in places, by plumes of partially vegetated dunes and "active masses" of mobile, transverse barchanoid dunes composed of calcareous sand. These unconsolidated dune sands have been provisionally named the Witzand formation after the farm Witzand. The formation was deposited during the Holocene (Rogers *et al.* 1990).

3.3: The Hoedjiespunt Peninsula

3.3:1: The geology of the Hoedjiespunt Peninsula

The Hoedjiespunt Peninsula forms part of a larger geological formation that extends into the Saldanha Naval Reserve and to the Sea Harvest locality (Grine and Klein 1993). The regional geology has been described by Butzer (as quoted in Grine and Klein 1993) as a series of beach and dune sands that lie on an emerged beach 6-7 metres above modern high tide. Both archaeological and vertebrate palaeontological assemblages commonly occur in the dune sand component of the peninsula, the former in unconsolidated surface context, the latter buried and often cemented.

Sediments belonging to the Varswater Formation, as well as to the Saldanha Formation are exposed on the Hoedjiespunt Peninsula (McMillan 1990). The emerged beach on which these sediments lie, is not visible from HDP1 however, though it is exposed in the Naval reserve. Overlaying these sediments, are the consolidated and partially consolidated aeolian sands of the Langebaan Formation (J. E. Parkington, pers. comm.). These dune sands form part of what is an extensive system of dunes along the south-western Cape coast.

According to Deacon and Lancaster (1988), mobile or active continental sand dunes exist today in regions where there is a sufficient supply of sand, and where the mean annual rainfall is 150-100 mm or less. Thus, the existence of such sand dunes is an indicator of aridity. According to Hendey (1983a), the sand constituting these dunes is a weathering product of the local pre-Cenozoic bedrock. Although these sands were deposited either as fluviatile or marine sediments during marine transgressions, the dunes were actually formed during marine regressions (Hendey 1983a). The exposure of coastal sand bodies during regressions provided an abundant source of material for dune formation by aeolian processes.

Like other dunes, the Hoedjiespunt dune started off as an unconsolidated, mobile sand body, which eventually become consolidated and vegetated. The presence of calcretized horizons in the sediments however, indicate that the dune had a complex history. According to Hendey (1983a) calcretized horizons are common in consolidated dunes because they have a high lime content. This is due to the addition of the remains of marine organisms, during deposition either as fluviatile or marine sediments, and before dune formation. The process of calcification, requires more than a high lime content however. According to Krumbein and Sloss (1963), dry climates with brush or grass cover are important components of the calcification process. Since several such horizons occur at Hoedjiespunt, it is likely that the entire dune was not formed all at once and that the calcretized horizons indicate different stages of dune formation, when the sediments which were exposed to the dry climate and vegetation growth, became calcretized. This is supported by the sand grain analysis of a number of horizons at HDP1 (see stratigraphic setting of HDP1) as well as by Hendey (1983a), who notes that individual sand bodies may have a complex history of erosion and redeposition.

3.3:2: Stratigraphic setting of HDP1 (refer to figure 3:4)

As mentioned earlier, archaeological as well as palaeontological assemblages are common in the aeolian sediments of the Hoedjiespunt-Sea Harvest area. So far, the Sea Harvest site (Fig. 3:1) has provided the majority of the material from this area. This site was regularly collected by R.G. Klein and G. Avery as material eroded out of the cliff face. Bones generally occur in pockets that contain no artefacts or cut-marked bones (Grine and Klein 1993). However, large numbers of hyaena coprolites are associated with these bones. At a higher level in the same cliff, there is a cemented shell midden which contains intertidal marine shells, ostrich eggshell fragments, bird and mammal bones, and numerous Middle Stone Age artefacts (Grine and Klein 1993).

So far, erosion or earthmoving has revealed three localities on the Hoedjiespunt Peninsula which contain material comparable to the Sea Harvest material. These sites are HDP1, HDP2 and

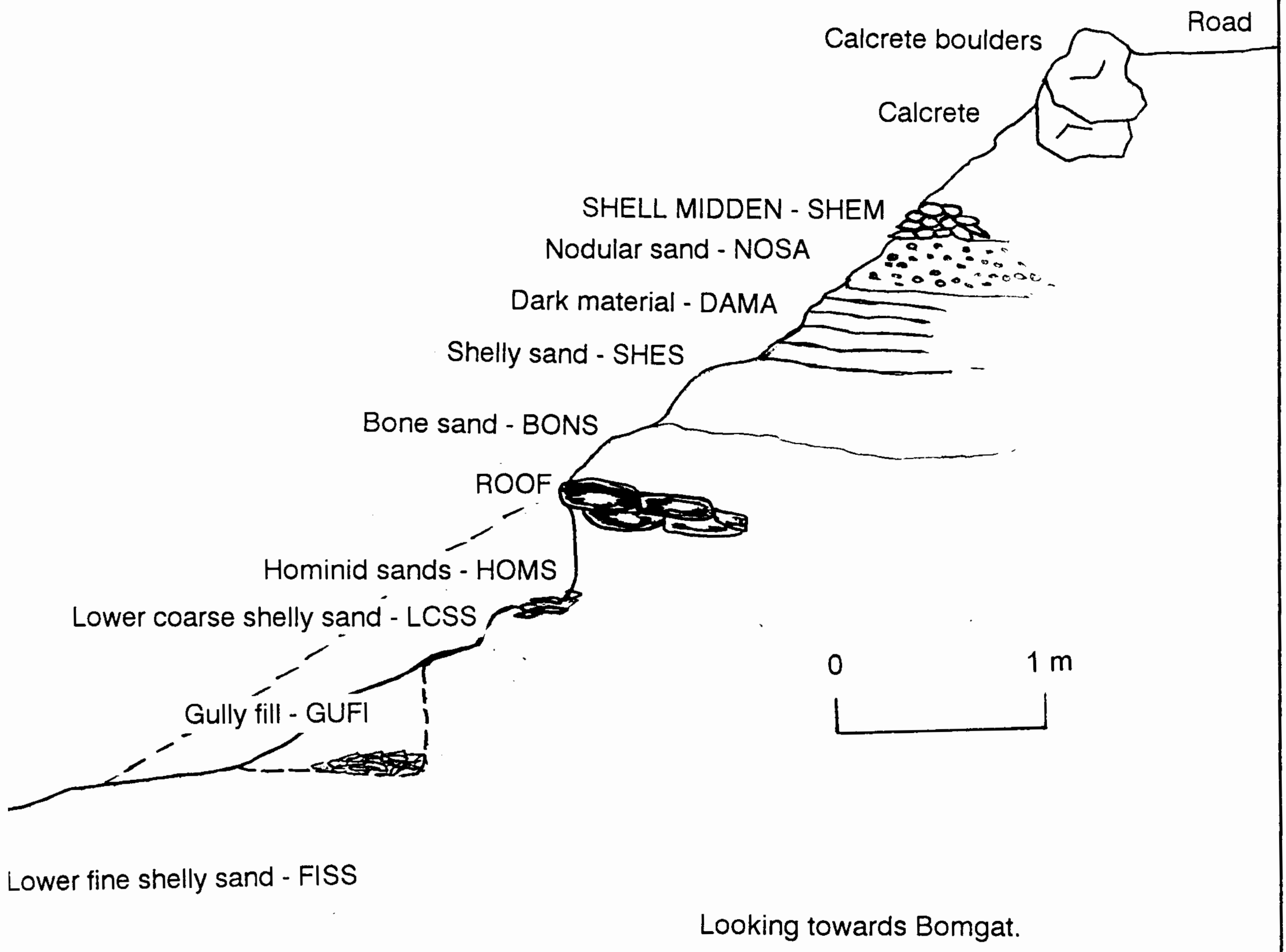


Figure 3:4 :
The stratigraphic sequence at HDP1.

HDP3 (Fig. 3:1). Generally the Hoedjiespunt hill is capped by about two metres of calcrete carapace in the base of which shell midden lenses with MSA stone tools, ostrich eggshell fragments, ochre, marine shell and animal bones occur. Burnt patches of shell and ostrich eggshell are also present, as well as lenses of clay-rich ashy occupation debris.

Of the three sites identified on the Hoedjiespunt hill, HDP1 is stratigraphically the closest to the Sea Harvest assemblage. As at Sea Harvest, distinctive archaeological and palaeontological horizons, can also be recognised in the HDP1 stratigraphic sequence. The horizons containing archaeological material also occur higher up in the stratigraphic sequence than do the palaeontological horizons. As indicated in figure 3:4 the sequence of archaeological horizons at HDP1 start at the base of the carapace, where there is a shell midden. This horizon is known as SHEM. It is firmly cemented with lots of limpets (*Patella* spp.) and some mussel (*Chloromytilus*). In addition, there are lots of ostrich eggshell fragments, as well as stone, mostly fine grained silcrete and quartz. Beneath SHEM, there is a stiff, firm sand with nodules. This horizon is called nodular sand (NOSA). It contains the occasional ostrich eggshell fragment, as well as some fragmented marine shell, but a lot less than SHEM does. Below NOSA there is a dark, loamy horizon, with calcareous material threaded through it. This horizon which is called dark material (DAMA), contains substantial bone, especially bone from marine vertebrates and small animals, as well as large quantities of quartz. Limpets and ostrich eggshell are present in this horizon. Although these horizons contain a lot of stone, mostly quartz, about 90% of the stone assemblage which was excavated, is adiagnostic (J. E. Parkington, pers. comm.). The small number of tools that could be identified, are almost certainly MSA, with rare faceted platform flakes present (Berger and Parkington 1995).

Separating the archaeological horizons from the palaeontological horizons, there is a horizon of fine, stiff, shelly sand. This is called shelly sand (SHES) and appears to have no mammalian fossils. The horizon below SHES is called bone sand (BONS). It is not as shelly or stiff as SHES, and contains bone. Separating this horizon from the main bone-bearing horizon (HOMS) there is a row of consolidated material (Fig. 3:4). These blocks are composed of fine shelly sand, similar to that of the SHES horizon. Mixed in with these blocks, are a few marine shells. These may originally have come from the archaeological horizons. The horizons below the blocks consist of fine as well as coarser grained sand. The hominid sands, or HOMS horizon (Fig. 3:4), is the main bone-bearing horizon in the palaeontological assemblage. Very few marine shell occur in this horizon, and those that do, may have originated in the archaeological horizons, and filtered down through the roof blocks into the HOMS horizon. No stone tools occur here, although ostrich eggshell fragments are common. Most of the bones in this horizon are from large grazing ungulates such as *Connochaetes/Alcelaphus* and carnivores such as *Canis mesomelas*. The hominid remains were also found in this horizon.

HOMS can be separated into fossil-bearing as well as non-fossiliferous material. The non-fossiliferous material is more consolidated than the fossil-bearing material, and occur in the form of pillar-like structures. Grain size analysis carried out on the sediments of HOMS, also indicate a difference between the fossil bearing and non-fossiliferous material, the former being finer grained and less well sorted than the latter (D. Roberts, pers. comm.). A smaller bone-bearing horizon of coarse shelly sand, LCSS, occurs below HOMS. Grain-size analysis suggest a close correspondence between the matrix of this fossil-bearing horizon and the non-fossiliferous material from the HOMS horizon, indicating a similar derivation of these sediments (D. Roberts, pers. comm.). The grain size in the LCSS horizon does however differ appreciably from that in the fossil-bearing horizon in HOMS. Below the HOMS horizon, there is a gully that contains a high concentration of bones. This occurrence is known as GUFI. The bones in this concentration differs from that in HOMS. Most of the bones in GUFI are fragments from larger bones, or the bones of small bovids and carnivores, whereas HOMS has a large number of complete to almost complete bones of large animals. The sand horizon below the palaeontological assemblage consists of fine shelly sand. This lower fine shelly sand, or FISS, is however not as fine-grained as SHES is. SHES is also better sorted than FISS (D. Roberts, pers. comm.).

3.3:3: Age of the dune and the HDP1 archaeological and palaeontological assemblages

The age of the dune and the assemblages which are stratified in it, are presently still not well defined. As noted by Hendey (1983a), individual sand bodies have complex histories of erosion and redeposition. This makes it difficult to date them. All dates so far suggest however, that the sediments that constitute the geological formation that houses the Sea Harvest and Hoedjiespunt sites, were formed during the Pleistocene. Foraminifera from the shelly parts of the main limestones (the Varswater Formation and Saldanha Formation) overlying the emerged beach on the Hoedjiespunt Peninsula, indicate a later Early Pleistocene age for these deposits (McMillan 1990). The ages of the overlying aeolian sands are however, more difficult to determine because these were more easily affected by erosion and redeposition. Based on sand granulometry and the evaluation of the entire Sea Harvest sequence, Butzer (as quoted in Grine and Klein 1993), suggested that the sandstone cliff that houses the Sea Harvest site was formed during a marine regression, most probably corresponding to one or more of the colder intervals within the Last Interglacial. According to Grine and Klein (1993), the faunal evidence, which includes no strictly mid-Pleistocene (or older) forms, and includes marine animals, also supports a Last Interglacial age for the Sea Harvest accumulation.

On the Hoedjiespunt Peninsula, foraminifera obtained from unconsolidated aeolian sands which unconformably overlie the Varswater Formation limestones on the northern side of the peninsula (about 8m above high tide mark), indicate a latest Eemian-earliest Weichselian age (± 70 000 years B.P.) for the deposit (McMillan 1990, 1993). The foraminifera from the SHES, BONS and HOMS horizons at HDP1 do however not resemble those from the unconsolidated sands on the northern side of the peninsula (I. K. McMillan, pers. comm.). The species which are present in these horizons are rather consistent with two earlier ages, namely, a latest Cromerian-earliest Elsterian age (± 480 000 years B.P.) and a latest Holsteinian-earliest Saalian age (± 180 000 years B.P.) (I. K. McMillan, pers. comm.). A latest Cromerian-earliest Elsterian age (± 480 000 years B.P.) is however favoured (I. K. McMillan, pers. comm.). These dates suggest that the sands from these HDP1 horizons are much older than the unconsolidated sands on the northern side of the peninsula. Although foraminifera were found in DAMA as well, they were extremely rare, and may have originated in the horizons below DAMA (I. K. McMillan, pers. comm.). The extreme rarity of foraminifera in DAMA suggest that this horizon may not be the same age as the lower SHES, BONS and HOMS horizons, and may in fact be younger.

In addition to these dates, preliminary luminescence dates on the sediments from the palaeontological horizons indicate an age of around 300 000 years old (S. Woodborne, pers. comm.). By contrast, the same technique suggests that the sediments from the archaeological horizons are about 90 000 years old (S. Woodborne, pers. comm.). U series analysis of the calcrete capping at HDP1 gave a date of around 300 000 years B.P. (Vogel, as quoted in Berger and Parkington 1995). Thus, apart from the 90 000 year date from the archaeological horizons, all dates from HDP1 indicate deposition of the sediments during the later Middle Pleistocene. This is much older than the Last Interglacial age suggested for the deposition of the Sea Harvest sediments (Butzer, as quoted by Grine and Klein 1993).

The dates on the archaeological and palaeontological material from HDP1, are just as uncertain. Since both assemblages are beyond the range of radio carbon dating, absolute ages are difficult to give. The dating methods that were employed did not provide any firm dates, however, they do suggest that accumulation of both assemblages most likely occurred sometime during the later Middle Pleistocene to Late Pleistocene.

U series analysis of ostrich eggshell from the archaeological horizon of DAMA at HDP1, gave a date of 117 000 ± 110 000 B.P. (S. Woodborne, pers. comm.). In addition to this date, dates were obtained from the site of HDP3 on the eastern side of the Hoedjiespunt Peninsula, which contains a similar shell midden accumulation as that at the top of the HDP1 stratigraphic sequence. Yoshida (1996), who employed ESR dating methods to date marine shells from this site, generated a whole series of dates. Depending on the signal used in the analysis of the material, dates ranging from 86 000 to 199 000 years B.P. were obtained. Yoshida (1996) states that, based on geological expectations, he would be inclined to accept the dates based on the annealed g= 2.0058 signal, which provides dates which cluster around the time of the Last Interglacial (isotope stage 5e). An interglacial age is also supported by the large quantities of marine shell and bird bones present in both the HDP1 archaeological assemblage, and HDP3 assemblage. Whether these assemblages were accumulated during the Last Interglacial or a former interglacial, is less clear.

Further indication of possible accumulation during the late Middle Pleistocene to Late Pleistocene period, was provided by the stone tool assemblage. According to Berger and Parkington (1995), the presence of the informal tool assemblage indicates an age of between 40 000 and 240 000 years B.P.

U series analysis of ostrich eggshell from the palaeontological horizons at HDP1 gave a date of 100 000 ± 50 000 B.P. (S. Woodborne, pers. comm.). As was the case with the U series date on the ostrich eggshell from the archaeological assemblage, a date with a huge standard deviation was also obtained here. These two dates seem to indicate that the HDP1 archaeological and palaeontological assemblages, do not differ much in age from one another. These dates are however not conclusive. Here too, more dating by a wider range of techniques is required to confirm or disprove the current dates.

Although the fauna supports the existence of glacial conditions during the time of site formation (see Chapter 8), it is not certain whether the palaeontological assemblage was accumulated during the Last Glacial, or a Glacial before the Last Interglacial. Because the sediments in which the palaeontological material occur probably date from the later Middle Pleistocene, it is possible that the palaeontological assemblage could have been accumulated during a glacial period before the Last Interglacial. The possibility that this assemblage could indeed date from an earlier "glacial", is suggested by the human remains from the HOMS horizon. Although it is still too early to be certain about whether the remains are those of archaic *Homo sapiens*, or anatomically modern *Homo sapiens*, Berger (pers. comm.) believes that the remains are more likely to have come from individuals of an archaic population of *Homo sapiens*. The dating and environmental implications of the fauna will be discussed further in chapter 8.

3.4: Modern climate

Hoedjiespunt 1 is situated within the winter rainfall area of the south-western Cape, which has a Mediterranean-type climate. The coast has a semi-arid climate, with annual rainfall of less than 200mm, which falls mostly from April to September. The daily temperature amplitude for the west coast is 6,9 degrees centigrade, and the annual amplitude is 4,3 degrees centigrade. The average maximum temperature in February is given as 21,1 degrees centigrade and the July average minimum is 10,0 degrees centigrade. Winds are moderate to strong southerly during the summer months and light to moderate north-easterly or north-westerly during the winter months (Miller 1987; Lancaster 1987). The adjacent ocean, is the South Atlantic Ocean. Unlike the ocean adjacent to the east and south coast of South Africa, this ocean is characterised by low temperatures which is caused by an upwelling of Southern Ocean water in the Benguela Current System. This cold water is a major factor contributing to the aridity of the region (Hendey 1981b).

3.5: Modern vegetation

The climate of this area has been an important factor in the development of its unique vegetation, known locally as fynbos (Hendey 1974). Klein (1980) notes that typical fynbos plants are shrubs of various kinds, with small, hard leaves that are capable of withstanding summer drought. Fynbos may be subdivided into a number of groups, the distribution of which is largely dependent on the amount of rainfall (Hendey 1974). Strandveld and coastal fynbos are well suited to drier coastal regions of the Cape ecozone, and are therefore the dominant vegetation types here (Acocks 1953) (Fig. 3:5). These two types comprise chiefly of broadleaved sclerophyllous

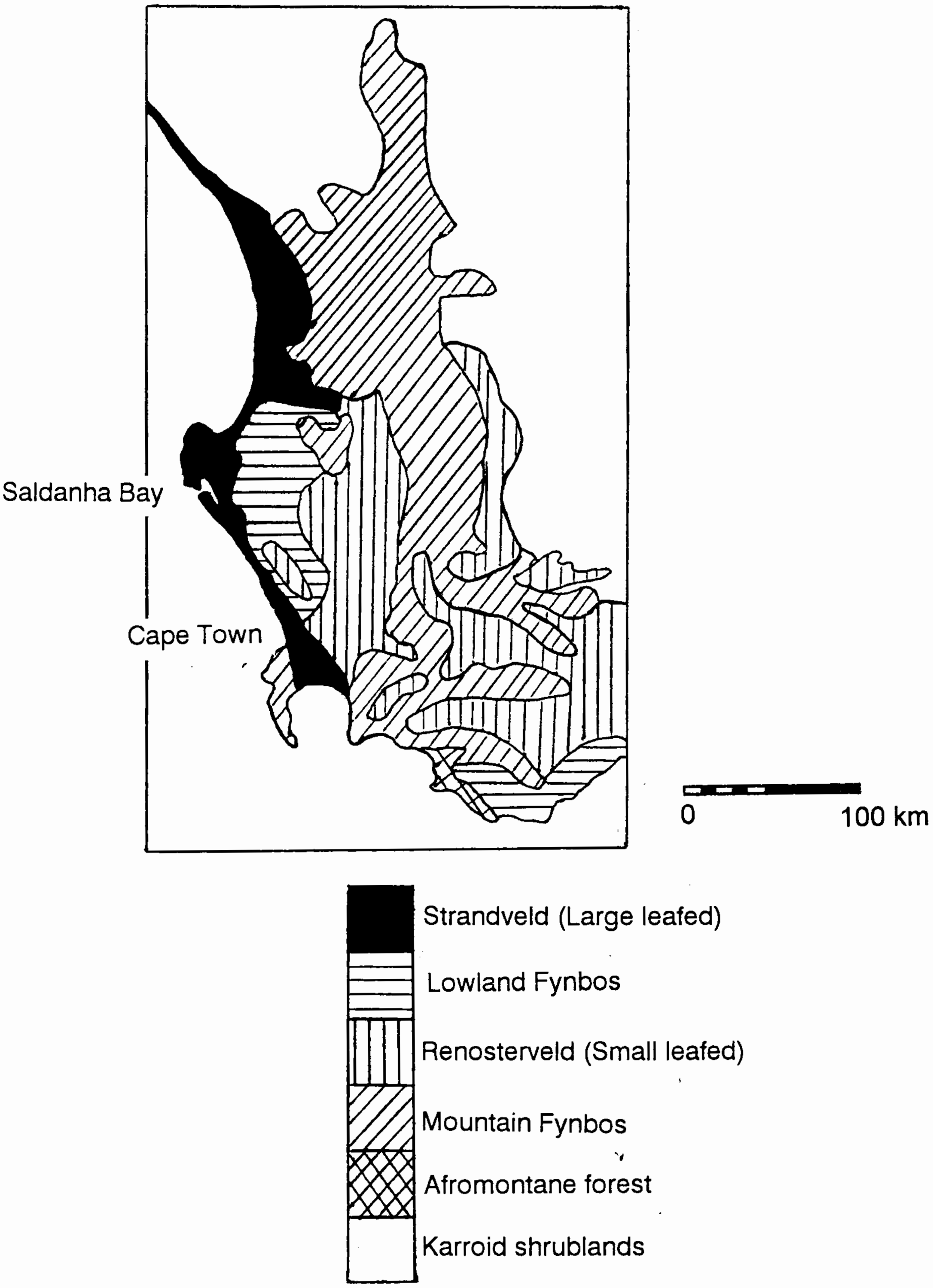


Figure 3:5 :
The distribution of the major vegetation communities of the Fynbos biome in c. 1600 A.D.

(From Moll and Bossi 1984)

woody shrubs (Taylor 1978). Grasses (Gramineae) are relatively rare along the coastal region (Klein 1980).

3.6: Modern and historical faunal occurrences

According to Hendey (1974), the south-western Cape is part of the Ethiopian faunal region, and its mammalian fauna is "African" in character. Records quoted in Skead (1980) indicate that during historical times, this region had as rich a mammalian fauna as any other part of sub-Saharan Africa explored subsequently. Large mammals such as the African elephant (*Loxodonta africana*), black rhinoceros (*Dicerus bicornis*) and Hippopotamus (*Hippopotamus amphibius*) were common in the south-western Cape (Skead 1980). Large ungulates such as the eland (*Taurotragus oryx*), mountain zebra (*Equus zebra*) and red hartebeest (*Alcelaphus buselaphus*), as well as primary predators such as lions (*Panthera leo*) and scavengers such as the brown hyaenas (*Hyaena brunnea*), also occurred here.

The arrival of European settlers however, initiated the decline of the majority of species, with hunting and destructive agricultural practices being the main causes. Today, apart from species that were re-introduced mainly into game reserves, all the herbivores larger than the grey duiker (*Sylvicapra grimmia*) have become extinct, and of the primary carnivores only the leopard (*Panthera pardus*) survives in small numbers in mountainous areas. Steenbok (*Raphicerus campestris*), grysbok (*Raphicerus melanotis*), rock hyrax (*Procavia capensis*), molerat (*Bathyergus suillus*), are still common in the area, as well as smaller carnivores such as caracal (*Felis caracal*), black-backed jackal (*Canis mesomelas*), Cape fox (*Vulpes chama*) and bat-eared fox (*Otocyon megalotis*). Cape fur seals (*Arctocephalus pusillus*) also occur in reasonably large numbers (Skinner and Smithers 1990).

The south-western Cape coast still supports a wide variety of birds. Endemic breeders such as the Cape cormorant (*Phalacrocorax capensis*) and bank cormorant (*Phalacrocorax neglectus*) as well as the jackass penguin (*Spheniscus demersus*) are common along the coast. During the summer months, migrant species from the northern latitudes swell the number of species which occur along the coast (Sinclair and Mendelsohn 1981).

CHAPTER FOUR

THE HDP1 FAUNA

This chapter describes the faunal sample retrieved from HDP1. The sample analysed here, includes all fossils retrieved from the site since the beginning of excavations in 1993 up to July 1996. Although the palaeontological assemblage will be the focus, the small sample from the archaeological assemblage will also be described.

Species lists for both the palaeontological as well as the archaeological samples are presented, followed by a detailed description of the taxa. As the assemblage is heavily dominated by the bones of large mammals, these will be the main focus (Table 4:1 and Table 4:5). Smaller components include the avian (Table 4:2 and Table 4:6), microfauna (Table 4:4) and reptilian assemblages (Table 4:3 and Table 4:7). A small number of fish vertebrae are also present. The avifauna, which have important environmental implications, will also be described. Because the microfaunal assemblage is highly fragmented, it was only possible to obtain a general idea of the species composition.

4.1: Description of the faunal material

In this thesis, "large mammals" are defined according to the criterion suggested by Klein

Table 4:1 :
The species of large mammals represented in the excavated sample from the HDP1 palaeontological site.

SCIENTIFIC NAMES	COMMON NAMES	NISP	MNI
Homo sapiens,	people	14?	2?
Pelea capreolus,	vaalribbok	12	2
Antidorcas australis,	springbok	64	4
Pelea/Antidorcas,	vaalribbok/springbok	57	3
Redunca arundinum,	southern reedbuck	8	3
Damaliscus dorcas,	bontebok	16	2
Redunca/Damaliscus,	reedbuck/bontebok	56	2
Tragelaphus strepsiceros,	kudu	34	3
Connochaetes gnou/ Alcelaphus buselaphus,	black wildebeest/ Cape hartebeest	479	16
Connochaetes/Alcelaphus/ Tragelaphus,	black wildebeest/hartebeest/ kudu	112	2
Raphicerus sp.,	steenbok/grysbok	143	10
Hippotragus leucophaeus,	blue antelope	1	1
Taurotragus oryx,	eland	29	1
Syncerus caffer,	Cape buffalo	10	1
Pelorovis antiquus,		2	1
Taurotragus/Megalotragus/ Syncerus/Pelorovis,		24	2
Hyaena brunnea,	brown hyaena	4	1
Crocuta crocuta,	spotted hyaena	1	1
Hyaenid-general		19	3
Felis lybica,	wildcat	14	2
Felis nigripes,	small spotted cat	1	1
Felis serval/Felis caracal,	serval/caracal	27	2
Panthera pardus,	leopard	22	2
Panthera leo,	lion	3	1
Lycaon pictus,	wild dog	8	1
Vulpes chama,	Cape fox	15	2
Canis mesomelas,	black-backed jackal	343	11
Mellivora capensis,	honey badger	5	1
Aonyx capensis,	clawless otter	9	2
Ictonyx striatus,	striped polecat	5	2
Herpestes ichneumon,	Egyptian mongoose	7	1
Atilax paludinosus,	water mongoose	3	1
Genetta tigrina,	genet	3	1
Suricata suricatta,	suricate	2	1
Veverrids-general		3	1
Equus capensis,	"giant" Cape zebra	7	1
cf. Equus quagga	plains zebra	1	1
cf. Ceratotherium simum	white rhinoceros	4	1
rhinocerotid-general		1	1
suid-general		3	2
Lepus capensis,	Cape hare	4	1
Lepus saxatilis,	scrub hare	1	1
Bathyergus suillus,	dune molerat	32	3
Procavia capensis,	rock hyrax	79	8
Hystrix africaeaustralis,	porcupine	2	1
Delphinidae gen. et sp. indet.,	dolphin	5	1
Arctocephalus pusillus,	Cape fur seal	34	2

Table 4:2 :

The bird species represented in the excavated sample from the HDP1 palaeontological site.

SCIENTIFIC NAME	COMMON NAME	NISP	MNI
Struthio camelus,	ostrich	3	1
Francolinus sp.,	francolin	1	1
Butio sp.,	buzzard	1	1
Gyps sp.,	vulture	1	1
Diomedea sp.,	albatros	1	1
Alopochen aegyptiacus,	Egyptian goose	1	1
Tadorna cana,	South African shelduck	1	1
Spheniscus demersus,	jackass penguin	12	1

Table 4:3 :

The reptilian species represented in the excavated sample from the HDP1 palaeontological site.

SCIENTIFIC NAME	COMMON NAME	NISP	MNI
Chersina angulata,	angulate tortoise	67	8

Table 4:4 :

The micromammalian species represented in the excavated sample from the HDP1 palaeontological site.

SCIENTIFIC NAMES	COMMON NAMES
Order insectivora	
Myosorex varius,	Forest shrew
Order chiroptera	
Rhinolophus clivosus,	Geoffroy's horseshoe bat
Order rodentia	
Tatera afra,	Cape gerbil
Acomys spinosissimus,	Spiny mouse
Aethomys namaquensis,	Namaqua rock mouse
Myomyscus verreauxii,	Verreaux's mouse
Rhabdomys pumillio,	Striped mouse
Mystromys albicaudatus,	White-tailed mouse
Otomys irroratus,	Vlei rat
Otomys saundersiae,	Saunder's vlei rat
Otomys unisulcatus,	Karoo bush rat
Parotomys brantsii,	Brant's whistling rat

Note:

Microfauna identified by D. M. Avery.

Table 4:5 :

The large mammal species represented in the excavated sample from the HDP1 archaeological site.

SCIENTIFIC NAMES	COMMON NAMES	NISP	MNI
Raphicerus sp.,	steenbok/grysbok	1	1
Redunca arundinum,	southern reebuck	1	1
Tragelaphus strepsiceros,	kudu	1	1
Canis mesomelas,	black-backed jackal	4	1
Bathyergus suillus,	dune molerat	12	1
Procavia capensis,	rock hyrax	6	2

Table 4:6 :

The bird species represented in the excavated sample from the HDP1 archaeological site.

SCIENTIFIC NAMES	COMMON NAMES	NISP	MNI
Spheniscus demersus,	jackass penguin	17	4
Phalacrocorax capensis,	Cape cormorant	2	1

Table 4:7 :

The reptilian species represented in the excavated sample from the HDP1 archaeological site.

SCIENTIFIC NAME	COMMON NAME	NISP	MNI
Chersina angulata,	angulate tortoise	36	4

(1980). Loosely, large mammals include all mammalian species in which adults weigh at least 0,7-0,9 kg. The principal animals excluded by this definition are bats, insectivores and small rodents. Where a species is represented by a small number of bones, each bone will be identified and described. Bones used to distinguish one species from another, are also identified and described. Where species are represented by a large number of bones, a general description of the material will be given. When a specific bone is identified, its catalogue number will be provided, if available. Bones which were not assigned catalogue numbers, will only have their stratigraphic units provided.. A description of the habitat preferences of microfauna and bird species will be included, as these are generally less well-known compared to those of large mammals. The classification of Skinner and Smithers (1990) is generally followed for mammals. However, the classification of Gentry (1980) is used for the Family Bovidae. The classification used in Sinclair (1988) is largely followed for birds, and the classification used in Branch (1991) is followed for reptiles.

4.1:1: Large mammalian taxa represented in the HDP1 palaeontological sample

ORDER PRIMATES

Family Hominidae

Homo sapiens Linnaeus, 1758

A left maxillary second molar (HDP1-1) was discovered on the surface of what is now the Hoedjiespunt 1 palaeontological site, during a survey of several faunal sites on the Hoedjiespunt hill and surrounding areas in 1993. With the commencement of excavations, a right maxillary third molar (HDP1-49 referred to as HDP1-2 by Berger and Parkington 1995) was discovered in the HOMS horizon. These molars, which are thought to have derived from an individual in its early teens, are large by comparison with modern human teeth (Berger and Parkington 1995). Morphologically however, they are comparable to those of the modern human dental sample. Subsequently, two incisors (HDP1-937 and HDP1-3150), several cranial fragments (HDP1-1515, HDP1-1252, HDP1-3076, and possibly HDP1-2796 and HDP1-3012) and a possible metatarsal (HDP1-2892) and an ulna (HDP1-3363a&b) have also been discovered in the HOMS horizon. Preliminary analyses of these latest finds, suggest that there may at least be two individuals represented at the site (L. R. Berger, pers. comm), however, this would only be confirmed once analyses have been completed.

At this stage, the paucity of human remains from this site, makes it impossible to determine whether individuals from a robust, archaic population of *Homo*, such as represented by the Florisbad and Broken Hill specimens are represented at Hoedjiespunt 1, or whether the remains are those of an "anatomically modern" population of *Homo*.

ORDER LAGOMORPHA

Family Leporidae

Lepus capensis Linnaeus, 1758

Three bones from the HOMS horizon, namely a left calcaneum (HDP1-1588), a left navicular (HDP1-1227) and a first phalange (HDP1-2437), as well as a right calcaneum (HDP1-2111) from GUFI, were assigned to the Cape hare.

Lepus saxatilis F.Cuvier, 1823

A right humerus from HOMS has been assigned to the scrub hare. It is slightly more robust than a *L. capensis* humerus in the comparative collection, reflecting the larger size of *L. saxatilis*.

ORDER RODENTIA

Family Bathyergidae

Bathyergus suillus Schreber, 1782

The dune molerat has been identified in three palaeontological horizons, namely HOMS, GUFI and ROOF from both cranial and postcranial material.

This species which is common in most archaeological and palaeontological assemblages along the Cape West Coast (Klein and Cruz-Uribe 1987), occurs only where there is a sandy substrate, such as in coastal dune sands, in sandy flats or in alluvial sands along river systems (Skinner and Smithers 1990).

Family Hystricidae

Hystrix africaeaustralis Peters, 1852

The only bones from the porcupine, are two molars, HDP1-2009 and HDP1-2422 from HOMS and ROOF respectively. The presence of this species in the area at the time, is also reflected by its distinctive incisor gnaw marks which are present on some bones in the assemblage.

ORDER CETACEA

Family Delphinidae

Vertebral fragments constitute the only cetacean remains in the sample. These are too fragmented to identify to the species level. They, in addition to the remains of marine birds and seals do however signal that the coast remained within range of the bone collector during the accumulation of the assemblage (discussed further in Chapter 8).

ORDER HYRACOIDEA

Family Procaviidae

Procavia capensis Pallas, 1766

Cranial and postcranial remains of the rock hyrax are relatively common in the palaeontological sample from HDP1. Both adults and juveniles are represented.

Another common species at Cape West Coast archaeological sites (Klein and Cruz-Uribe 1987), *P. capensis* occurs in areas where there are rocky outcrops for shelter, and bushes and trees which could provide browse (Skinner and Smithers 1990).

ORDER CARNIVORA

Family Hyaenidae

Hyaenid - general

Most of the hyaena material could not be assigned with any certainty to either *Hyaena brunnea* or *Crocuta crocuta*, and have been assigned to a general hyaenid category. Material assigned to this general category include fragmented postcranial bones as well as cranial bones such as incisors, canines, premolars and deciduous teeth.

Hyaena brunnea Thunberg, 1820

A right calcaneum (HDP1-1164b) and a right pisiform (HDP1-1999) from the HOMS horizon, have been assigned to the brown hyaena on account of their small size. The epiphyses of the calcaneum is fused, indicating that it is from an adult animal. In its general shape and size, it also compares favourably with the calcanea of *H. brunnea* specimens in the S.A. Museum's comparative collection. The pisiform also compares favourably on these two criteria with the S.A. Museum's comparative specimens.

Crocuta crocuta Erxleben, 1777

An extremely large right calcaneum (HDP1-666) from the LCSS horizon and an almost complete upper left fourth premolar (HDP1-2970) from the HOMS horizon (Fig. 4:1), have been identified as belonging to *C. crocuta*. As Figure (4:1) indicates, the fourth premolar of *C. crocuta* is a more elongated tooth than that of *H. brunnea*, which is slightly shorter and somewhat rounded. The protocone on the fourth premolar of *C. crocuta* is also positioned more anteriorly than that of *H.brunnea*.

Family Canidae

Lycaon pictus Temminck, 1820

The wild dog is represented in the sample by postcranial material as well as dentition. The postcranial material consists of a fourth right metacarpal (HDP1-2722a) from ROOF, a fifth left metatarsal (HDP1-2797), a left navicular (HDP1-3099) from HOMS and a metapodial (HDP1 -164) from HOMS which could not be sided. The dentition consists of a lower right fourth premolar (HDP1-280) from HOMS, a lower left fourth premolar (HDP1-25) from HOMS, a fragment of an upper left first molar (LCSS) and a fragment of an incisor (HDP1-69) from HOMS.

The teeth of *L. pictus* differ from other canids in that they show an adaption both to holding and slicing and a much lesser function of grinding than is present in some other canid species (Skinner and Smithers 1990). The premolars are especially catlike, with the various cusps being well developed (Fig. 4:2).

Vulpes chama A.Smith, 1833

Bones assigned to the Cape fox comprise postcranial as well as cranial material. The dentition includes the following: a lower right third premolar, an upper left fourth premolar (HDP1-1452b) from GUFI, a lower right first molar (HDP1-2495c) from HOMS, a lower left canine (HDP1-2902e) from HOMS and an upper left fourth premolar (HDP1-2521e) from HOMS. Generally, the teeth are not as well developed as those of other carnivores, being adapted predominantly to deal with insect food (Skinner and Smithers 1990).

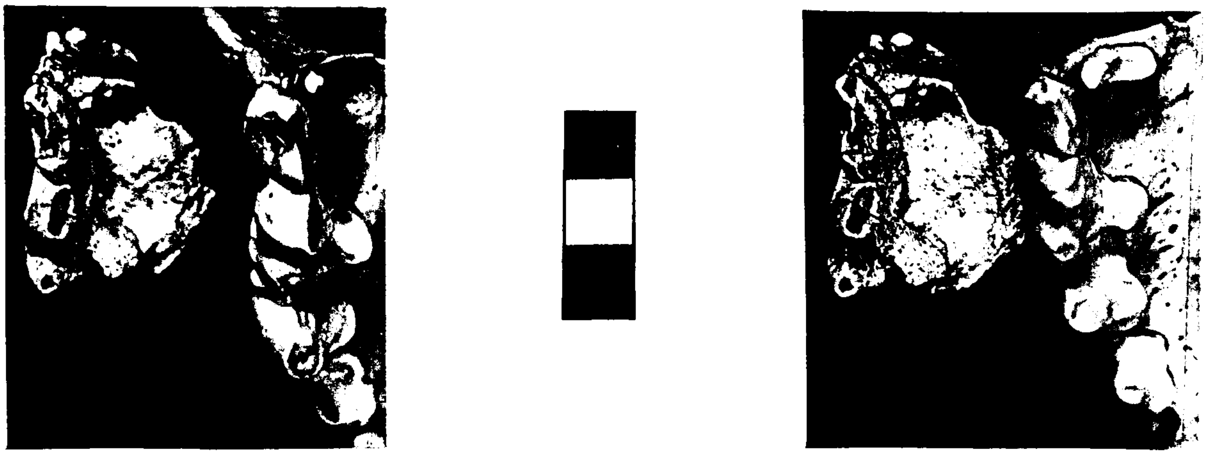


Figure 4:1 :

A left upper fourth premolar of a spotted hyaena (palaeontological site) (HDP1-2970) compared to the left upper fourth premolars of a modern spotted hyaena (SAM ZM 19469) (left) and a modern brown hyaena (SAM 17238) (right). Occlusal view. (Scale in centimetres).

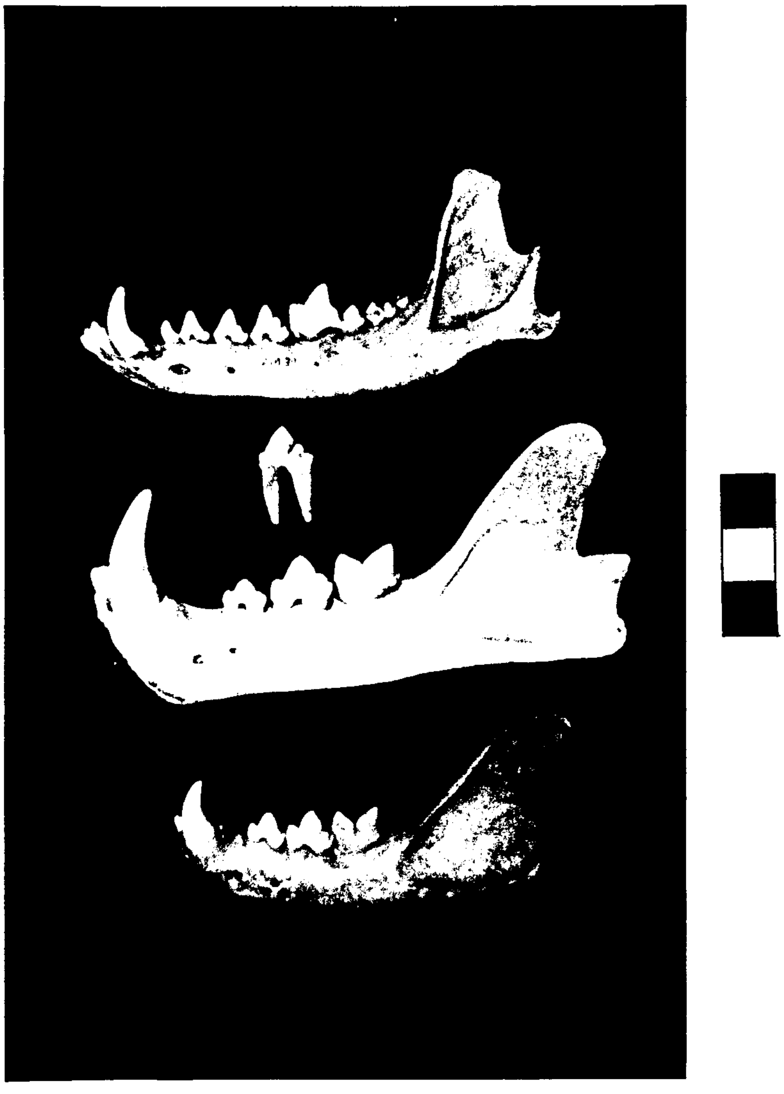


Figure 4:2 :

A left lower fourth premolar of a wild dog (palaeontological site) (HDP1-25) compared to the lower left fourth premolars of a jackal (ZM 39476) (top), a leopard (ZM 41291) (centre) and a caracal (ZM 37163) (bottom). Buccal view. (Scale in centimetres).

Canis mesomelas Schreber, 1778

The black-backed jackal is the most common carnivore species present in the palaeontological sample. Both juvenile and adult animals are represented. Generally, the bones are more robust than the modern specimens in the S.A. Museum's comparative collection. This is particularly evident when comparing dentition (Fig. 4:3). Hendey (1974) as well as Klein and Cruz-Uribe (1984) have also commented on the more robust nature of black-backed jackal bones from hyaena accumulations which they have studied.

Family Mustelidae

Aonyx capensis Schinz, 1821

Three vertebrae make up the sum of the postcranial material assigned to the Cape clawless otter. These include two cervical vertebrae (HDP1-3513 and HDP1-2975) and a thoracic vertebra (HDP1-2978) from HOMS. Cranial material include an upper right second premolar (HDP1-542a) from HOMS, two lower left fourth premolars (HDP1-1838 and HOMS), a lower right third deciduous premolar (HDP1-1i) from HOMS, an upper left third deciduous premolar (HDP1-48b) from HOMS and a lower right mandible lacking teeth. These bones are not much larger than the modern specimens in the comparative collection.

Mellivora capensis Schreber, 1776

A partially complete maxilla (HDP1-3454) from HOMS comprises the only cranial material assigned to the honey badger. The postcranial material consists of a thoracic vertebra (HDP1-

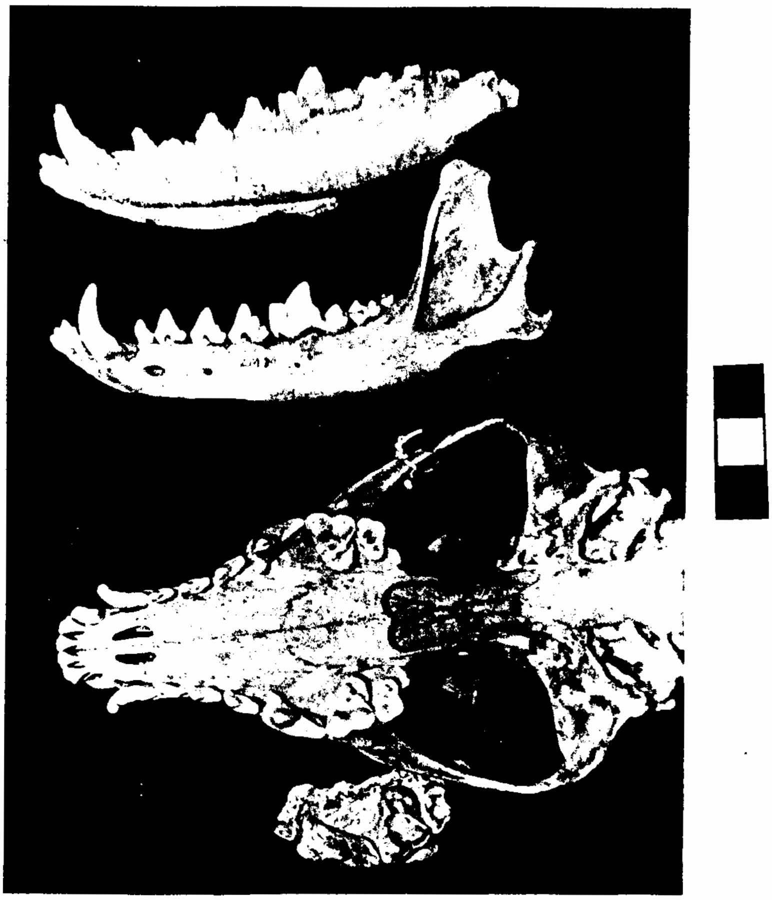


Figure 4:3 :

The right upper fourth premolar, first molar and second molar (palaeontological site) (HDP1-121), as well as left mandible (palaeontological site) (HDP1-121) of a black-backed jackal (bottom and top respectively), compared to their counterparts in a modern specimen (ZM 39476) (centre). (Scale in centimetres).

Figure 4:4 :

The right second metacarpal of a lion (palaeontological site) (HDP1-2617). (Scale in centimetres).

1020) from HOMS, a second phalange (HDP1-2212c) from HOMS, a third phalange (HDP1-3452b) from ROOF and a second metatarsal (GUFI).

Ictonyx striatus Perry, 1810

The striped polecat is only represented by postcranial material. These include a metapodial (HDP1-1965c) from HOMS, an axis (HDP1-5a) from HOMS, a radius (sieved material), and two left humeri, HDP1-1649 and HDP1-3144a from ROOF and GUFI respectively. The material is quite robust when compared to specimens in the S.A. Museum's comparative collection.

Family Viverridae

Herpestes ichneumon Linnaeus, 1758

Postcranial material assigned to the large grey mongoose consists of a right astragalus (HDP1-1244) from GUFI, a metapodial (sieved material), two first phalanges (HDP1-2973e and sieved material) and a right humerus (HDP1-1908) from GUFI. Cranial material consists of a third incisor (HDP1-2284e) from HOMS and a second incisor (HDP1-1225m) from HOMS.

Atilax paludinosus G. Cuvier, 1829

The water mongoose is only represented by postcranial material. These consist of a fifth metatarsal (HDP1-3407) from HOMS, and two humeri (HDP1-2686 and GUFI) from GUFI.

Suricata suricatta Schreber, 1776

Two canines (HDP1-2096 and SURF) have been assigned to the suricate.

Genetta tigrina Schreber, 1776

Two metapodials (HDP1-1642g and HDP1-2a) from HOMS, as well as a first phalange (HDP1-2236) from HOMS, have been assigned to the large-spotted genet.

Family Felidae

Panthera pardus Linnaeus, 1758

The leopard is the most common big cat represented in the sample, with a much higher NISP value than that of the lion (*Panthera leo)*. This is the case at the nearby site of Sea Harvest as well (Grine and Klein 1993). The cranial material consists of an upper left fourth premolar (HDP1-1182b) from ROOF, two lower left first molars, HDP1-1935 and HDP1-1611 from CHANF and HOMS respectively, a lower right fourth premolar (HDP1-151) from ROOF, an upper left third premolar (HDP1-1182c) from ROOF and an upper right third premolar (HDP1-3321) from HOMS. The postcranial material is limited to vertebrae and small compact bones, such as phalanges and tarsals. An exception is a left distal fibula (HDP1-2388b) from HOMS.

Panthera leo Linnaeus, 1758

The lion is represented by three limb bones. These are a right external cuneiform (HDP1-2084b), a left internal cuneiform (HDP1-3160a) from GUFI and a right second metacarpal (HDP1-2617a&b) from HOMS (Fig. 4:4). The HDP1 lion remains are generally larger, and more robust than the modern specimens in the comparative collection.

Felis caracal Schreber, 1776/*Felis serval* Schreber, 1776

The caracal/serval material have been included into a general category, because the sample consists of fragmented postcranial bones, small compact bones and isolated teeth that are difficult to assign to any one of these two similar sized felids. The only exception to this, a fragmented left mandible, has been assigned to the serval because of its lighter build when compared to a modern caracal mandible (Fig. 4:5).

Felis lybica Forster, 1780

The African wild cat material consists mostly of postcranial bones. Again these bones are larger and more robust than their modern counterparts in the comparative collection. Two teeth, an incisor (HDP1-2284f) from HOMS and an upper left fourth premolar (HDP1-1796d) from HOMS, have also been assigned to this species.

Figure 4:5 :
The left mandible of a serval cat (palaeontological site) (HDP1-1178) (top) compared to the left mandible of a modern caracal (ZM 37163) (bottom). Buccal view. (Scale in centimetres).

Figure 4:6 :
A left external cuneiform of a plains zebra (palaeontological site) (HDP1-864) (left) compared to a right external cuneiform of *Equus capensis* (palaeontological site) (HDP1-1296) (right).

(Scale in centimetres).

Felis nigripes Burchell, 1824

A left tibia (HDP1-3236b) from GUFI has been assigned to the small spotted cat.

Family Otariidae

Arctocephalus pusillus Schreber, 1776

The Cape fur seal material from HDP1, consists mostly of cranial bone fragments and premolars. Bone fragments from adult as well as juvenile seals are represented in the sample.

ORDER PERISSODACTYLA

Family Rhinocerotidae

Rhinocerotid-general

A rhinocerotid tooth fragment (HDP1-2177) from GUFI could not be assigned to a specific tooth, or species, and has been included in a general rhinocerotid category.

cf. *Ceratotherium simum* Burchell, 1817

Four postcranial bones have been assigned to the white rhinoceros. These include a right second phalange (fore limb) (HDP1-204) from HOMS, a left magnum (HDP1-1190) from HOMS, a right second phalange (hind limb) (HDP1-3492) from ROOF and a proximal sesamoid (HDP1-2426) from ROOF. These bones resemble modern specimens in size and morphology.

Family Equidae

cf. *Equus quagga* Boddaert, 1785

An external cuneiform (HDP1-864) from HOMS has been assigned to the extinct quagga on account of its smaller size in comparison to the other zebra material from HDP1 (Fig. 4:6). Although *Equus burchelli* is of similar size, this species is not thought to have occurred south of the Orange River (Churcher and Richardson 1978).

Equus capensis Broom, 1909

All the equid material too large to be included in the *E. quagga* group has been classified as belonging to the extinct *E. capensis*. The postcranial material consists of a second phalange (HDP1-2086) from HOMS, a right external cuneiform (HDP1-1296) from HOMS, a distal sesamoid (HDP1-2066a/2068) from CHANF, a right metatarsal (HDP1-6) from HOMS and a left lunate (HDP1-3078) from HOMS. Two lower deciduous cheek teeth (HDP1-1806 and HDP1-80a) from HOMS have also been assigned to this species.

ORDER ARTIODACTYLA

Family Suidae

Suid-general?

Three cuneiforms (HDP1-2765, HDP1-1622c and HDP1-1785) from HOMS which are morphologically slightly different, but of a similar size to those of the bushpig (*Potamochoerus porcus*) and the warthog (*Phacochoerus aethiopicus*), have been assigned to a general suid category.

Family Bovidae

Tribe Neotragini

Raphicerus sp.

Although *R. campestris* (steenbok) and *R. melanotis* (grysbok) are osteologically very similar, Klein (1976b) notes that it is possible to distinguish between the two species on the difference in curvature of the inferior margin of the mandible's horizontal ramus. In the case of *R. melanotis* the horizontal ramus is markedly curved, while in the case of *R. campestris*, the horizontal ramus is fairly straight. As no complete *Raphicerus* mandibles were identified in the sample, it was not possible to determine which of the two species are present. As both species were identified at the nearby Sea Harvest site, it is possible that both could be represented at HDP1. Because the bones could not be identified to species level, it was decided to leave identification at the genus level.

The *Raphicerus* genus is the second most numerous in the sample. Cranial and postcranial material are both well represented.

Pelea capreolus Forster, 1790

The grey rhebok is uncommon in the sample. Five teeth are the only sure indicators of the presence of this species at HDP1. These consist of a lower left fourth premolar, an upper right third premolar (HDP1-1646e) from ROOF, a lower left fourth premolar (HDP1-1644) from ROOF, an upper left third premolar (HDP1-1225d) from HOMS and an upper right third premolar. Although it is difficult to distinguish between the postcranial remains of the grey rhebok and the Cape springbok (*Antidorcas australis*), which is also present in the sample, this is possible as demonstrated by Peters and Brink (1992). Seven postcranial bones from the sample have been assigned to the grey rhebok.

Tribe Antilopini

Antidorcas australis Hendey, 1974

This extinct species which is present at Swartklip 1 (Klein 1975), Sea Harvest (Grine and Klein 1993) and other Cape sites, was at first described as a subspecies of *A. marsupialis*, but is now thought of as a separate species (Hendey 1974). Generally, *A. australis* differs from the extant springbok in that it has smaller and more mediolaterally compressed horn cores without any sharp bending backwards and outwards. It also has smaller dentition than the extant species (Gentry 1978).

A. australis is common in the sample, and is mostly represented by cranial material. Dentition is generally smaller than that of the extant springbok specimens in the S.A. Museum's comparative collection. A pair of horn cores (HDP1-216a) from HOMS are also present in the sample. In addition to being mediolaterally compressed, they also exhibit the low degree of curvature, both backwards and outwards, that is said to characterise the horns of this species. In figure 4:7, these horn cores are compared to those of an extant springbok. This species is also well represented postcranially.

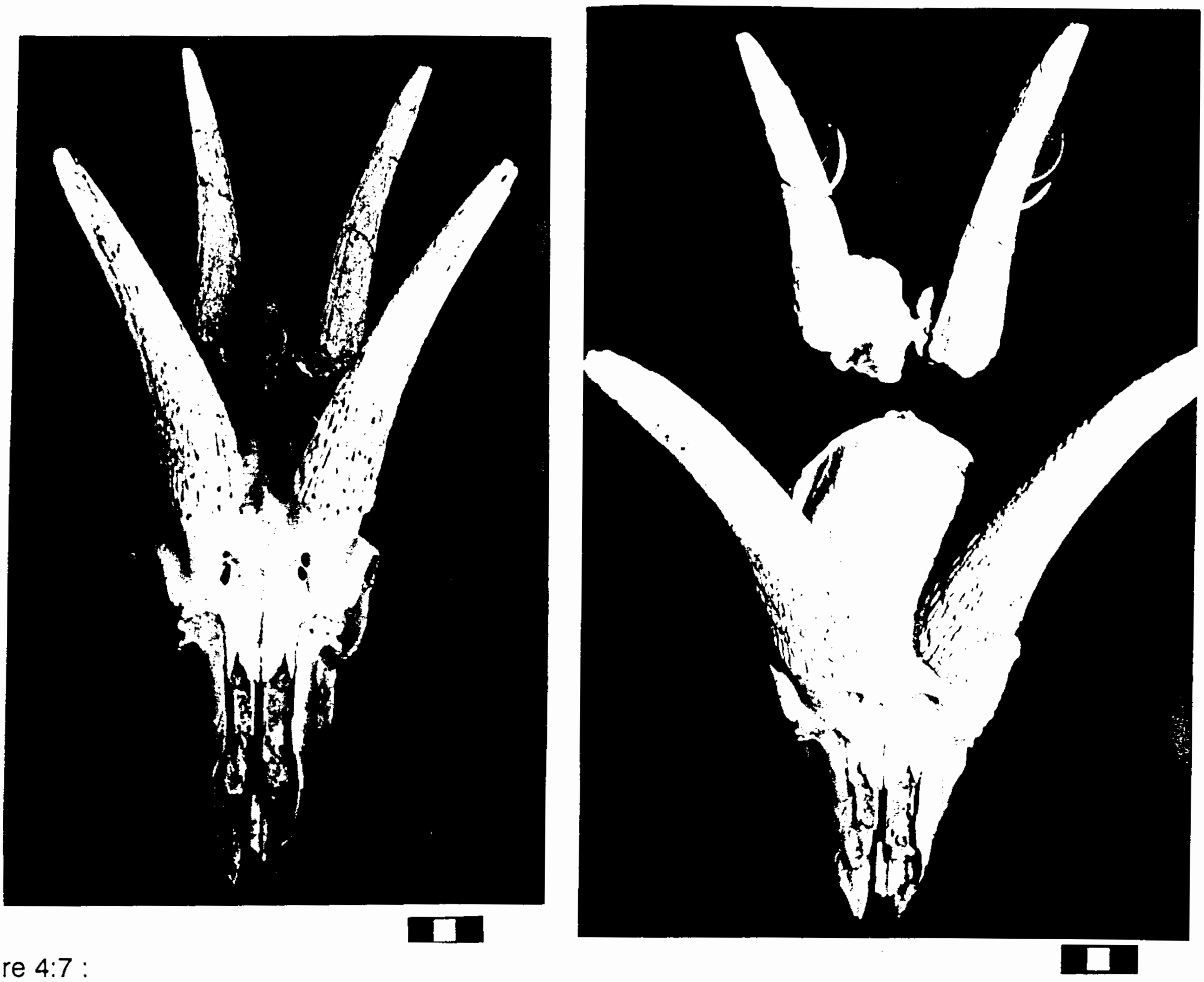


Figure 4:7 :

Antidorcas australis horncores (palaeontological site) (HDP1-216a) (top), compared to those of a modern springbok *Antidorcas marsupialis* ram (ZM 36927) (bottom). (Scale in centimetres).

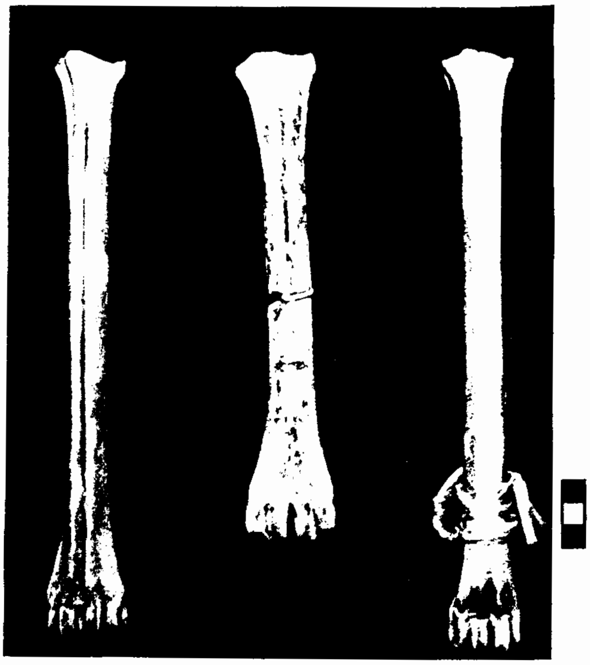


Figure 4:8 :

The right metatarsal of a blue antelope (palaeontological site) (HDP1-81) (centre) compared to the right metatarsals of a blesbok (ZM 39226) (left) and a southern reedbuck (ZM 38808) (right). (Scale in centimetres).

P. capreolus/A. australis

All small-medium sized bovid postcranial bones which are too fragmented to assign to either *P. capreolus* or *A. australis*, have been included in this category. Small bones such as sesamoids which are difficult to assign to either species have also been included.

Tribe Reduncini

Redunca arundinum Boddaert, 1785

The reduncine teeth present in the sample all belong to the reedbuck. These include a lower left second molar (HDP1-2034d), a section of an upper left maxilla (HDP1-169), a lower left first molar (HDP1-1809), an upper molar (HDP1-2192c), a lower left second molar (HDP1-1526), a lower right third premolar (HDP1-1796e) and a lower left molar (HDP1-3558h) all of which were found in the HOMS horizon. A magnum (HDP1-3163) from HOMS was also assigned to this species.

Tribe Hippotragini

Hippotragus leucophaeus Pallas, 1766

A right metatarsal (HDP1-81a&b) from HOMS has been assigned to the extinct blue antelope. Compared to the metatarsals of similar sized antelope such as *R. arundinum* and *Damaliscus dorcas phillipsi* (blesbok), that of *H. leucophaeus* is shorter, and broader (Fig. 4:8).

Tribe Alcelaphini

Damaliscus dorcas dorcas Pallas, 1766

A few loose adult alcelaphine teeth too small to be assigned to either *Connochaetes gnou* or *Alcelaphus buselaphus*, have been assigned to the bontebok. A few postcranial bones have also been assigned to this species.

R. arundinum/H. leucophaeus/D. d. dorcas

All postcranial bones in this size range which could not be assigned to any of the three species, have been included in this category.

Connochaetes gnou Zimmerman, 1780/ *Alcelaphus buselaphus* Pallas, 1766

Both the black wildebeest and the Cape hartebeest are present at the nearby Sea Harvest site. Both species are present at HDP1 as well (Fig. 4:9). However, because of the fragmentary state of the bones, it was not possible to distinguish between material from either of the two species on a consistent basis. It was thus decided to follow Grine and Klein's (1993) example of lumping all large-medium to large alcelaphine bones into a combined class.

The *Connochaetes/Alcelaphus* class is the most numerous in the sample. Postcranial as well as cranial material are well represented. Juveniles are also common, as indicated by the presence of numerous deciduous teeth.

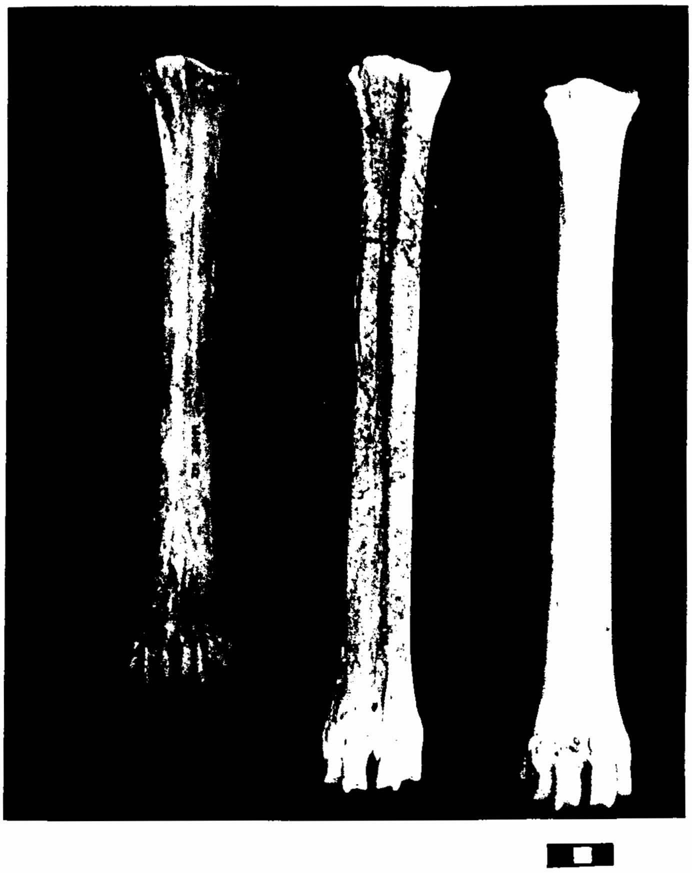


Figure 4:9 :

The right metatarsal of a Cape hartebeest (palaeontological site) (HDP1-1668) (centre) compared to the right metatarsals of a modern Cape hartebeest (ZM 38773) (right) and black wildebeest (ZM 38773) (left). (Scale in centimetres).

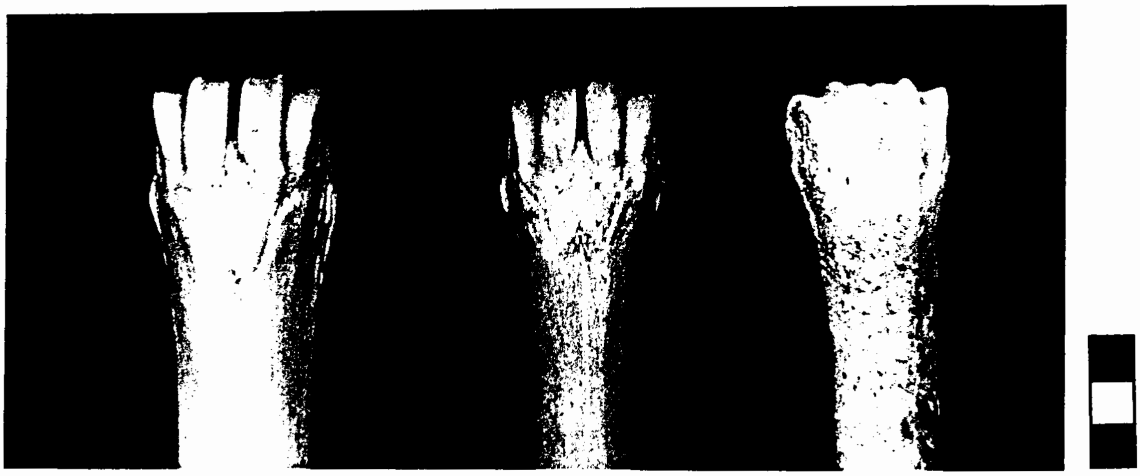


Figure 4:10 :

The distal end of a kudu metacarpal (palaeontological site) (HDP1-1936) (right) compared to modern kudu metacarpals - male (ZM 36035) (left) and female (ZM 39387) (centre). (Scale in centimetres).

Tribe Tragelaphini

Tragelaphus (strepsiceros) sp.

The presence of a kudu intermediate in size between the greater and lesser kudu, has been noted in the Later Pleistocene of the Western Cape (Hendey 1968; Klein 1976a). According to Gentry (1978), the horns of this species are much more tightly spiralled, and the teeth smaller than those of the greater kudu. Not much is known postcranially about this kudu, but the bones should be smaller than those of the greater kudu.

The *Tragelaphus strepsiceros* teeth from HDP1 are generally smaller than those of the modern specimens. A small tragelaphine metacarpal (HDP1-1936c) has also been identified in the HDP1 sample. This adult metacarpal is approximately the size of the smallest adult female kudu in the comparative collection of the S.A. Museum (Fig. 4:10). Although no horn cores are present in the sample to strengthen suspicions that the kudu which is present, is the small kudu, the relatively small size of the dentition and metacarpal is suggestive.

C. gnou/A. buselaphus/T. strepsiceros

All material in this size range that could not be assigned to any of these species, is included in this general category.

Taurotragus oryx Pallas, 1766

The eland is the most common large bovid in the sample. Postcranial elements constitute the vast majority of identifiable material. Dentition is limited to one potential eland deciduous incisor (HDP1-3469).

Tribe Bovini

Syncerus caffer Sparrman, 1779

Postcranial bones assigned to the African buffalo is limited to a few long bone fragments and small compact bones. No dentition has been identified.

Pelorovis antiquus Duvernoy, 1851

The extinct giant buffalo has been referred to as "*Bubalus baini*" (Dreyer and Lyle 1931) and "*Homoioceras baini*" (Cooke 1964) in the past. Today, these names are synonymous with *P. antiquus*.

Two left second phalanges (HDP1-1857 and HDP1-619) have been assigned to this species. No dentition has been identified.

T. oryx/S. caffer/P. antiquus/

Megalotragus priscus Broom, 1913

All large bovid material that could not be identified to species level, have been included in this category. Although *M. priscus* has not been identified in the sample, it was identified in the Old Hoedjiespunt collection. It is thus possible that some of the unidentified postcranial material could belong to this species.

4.1:2: The microfaunal taxa

As mentioned earlier, the microfaunal remains from HDP1 are extremely fragmented. A general idea of species representation in the sample could however be obtained from the few complete and partially complete mandibles and maxilla, as well as, selected incisors which are present (D.M. Avery, pers. comm.). Species which were identified include the following.

ORDER INSECTIVORA

Family Soricidae

Myosorex varius Smuts, 1832

The forest shrew (HDP1-2360, GUFI, GUFI) is the only shrew species identified in the sample. This species prefers a moist densely vegetated habitat, although, in the Cape, they occur under drier conditions on coastal mountains (Skinner and Smithers 1990).

ORDER CHIROPTERA

Family Rhinolophidae

Rhinolophus clivosus Cretzchmar, 1828

Geoffroy's horseshoe bat (HDP1-718a) is the only bat species identified in the sample. This species occurs widely across Africa today, preferring savanna woodland, but also occurring on forest fringes and in deserts (Skinner and Smithers 1990).

ORDER RODENTIA

Family Muridae

Tatera afra Gray, 1830

The Cape gerbil (HDP1-1747f) is confined to the Cape West and South coast today. It prefers areas of loose, sandy soils (Skinner and Smithers 1990).

Acomys spinosissimus Peters, 1852

A left mandible (HDP1-1646b) could possibly belong to the spiny mouse. This species commonly occurs in rocky terrain, but can also occur in sandy alluvium along rivers as well as in woodland and thicket (Skinner and Smithers 1990).

Aethomys namaquensis A. Smith, 1834

The Namaqua rock mouse (HDP1-1646b) is widely spread in southern Africa today, occurring where there are rocky outcrops or boulder-strewn hillsides (Skinner and Smithers 1990).

Myomyscus verreauxii A. Smith, 1834

Verreaux's mouse (HDP1-3131b) has been recorded in habitats ranging from grassy hillsides (Rautenbach and Nel 1980) to damp meadows, vleis and forests (De Graaff 1981).

Rhabdomys pumilio, Sparrmann, 1784

The striped mouse (HDP1-1646b, HDP1-1747f, GUFI) is a grassland species, and occurs in a wide variety of habitats where grass cover is available (Skinner and Smithers 1990).

Mystromys albicaudatus A. Smith, 1834

The white-tailed mouse (HDP1-1709, GUFI) is another grassland species, but can also occur in dry areas such as the Karoo and in the fynbos zone (Skinner and Smithers 1990).

Otomys irroratus Brants, 1827

The vlei rat (HDP1-1225e, HDP1-1227d, HDP1-1563b, HDP1-1586c, HDP1-1646b, HDP1-1704b, HDP1-1747f, HDP1-3131b, GUFI, GUFI) is well represented in the sample. This species occurs in grasslands, but is more abundant in moist habitats associated with damp soils along river beds and vleis (Skinner and Smithers 1990).

Otomys saundersiae Roberts, 1929

Saunder's vlei rat (HDP1-1309c, HDP1-1563b, HDP1-1586c, HDP1-1646b, HDP1-1747F, GUFI) is another common species in the sample. It occurs in mountainous habitats (Skinner and Smithers 1990).

Otomys unisulcatus F. Cuvier, 1829

The Karoo bush rat (HDP1-1563b, HDP1-1646b, HDP1-1747f, GUFI) occurs in shrub and *fynbos* associated with rocky outcrops (Skinner and Smithers 1990).

Parotomys brantsii A. Smith, 1834

Brant's whistling rat (HDP1-1309c, HDP1-1586c, HDP1-3529h) is associated with dry sandy substrate in arid regions (Skinner and Smithers 1990).

4.1:3: The Avifauna taxa

The avifauna represented in the palaeontological sample can broadly be divided into species that occur largely inland (grassland/woodland/arid regions) and species that occur along the coast.

The inland species

ORDER STRUTHIONIFORMES

Family Struthionidae

Struthio camelus

The ostrich material (HDP1-1996, HDP1-1188 and HDP1-800) is generally larger than the modern comparative material (Fig. 4:11).This has been noted in many mammalian species as mentioned earlier. This species generally occurs in arid areas, but is not uncommon in savanna and woodland areas (Sinclair 1988).

ORDER GALLIFORMES

Family Phasianidae

Francolinus sp.

A tarsometatarsus (HDP1-2416b) has been assigned to an unidentified francolin species. Francolins are usually found in grassland or woodland habitats (Sinclair and Mendelsohn 1981).

ORDER FALCONIFORMES

Family Accipitridae

cf. *Buteo sp.*

A phalange of a small-medium sized raptor was found in GUFI. This possibly belongs to one of the buzzard species.

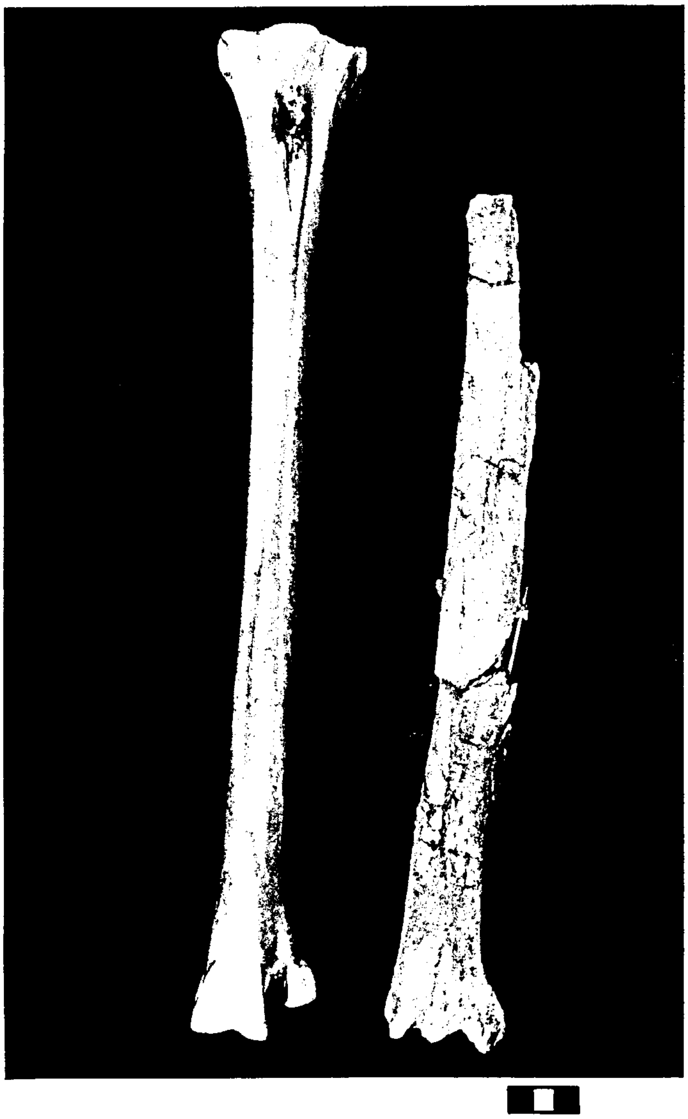


Figure 4:11 :

The tarso-metatarsus of an ostrich (palaeontological site) (HDP1-1188) (right) compared to a modern specimen (ZM 058259) (left). (Scale in centimetres).

cf. *Gyps sp.*

A phalange (HDP1-1747h) belonging to a large raptor has been assigned to a general vulture category.

ORDER ANSERIFORMES

Family Anatidae

Alopochen aegyptiacus

The Egyptian goose is the only representative of the duck family in the sample.

Coastal birds

ORDER SPHENISCIFORMES

Family Spheniscidae

Spheniscus demersus

The jackass penguin has the highest NISP value of all the bird species in the sample. It is normally an offshore and island-dwelling penguin which only comes to the mainland when ill (Sinclair and Mendelsohn 1981).

ORDER PELICANIFORMES

Family Diomedeidae

cf. *Diomedea sp.*

A large quadrate (HDP1-89b) possibly belonging to an albatross has also been identified in the sample.

4.1:4: The reptilian taxa

ORDER CHELONII

Family Testudinidae

Chersina angulata

The tortoise remains come from the angulate tortoise. This species is the most numerous tortoise in the area today.

4.2:1: The mammalian taxa represented in the archaeological sample

ORDER CARNIVORA

Family Canidae

Canis mesomelas

The black-backed jackal is the only carnivore represented in the archaeological sample. The lack of carnivore remains in archaeological assemblages have also been noted by Klein and Cruz-Uribe

(1984), who analysed several archaeological as well as palaeontological sites.

ORDER ARTIODACTYLA

Family Bovidae

Tribe Neotragini

Raphicerus sp.

A single left innominate assigned to the genus *Raphicerus*, has been retrieved from the horizon NOSA 2.

Tribe Reduncini

Redunca arundinum Boddaert, 1785

A third phalange constitutes the only identifiable material of the reedbuck in the archaeological sample.

Tribe Tragelaphini

Tragelaphus strepsiceros Pallas, 1766

A calcaneum from DAMA (HDP1-91) has been assigned to the greater kudu.

ORDER RODENTIA

Family Bathyergidae

Bathyergus suillus Schreber, 1782

The dune molerat is a common species in most Cape west coast archaeological sites. At HDP1, it is represented in most of the archaeological units.

ORDER HYRACOIDEA

Family Procaviidae

Procavia capensis Pallas, 1766

The rock hyrax is also a relatively common species at Western Cape archaeological sites, and this is the case at HDP1 as well.

4.2:2: The avifauna taxa represented in the archaeological sample

ORDER SPHENISCIFORMES

Family Spheniscidae

Spheniscus demersus

The jackass penguin is the most common bird species in the sample.

ORDER PELICANIFORMES

Family Phalacrocoracidae

Phalacrocorax capensis

The Cape cormorant is a marine cormorant which is common along the Cape west coast. A left tarsometatarsus (NOSA) and a left tibio-tarsus of this species have been retrieved from the archaeological horizons.

4.2:3: The reptilian taxa represented in the archaeological sample

ORDER CHELONII

Family Testudinidae

Chersina angulata

The angulate tortoise is the most common species in the archaeological sample.

4.3: Discussion

4.3:1: Composition of the fauna

The HDP1 palaeontological sample is dominated by grazing ungulates and carnivores. Both groups show a high diversity. The kudu is the only large-bodied browser present in the sample. Very large herbivores such as Proboscidae, Giraffidae and Hippopotamidae are absent, with the largest herbivore being the white rhino. The microfauna are also very diverse. All the species that are present in the sample are also present in the area today.

By contrast, ungulates and carnivores are rare in the small archaeological sample. Small animals such as the dune molerat, tortoise and rock hyrax are more common than the larger animals. Marine birds like the penguin and Cape cormorant are also common.

4.3:2: Dating implications of the fauna

The HDP1 palaeontological and archaeological faunas are quite modern overall. This is reflected by the low number of extinct species which were identified in the sample. Five species, *Antidorcas australis, Hippotragus leucophaeus, Pelorovis antiquus, Equus capensis, Equus quagga* and a possible sixth, *Tragelaphus (strepsiceros)* sp. are the only extinct species recorded in the palaeontological sample. None were recorded in the archaeological sample. *H. leucophaeus* and *E. quagga* were the only extinct species that were recorded in historic times. The other species became extinct during the Terminal Pleistocene-Early Holocene (Klein 1980).

Based on the extinctions of these species, the HDP1 palaeontological assemblage has to be older than ± 10 000 years B.P. Most of the species in HDP1's faunal sample already existed during the Middle Pleistocene, however the absence of certain species that were present in the Middle Pleistocene assemblage of Elandsfontein (Klein 1983), such as cf. *Rabaticeras arambourgi*, suggest that the fossils at HDP1 were probably deposited after the Middle Pleistocene.

4.3:3: Endemic species (Palaeontological sample)

The fauna is characteristic of the fossil fauna from the Cape ecozone. The endemic species which are present in the sample consist of the bontebok (*Damaliscus dorcas dorcas*), the blue antelope (*H. leucophaeus*), and the small kudu (*Tragelaphus strepsiceros* sp.). Of the three species, only the bontebok is extant. It was previously thought that the extinct antilopine, *A. australis*, which was first identified at Swartklip 1, was endemic to the Cape. However discoveries of this species at Swartkrans suggested that it became restricted to the Cape ecozone in post Swartkrans times (Vrba 1973, 1976). Brink (1987) suggests that this restriction in geographical range is of high antiquity, as this species does not occur at Vlakkraal and Kromdraai.

4.3:4: Robust features of the fauna (Palaeontological sample)

Many extant species in the sample also display certain differences in size that distinguish them from their modern counterparts. The carnivores are generally quite robust. Limb bones of some bovids, especially *Raphicerus*, are robust. The kudu dentition on the other hand tend to be smaller than that of the extant kudu. Hendey (1974) as well Klein and Cruz-Uribe (1984) also noted the general robustness of the Late Pleistocene carnivores from the Cape ecozone. Brink (1987) noted the same trend in the Florisbad fossil sample from the Free State.

Klein (1983, 1986) links this increase in mean body size, to colder episodes during the Late Pleistocene. Brink (1987) however notes that larger forms have also been found in Last Interglacial deposits such as at Herolds Bay Cave. This suggests that this trend may not entirely be a reflection of colder episodes in the past, and may in part, reflect a general stage of mammal evolution in southern Africa (Brink 1987).

4.4: Comparison with the faunas from Sea Harvest and the Old Hoedjiespunt sample.

Like the faunas from Sea Harvest (Appendix A : Table 1) and the Old Hoedjiespunt sample (Appendix A : Table 2), the palaeontological sample from HDP1 is dominated by grazing ungulates and carnivores. The taxa are similar in all three samples, suggesting accumulation under similar environmental and climatic conditions. The same extant and extinct species occur in all samples. Species also occur in similar frequencies in all three samples. For example, *Connochaetes gnou Alcelaphus buselaphus* and *Raphicerus* sp. are the most common bovid species. *Canis mesomelas* on the other hand, is the most common carnivore. All three samples also contain an impressive range of species. The remains of birds and reptiles are also present in the Sea Harvest sample (Grine and Klein 1993), the Old Hoedjiespunt sample (pers. obs.) and the HDP1 sample.

In addition to being dominated by grazing ungulates and carnivores, the Hoedjiespunt 1, Sea Harvest and Old Hoedjiespunt samples also have small marine components. The presence of marine animals is further proof that similar environmental and climatic conditions prevailed during the accumulation of these assemblages.

Small-mammals (*Bathyergus suillus*, *Procavia capensis* and *Lepus capensis*) on the other hand, are better represented in the Sea Harvest and HDP1 samples than they are in the Old Hoedjiespunt samples. Microfaunal remains are also much more common in the HDP1 sample than in the Sea Harvest and Old Hoedjiespunt samples (pers. obs.).

Large animals are thus well represented in both the systematically excavated HDP1 sample and the two largely unexcavated Sea Harvest and Old Hoedjiespunt samples. Small-mammals are however better represented in the HDP1 and Sea Harvest samples than in the Old Hoedjiespunt sample. The scarcity of small animal bones in the Old Hoedjiespunt sample may however be attributed to the fact that the fossils from here were not retrieved by means of systematic excavations, but were collected as they weathered out of the face of a cliff. This view is supported by the excavation at HDP1 and the excavation of a rich bone pocket at Sea Harvest by R. Klein and G. Avery (Grine and Klein 1993). Both excavations yielded sizable amounts of small-mammal bones.

The sample from Sea Harvest is however extremely rich in small animal bones, much richer than HDP1. Grine and Klein (1993) suggest that the large numbers of small animal bones in the Sea Harvest assemblage may not have been accumulated by hyaenas, which are thought to have been the main accumulators of the assemblage. Instead, a different accumulator, such as a jackal or raptor, is thought to have been responsible for the presence of the small-mammal bones (Grine and Klein 1993). Although this could have been the case, the possibility of contamination from the archaeological horizons must also be considered. As mentioned earlier, although small, the archaeological sample contains more, small-mammal remains than bovids or carnivores. Although it is too early to be sure, it does appear that small animals may dominate the faunal assemblage in these horizons. This could also be the case at Sea Harvest. Since the stratigraphy of the Sea Harvest site is not well understood, there is no way of knowing whether material from the palaeontological horizons may have been contaminated by material from the archaeological horizons. There is therefore a chance that a large percentage of small-mammal remains at Sea Harvest may originally have come from the archaeological horizons, and not from the palaeontological horizons.

The low numbers of small mammals in the Old Hoedjiespunt sample, in combination with the dominance of grazing ungulates and carnivores, also suggest strongly that these fossils came mainly from the lower palaeontological fossil-bearing sands at HDP1. Although these fossils may be part of the HDP1 palaeontological accumulation, it is unlikely, as the Old Hoedjiespunt fossils were collected about 10 metres to the south of where excavations are currently being carried out (G. Avery, pers. comm.). These fossils may however be a separate accumulation by the same agent that is responsible for accumulating the HDP1 palaeontological assemblage.

CHAPTER FIVE

THE AGENT OF ACCUMULATION

When it comes to identifying the bone accumulator at a fossil bone site, contextual controls can be very useful. Thus, for example, at a site that has numerous artefacts and features, it would not be wrong to assume that humans had a big role to play, while at a site which lacks artefacts and features but contains coprolites, hyaenas may be implicated.

In many cases however, more than one agent may have contributed to an assemblage. This certainly seems to have been the case at Hoedjiespunt 1. Here, the contextual evidence suggest that humans were involved in the accumulation of the fauna in the upper units of the stratigraphic sequence. These upper artefact bearing horizons include a shell midden containing limpets and mussels as well as large numbers of ostrich eggshell fragments and MSA stone tools. The faunal remains associated with these are mostly of small animals. This differs markedly from the lower deposits which have no shell midden, apart from the odd shell, and no stone tools. Ostrich eggshell fragments are present however. These deposits consist almost exclusively of fossil bone, and the fauna is similar in composition to those of the fossil sites of Swartklip 1 (Klein 1975) and Sea Harvest (Grine and Klein 1993), in that the fauna is heavily dominated by grazing fauna such as *Connochaetes/Alcelaphus*, and carnivore remains abound. Numerous coprolites are also found in these lower deposits. This is almost certainly the result of accumulation by a large predator. The aim of this chapter is to attempt a possible identification of the agent responsible for this fossil bone assemblage.

5.1: Possible accumulators

The gnaw marks (Fig. 5:1) of porcupines do occur on bones in the HDP1 palaeontological accumulation. Although porcupines are acknowledged bone collectors (Skinner and Smithers 1990), it is unlikely that they had been major accumulators of bone at HDP1.The reason for this is that porcupines leave gnaw marks on a sizable proportion of bones they collect. Brain (1968) estimated that roughly 70% of bones analysed by Hughes and himself from porcupine lairs in the Kalahari Gemsbok National Park, were clearly gnawed. In addition to this, Hendey and Singer (1965) also reported gnawing on roughly 60% of the bones they examined from the Andrieskraal II porcupine lair in the Southern Cape. In contrast, less than 1% of the identified bones from HDP1 (excluding bird and microfauna) bear the gnaw marks of porcupine incisors.

Leopards and hyaenas are also known to accumulate bones. Skinner and Smithers (1990) state that in semi-desert areas such as the Kalahari where trees are scarce, leopards have been known to cache their prey in holes. At HDP1 however, contextual evidence points to hyaenas, rather than leopards as being the main accumulators of the HDP1 palaeontological assemblage. Firstly, the numerous coprolites which accompany the bones, are similar in shape and size to those of hyaenas (Fig. 5:2). Secondly, the sheer quantity of bones in the fossil assemblage, suggests strongly that hyaenas were the primary collectors, as no other carnivore accumulates bones in such quantities (Klein and Cruz-Uribe 1984). Thirdly, accumulation by hyaenas also seem more probable if the possibility is accepted that the pockets in which bones occur in the lower deposits of HDP1, represent sections of the collapsed burrow system of a hyaena den.

Figure 5:1 :
Porcupine gnaw marks on a bone from the palaeontological site.

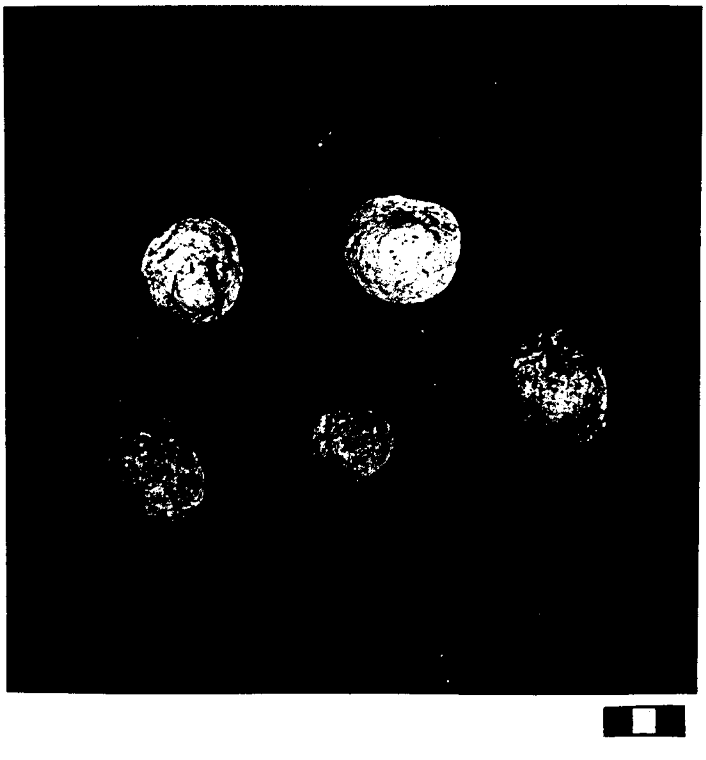


Figure 5:2 :
Hyaena coprolites from the palaeontological site (top) compared to modern hyaena coprolites (bottom) (Uniab - Namib Desert).

5.2: Hyaenas as taphonomic agents

The mode of accumulation of bones in the Transvaal australopithecine sites has been a controversial issue ever since Dart ascribed both the fracture patterns and the element frequencies he had documented in the bone assemblage from the Makapansgat australopithecine site, to the actions of hominids (Dart 1925, 1949a, 1949b, 1957). Dart argued that the australopithecines were predatory implement users, and that many of the bones he had collected from Makapansgat were bone tools, manufactured by the australopithecines. He named this bone-collecting, tool-making culture, the osteodontokeratic or bone, tooth and horn culture and assigned it specifically to *Australopithecus prometheus* (now known as *A. africanus*).

Dart's interpretations were supported by little in the way of contemporary observations of bone fracture and attrition or the means whereby bones can accumulate naturally in caves or rock shelters. His theory rested on two underlying assumptions about bone fracture and the formation of the breccia sites. First, he assumed that spiral fractures of long bones could only be produced by a "crack and twist" technique, which only hominids could execute. Second, he assumed that all the cavities in which bones occurred, had been inhabitable. Both assumptions have been disproved by later research into natural versus hominid patterns of bone modification and accumulation by various authors (Gifford 1981).

One of the main challengers to Dart's contentions was C. K. Brain. He carried out a series of methodical studies of the dynamics of bone attrition and assemblage formation, and established that a number of Dart's assumptions were incorrect (Brain 1967, 1968, 1970, 1980). Brain found that the patterns of damage, and element frequencies similar to those of the Makapansgat assemblage could be produced by nonhuman agents. He highlighted the role that varying levels of durability of different elements of a skeleton can play in determining their survival rate. Moreover, Brain also brought to the attention of researchers, the major role that carnivores, and especially hyaenas, play in the accumulation of bone assemblages.

The issue of whether or not hyaenas accumulate bones at den sites has long been an issue of contention. Hughes (1954) and Dart (1957) were among those who argued that hyaenas were not major accumulators of bone. Brain's research however indicated that the pattern of damage on bones from Makapansgat is common in hyaena collections, and that hyaena gnawing as opposed to hominid tool making was most likely responsible for the various bone shapes found at Makapansgat. Because of the work of Brain, as well as Hughes (1954, 1958, 1961), Sutcliffe (1970), Hill (1976, 1979a, 1979b, 1980) and others, it is now accepted that hyaenas are important taphonomic agents, being able to collect bones and alter assemblages.

5.3: The feeding habits of hyaenas

Skinner and Smithers (1990) note that the Family Hyaenidae is the second smallest family of carnivores in Africa. It is represented by two genera and three species: the spotted hyaena (*Crocuta crocuta*) (Fig. 5:3); the brown hyaena (*Hyaena brunnea*) (Fig. 5:4), and the striped hyaena (*Hyaena hyaena*) (Fig. 5:5).

According to Mills (1997) the three hyaena species demonstrate different feeding habits. This has to do with the differences in their social systems (Skinner *et al.* 1980; Skinner and

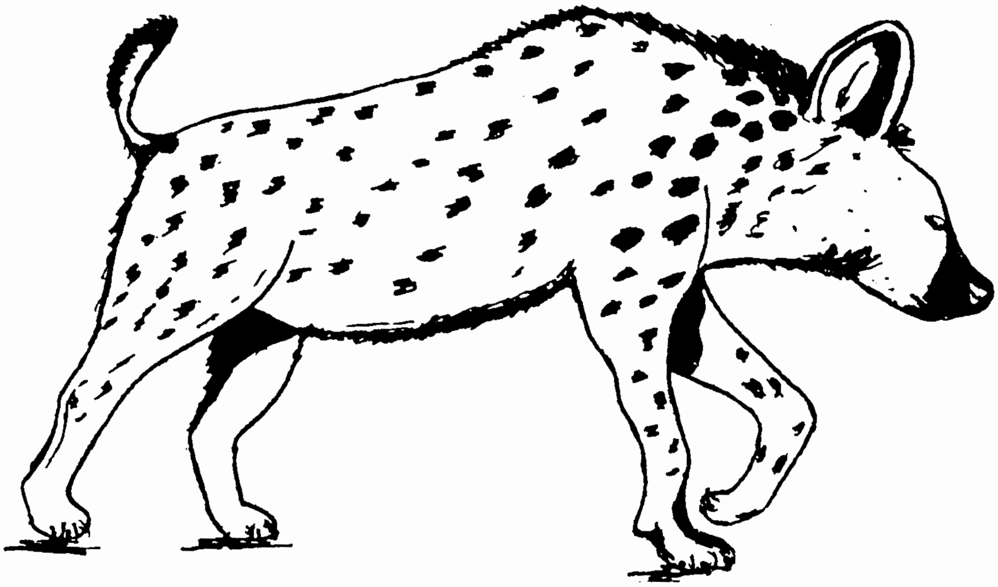


Figure 5:3 :
The spotted hyaena
(Crocuta crocuta).

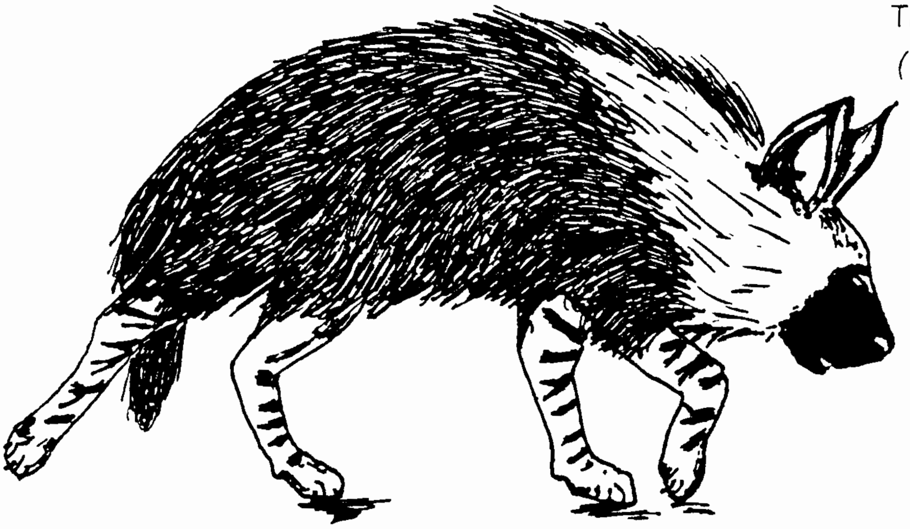


Figure 5:4 :
The brown hyaena
(Hyaena brunnea).

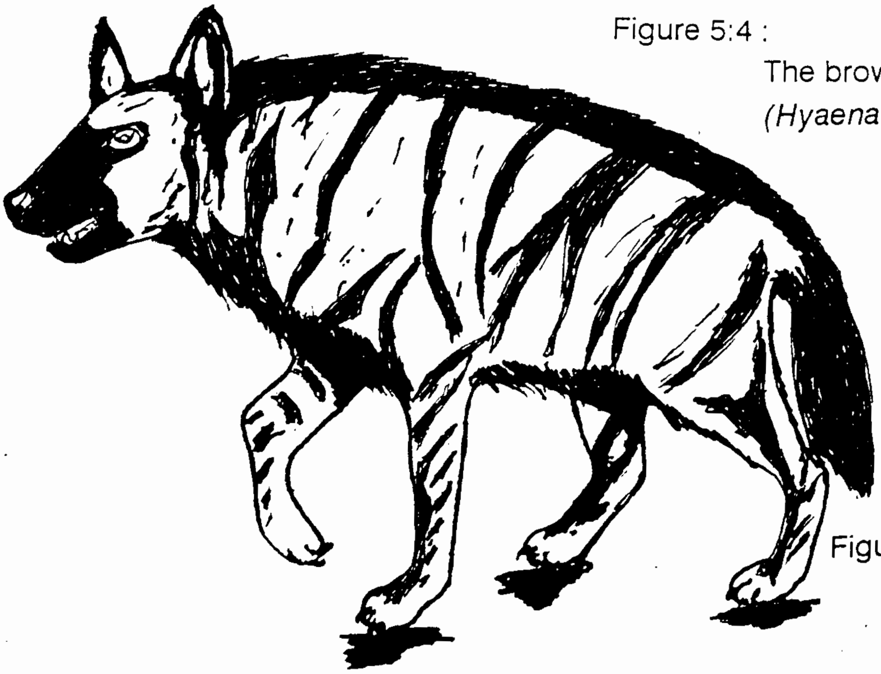


Figure 5:5 :
The striped hyaena
(Hyaena hyaena).

Smithers 1990; Mills 1997). Mills (1997) argues that the spotted hyaena probably has the most complex system of any carnivore. Its strongly hierarchical groups are female dominated. In these groups, or clans, daughters inherit their mother's rank and the lowest ranking female is dominant over the highest ranking male (Kruuk 1972; Skinner and Smithers 1990; Mills 1997).

The brown hyaena, like the striped hyaena, is more solitary. Individuals may however form small, more egalitarian clans than those of the spotted hyaenas (Skinner and Smithers 1990; Mills 1997).

Because of its social system, the spotted hyaena is one of the most successful carnivores in Africa. The clan system allows it to hunt large animals, like wildebeest and zebra, as efficiently as lions do, but unlike lions, spotted hyaenas are also adept at scavenging, being equipped to locate and consume carcasses much better than lions are (Kruuk 1972; Skinner and Smithers 1990; Mills 1997). On the other hand, the brown hyaena is more of a scavenger than a predator (Mills 1997; Skinner and Smithers 1990). Because of its smaller size and solitary behaviour, the brown hyaena is only able to hunt small animals such as springhares. It supplements its diet with reptiles, birds, bird eggs, insects and wild fruits (Skinner 1976; Mills and Mills 1978; Mills 1997; Skinner and Smithers 1990).

5.4: Bone accumulation by hyaenas

Mills (1997) states that it is usually possible to identify which species is using a den by the accumulation of bones and other food remains scattered around. Dens occupied by the spotted hyaena have few remains lying around and most of the remains that are there, come from medium sized and large herbivores. In the Kalahari, where he studied the behaviour of both the spotted and the brown hyaena, Mills (1997) found an average of 1.7 food remains per spotted hyaena den. At brown hyaena dens however, he found an average of 15.1 food remains per den. These comprised small carnivores and herbivores, as well as birds, eggs, tortoises and relatively fewer large and medium sized herbivores.

The reason for this disparity, is that spotted hyaena cubs depend on their mother's milk as virtually their sole source of food until they are well over a year, whereas in the case of brown hyaenas, the milk diet is supplemented with meat from an early age (Mills and Mills 1977; Mills 1997). From about 10 months of age, brown hyaena cubs are feeding on a diet which includes only a small percentage of milk. Because of this, brown hyaenas bring back a large proportion of their prey to the den. Although spotted hyaenas also bring food back to the den occasionally, it is more for the benefit of the carrier than the cubs. In the case of the spotted hyaena, most of the prey is consumed at the kill site. The usually large clan size, and the resulting competition for food plays a part in this. The more solitary brown hyaena has time to consume its share of prey at the site where it was found, and take the rest back to provision the pups. Unlike the spotted hyaena, unrelated brown hyaena clan members also provision pups with food.

Skinner *et al.* (1980) and Skinner and van Aarde (1991) state that in addition to being major bone accumulators, the diets of all three hyaena species, but especially those of the brown and striped hyaenas can accurately reflect the composition of the vertebrate fauna of a region at the time of collection. Skinner and van Aarde (1991) studied two Namib Desert brown hyaena dens, a coastal den, and an inland den. At the coastal den, most of the bones found, were those of seal (*Arctocephalus pusillus*) and black-backed jackal (*Canis mesomelas*), reflecting the large vertebrate fauna, excepting the hyaenas themselves, found along the coast. Seal was also well represented at the inland site. In addition to the seal bones, there was a greater percentage of bovid bones at the inland site as well, reflecting a greater presence of these away from the coast.

5.5: Hyaenas as the accumulators of the HDP1 fossil bone assemblage

Klein and Cruz-Uribe (1984) have analysed several fossil and subfossil samples that were collected by hyaenas. Based on their observations, they were able to compile a list of criteria which distinguish fossil samples collected by hyaenas from those collected by humans (Klein and Cruz-Uribe 1984; Cruz-Uribe 1991). Analysing the HDP1 palaeontological sample in terms of these criteria, strengthens the view that it was accumulated by hyaenas.

5.5:1: Carnivore-ungulate ratio

It is well documented that brown and striped hyaenas prey actively on small carnivores such as the black-backed jackal (*Canis mesomelas*) (Mills and Mills 1977; Mills and Mills 1978; Skinner *et al.* 1980; Skinner and van Aarde 1991). As a result, carnivores comprise a high percentage of the total prey species found at the dens of these two hyaena species. In contrast, carnivores do not constitute a major part of the diet of the spotted hyaena (Kruuk 1972). Skinner *et al.* (1986) reported that carnivores are rare in the Kruger National Park spotted hyaena dens which were investigated by them, while Henschel *et al.* (1979) state that carnivores were entirely absent from the small spotted hyaena assemblage which they collected in the Namib Desert.

Klein and Cruz-Uribe (1984) state that carnivores are also numerous in fossil hyaena assemblages analysed by them. Cruz-Uribe (1991) states that in hyaena collected assemblages, the percentage of carnivores is always at least 20% of the total carnivore plus ungulate MNI. In archaeological assemblages however, carnivores are usually less than 10% and always less than 13% of the total carnivore plus ungulate MNI (Klein and Cruz-Uribe 1984). Cruz-Uribe (1991) speculates that the reason for the paucity of carnivores in archaeological assemblages is that, in general, people and carnivores tend to avoid each other.

In the case of HDP1, carnivores represent 39% of the total carnivore plus ungulate MNI. This compares very well with the carnivore-ungulate ratios of other presumed fossil hyaena assemblages (Table 5:1). Only Sea Harvest has a greater carnivore-ungulate ratio.

5.5:2: Damage to bone surfaces

Like modern porcupine bone assemblages, modern hyaena bone assemblages also tend to have high percentages of specimens exhibiting hyaena gnaw marks. Maguire *et al.* (1980) reported damage on 47% of the bones from striped hyaena accumulations, damage on 68% of the bones from brown hyaena accumulations, and damage on 80% of the bones from spotted hyaena accumulations. Horwitz and Smith (1988) reported that all the human remains from two striped hyaena dens in Israel, showed evidence of damage. As did all the bones from spotted hyaena dens 1, 3 and 5 in the Kruger National Park analysed by Skinner *et al.* (1986).

Blumenschine (1988) also recorded a high incidence of carnivore tooth-marks on bovid long bones which he had collected after they had been fragmented by spotted hyaenas in the Serengeti National Park, Tanzania. In an attempt to tabulate the frequency of tooth-marks along

Tabel 5:1 :

The proportional representation of carnivores in the excavated sample from the HDP1 palaeontological assemblage compared with the representation of carnivores in the excavated samples from four Western Cape fossil hyaena assemblages.

SITE	CARNIVORE REPRESENTATION
Swartklip 1	24% (MNI 426)
Sea Harvest	42% (MNI 115)
Old Hoedjiespunt sample	31% (MNI 42)
Ysterfontein	35% (MNI 26)
Hoedjiespunt 1 (HDP1)	39% (MNI 37)

Note:

Carnivore abundances are expressed by a ratio of carnivores (MNI) to carnivores plus ungulates (MNI) (Klein and Cruz-Uribe 1984). The data for the fossil hyaena assemblages are from Cruz-Uribe (1991).

the surfaces of long bones, he divided them into epiphyseal fragments (bearing all or a portion of the proximal or distal articular surfaces), near-epiphyseal fragments (lacking articular surfaces, but preserving cancellous tissue) and shaft fragments (lacking articular surfaces and cancellous bone). Each category was scanned for tooth-marks and these were recorded. Blumenschine (1988) found that 100% of the epiphyseal long bone fragments had at least one tooth-mark on them, 77.78% of the near-epiphyseal fragments had at least one tooth-mark on them, and 68.75% of the shaft fragments had at least one tooth-mark on them (all bovid size classes 1 and 2). In the case of bovid size 3, there was a marked increase in the percentages in each category with 100% of epiphyseal long bone fragments being tooth-marked, 95.2% of near epiphyseal fragments being tooth-marked and 86.2% of shaft fragments being tooth-marked. Marean (pers. comm.) who carried out the same experiment with captive hyaenas, found that 44.44% of the epiphyseal long bone fragments had been tooth-marked, 86.67% of the near epiphyseal long bone fragments had been tooth-marked and 81.22% of the shaft fragments had also been tooth-marked.

In contrast to modern hyaena assemblages, fossil hyaena assemblages tend to have much lower percentages of bones showing tooth-marks. According to Cruz-Uribe (1991), the number of tooth-marked bones from the assemblages of both Equus Cave and Swartklip 1 do not begin to approach those reported for modern samples. This is also quite clearly the case at HDP1 as well. To demonstrate this, I divided the identified bovid long bones for sizes 1, 2 and 3, in the same manner as Blumenschine (1988) had done, and determined the percentage of each category that was tooth-marked (Table. 5:2). The analysis of hyaena tooth-marks was done according to the categories defined by Horwitz and Smith (1988).

For bovid size 1 and 2, 2.56% of the epiphyseal long bone fragments had been tooth-

Table 5:2 :

The frequency of carnivore tooth-marks on long bone fragments in the excavated sample from the HDP1 palaeontological site, compared with taphonomic models.

TOOTH-MARKED CATEGORIES	TOTAL SAMPLE SIZE	NUMBER OF MARKED SPECIMENS	% OF MARKED SPECIMENS
EPIPHYSEAL			
Blumenschine's carnivore only model (size 1&2 bovids)	2	2	100.00%
Marean's experimental model (size 1&2 bovids)	27	12	44.44%
HDP1 (size 1&2 bovids)	39	1	2.56%
HDP1 (size 3 bovids)	178	11	6.18%
NEAR-EPIPHYSEAL			
Blumenschine's carnivore only model (size 1&2 bovids)	9	7	77.78%
Marean's experimental model (size 1&2 bovids)	135	117	86.67%
HDP1 (size 1&2 bovids)	34	10	29.41%
HDP1 (size 3 bovids)	146	18	12.33%
SHAFT			
Blumenschine's carnivore only model (size 1&2 bovids)	80	55	68.75%
Marean's experimental model (size 1&2 bovids)	197	160	81.22%
HDP1 (size 1&2 bovids)	32	7	21.88%
HDP1 (size 3 bovids)	122	19	15.57%

Note:

Blumenschine's carnivore only data is from Blumenschine (1988) and Marean's experimental data was obtained via personal communication. Blumenschine's (1988) bovid size classes 1 and 2 are composed of Thompson's gazelle, impala and Grant's gazelle. HDP1's bovid size classes 1 and 2 are composed of steenbok/grysbok, springbok and vaalribbok, while bovid size class 3 is composed of bontebok, blue antelope, southern reedbuck, black wildebeest/Cape hartebeest.

marked, 29.41% of the near epiphyseal long bone fragments had been tooth-marked, and 21.88% of the shaft fragments had been tooth-marked. For bovid size 3, 6.18% of the epiphyseal long bone fragments had been tooth-marked, 12.33% of the near epiphyseal long bone fragments had been tooth-marked, while 15.57% of the shafts had been tooth-marked.

Cruz-Uribe (1991) suggests that the reason for this could lie with bad surface preservation. Bones from the presumed hyaena dens of Swartklip 1 and Sea Harvest are often soft and chalky. This is evident in the Hoedjiespunt 1 bone accumulation as well. Because of the chalky nature of the bone, some of the marks may have been obliterated by exfoliation of the bone surface. The surfaces of many bones at HDP1 are also damaged by root growth which can also obliterate gnaw marks. The high salt content in the bones is also a factor, often causing bones to crack and sometimes shatter, further complicating attempts to identify tooth marks. Fossil hyaena assemblages thus need not be characterised by a high percentage of tooth-marked bones.

5.5:3: Bone breakage patterns

Data from modern hyaena dens suggest that when hyaenas gnaw bones, they often attack from the epiphyses, gnawing from the ends, into the shafts (Sutcliffe 1970; Mills and Mills 1977; Skinner *et al.* 1980; Brain 1981; Potts *et al.* 1988; Horwitz and Smith 1988) (Fig. 5:6). Humans however, tend to break into the shafts of long bones first, probably to get at the marrow (Bunn 1983; Richardson 1980). This often results in individual bones being more fragmented than those attacked by hyaenas.

As table 5:3 indicates, there are quite a few bovid long bone shaft ends without epiphyses

Figure 5:6 :

Hyaena gnawing on the ends of long bones from a modern hyaena assemblage (Uniab - Namib desert).
(Scale in centimetres).

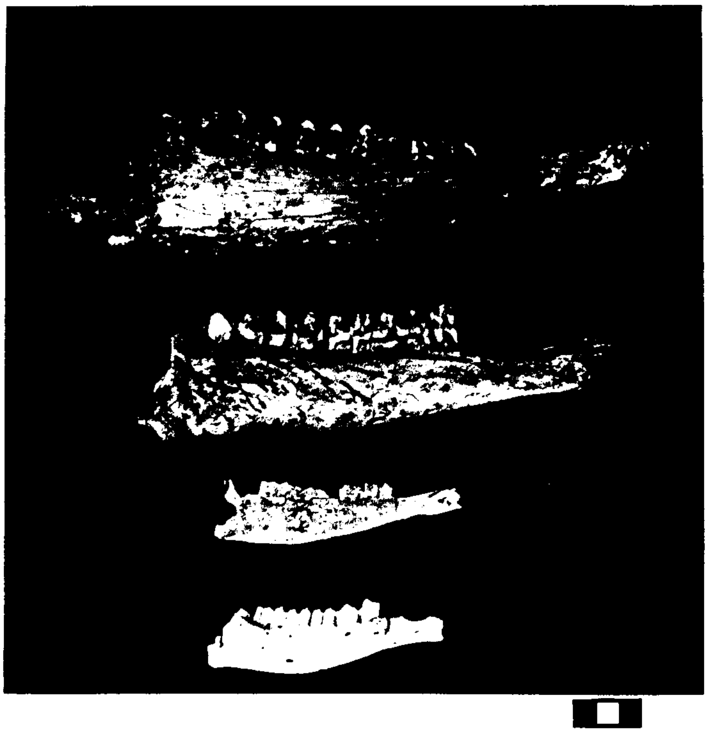


Figure 5:7 :

Bovid mandibles from the HDP1 palaeontological site (bottom two) and a modern hyaena assemblage (Uniab - Namib desert) displaying hyaena gnawing.
(Scale in centimetres).

Table 5:3 :

The minimum number of bovid individuals represented by limb-bone epiphyses and shafts in the excavated sample from the HDP1 palaeontological site.

SKELETAL PART	R	PC	AA	P/A	D/R	C/A	C/A/T	TS	TO	T/S/P/M
HU-PE										
-PS										
HU-DE						3	1	1		
-DS										
SHAFT				1	1	1	1			
RA-PE	1		1	1	1	4	1		1	
-PS										
RA-DE	2		2	1		4	1		1	
-DS						1	1			
SHAFT	1			1	1	1				
FE-PE				1		1	1			
-PS				1						
FE-DE	1					1	2			
-DS										
SHAFT										
TI-PE	1				1		1			1
-PS						1	1			
TI-DE	3			1		3	2		1	
-DS						2				1
SHAFT				1		2	1			

Total MNI from epiphyses: 20
Total MNI from shafts lacking epiphyses:47

Note:

R= *Raphicerus sp.* AA= *Antidorcas australis*
P/A= *Pelea/Antidorcas*
PC= *Pelea capreolus* D/R= *Damaliscus/Redunca*
C/A= *Connochaetes/Alcelaphus* TS= *Tragelaphus strepsiceros*
C/A/T= *Connochaetes/Alcelaphus/Tragelaphus*
TO= *Taurotragus oryx*
T/S/P/M= *Taurotragus/Syncerus/Pelorovis/Megalotragus*
HU=Humerus, RA=Radius, FE=Femur, TI=Tibia
PE=Proximal epiphysis, PS=Proximal shaft lacking epiphysis
DE=Distal epiphysis, DS=Distal shaft lacking epiphysis.
Shaft=Shaft lacking both epiphyses

in the HDP1 assemblage. The number of bovid long bone epiphyses however still outnumber shafts without epiphyses. This is demonstrated by the MNI from identifiable bovid long bone shafts which is 20, as opposed to 47 from identifiable bovid epiphyses. Most of these epiphyses are however still attached to a part of a shaft, so this does not exclude these bones from having been gnawed from an end.

Sutcliffe (1970) reports that distal humeri occurred in disproportionally high numbers in the assemblages which he recovered from East African hyaena dens. As demonstrated in table 5:3, this is also the case at HDP1. As no identifiable bovid proximal humeri had been identified in the assemblage, it could only mean that the hyaenas had removed them, as there is an MNI of 5 for the distal humeri, and 4 for the shafts without any epiphyses. Sutcliffe (1970) also reports that the ascending rami of herbivore jaws from his hyaena dens were frequently bitten off. The reason for this is that this part contains a cavity for marrow and blood supply to the teeth (Brink 1987). This pattern is also visible in the HDP1 assemblage (Fig. 5:7). So too is the pattern of disproportionally high numbers of bovid metapodials which Sutcliffe (1970) describes in the analysis of his hyaena den material.

Although hyaena assemblages are often characterised by a pattern in which long bone shafts survive relatively completely while their epiphyses are missing, this is not always the case. Cruz-Uribe (1991) reports that at Equus Cave, fragmentation of the assemblage is extreme, most probably due to postdepositional pressures. There is no pattern of long bone shafts lacking epiphyses. Yet, it is relatively certain that hyaenas were the major accumulators of the assemblage.

5.5:4: Cranial/postcranial ratio

Klein and Cruz-Uribe (1984) and Cruz-Uribe (1991) note that in hyaena accumulations, the cranial-postcranial ratio tends to decrease with ungulate size. Thus, smaller ungulates are better represented by cranial bones and larger ungulates are better represented by postcranial bones. Hominid accumulations either show no clear relationship with size, or else the cranial/postcranial ratio tends to increase with ungulate size. In addition, large ungulate postcranial bones from hyaena accumulations tend to come from adults, while large ungulate dentition tend to come from juveniles.

Cruz-Uribe (1991) suspects that the reason for this, is almost certainly related to transport. Hyaenas are limited in what they can move to their dens, and therefore have difficulty transporting the skulls of adult large ungulates. They are however capable of transporting the crania of small ungulates and juvenile large ungulates. Both small and large ungulate postcranial material can be transported as elements can be detached from the carcass. Predepositional destruction of bones by the hyaenas also play a role. Unlike the postcranial bones of adult large ungulates, the relatively soft bones of juveniles, and the bones of small ungulates, adult or juvenile, are more likely to be destroyed. These are thus selectively removed from the final assemblage. The reasons for the discrepancies in skeletal part frequencies between ungulate size groups are also dealt with in Chapter 7.

In the case of HDP1, as with other fossil hyaena accumulations it is quite evident that the cranial-postcranial ratio tends to decrease with ungulate size (Table 5:4 and Table 5:5). Table 5:4 indicates that the ratio for small bovids is 3.3, which is the highest for all ungulate size groups.

Table 5:4 :

Cranial/postcranial ratios for bovids in the excavated sample from the HDP1 palaeontological site.

BOVID SIZE GROUP	CRANIAL MNI	POSTCRANIAL MNI	RATIO
Small bovids	10	3	3.3
Small-medium bovids	5	3	1.67
Large-medium bovids	12	17	0.71
Large bovids	1	2	0.50

Note:

Small bovids=	*Raphicerus sp.*
Small-medium bovids=	*Pelea capreolus, Antidorcas australis*
Large-medium bovids=	*Damaliscus dorcas, Redunca arundinum, Hippotragus leucophaeus, Connochaetes gnou/ Alcelaphus buselaphus, Tragelaphus strepsiceros*
Large bovids=	*Taurotragus oryx, Syncerus caffer, Pelorovis antiquus*

These MNI values are based on identified bones which were lumped into the various size categories and computed according to these size categories and not according to species categories.

Table 5:5 :

Cranial/postcranial ratios for bovids in the excavated sample from the HDP1 palaeontological site compared with the cranial/postcranial ratios for bovids in the excavated samples from three Western Cape fossil hyaena dens.

BOVID SIZE CLASS	SWARTKLIP 1	SEA HARVEST	OLD HOEDJIESPUNT	HDP1
Small bovids	1.93	1.33	0.50	3.33
Small-medium bovids	1.17	1.43	1.33	1.67
Large-medium bovids	1.13	0.68	0.73	0.71
Large-bovids	0.55	1.33	0.33	0.50

Note:

The data for the Swartklip 1, Sea Harvest and Old Hoedjiespunt samples are from Cruz-Uribe (1991).

This ratio decreases steadily in accordance with ungulate size, until a ratio of 0.50 is obtained for large bovids. It is also noteworthy that large-medium to large bovid juveniles are more common than those of small bovids. More than half of the identified *Connochaetes/Alcelaphus* dentition are deciduous, compared to only about a quarter for *Raphicerus sp.* Klein *et al.* (1991) suspect that this paucity of young individuals from smaller bovid species could be attributed to the possibility that their smaller, more fragile skulls were more prone to being destroyed by hyaena feeding and subsequent profile compaction and leaching.

5.5:5: The representation of small, hard bones

Small, compact bones such as sesamoids, carpals and tarsals are very durable, and are likely to survive destructive postdepositional pressures. It is therefore to be expected that they should be abundant in hyaena, and human accumulated bone assemblages. Although this generally is the case with human accumulations, Klein and Cruz-Uribe (1984) and Cruz-Uribe (1991) note that these bones are actually rare in fossil hyaena assemblages relative to other postcranial bones. Cruz-Uribe (1991) suspects that the comparative rarity of these bones is due to the likelihood that they could have been swallowed by hyaenas because of their small size.

The HDP1 assemblage however, contains quite a high number of carpals, tarsals, phalanges and sesamoids relative to other postcranial parts (Table 5:6 and Table 5:7). These small, hard bones are relatively more common in the HDP1 assemblage than in the sample from Equus Cave, which is also thought to have been accumulated by hyaenas. The bones from Equus Cave were severely affected by postdepositional forces, and are as a result, extremely fragmented (Klein, Cruz-Uribe and Beaumont 1991). It is however unlikely that postdepositional forces were

Table 5:6 :

The minimum number of small, small-medium, large-medium and large bovids represented by carpals, phalanges, cuneiform tarsals and sesamoids in the excavated sample from the HDP1 palaeontological site.

SKELETAL PART	SMALL BOVID MNI	SMALL-MEDIUM BOVID MNI	LARGE-MEDIUM BOVID MNI	LARGE BOVID MNI
Carpals	2 (20%)	1 (20%)	10 (58.8%)	2 (66.7%)
Phalanges	5 (50%)	5 (100%)	10 (58.8%)	3 (100%)
Cuneiform tarsals	0 (0%)	2 (40%)	9 (52.9%)	2 (66.7%)
Sesamoids	1 (10%)	1 (20%)	8 (47.1%)	2 (66.7%)
Highest MNI	10 (100%)	5 (100%)	17 (100%)	3 (100%)

Note:

The highest minimum number of individuals for each size group were used to calculate the percentage representation of the carpals, tarsals, phalanges and sesamoids. The percentage representation of each skeletal part is in round brackets next to its MNI. The size categories include the same species as those in table 5:4.

Table 5:7 :

A comparison of the minimum numbers of large-medium bovids represented by carpals, tarsals, phalanges and sesamoids in the excavated samples from the HDP1 palaeontological site, Layers 1B-2B at Equus Cave, the MSA and Prepastoralist LSA Layers of Boomplaas Cave A and the terminal Pleistocene layer 4 at El Juyo Cave (Northern Spain).

Skeletal Part	HDP1	Equus Cave	Boomplaas	El Juyo
Carpals	10(58.8%)	13(7.1%)	5(9.6%)	7(20.6%)
Phalanges	10(58.8%)	12(6.6%)	10(19.2%)	17(50%)
Cuneiform tarsals	9(52.9%)	23(12.6%)	9(17.3%)	16(47.1%)
Sesamoids	8(47.1%)	5(2.7%)	9(17.3%)	11(32.4%)
Highest MNI	17(100%)	183(100%)	52(100%)	34(100%)

Note:

The data from Equus Cave, Boomplaas, and El Juyo is from Klein et al. 1991.

the cause of the relatively low numbers of small, hard bones in this assemblage. Klein, Cruz-Uribe and Beaumont (1991) note that comparably leached and fragmented archaeological bone assemblages from the MSA and Prepastoralist LSA Layers of Boomplaas A and the terminal Pleistocene layers (layer 4) of El Juyo Cave, contain relatively more of these small, hard bones. In the case of Equus Cave, it is suspected that most of these small bones were swallowed by hyaenas and were deposited elsewhere.

The frequencies of these small bones do however vary in modernday hyaena assemblages, as demonstrated by Lam's (1992) Koobi Fora hyaena den, which differs in several ways from other hyaena assemblages, including having a higher number of tarsals, carpals, phalanges and sesamoids than is usually encountered in hyaena assemblages. Lam (1992) makes the point that his study shows that hyaena behaviour is more idiosyncratic than originally anticipated, so variations between assemblages could be expected.

5.5:6: Age (mortality) profiles

Klein and Cruz-Uribe (1984) note that hyaena assemblages tend to be characterised by age profiles that are attritional, rather than catastrophic. Catastrophic and attritional profiles are two idealized, theoretical age profiles (Klein and Cruz-Uribe 1984). Typically, a catastrophic mortality profile is shaped like a down staircase in which succeeding age classes contain fewer members than the preceding ones. This profile represents the demographic structure of a stable population and will have more prime adults and fewer senile animals (Cruz-Uribe 1991). An attritional profile on the other hand, is characterised by many individuals in the youngest age class, few in the middle-age "prime adult class", and relatively more adults in the senile class. In this case, the profile represents natural "attritional" mortality in a stable population (Cruz-Uribe 1991).

Klein and Cruz-Uribe (1984) base their age profiles on tooth-crown height, and measure the dP4's and M3's of bovids to determine these profiles. Unfortunately the ungulate species from HDP1 are represented by too few dP4's and M3's to provide reliable mortality profiles. The high number of deciduous teeth for medium-large bovids however, do hint at an attritional profile (Table 5:8). As mentioned earlier, more than half of the identified dentition for medium-large bovids were deciduous. The lower count for deciduous teeth from smaller bovids probably has to do with disproportionate destruction of the fragile cranial bones of these species by hyaenas and postdepositional forces. It is however difficult to determine the percentage of prime aged, young and senile individuals represented in the assemblage without doing mortality profiles.

5.6: The species of hyaena responsible for the accumulation

The brown hyaena (*Hyaena brunnea*) is the most likely hyaena species responsible for the palaeontological accumulation at HDP1. The sheer quantity of bone at the site is indicative of a brown hyaena assemblage. The striped hyaena (*Hyaena hyaena*) also accumulates large quantities of bone at its den sites, but it did not occur in southern Africa at the time of accumulation, having become extinct long before. In addition, the great diversity of species represented in the accumulation, is similar to the diversity of species which is common in brown hyaena accumulations today (Skinner and Smithers 1990). Furthermore, the presence of ostrich eggshell in the accumulation is reflected in modern assemblages as well, with brown hyaenas often eating ostrich eggs (Mills and Mills 1978). Finally, ungulates in the springbok-reedbuck range are well represented in the accumulation. This is to be expected of a brown hyaena assemblage (Klein and

Table 5:8 :

The representation of deciduous bovid teeth in the excavated sample from the HDP1 palaeontological site.

BOVID SPECIES	TOTAL NUMBER OF TEETH IN THE SAMPLE	NUMBER OF DECIDUOUS TEETH	% NUMBER THAT ARE DECIDUOUS
Raphicerus sp.	105	15	14.29%
Redunca arundinum	8	3	37.5%
Tragelaphus strepsiceros	14	5	35.71%
Connochaetes/Alcelaphus	75	41	54.67%
Taurotragus oryx	1	1	100%
Large indeterminate bovid	2	2	100%

Note:

Bovids not in the table, were not represented by deciduous teeth.
Teeth are recorded as deciduous if the tooth germ is deciduous.

Cruz-Uribe 1984; Klein *et al.* 1991). Although the brown hyaena is the most likely accumulator of the HDP1 palaeontological bone assemblage, it has to be remembered that the evidence remains circumstantial.

Discussion and conclusion

The palaeontological deposit, was almost certainly accumulated by hyaenas. In addition to the circumstantial evidence such as the lack of any artefacts or archaeological features in the deposit, the presence of numerous coprolites and the sheer quantity of bones at the site, certain characteristics of the bone assemblage also strengthens this view. HDP1 has a high carnivore-ungulate ratio which is characteristic of fossil carnivore assemblages (Klein and Cruz-Uribe 1984; Cruz-Uribe 1991). Similar to other presumed hyaena accumulations, the presence of gnaw marks on bones is also remarkably low at HDP1. This is probably due to the bad surface preservation on the majority of bones. The cranial-postcranial ratio for ungulates from HDP1 shows a definite decrease with ungulate size. This was also noted at other fossil hyaena accumulations (Klein and Cruz-Uribe 1984; Cruz-Uribe 1991). Generally, the bone breakage patterns in the accumulation, is what would be expected of hyaena accumulations (Sutcliffe 1970). Long bones tended to be gnawed from the epiphyseal ends. However, bones with epiphyseal ends still outnumber those without in the HDP1 sample. Unlike other hyaena assemblages, HDP1 contains a high number of small, hard bones, such as carpals and tarsals. These are generally uncommon in fossil, as well as modern hyaena dens, because hyaenas tend to swallow them whole and deposit them in scats away from the den. There are however cases where these bones are quite common in assemblages. Although it was not possible to construct age mortality profiles for the ungulates at HDP1, the high number of deciduous dentition from large-medium bovids is consistent with what would be expected for hyaena accumulations, that is that a high number of juvenile ungulates would fall prey.

Although the HDP1 assemblage differs in some respects from other fossil hyaena accumulations, it generally confirms Klein and Cruz-Uribe (1984) and Cruz-Uribe's (1991) criteria for distinguishing hyaena-accumulated from humanly accumulated bone assemblages. Most hyaena accumulations do however vary from one another in one respect or another. Potts *et al.* (1988) and Lam (1992), among others have demonstrated that hyaena behaviour is more idiosyncratic than was originally thought.

Finally, circumstantial evidence point to the brown hyaena as being the most likely hyaena species responsible for the HDP1 palaeontological assemblage. Klein and Cruz-Uribe (1984) also regard the brown hyaena as the most likely collector of the fossil hyaena assemblages which they have analysed.

CHAPTER SIX

THE CONTEXTS IN WHICH THE PALAEONTOLOGICAL AND ARCHAEOLOGICAL ASSEMBLAGES WERE DEPOSITED: ACCUMULATION IN A DEN OR OPEN-AIR SITUATION ?

The fossiliferous horizons in the HDP1 palaeontological assemblage are stratified below an overlying horizon of consolidated material and an underlying non-fossiliferous horizon. In addition, the bones are not evenly distributed throughout the fossiliferous horizons. Bones tend to cluster in some areas, while lower concentrations occur in others. Large animal bones seem to be differently distributed to smaller animal bones. Coprolites and ostrich eggshell fragments are also generally uncommon in the areas where bones cluster. As hyaenas are known to accumulate bones in cavities (Skinner and van Aarde 1991) as well as in the open (Avery *et al.* 1984; Avery 1988), it is possible that the bones in the HDP1 palaeontological assemblage could either have been deposited in already existing dune sediments, or on top of one or other sand horizon, during the formative stages of the dune. The material in the archaeological horizons could also have been accumulated in an open-air situation, or in a cavity, in already existing dune sediments.

Knowing the contexts in which these assemblages were deposited, could shed light on whether they postdated the sediments in which they occur, or whether they and the sediments surrounding them, were deposited at more or less the same time. This knowledge is important when it comes to the interpretation of dates on these sediments. In this chapter I will investigate the contexts in which the HDP1 palaeontological and archaeological assemblages were deposited.

6.1: The stratigraphical evidence

In this section I will attempt to determine, whether or not the bones in the palaeontological site post-date the deposits in which they occur. Understanding the stratigraphic sequence is therefore extremely important.

A major feature in the stratigraphic sequence of the HDP1 palaeontological site, is the layer of consolidated material that lies above the bones in the HOMS horizon (Fig. 6:1 and Fig. 6:2). These blocks are composed of a relatively fine grained, slightly shelly sand, similar to that found in the SHES horizon situated slightly above. As mentioned earlier (Chapter 3), the hominid sands (HOMS) horizon below these blocks, consists of a fossil-bearing matrix and non-fossiliferous material. Grain-size analysis prove that the fossil-bearing matrix is finer grained and less well sorted than the non-fossiliferous material (D. Roberts, pers. comm.). The horizon known as lower coarse shelly sand (LCSS) occurs below HOMS. Grain-size analysis indicates that a close correspondence exists between the fossil-bearing matrix of LCSS and the non-fossiliferous HOMS material, suggesting a similar derivation of these sediments (D. Roberts, pers. comm.). However, there is an appreciable difference between the fossil-bearing HOMS matrix and LCSS. Below LCSS there is a horizon of fine shelly sand known as FISS (lower fine shelly sand).

6.1:1: Interpretation of the stratigraphic sequence

It is highly likely that the consolidated fine shelly sand material presently stratified above

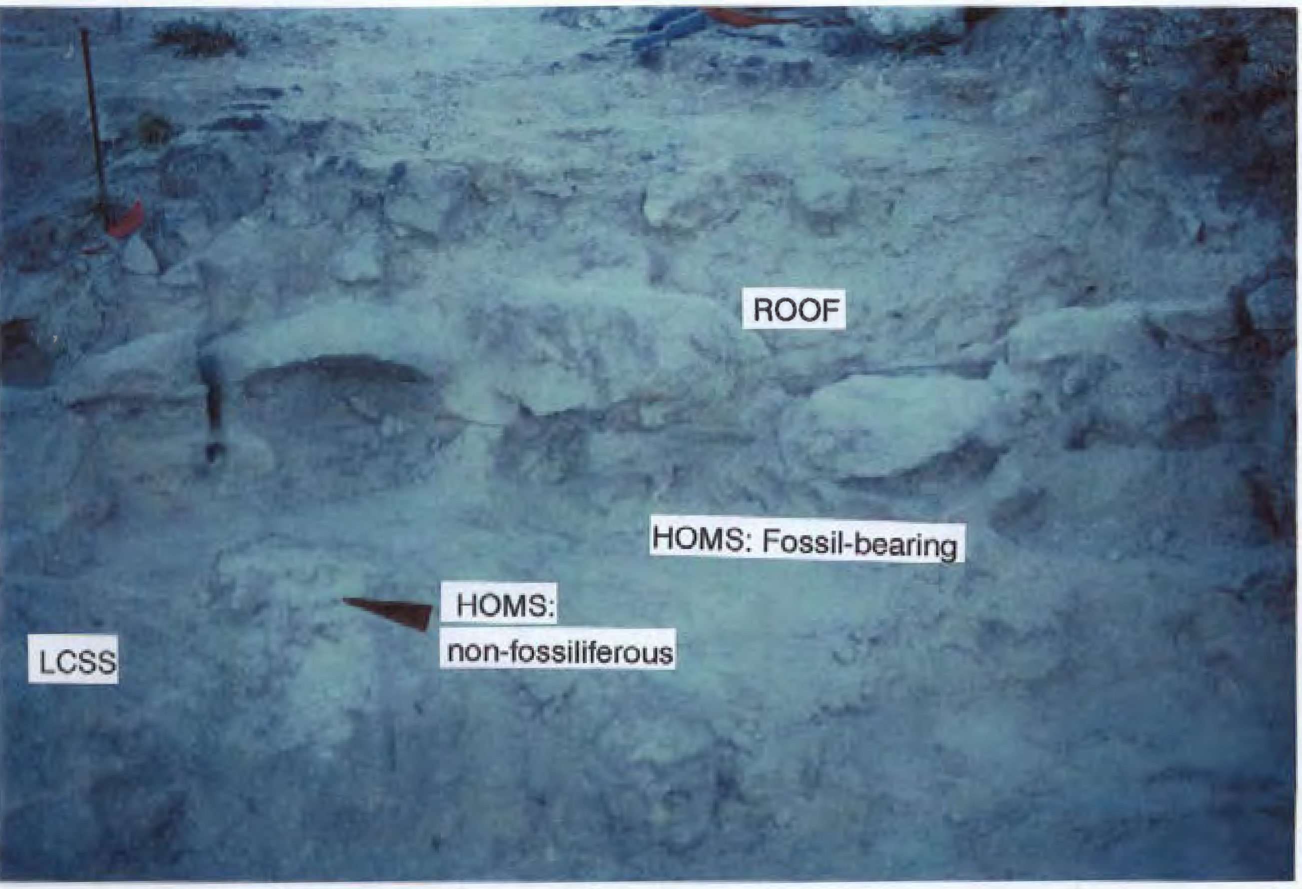


Figure 6:1 :
The horizon of consolidated material above the main fossil-bearing horizon in the palaeontological site.
(Looking north towards the town of Saldanha).

Figure 6:2 :
The horizon of consolidated material from above.

the HOMS horizon could in the past have been part of the roof of a cavity, similar to the one in Figure 6:3. These cavities are common in the Saldanha Bay area today, and are formed when the unconsolidated sediments around calcretized horizons in older, partially consolidated dunes are weathered away. They are often not very deep (pers. obs.). At HDP1, the sediments below these blocks show signs of being bleached (S. Woodborne, pers. comm.), suggesting that, if the HDP1 fossils were deposited in such a cavity, it may also not have been deep.

A likely scenario for site formation (see Fig. 6:4) is that once the hyaenas started occupying the cavity (picture 1), they may have enlarged the area below the calcretized horizon by burrowing into the sediments that we now know as the coarse, non-fossiliferous material in the HOMS horizon. This non-fossiliferous material which is partially consolidated, usually occurs in the form of pillar-like structures or walls against which fossil-bearing sediments are stratified (picture 2). This provides further indication that hyaenas may indeed have been burrowing into this material. The burrowing loosened the coarse sediment below the roof of the cavity. In addition, it also exposed the finer sediments at the base of the roof. The actions of the hyaenas most probably churned these sediments, mixing the finer-grained sediments in with the coarse material resulting in a finer grained and less well sorted matrix. These sediments formed a horizon at the bottom of the cavity on which bones were deposited (picture 2). Today, this is the fossil-bearing matrix in HOMS.

Further indication that the cavity may not have been deep, is provided by the LCSS horizon, stratified below and slightly in front of the HOMS horizon. As mentioned earlier, the sediments in the LCSS horizon and the non-fossiliferous material from HOMS, demonstrate a close correspondence in grain-size, suggesting a similar derivation of these sediments (D. Roberts,

Figure 6:3 :

An example of the cavities which commonly occur in consolidated dunes in the area.

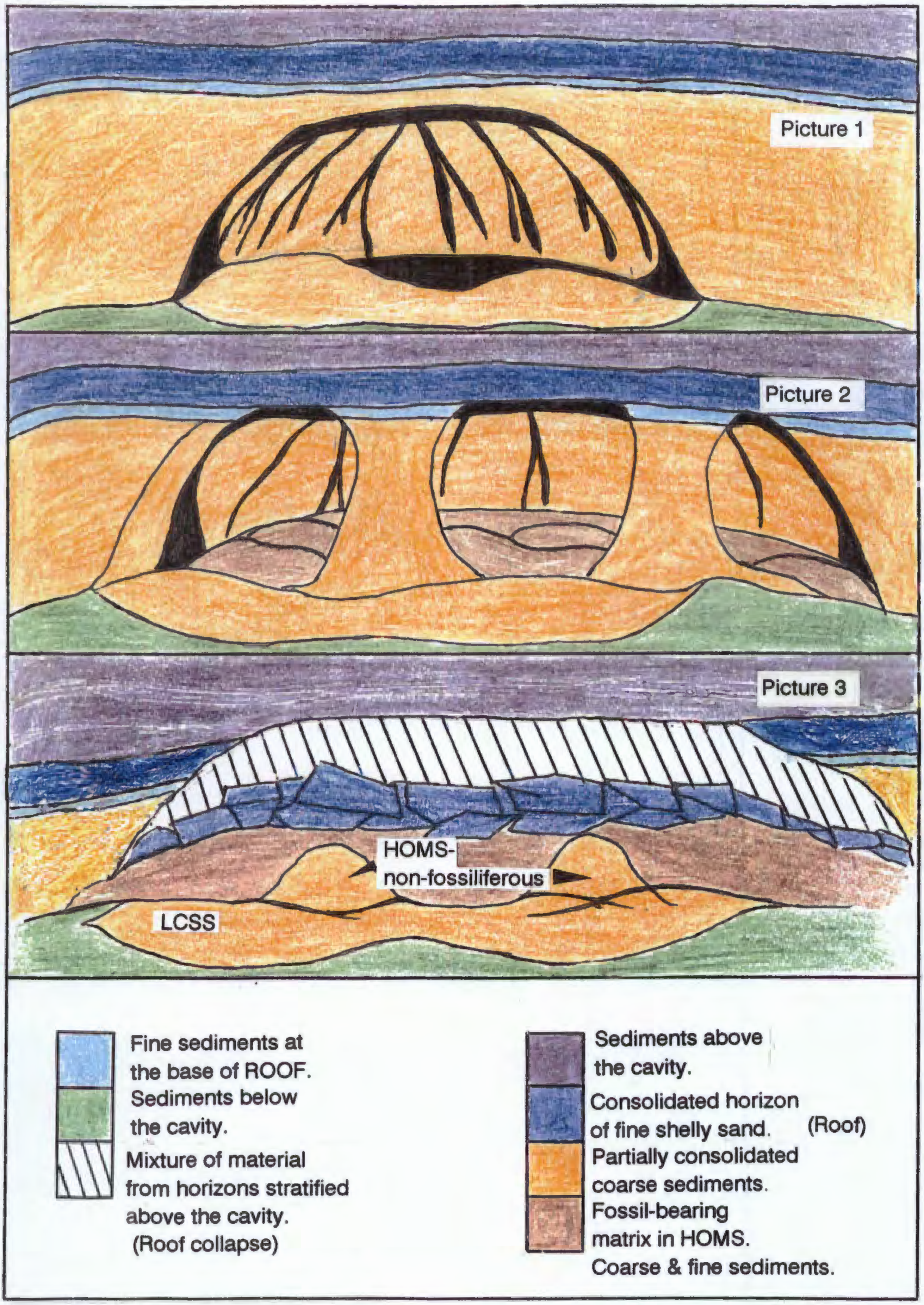


Figure 6:4 :

Scenario for site formation.

pers. comm.). The sediments in LCSS do however differ appreciably from the fossil-bearing matrix in HOMS. Since the sediments in the LCSS horizon are not as fine as the sediments in the HOMS fossil-bearing matrix, this horizon was in all probability not situated below the roof of the cavity. It is possible that the sediments in this horizon were deposited when the partially consolidated, coarse material under the calcretized horizon was loosened by weathering before the cavity developed (picture 1). Continuous weathering probably led to the formation of the shallow cavity, which was enlarged by the hyaenas. The roof of this cavity may eventually have caved in when all underlying supporting sediments were removed by continuous burrowing (picture 3).

Since hyaenas are known to reserve certain areas of their dens for specific activities (Skinner *et. al.* 1980), it is essential to determine whether the spatial distribution of the bones in the HDP1 sediments reflect this behaviour. This could strengthen the hypothesis that hyaenas accumulated the bones in a den which was situated in already existing dune sands.

6.2: The spatial distribution of bones in the fill

6.2:1: Spatial patterning produced by animals

Although archaeologists have documented spatial patterning at human sites, little attention have been paid to the possibility that animals, especially carnivores, may also be capable of creating non-random spatial distributions of bones in or near their dens.

According to Gargett (1994), when carnivores introduce parts of their prey to caves, they tend to do so in circumscribed areas, suggesting that their behaviour in relation to space is governed by habitual action. Skinner *et al.* (1980) who investigated several striped hyaena dens in Israel, state that the space in these dens seemed to be divided into several areas, each reserved for a specific activity. Thus for example, an exit from one of the caverns in a large maternity den, seemed to be used primarily as a latrine, while the main cavern was reserved as a feeding area.

Lam (1992) recorded a lack of bones immediately in front of a spotted hyaena den which he investigated in Kenya. He also recorded a preponderance of cranial elements within the den (Lam 1992). In another account of bone concentration by hyaenas, G. and D. M. Avery recorded concentrations of bones in pathways around brown hyaena dens at Uniab in the Skeleton Coast Park, Namibia (Avery *et al.* 1984; Avery 1988). Gargett (1994) who analysed an Upper Pleistocene cave bear (*Ursus spelaeus*) bone accumulation from Pod Hradem Cave in the Czech Republic, reported that more bones overall and more large, heavy bones, tended to occur near the wall of the cave, indicating a high level of activity in these areas. These accounts suggest that carnivores are capable of creating behaviourally meaningful non-random spatial distributions of bones.

6.2:2: Spatial distribution in the palaeontological horizons at HDP1

Although the HDP1 palaeontological assemblage encompasses a relatively small area, the bones are by no means uniformly distributed. Two areas which are characterised by high densities of bone stand out from areas with lower densities (Fig 6:5, Fig. 6:6 and Fig. 6:7; Appendix B. Figs. 1-10). One occurs in the HOMS horizon, and the other in GUFI. The sheer quantity and concentration of bones in these two bone clusters are remarkably similar to concentrations of

A fragmented springbok mandible which was exposed when a roof block was removed.

Articulated black wildebeest metatarsal and phalanges.

Figure 6:5 :
Bones situated in the fossil-bearing matrix in the HOMS horizon.

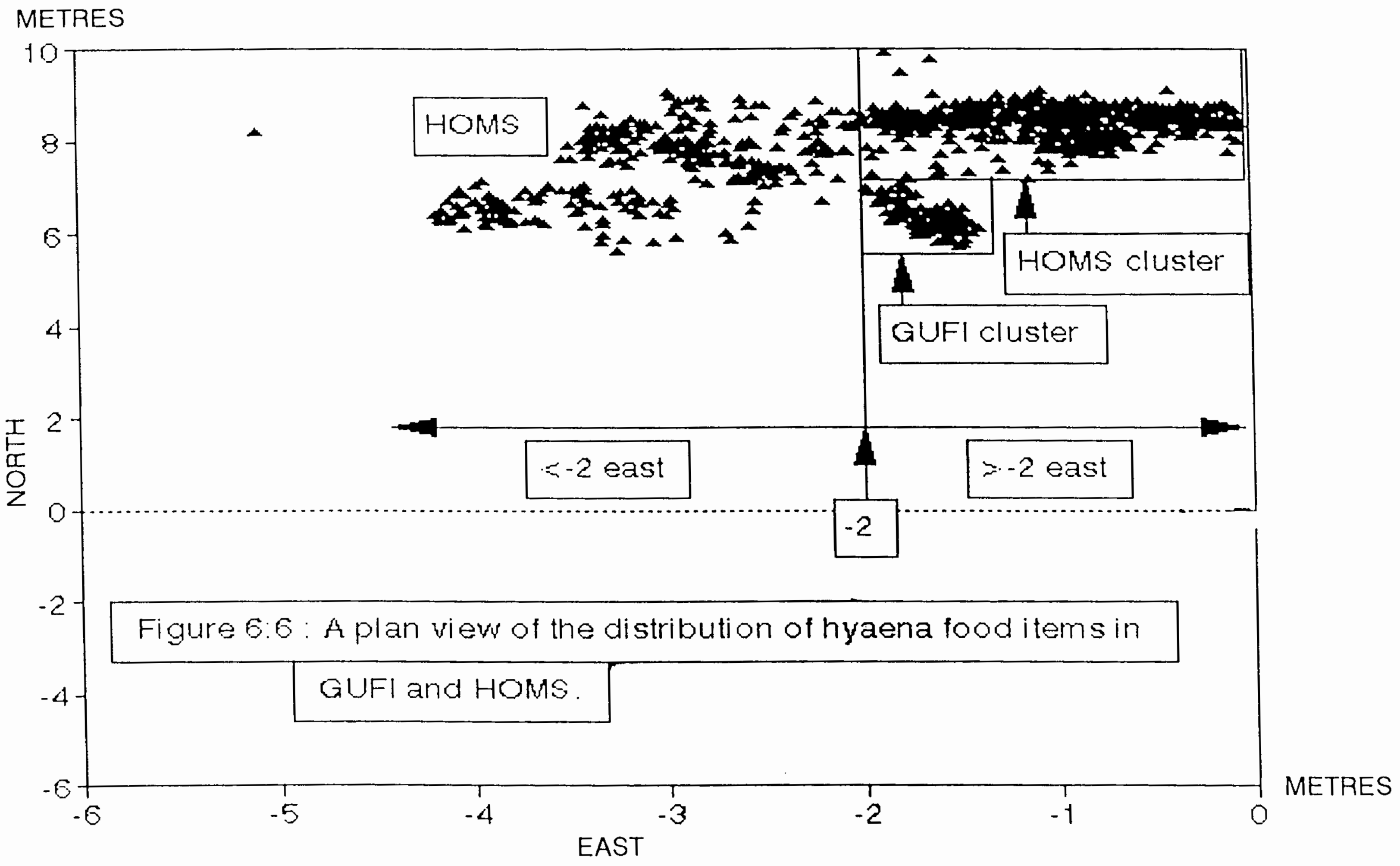


Figure 6:6 : A plan view of the distribution of hyaena food items in GUFI and HOMS.

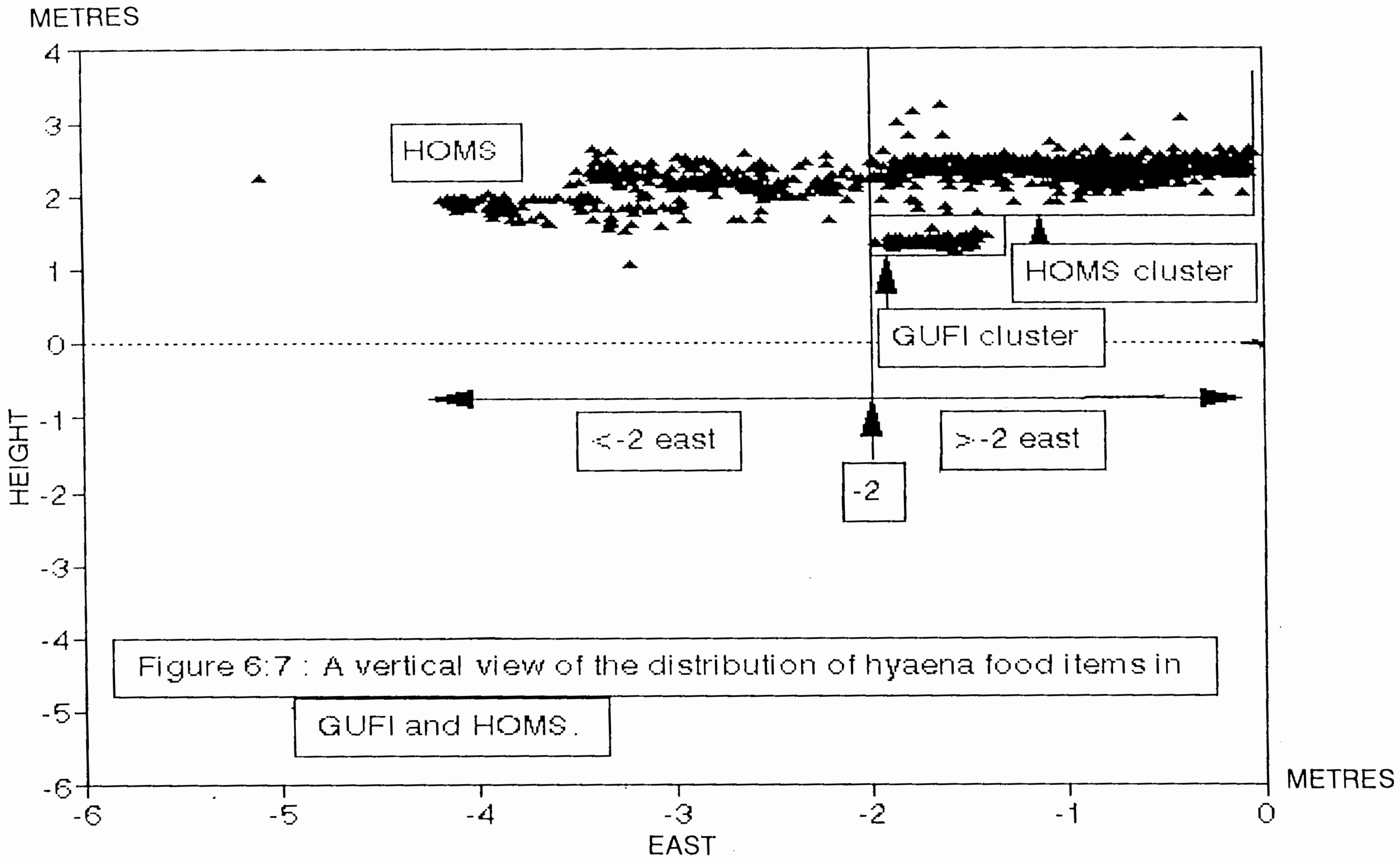


Figure 6:7 : A vertical view of the distribution of hyaena food items in GUFI and HOMS.

bones in the feeding areas of modern hyaena dens (Skinner *et al.* 1980), suggesting that these areas could have served as feeding areas.

6.2:3: The HOMS horizon

The bone cluster (HOMS >-2 east)

It has been noted that, in addition to being characterised by high concentrations of bones, the feeding areas in modern hyaena dens are also characterised by an abundance of large, heavy bones from large animals (Skinner *et al.* 1980; Maguire *et al.* 1980). This characterises the cluster of bones in HOMS as well.

The cluster is situated in the area greater than (>) -2 east (Figs. 6:6 and 6:7). The majority of animal bones, as well as the majority of large animal bones in the HOMS horizon, were recorded in this area. This is in contrast to the rest of the HOMS horizon (< -2 east) (Figs. 6:6 and 6:7), which not only displayed a lower density of bones in general, but also a lower density of large animal bones. As demonstrated in table 6:1, the majority of the recorded occurrences of large-medium bovid, large animal (large bovids/horses/rhinos), small-medium bovid/suid, carnivore, marine mammal, tortoise, bird and human bones (NISP values), were in the HOMS bone cluster (HOMS > -2 east). On the other hand, small-mammal and microfauna bones (NISP values), as well as coprolites, ostrich eggshell fragments and bird eggshell fragments were more often recorded outside of the bone cluster (HOMS < -2 east) (Table 6:1 and Table 6:2).

Large-medium bovid, large animal, carnivore, tortoise, bird and human bones are each

Table 6:1 :
The distribution of bones in the HOMS horizon at HDP1.

CATEGORIES	THE REST OF HOMS <-2 EAST	%	HOMS BONE CLUSTER >-2 EAST	%
Large-medium bovids	189	33.36%	373	66.37%
Large bovids/horses/rhinos	11	18.33%	49	81.67%
Small-medium bovids/suids	39	38.61%	62	61.39%
Small bovids	49	38.28%	79	61.72%
Carnivores	91	33.58%	180	66.42%
Marine mammals	13	44.83%	16	55.17%
Tortoises	13	29.55%	31	70.45%
Birds	5	22.73%	17	77.27%
Microfauna	56	59.57%	38	40.43%
Small-mammals	38	54.29%	32	45.71%
Humans	3	21.43%	11	78.57%

Note:

Large-medium bovids= black wildebeest/Cape hartebeest, kudu, bontebok, common reedbuck.
Small-medium bovids/suids= springbok, vaalribbok, suids.
Small bovids= grysbok/steenbok.
Large bovids/horses/rhinos= eland, Cape buffalo, *Pelorovis antiquus, Megalotragus priscus, Equus capensis,* plains zebra and white rhinoceros.
marine mammals= seal and dolphin.
Small-mammals= rock hyrax, dune molerat, hare.
Categories were combined roughly according to size in the cases of small-medium bovids/suids, large bovids/horses/rhinos, large-medium bovids and small bovids. Combined categories were used so that large enough values could be obtained to allow the chi-squared test to be employed- the total number of observations should exceed 20 (Hammond and McCullagh 1974).

Table 6:2 :

The distribution of coprolites, ostrich eggshell and bird eggshell in the HOMS horizon at HDP1.

CATEGORIES	REST OF HOMS <-2 EAST	%	HOMS BONE CLUSTER >-2 EAST	%
Coprolites	48	55.17%	39	44.83%
Ostrich eggshell	25	52.08%	23	47.91%
Bird eggshell	21	55.26%	17	44.74%

proportionally better represented in the excavated sample of possible hyaena food items from the HOMS cluster (> -2 east), than they are in the sample from the rest of the HOMS horizon (Table 6:3). On the other hand, small-medium bovid/suid, small bovid, marine mammal, microfauna and small-mammal bones, as well as ostrich eggshell and bird eggshell fragments are each proportionally better represented in the excavated sample of possible hyaena food items from the rest of the HOMS horizon (HOMS < -2 east), than they are in the sample from the bone cluster (Table 6:3). The one-sample chi-squared test, which compares a sample to a theoretical population (Shennan 1988) (see Fig. 6:8), was employed to determine whether the perceived greater abundances of each of these categories in the respective areas in HOMS, were statistically significant or not. Table 6:3 presents the result of the test in each of the categories. In the case of the HOMS bone cluster (> -2 east), it is indeed found that the bones of large animals (large bovids/horses/rhino) (Chi-squared = 8.97; df=1; $P<0.01$) are significantly more common in the bone cluster, than they are outside of it. Although large-medium bovid (Chi-squared = 2.74; df=1; ($P< 0.10$), carnivore (Chi-squared = 1.36; df=1; $P>0.10$), tortoise (Chi-squared = 1.05; df=1; $P>0.10$), bird (Chi-squared = 1.92; df=1; $P>0.10$) and human (Chi-squared = 1.46: df=1; $P>0.10$) bones are each proportionally better represented in the excavated sample from the HOMS bone cluster, than they are in the sample from the rest of HOMS, they are not significantly so (Table 6:3).

Comparing the distribution of large animal (large bovids/horses/rhino) bones to the distributions of large-medium bovid (Chi-squared = 5.81; df=1; $P<0.05$), small-medium bovid/suid (Chi-squared = 7.23; df=1; $P<0.01$), small bovid (Chi-squared = 7.49; df=1; $P<0.01$) and carnivore (Chi-squared = 5.35; df=1 $P<0.05$) bones using the chi-squared test for cross-classified data (Table 6:4), confirms that the large bovids/horses/rhino category and these other categories

Table 6:3 :

The proportional representation of food items in the samples from the two areas in the HOMS horizon.

CATEGORIES	REST OF HOMS HORIZON <-2 EAST	HOMS BONE CLUSTER >-2 EAST	CHI-SQUARED (ONE-SAMPLE TEST)
Large-medium bovids	189 (34.18%)	373 (40.19%)	2.74 (P< 0.10)
Large bovids/horses/rhino	11 (1.99%)	49 (5.28%)	8.97 (P<0.01)
Small-medium bovids/suids	39 (7.05%)	62 (6.68%)	0.11 (P>0.10)
Small bovids	49 (8.86%)	79 (8.51%)	0.09 (P> 0.10)
Carnivores	91 (16.46%)	180 (19.40%)	1.36 (P> 0.10)
Marine mammals	13 (2.35%)	16 (1.72%)	0.76 (P> 0.10)
Tortoise	13 (2.35%)	31 (3.34%)	1.05 (P> 0.10)
Bird	5 (0.90%)	17 (1.83%)	1.92 (P> 0.10)
Microfauna	56 (10.13%)	38 (4.09%)	20.55 (P< 0.001)
Small-mammals	38 (6.87%)	32 (3.45%)	8.97 (P< 0.01)
Humans	3 (0.54%)	11 (1.19%)	1.46 (P> 0.10)
Ostrich eggshell	25 (4.52%)	23 (2.48%)	4.68 (P< 0.05)
Bird eggshell	21 (3.80%)	17 (1.83%)	5.44 (P< 0.05)

Total number of food items in HOMS > -2 east: 928
Total number of food items in HOMS < -2 east: 553

Note:

The proportions that each food item constitutes in the respective areas, are recorded in round brackets.
The percentage values used to calculate the expected frequencies in the Chi-squared one-sample test, are the same as in Fig. 6:8.
Degrees of freedom = 1

How the one-sample Chi-squared test results were determined:

In the one-sampled Chi-squared test, a sample is compared to a specific theoretical population, and a test is made of how good the correspondence is between these two distributions (Shennon 1988). In the cases of the values in table 6:3, the theoretically derived expected frequencies to which the observed frequencies are compared, are calculated by postulating that the same density of fossil bone, ostrich eggshell and bird eggshell would be expected both inside (> -2 east) and outside (< -2 east) of the bone cluster. This represents the theoretically derived null hypothesis for calculating the expected frequencies. Thus, 553 food items that could have been introduced by hyaenas (bones, ostrich eggshell and bird eggshell) were retrieved from HOMS <-2 east, while 928 food items were retrieved from HOMS >-2 east. This means that 37% of all food items in the excavated sample from the HOMS horizon were found in HOMS <-2 east, while 63% were found in HOMS >-2 east. The expected frequencies for each area in HOMS is calculated by allotting the same proportion of the total number of observations to that area in HOMS as it occupies of the total area. Observed frequencies are compared to these (explanation based on Shennan 1988).

Example:

Total number of food items recorded in HOMS < -2 east :	553	37%
Total number of food items recorded in HOMS > -2 east :	928	63%
	1481	100%

Ho: Food items are equally distributed across both locations in HOMS.
H_1: Food items are not equally distributed across both locations in HOMS.

Large-medium bovids:

Location	Observed frequencies	%	Expected frequencies
< -2 east	189	37	207.94
> -2 east	373	63	354.06
	562	100	562.00

$$\text{Chi-squared} = \frac{(189 - 207.94)^2}{207.94} + \frac{(373 - 354.06)^2}{354.06}$$

$= 1.73 + 1.01$
$= 2.74$ (P < 0.10) (df=1) Accept null hypothesis.

Figure 6:8 :

Table 6:4 :

The distribution of large animal (large bovids/horses/rhino) bones compared to the distributions of large-medium bovid, small-medium bovid/suid, small bovid and carnivore bones in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Large-medium bovids	5.81 (P< 0.05)	(df=1)
Small-medium bovids/suids	7.23 (P< 0.01)	(df=1)
Small bovids	7.49 (P< 0.01)	(df=1)
Carnivores	5.35 (P< 0.05)	(df=1)

Table 6:5 :

The distribution of microfauna bones compared to that of small-mammal (rock hyrax, dune molerat, hare) bones in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUE	
Microfauna/small-mammals	0.45 (P> 0.10)	(df=1)

Table 6:6 :

The distribution of microfauna bones compared to the distributions of bird eggshell and ostrich eggshell in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Ostrich eggshell	0.73 (P> 0.10)	(df=1)
Bird eggshell	0.2 (P> 0.10)	(df=1)

Table 6:7 :

The distribution of small-mammal bones compared to the distributions of bird eggshell and ostrich eggshell in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Ostrich eggshell	0.06 (P> 0.10)	(df=1)
Bird eggshell	0.01 (P> 0.10)	(df=1)

are distributed differently across the two areas in HOMS, and that significantly more large animal bones occur in the sample from the HOMS bone cluster (> -2 east).

Thus based on the sheer quantity of bones in the HOMS bone cluster, and the presence of significantly more large animal bones in the cluster, it is possible that this area served as a feeding area. Based on the average size of the bones in this cluster, it may in all probability have been accumulated by adult hyaenas. It is unlikely that young cubs contributed to this cluster. Hyaena cubs usually feed on smaller mammals because they are prevented by their weaker jaws and deciduous teeth from consuming large animal bones (Mills and Mills 1978).

The rest of the HOMS horizon (<-2 east)

Although small-medium bovid/suid (Chi-squared = 0.11; df=1; $P>0.10$), small bovid (Chi-squared = 0.09; df=1; $P>0.10$) and marine mammal (Chi-squared = 0.76; df=1; $P>0.10$) bones are proportionally better represented in the excavated sample of possible hyaena food items from the rest of HOMS (< -2 east), than they are in the sample from the HOMS cluster (> -2 east), they are not significantly more common here than in the cluster (Table 6:3). At the same time, microfauna (Chi-squared = 20.55; df=1; $P<0.001$) and small-mammal (Chi-squared = 8.97; df=1; $P<0.01$) bones, as well as, ostrich eggshell fragments (Chi-squared = 4.68; df=1; $P<0.05$) and bird eggshell fragments (Chi-squared = 5.44; df=1; $P<0.05$) were found to be significantly more common in the excavated sample from the rest of the HOMS horizon (HOMS < -2 east), than in the sample from the bone cluster (Table 6:3).

Comparing the distributions of microfauna and small-mammal bones (Chi-squared = 0.45;

df=1; *P*>0.10), reveal that they are similarly distributed in the HOMS horizon (Table 6:5). Microfauna bones are also similarly distributed to ostrich eggshell fragments, and bird eggshell fragments in the HOMS horizon (Table 6:6). As is the case with microfauna bones, the distribution of small-mammal bones across HOMS, is also similar to that of ostrich eggshell fragments and bird eggshell fragments (Table 6:7).

When compared to the distributions of large animal, large-medium bovid, small-medium bovid/suid, small bovid and carnivore bones, both microfauna and small-mammal bones are differently distributed (Tables 6:8 and 6:9 respectively).

When the distribution of coprolites and the distributions of large bovid/horse/rhino (Chi-squared= 20.05; df= 1; *P*<0.001), large-medium bovid (Chi-squared= 15.08; df= 1; *P*<0.001), small-medium bovid/suid (Chi-squared= 5.15; df= 1; *P*<0.05) and small bovid (Chi-squared= 5.97; df= 1; *P*<0.05) (Table 6:10) bones are compared, it is clear that coprolites are differently distributed to these categories across the HOMS horizon. However, when the distribution of coprolites and that of small-mammal bones (Chi-squared= 0.012; df= 1; *P*>0.10), microfauna bones (Chi-squared= 0.358; df=1; *P*>0.10), ostrich eggshell fragments (Chi-squared= 0.12; df=1; *P*>0.10) and bird eggshell fragments (Chi-squared= 0.00006; df=1; *P*>0.10) are compared, it is found that coprolites are similarly distributed to these categories (Table 6:10).

Coprolites thus seem to have been deposited away from the bone cluster. According to Skinner *et al.* (1980), latrines are often situated separately from feeding areas in hyaena dens. It could be that HOMS <-2 east was such a latrine area. It is also possible that the significantly higher numbers of small-mammal and microfauna bones in this area, could have been deposited

Table 6:8 :

The distribution of microfauna bones compared with the distribution of large animal (large bovids/horses/rhino), small-medium bovid/suid, small bovid and carnivore bones in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Large bovids/horses/rhinos	25.33 (P< 0.001)	(df=1)
Large-medium bovids	23.16 (P< 0.001)	(df=1)
Small-medium bovids/suids	8.57 (P< 0.01)	(df=1)
Small bovids	9.85 (P< 0.01)	(df=1)
Carnivores	19.60 (P< 0.001)	(df=1)

Table 6:9 :

The distribution of small-mammal bones compared to the distributions of large animal (large bovids/horses/rhinos), large-medium bovid, small-medium bovid/suid, small bovid and carnivore bones in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Large bovids/horses/rhinos	17.80 (P< 0.001)	(df=1)
Large-medium bovids	11.55 (P< 0.001)	(df=1)
Small-medium bovids/suids	4.1 (P<0.05)	(df=1)
Small bovids	4.7 (P< 0.05)	(df=1)
Carnivores	10.14 (P< 0.001)	(df=1)

Table 6:10 :

The distribution of coprolites compared to the distributions of large animal (large bovids/horses/rhinos), large-medium bovid, small-medium bovid/suid, small bovid, carnivore, microfauna and small-mammal bones as well as with that of ostrich eggshell fragments in the HOMS horizon (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES	
Large bovids/horses/rhino	20.05 (P< 0.001)	(df=1)
Large-medium bovids	15.08 (P< 0.001)	(df=1)
Small-medium bovids/suids	5.15 (P< 0.05)	(df=1)
Small bovids	5.97 (P< 0.05)	(df=1)
Carnivores	12.93 (P<0.001)	(df=1)
Ostrich eggshell	0.12 (P> 0.10)	(df=1)
Bird eggshell	0.00006 (P> 0.10)	(df=1)
Small-mammals	0.012 (P> 0.10)	(df=1)
Microfauna	0.358 (P> 0.10)	(df=1)

in the hyaena coprolites, accounting for the similar distributions of these categories. Because animals such as rock hyraxes and dune molerats are so small, hyaenas often swallow them whole (Grine and Klein 1993), depositing their bones along with hair, and large-bone fragments in their scats (Mills and Mills 1978). It is also possible that the ostrich eggshell fragments and bird eggshell fragments were deposited in this area in a similar manner. Hyaenas often eat eggs, and shells have been recorded in scats (Mills and Mills 1978).

6.2:4: GUFI

Table 6:11 indicates that carnivore, small bovid, small-medium bovid/suid, marine mammal and bird bones are proportionally more common in the excavated sample of possible hyaena food items from GUFI than they are in the sample from the HOMS bone cluster (HOMS >-2 east). Chi-squared values confirm that the carnivore (Chi-squared = 14.98; df=1; $P<0.001$), small bovid (Chi-squared = 13.85; df=1; $P<0.001$) and marine mammal bones (Chi-squared = 4.69; df=1; $P<0.05$) are significantly more common in the sample from GUFI than in that from the bone cluster (HOMS >-2 east).

Table 6:11 also indicates that large-medium bovid, large animal (large bovids/horses/rhino), microfauna, small-mammal and tortoise bones, as well as ostrich eggshell fragments, are proportionally less common in the excavated sample of possible hyaena food items from GUFI, than in the sample from the bone cluster (HOMS >-2 east). Chi-squared values confirm that large-medium bovid (Chi-squared = 8.03; df=1; $P<0.01$) and large animal (Chi-squared = 7.53; df=1; $P<0.01$) bones are significantly less common in the sample from GUFI than in the sample from the bone cluster (HOMS >-2 east).

Table 6:11 :

The proportional representation of food items in the GUFI and HOMS (> -2 east) bone clusters.

CATEGORIES	GUFI	HOMS BONE CLUSTER	CHI-SQUARED (ONE SAMPLE-TEST)
Carnivores	72 (33.64%)	180 (19.40%)	14.98 (P< 0.001)
Small bovids	38 (17.76%)	79 (8.51%)	13.85 (P< 0.001)
Small-medium bovids/suids	19 (8.88%)	62 (6.68%)	1.04 (P> 0.10)
Large-medium bovids	59 (27.57%)	373 (40.19%)	8.03 (P< 0.01)
Large bovids/horses/rhinos	2 (0.93%)	49 (5.28%)	7.53 (P< 0.01)
Marine mammals	9 (4.21%)	16 (1.72%)	4.69 (P< 0.05)
Microfauna	4 (1.87%)	38 (4.09%)	2.46 (P> 0.10)
Small-mammals	3 (1.4%)	32 (3.45%)	1.48 (P> 0.10)
Ostrich eggshell	2 (0.93%)	23 (2.48%)	1.96 (P> 0.10)
Birds	4 (1.87%)	17 (1.83%)	0.00004 (P> 0.10)
Tortoises	2 (0.93%)	31 (3.34%)	3.58 (P< 0.10)
Bird eggshell	-	17 (1.83%)	-
Humans	-	11 (1.19%)	-

Total number of food items recorded in the GUFI cluster : 214

Total number of food items recorded in the HOMS cluster (> -2 east) : 928

Note:

The percentage representations of food items recorded in the GUFI and HOMS bone clusters are in round brackets.

The percentage values used to calculate the expected frequencies in the Chi-squared one-sample test, were calculated as follows:

The number of food items recorded in GUFI:	214	19%
The number of food items recorded in HOMS > -2 east	928	81%
	1143	100%

The degrees of freedom: 1

(refer to Fig. 6:8)

When the distributions of large-medium bovid and large animal bones are compared to the distributions of carnivore, small bovid and marine mammal (Tables 6:13 and 6:12 respectively) bones, it is clear that the larger animal bones are differently distributed. Small bovid, marine mammal and carnivore bones have similar distributions (Table. 6:14).

Based on these observations, it is possible that the bone cluster in GUFI could have been produced by hyaena cubs. Mills and Mills (1978) note that one of the biggest discrepancies in diet between brown hyaena adults and cubs, is that cubs eat more small mammals and fewer large mammals than adults do. Small bovids and carnivores are especially common in the diets of hyaena cubs as demonstrated in the study conducted by Mills and Mills (1978: 133: Table 3).

The fact that the spatial distributions of bones, coprolites and ostrich eggshell fragments appear to be non-random, further supports the hypothesis that the HDP1 bones were accumulated in a den, and not in the open. The distribution of bones and coprolites in the fossiliferous horizons are extremely similar to the distributions of bones and coprolites in modern hyaena dens (eg.Skinner *et al.* 1980). In addition, the concentration of smaller animal remains in GUFI, suggest that the den was probably used as a maternity den. Cubs often excavate chambers which are too small to admit adult hyaenas (Skinner and Smithers 1990). These tunnels are used by cubs for protection from adults or predators (Skinner and Smithers 1990).

Table 6:12 :
The distribution of large animal (large bovids/horses/rhino) bones compared to the distributions of small bovid, carnivore and marine mammal bones in the GUFI and HOMS (> -2 east) bone clusters (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES
Small bovids	15.96 df=1 (P< 0.001)
Carnivores	14.61 df=1 (P< 0.001)
Marine mammals	13.93 df=1 (P< 0.001)

Table 6:13 :
The distribution of large-medium bovid bones compared to the distributions of small bovid, carnivore and marine mammal bones in the GUFI and HOMS (> -2 east) bone clusters (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES
Small bovids	22.42 df=1 (P< 0.001)
Carnivores	22.87 df=1 (P< 0.001)
Marine mammals	9.31 df=1 (P< 0.01)

Table 6:14 :
The distribution of small bovid bones compared to the distributions of carnivore and marine mammal bones in the GUFI and HOMS (> -2 east) bone clusters (Chi-squared test for cross-classified data).

CATEGORIES	CHI-SQUARED VALUES
Carnivores	0.59 df=1 (P> 0.10)
Marine mammals	0.107 df=1 (P> 0.10)

6.3: The archaeological assemblage

Because the archaeological assemblage was only sampled, it is not possible to determine at this stage whether it was deposited under an overhang, or in an open-air situation. However, the presence of stone tools manufactured out of calcrete, suggests that the calcrete capping was already in place before the archaeological assemblage was deposited. Thus, here again, the sediments were in place before the archaeological material was deposited. It is possible that the archaeological assemblage may also have been accumulated under an overhang, possibly under the capping.

6.4: Implications for the Sea Harvest site

According to Grine and Klein (1993), the faunal remains at Sea Harvest occur in gully or swale fills that are texturally similar to the partially consolidated aeolian sands that surround them. This suggests that the faunal remains and the sediments may have been deposited at more or less the same time. Based on Butzer's (as quoted in Grine and Klein 1993) evaluation of the entire Sea Harvest sequence, it was postulated that these sands and the faunal material contained in them, were deposited during a marine regression. One or more of the colder intervals within the Last Interglacial (substages 5d and 5b, 109 000 and 92 000 B.P. respectively) were raised as possibilities.

The shell midden is also thought to have been deposited at about the same time as the surrounding sediments were. Based on Butzer's (as quoted by Grine and Klein 1993), stratigraphic and sedimentological observations, the most likely time is thought to have been during the early part of the Last Glaciation (isotope stage 4), sometime between 74 000 and 60 000 years ago.

Based on the observations at HDP1, there is however a strong possibility that the Sea Harvest palaeontological and archaeological assemblages may not have been deposited at the same time that the surrounding sediments were. It is highly likely that these assemblages postdate the sediments in which they occur.

It is also possible that the two assemblages are much farther apart in age than what Grine and Klein (1993) suspect. Depending on the actual ages of the two assemblages, this could mean that the human remains found in the palaeontological horizons, and the shell midden situated in the archaeological horizons, respectively represent the physical and cultural remains of two very different human populations.

Summary and Conclusion

Based on the stratigraphic evidence, the HDP1 palaeontological assemblage was accumulated in a cavity in a partially consolidated dune. All the bone-bearing sediments at the site, were therefore present before the bones were deposited. Evidence that hyaenas burrowed into the already existing sediments, is provided by the grain-size analyses of various horizons at the site. This provides evidence for the mixing of sediments, which could have occurred during burrowing.

The spatial patterning of fossil bone, ostrich eggshell and coprolites in the HDP1 palaeontological assemblage further supports the hypothesis that the bones were accumulated in a den situation.

The non-random distributions of bone, ostrich eggshell, and coprolites in the sediments of the palaeontological site are remarkably similar to the distributions of the same categories in modern hyaena assemblages. Just as in modern hyaena assemblages, a possible feeding area is present which is characterised by the abundance of large mammal bones. A possible latrine area away from the main feeding area is also evident. Small-mammal and microfauna bones are more common outside the bone cluster and are similarly distributed to the coprolites, suggesting that they could have been deposited in the hyaena scats. A second feeding area which is dominated by small bovids and carnivores is also present. This was possibly a pup feeding area.

Tools manufactured out of calcrete, similar to that of the capping covering parts of the dune, were found in the archaeological horizons at HDP1. The implication of this is that, here too the material in the archaeological horizon most probably postdate the dune sands. It is thus possible that these horizons also formed in a cavity in the dune. This will however become clearer, with the aid of further excavations.

The fact that these assemblages seemed to have been accumulated in already existing dune sediments, have important ramifications for the interpretation of the dates on the sediments in which they occur. The surrounding sediments are most probably older than both the palaeontological and archaeological assemblages, and as such cannot be used as a means to date these assemblages. The sediments do however provide a maximum age for the accumulations. As discussed earlier (Chapter 3), most dates on the sediments so far, suggest that they were deposited during the later Middle Pleistocene. This places a limit on the maximum age of the material contained in them.

CHAPTER SEVEN

DISCREPANCIES IN SKELETAL ELEMENT REPRESENTATION IN THE HDP1 PALAEONTOLOGICAL ASSEMBLAGE

In order to reconstruct the palaeoenvironmental and palaeoclimatic conditions which prevailed when the palaeontological site was being formed, it is necessary to determine whether the assemblage is a true reflection of the animal community that lived at the time. As was mentioned in chapter 5, the diets of brown hyaenas can accurately reflect the composition of the vertebrate fauna of a region from which brown hyaenas scavenge food (Skinner and van Aarde 1991). Many fossil hyaena assemblages however demonstrate discrepancies in skeletal part frequencies (i.e. some skeletal parts are more common than others), which suggest that they were altered in some way, and may in fact not be a true reflection of the animal population at the time. As the HDP1 palaeontological sample also displays these discrepancies, it is necessary to determine what caused them, and whether the sample may have been biased in any way.

7.1: Discrepancies in skeletal part frequencies

Klein and Cruz-Uribe (1984), borrowing from Clark and Kietzke (1967) and Meadow (1980), proposed five basic stages through which a fossil fauna passes, before it reaches the analyst. Every fossil fauna begins as part of a life assemblage (a live community of animals), it then passes into the death assemblage (the portion of the live community available to the bone collector), which is followed by the deposited assemblage (the bones actually deposited at a site), the fossil assemblage (the bones that survive until excavation or collection) and finally the sample assemblage (the part of the fossil assemblage which is actually excavated and collected) (Klein and Cruz-Uribe 1984).

Species passing through the life and death assemblages are characterised by whole animals or whole carcasses. This means that the range and number of bones which were present before the death of an animal should also be present after its death. However, most, if not all fossil samples demonstrate variability in the representation of skeletal parts of particular taxa.

As these discrepancies could not have originated during the life and death assemblages, they must therefore have originated either when the death assemblage was transformed into the deposited assemblage (collector behaviour), when the deposited assemblage was transformed into the fossil assemblage (postdepositional forces) or when the fossil assemblage was sampled during excavation. Klein and Cruz-Uribe (1984) suggest that MNE discrepancies in most fossil samples, are probably due to a complex mix of events that occurred during all three transformations.

Although excavations are still ongoing at HDP1, a large enough sample has now been excavated from the palaeontological assemblage to suggest that these discrepancies in skeletal part frequencies are also present here. The sample is also large enough to provide information on the possible cause or causes of these discrepancies.

7.2: Methods

Being the largest category in the sample, bovids are chosen to investigate the causes of these discrepancies. Bovids are divided into four size classes, namely small, small-medium, large-medium and large bovids. The species included in these size classes, are the same as in table 5:4 (Chapter 5).

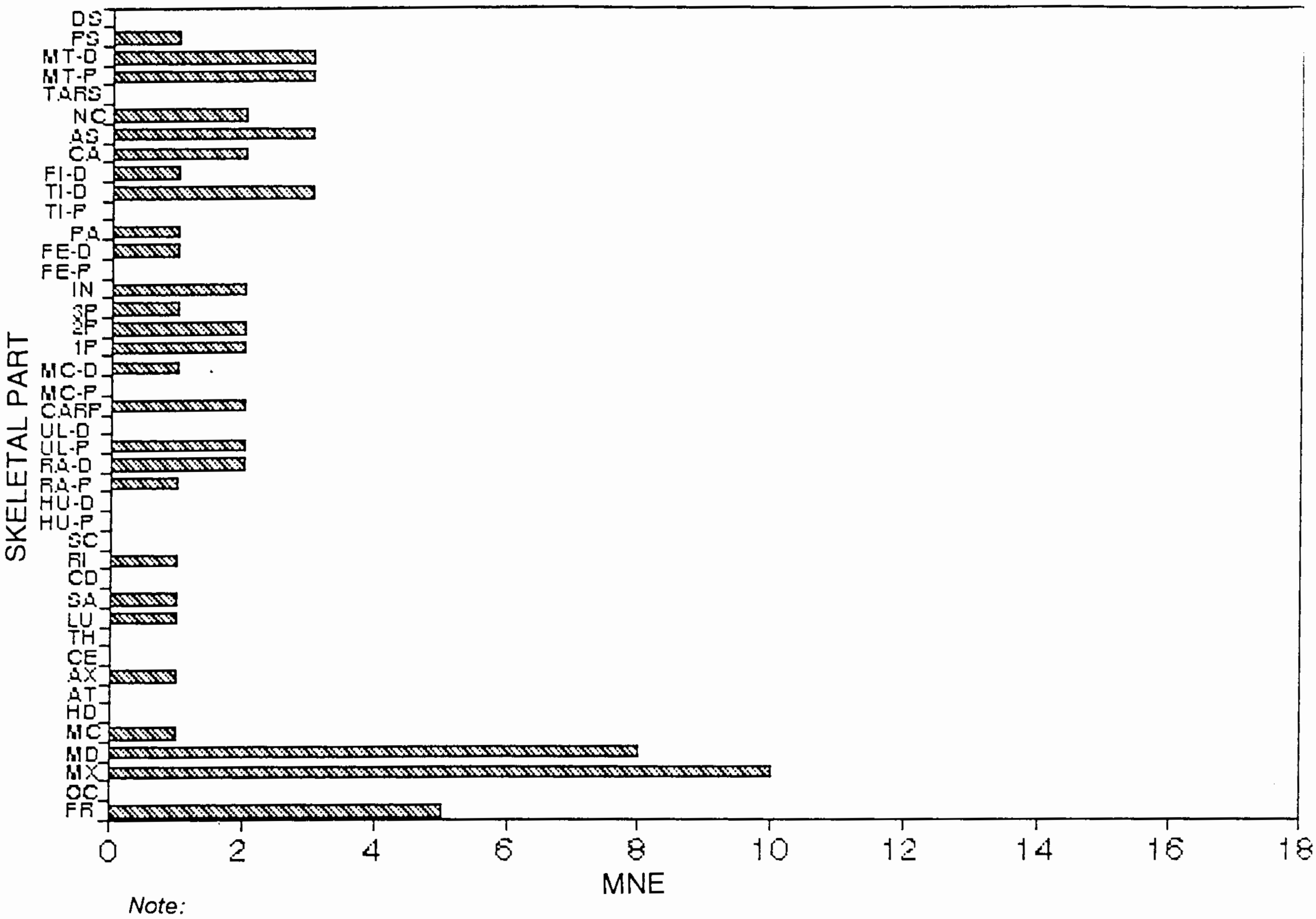
When comparing patterns of skeletal part representation between these bovid size classes, the Kolmogorov-Smirnov test is employed to determine the probability that they differed simply by chance. According to Klein and Cruz-Uribe (1984), this is the most useful statistical procedure for this purpose. Significant correlations are those for which *P* is less than or equal to 0.05.

To determine whether the discrepancies in skeletal part representation are the result of differential transport of elements by the hyaenas, or are the result of density mediated destruction of less dense bones, I employ a method proposed by Grayson (1989) in which the abundance of each skeletal part is plotted first against its basic food value (a measure of the likelihood that hyaenas will encounter it at a carcass) and second, against its density (a measure of its ability to survive hyaena feeding). Metcalfe and Jones'(1988) standardized food utility index is used as my measure of economic utility and Lyman's (1984, 1985) bulk density values as my bone density measure. My measure of abundance is the percentage minimum animal unit (%MAU). As MAU values are believed to be ordinal scale (Grayson 1984; Lyman 1993), Spearman's rho is used to test the statistical significance of the relationships between abundance and these values. Significant correlations are those for which *P* is less than or equal to 0.05. As a measure of the effect that postdepositional factors may have had on the assemblage, I employ Marean's (1991) "completeness index" for compact bones.

7.3: Skeletal part representation at HDP1 (Palaeontological site)

Statistically (Kolmogorov-Smirnov $Z= 0.75$, $P>.10$), the patterns of skeletal part representation between the small and small-medium bovid size classes are quite similar. In general, it is clear that both the small (Fig. 7:1) and small-medium (Fig. 7:2) bovid size classes are better represented by cranial bones, as opposed to postcranial bones, although less so in small-medium bovids. This has already been mentioned in an earlier chapter (Chapter 5). Amongst the postcranial bones, the small, hard, carpals, tarsals, and phalanges are proportionally well represented. There is also not a significant difference in the skeletal part representations of small-medium bovids and large bovids (Fig. 7:3) in the sample (Kolmogorov-Smirnov $Z= 1.14$, $P>0.10$). However, when comparing small and large bovids, a statistically significant relationship is obtained (Kolmogorov-Smirnov $Z= 1.47$, $P<0.05$). This difference is possibly due to the greater representation of cranial bones in the small bovid size class compared to the small-medium and large bovid size classes. The skeletal part representation in the small bovid size class is also skewed towards a greater range of skeletal parts (Fig. 7:1).

Statistically and visually, the patterns of skeletal part representation differ strongly between the large-medium bovid size class (Fig. 7:4) and the small and small-medium bovid size classes. A Kolmogorov-Smirnov value of $Z= 2.6$ [$P< 0.001$] is obtained when comparing the large-medium and small bovid size classes, and a value of $Z= 1.39$ [$P< 0.5$] when comparing large-medium and small-medium bovid size classes.



Note:

The bars are proportional to the MNE's (Minimum Number of Elements) for each skeletal part. The skeletal parts have been ordered anatomically from the most proximal to the most distal.

Steenbok/grysbok make up this size category.

CARP	2	FR	5
MC-P	0	OC	0
MC-D	1	MX	10
1P	2	MD	8
2P	2	MC	1
3P	1	HD	0
IN	2	AT	0
FE-P	0	AX	1
FE-D	1	CE	0
PA	1	TH	0
TI-P	0	LU	1
TI-D	3	SA	1
FI-D	1	CD	0
CA	2	RI	1
AS	3	SC	0
NC	2	HU-P	0
TARS	0	HU-D	0
MT-P	3	RA-P	1
MT-D	3	RA-D	2
PS	1	UL-P	2
DS	0	UL-D	0

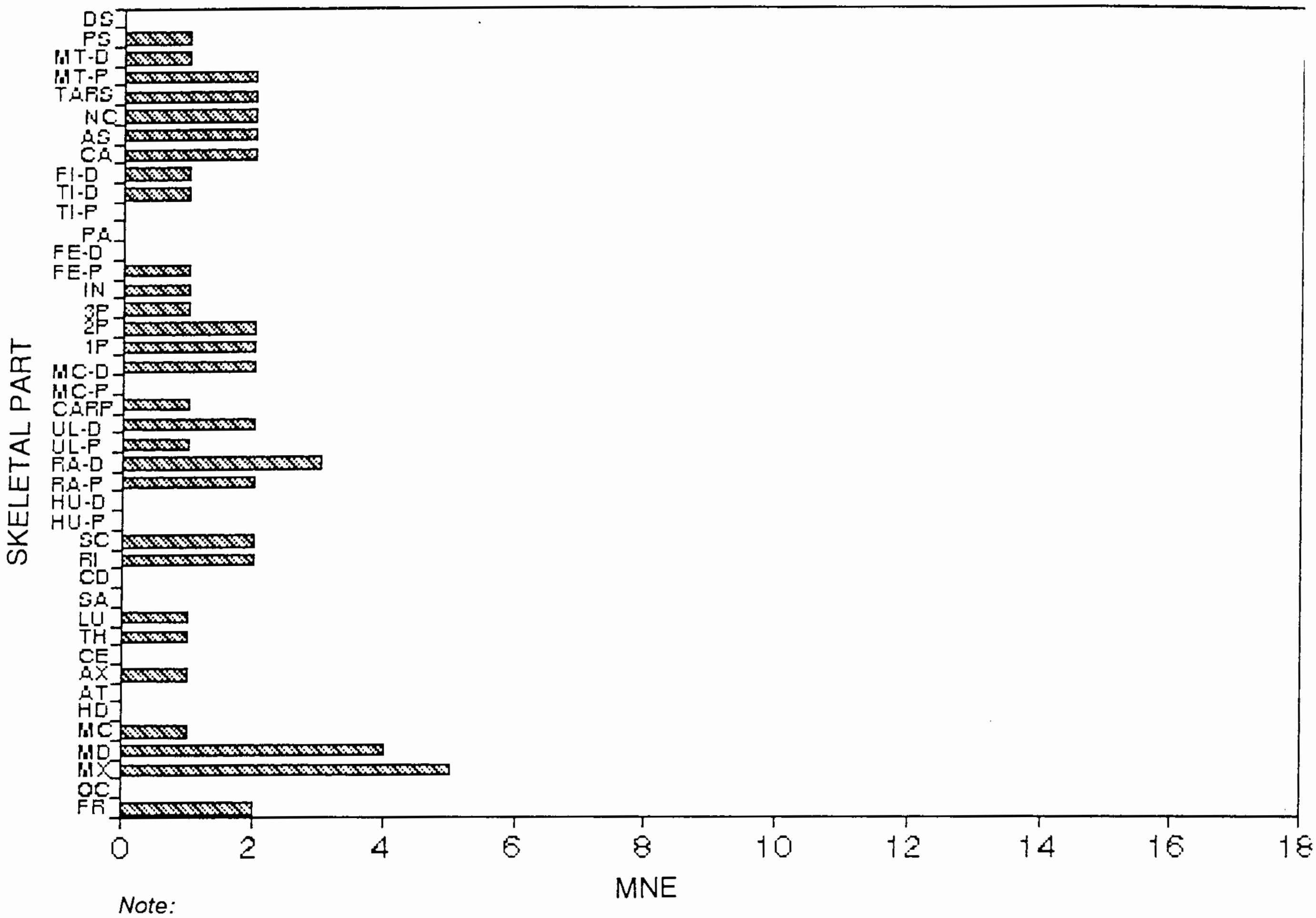
KEY:

FR - Frontlet
OC - Occiptal condyle
MX - Maxilla
MD - Mandible
MC - Mandibular condyle
HD - Hyoid
AT - Atlas
AX - Axis
CE - Cervical vertebrae 3 - 7
TH - Thoracic vertebrae
LU - Lumbar vertebrae
SA - Sacral vertebrae
CD - Caudal vertebrae
RI - Rib
SC - Scapula
HU-P - Humerus - proximal
HU-D - Humerus - distal
RA-P - Radius - proximal
RA-D - Radius - distal
UL-P - Ulna - proximal
UL-D - Ulna - distal

CARP - Carpals
MC-P - Metacarpal - proximal
MC-D - Metacarpal - distal
1 P - First phalange
2 P - Second phalange
3 P - Third phalange
IN - Innominate
FE-P Femur - proximal
FE-D - Femur - distal
PA - Patella
TI-P - Tibia - proximal
TI-D - Tibia - distal
FI - Fibula - distal
CA - Calcaneum
As - Astragalus
NC - Naviculo - cuboid
TARS - Tarsals
MT-P - Metatarsal - proximal
MT-D - Metatarsal - distal
PS - Proximal sesamoid
DS - Distal sesamoid

'e 7:1 :

Skeletal part representation in the small bovid size class.



Note:

The bars are proportional to the MNE's (Minimum Number of Elements) for each skeletal part. The skeletal parts have been ordered anatomically from the most proximal to the most distal.

Springbok and vaalribbok make up this size category.

CARP	1	FR	2
MC-P	0	OC	0
MC-D	2	MX	5
1P	2	MD	4
2P	2	MC	1
3P	1	HD	0
IN	1	AT	0
FE-P	1	AX	1
FE-D	0	CE	0
PA	0	TH	1
TI-P	0	LU	1
TI-D	1	SA	0
FI-D	1	CD	0
CA	2	RI	2
AS	2	SC	2
NC	2	HU-P	0
TARS	2	HU-D	0
MT-P	2	RA-P	2
MT-D	1	RA-D	3
PS	1	UL-P	1
DS	0	UL-D	2

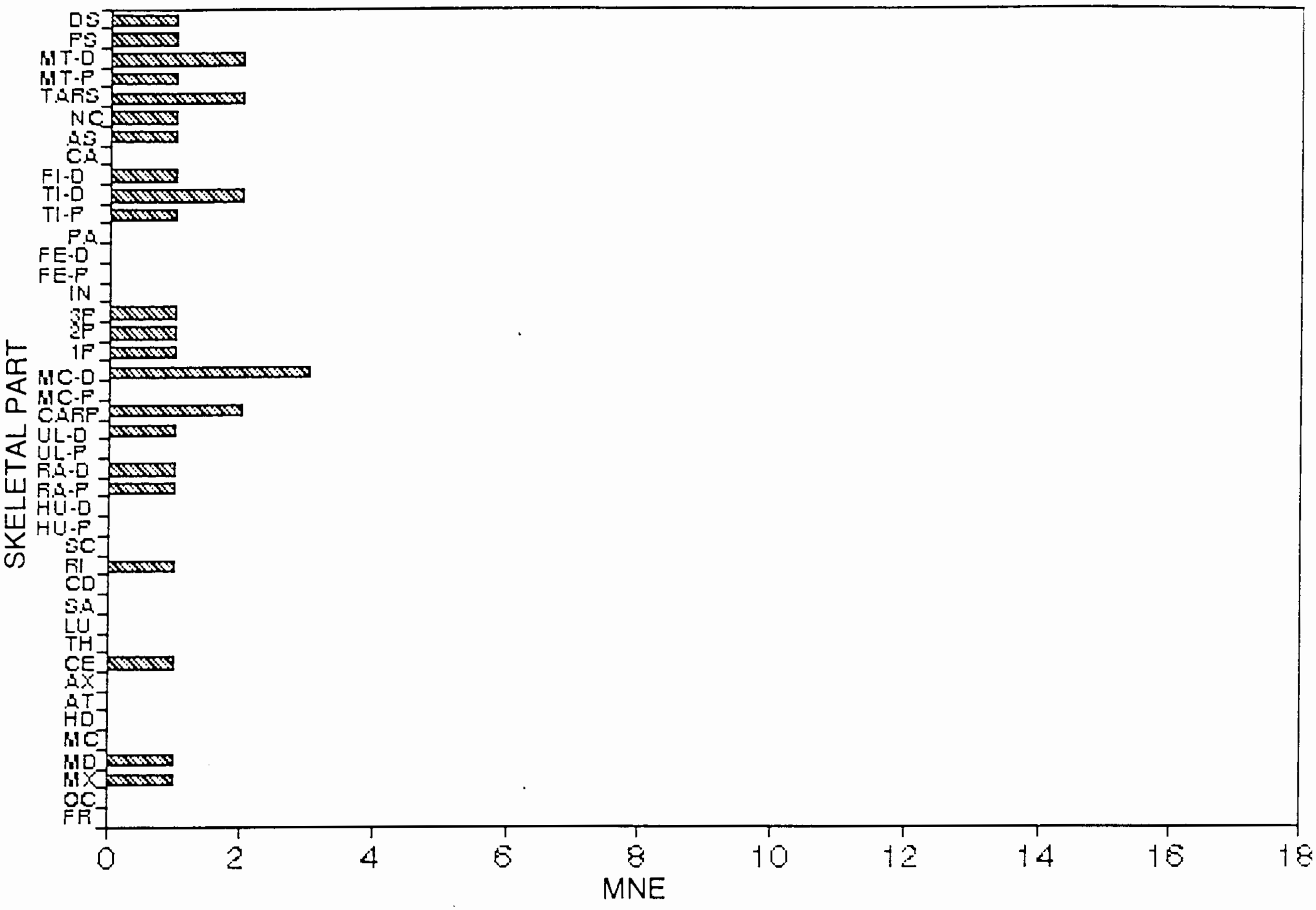
KEY:

FR - Frontlet
OC - Occiptal condyle
MX - Maxilla
MD - Mandible
MC - Mandibular condyle
HD - Hyoid
AT - Atlas
AX - Axis
CE - Cervical vertebrae 3 - 7
TH - Thoracic vertebrae
LU - Lumbar vertebrae
SA - Sacral vertebrae
CD - Caudal vertebrae
RI - Rib
SC - Scapula
HU-P - Humerus - proximal
HU-D - Humerus - distal
RA-P - Radius - proximal
RA-D - Radius - distal
UL-P - Ulna - proximal
UL-D - Ulna - distal

CARP - Carpals
MC-P - Metacarpal - proximal
MC-D - Metacarpal - distal
1 P - First phalange
2 P - Second phalange
3 P - Third phalange
IN - Innominate
FE-P Femur - proximal
FE-D - Femur - distal
PA - Patella
TI-P - Tibia - proximal
TI-D - Tibia - distal
FI - Fibula - distal
CA - Calcaneum
As - Astragalus
NC - Naviculo - cuboid
TARS - Tarsals
MT-P - Metatarsal - proximal
MT-D - Metatarsal - distal
PS - Proximal sesamoid
DS - Distal sesamoid

gure 7:2 :

Skeletal part representation in the small-medium bovid size class.



Note:

The bars are proportional to the MNEs (Minimum Number of Elements) for each skeletal part. The skeletal parts have been ordered anatomically from the most proximal to the most distal.

Pelorovis antiquus, Megalotragus priscus,
Cape buffalo and the eland make up this size category.

CARP	2	FR	0
MC-P	0	OC	0
MC-D	3	MX	1
1P	1	MD	1
2P	1	MC	0
3P	1	HD	0
IN	0	AT	0
FE-P	0	AX	0
FE-D	0	CE	1
PA	0	TH	0
TI-P	1	LU	0
TI-D	2	SA	0
FI-D	1	CD	0
CA	0	RI	1
AS	1	SC	0
NC	1	HU-P	0
TARS	2	HU-D	0
MT-P	1	RA-P	1
MT-D	2	RA-D	1
PS	1	UL-P	0
DS	1	UL-D	1

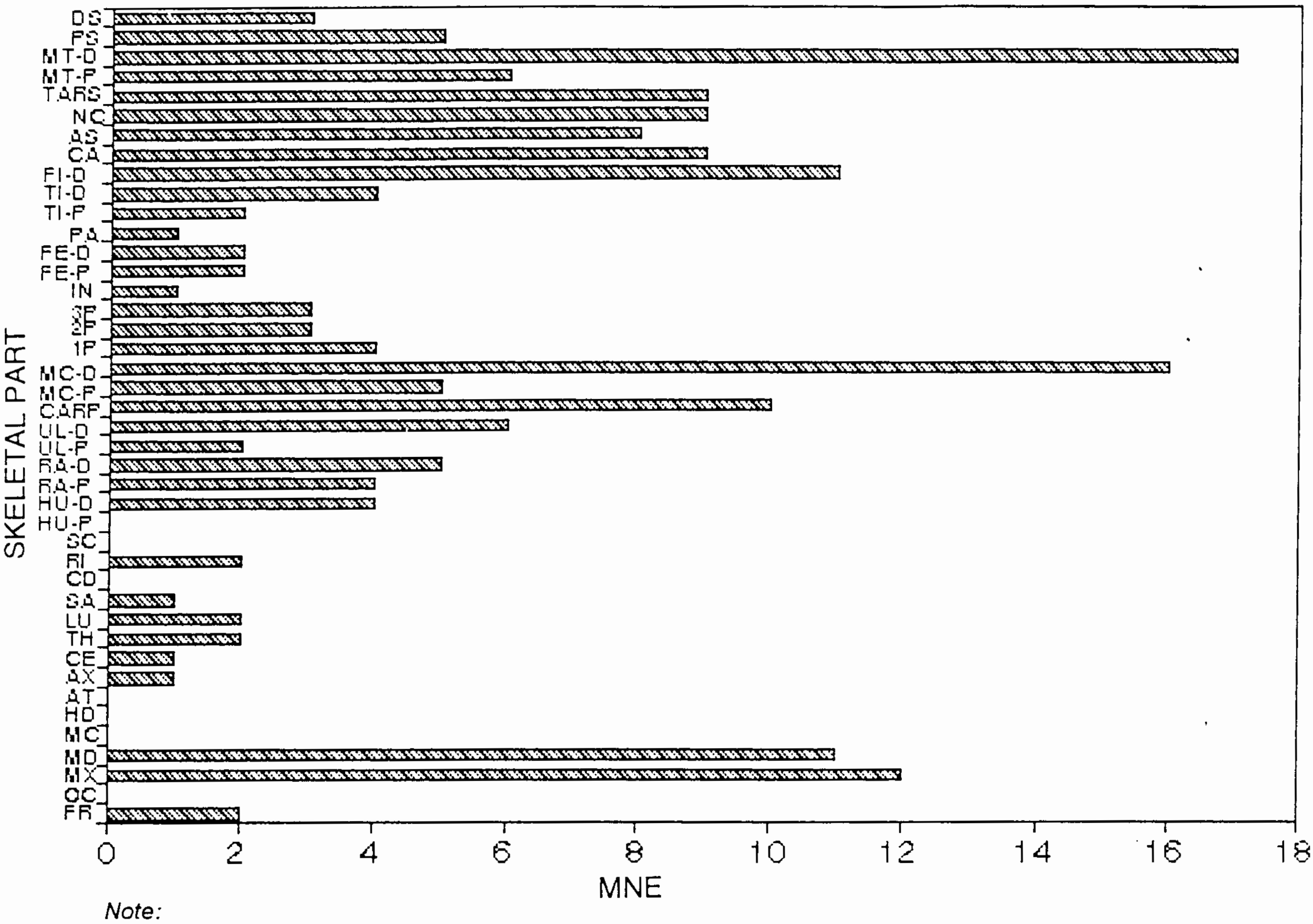
KEY:

FR - Frontlet
OC - Occiptal condyle
MX - Maxilla
MD - Mandible
MC - Mandibular condyle
HD - Hyoid
AT - Atlas
AX - Axis
CE - Cervical vertebrae 3 - 7
TH - Thoracic vertebrae
LU - Lumbar vertebrae
SA - Sacral vertebrae
CD - Caudal vertebrae
RI - Rib
SC - Scapula
HU-P - Humerus - proximal
HU-D - Humerus - distal
RA-P - Radius - proximal
RA-D - Radius - distal
UL-P - Ulna - proximal
UL-D - Ulna - distal

CARP - Carpals
MC-P - Metacarpal - proximal
MC-D - Metacarpal - distal
1 P - First phalange
2 P - Second phalange
3 P - Third phalange
IN - Innominate
FE-P Femur - proximal
FE-D - Femur - distal
PA - Patella
TI-P - Tibia - proximal
TI-D - Tibia - distal
FI - Fibula - distal
CA - Calcaneum
As - Astragalus
NC - Naviculo - cuboid
TARS - Tarsals
MT-P - Metatarsal - proximal
MT-D - Metatarsal - distal
PS - Proximal sesamoid
DS - Distal sesamoid

Figure 7:3 :

Skeletal part representation in the large bovid size class.



Note:

The bars are proportional to the MNEs (Minimum Number of Elements) for each skeletal part. The skeletal parts have been ordered anatomically from the most proximal to the most distal.

Black wildebeest, Cape hartebeest, southern reedbuck, bontebok, blue antelope and kudu make up this category.

CARP	10	FR	2
MC-P	5	OC	0
MC-D	16	MX	12
1P	4	MD	11
2P	3	MC	0
3P	3	HD	0
IN	1	AT	0
FE-P	2	AX	1
FE-D	2	CE	1
PA	1	TH	2
TI-P	2	LU	2
TI-D	4	SA	1
FI-D	11	CD	0
CA	9	RI	2
AS	8	SC	0
NC	9	HU-P	0
TARS	9	HU-D	4
MT-P	6	RA-P	4
MT-D	17	RA-D	5
PS	5	UL-P	2
DS	3	UL-D	6

KEY:

FR - Frontlet
OC - Occiptal condyle
MX - Maxilla
MD - Mandible
MC - Mandibular condyle
HD - Hyoid
AT - Atlas
AX - Axis
CE - Cervical vertebrae 3 - 7
TH - Thoracic vertebrae
LU - Lumbar vertebrae
SA - Sacral vertebrae
CD - Caudal vertebrae
RI - Rib
SC - Scapula
HU-P - Humerus - proximal
HU-D - Humerus - distal
RA-P - Radius - proximal
RA-D - Radius - distal
UL-P - Ulna - proximal
UL-D - Ulna - distal

CARP - Carpals
MC-P - Metacarpal - proximal
MC-D - Metacarpal - distal
1 P - First phalange
2 P - Second phalange
3 P - Third phalange
IN - Innominate
FE-P Femur - proximal
FE-D - Femur - distal
PA - Patella
TI-P - Tibia - proximal
TI-D - Tibia - distal
FI - Fibula - distal
CA - Calcaneum
As - Astragalus
NC - Naviculo - cuboid
TARS - Tarsals
MT-P - Metatarsal - proximal
MT-D - Metatarsal - distal
PS - Proximal sesamoid
DS - Distal sesamoid

gure 7:4 :

Skeletal part representation in the large-medium bovid size class.

As illustrated in figure 7:4, not only are cranial bones well represented in the large-medium size class, but postcranial bones are too. In fact, distal metacarpals and metatarsals provide the highest MNE values for this class. Carpals, tarsals, phalanges and sesamoids are also well represented. The large-medium bovid size class is also represented by a wider range of skeletal parts than are the two small bovid size classes. Visually, there is also a marked difference in the patterns of skeletal part representation between the large-medium bovid size class and large bovid size class. This is statistically confirmed by the Kolmogorov-Smirnov value (Kolmogorov-Smirnov Z= 4.05, *P*<0.001). Large-medium bovids are better represented both cranially and postcranially than large bovids. Large bovids are also represented by a more restricted range of skeletal parts.

7.4: Possible causes of these discrepancies

Meticulous care had been taken when excavating this site to recover all fossils without further damaging them. However, some bones have been damaged during the process of excavation despite the care taken. This was mainly due to their fragile nature. Most of the bones that were destroyed during the excavation, had already been weakened by postdepositional factors such as root growth and salt crystal formation, and were disintegrating before they were excavated.

Despite the loss of these fossils, the conservation methods employed during the excavation, have proved successful and the majority of the fossils survived the excavation. Although there is no doubt that the excavation process contributed to the discrepancies in skeletal part frequencies at HDP1, it is unlikely that it was the major cause. It is more likely that they had originated sometime between the death assemblage and the fossil assemblage. Differential transport as well as density mediated destruction of bones are the major causes of discrepancies in fossil assemblages during these two stages.

7.4:1: Differential transport

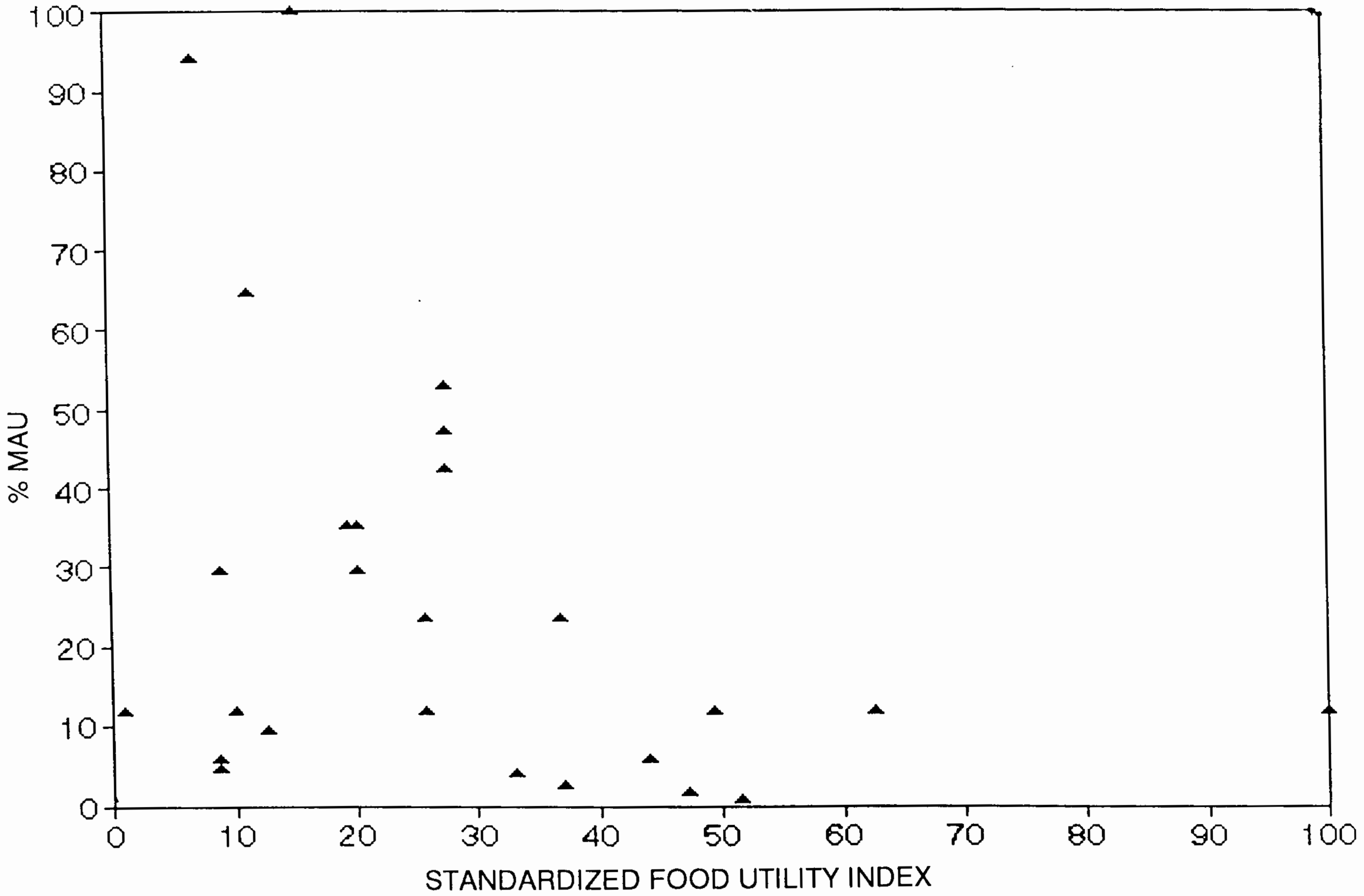
As I have already mentioned (Chapter 5), Klein and Cruz-Uribe (1984) and Cruz-Uribe (1991) believe that transport was a major cause of the differences in skeletal part representation between large and small ungulates. This is mainly because hyaenas are limited in what they can transport back to their dens. For instance, they often have difficulty carrying back large ungulate cranial bones, while not having the same problem with large ungulate postcranial bones, juvenile large ungulate cranial or postcranial bones, or small ungulate cranial or postcranial bones (Cruz-Uribe 1991).

To determine whether differential transport of skeletal parts caused these discrepancies at HDP1, I employed the method proposed by Binford (1978) and later by Metcalfe and Jones (1988) and Grayson (1989) in which the abundance of each skeletal part is plotted against its basic food value (which ranks each anatomical part of an animal according to the quantity of food associated with that part). Binford (1978), plotting skeletal part abundance against their food values, or their "Modified General Utility Indices" (MGUI) which is Binford's (1978) measure of economic utility, produced a family of curves, each of which may be associated with a very different animal utilisation strategy. Thus, if hunters butcher an animal at a site (the kill/butcher site) and remove only parts extremely high in utility, or basic food value, to another site, while those of lower utility are left at the kill/butcher site, very different curves would be produced at the two sites.

The site to which the high utility parts were transported to, for example, will produce a positive parabolic curve that extends from the lower left hand side of the graph to the upper right hand side. This is known as the gourmet strategy. The kill/butcher site on the other hand, contains all the low utility parts, and will produce a negative hyperbolic curve, or reverse utility curve. This is termed the reverse utility strategy (after Thomas and Meyer 1983).

Based on observations of extant brown hyaenas, it could be hypothesized that when skeletal part abundance for large bovids from HDP1 or any hyaena assemblage is plotted against utility, that a reverse utility curve would be generated. The reason for this is that most of the large animal body parts at the den would be the result of scavenging from the kills of other carnivores, and as a result, would most likely be the less desirable (low utility) parts left over at the kill site (Klein *et al.* 1991). In the case of small bovids however, a positive curve would be generated. The reason for this is that brown hyaenas are more likely to transport back to the den, the higher utility parts of small bovids, as they are capable of hunting these. There would thus be a greater presence of small bovid high utility parts at the den (Klein *et al.* 1991). Both scenarios require that the assemblage under investigation was not subjected to density mediated destruction.

Figure 7:5 indicates that plotting the skeletal part frequencies of large-medium sized bovids, measured as percentage minimal animal units (%MAU), against the "standardized food utility index" provided by Metcalfe and Jones (1988), does indeed generate a reverse utility pattern. The relationship between the two variables is however insignificant (Spearman's rho =



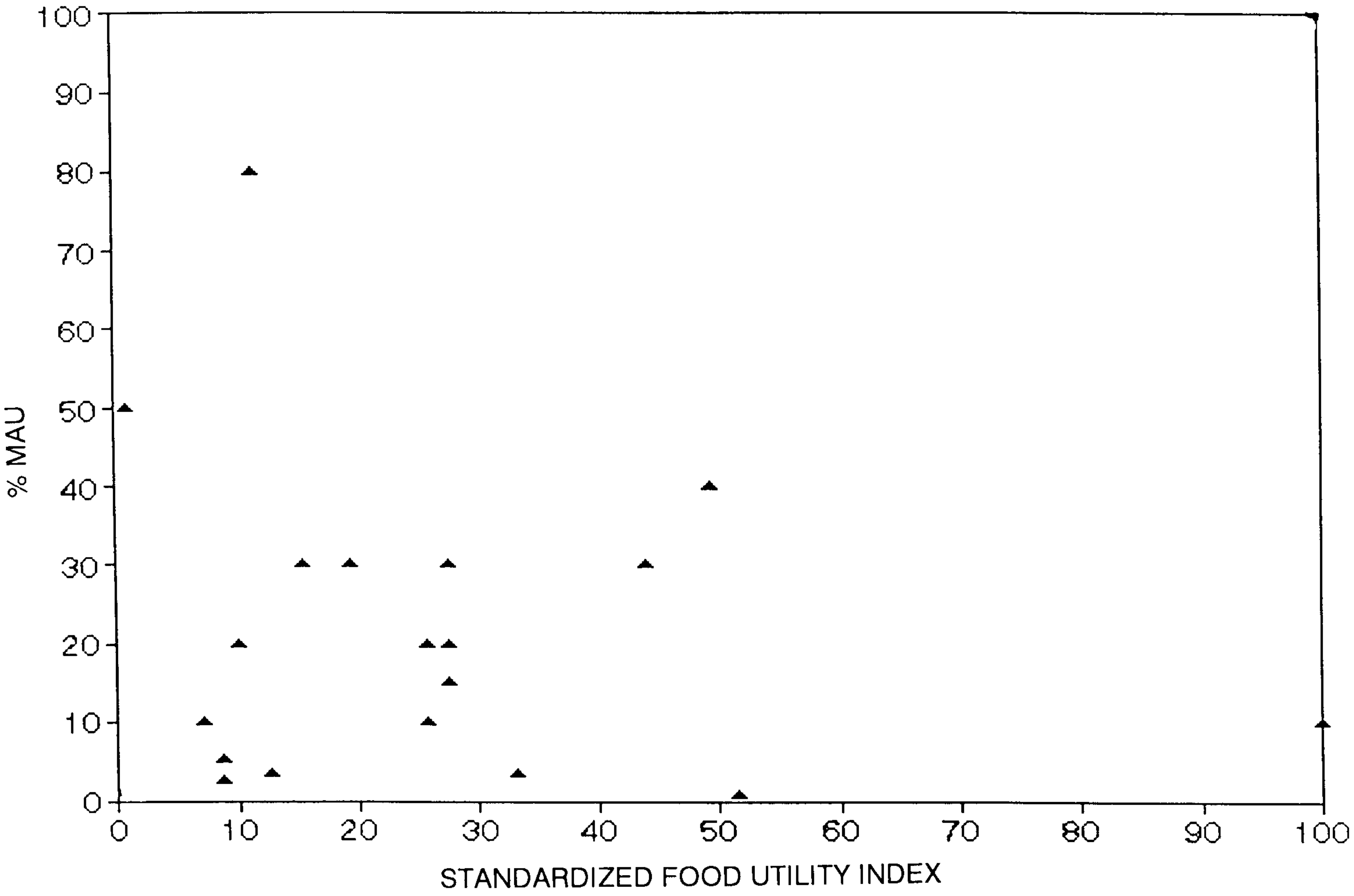
Note:

The food value estimates (Metcalfe and Jones 1988) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = -0.256; df=28; (P> 0.1)

Figure 7:5 :

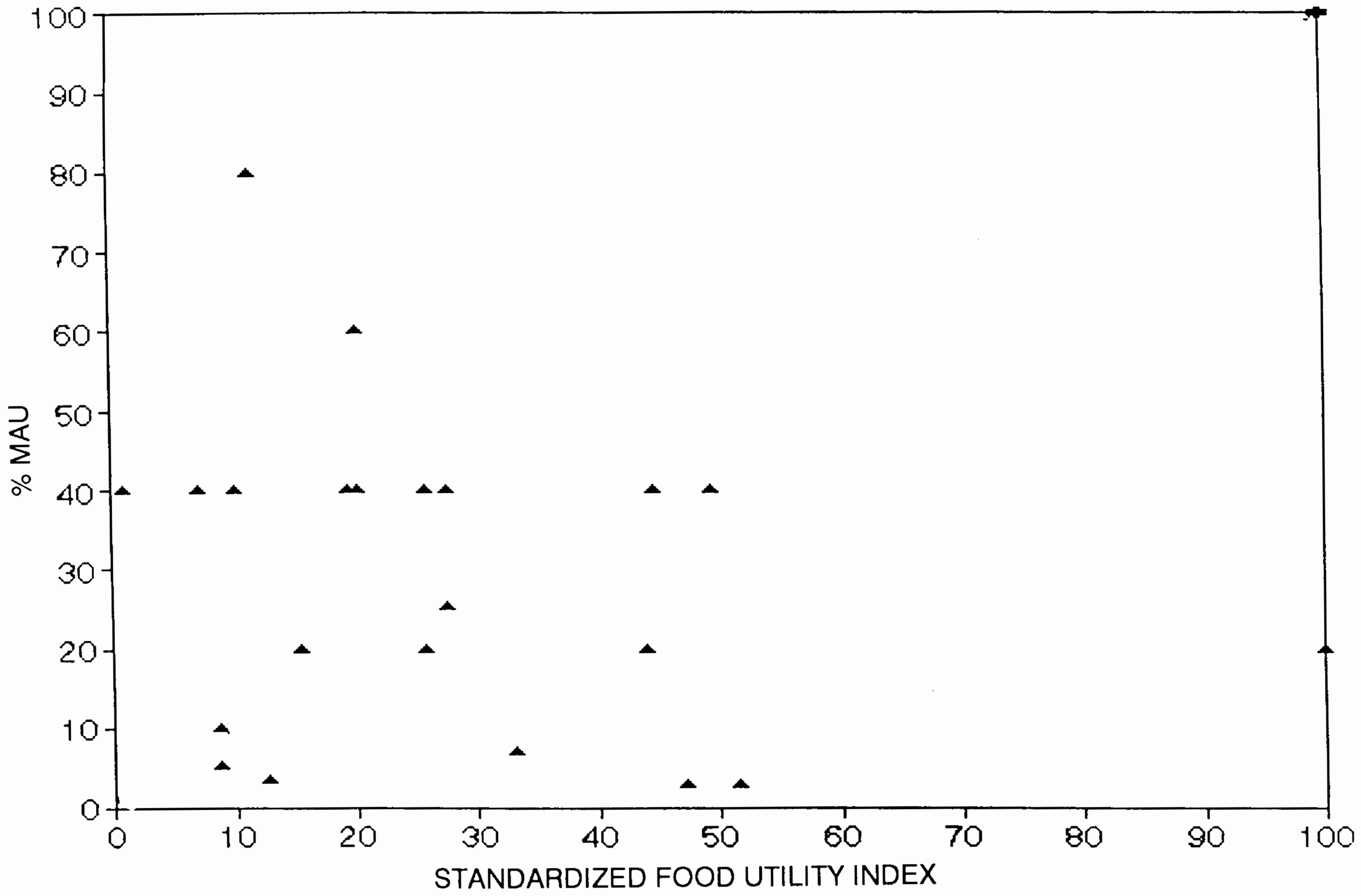
The relationship between food value and skeletal part abundance in large-medium bovids.



Note:
The food value estimates (Metcalfe and Jones 1988) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = -0.0069; df=21; (P> 0.1)

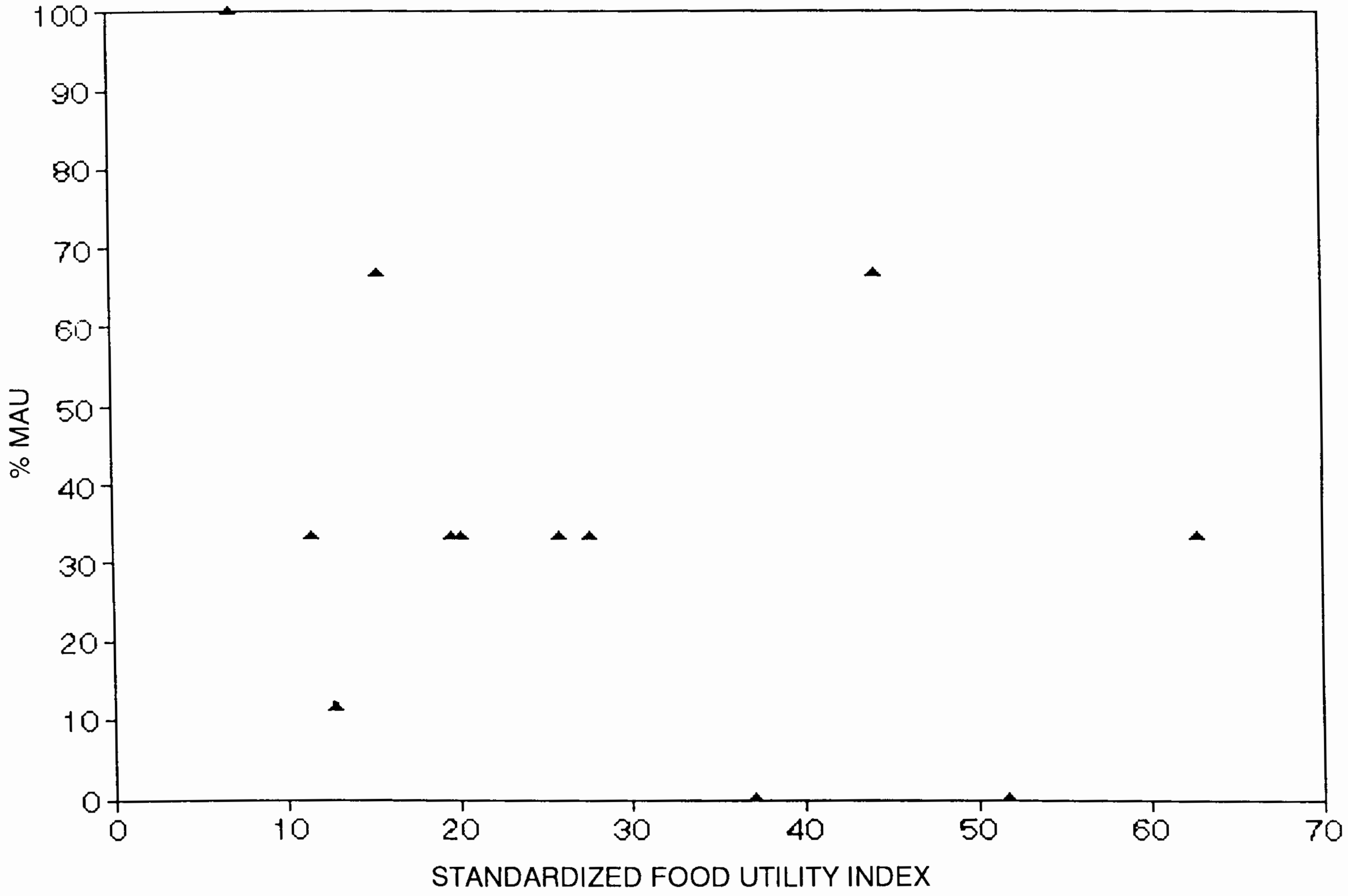
Figure 7:6 :
The relationship between food value and skeletal part abundance in small bovids.



Note:
The food value estimates (Metcalfe and Jones 1988) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = -0.173; df=24; (P> 0.1)

Figure 7:7 :
The relationship between food value and skeletal part abundance in small-medium bovids.



Spearman's r = -0.025; df=17; (P> 0.1)

Note:

The food value estimates (Metcalfe and Jones 1988) were derived from anatomically similar, close relatives of the HDP1 species.

Figure 7:8 :

The relationship between food value and skeletal part abundance in large bovids.

-0.256; $P>0.10$). Reverse utility patterns are also produced in the cases of small (Fig. 7:6), small-medium (Fig. 7:7) sized and large bovids (Fig. 7:8). The relationships between the two variables in all three cases are negative and insignificant [(small bovid) Spearman's rho = -0.0069; $P>0.10$; (small-medium bovids) Spearman's rho = -0.173; $P>0.10$; (large bovids) Spearman's rho = -0.025; $P>0.10$].

Thus, reverse utility patterns have been produced in all four classes. That they were produced in both of the large bovid classes, does not mean that this was due to differential transport of skeletal parts by the hyaenas. In both cases, there is an insignificant relationship between food utility and abundance. This and the fact that insignificant negative relationships between food utility and abundance also occurred in the two small bovid classes, are strong indicators that differential transport of low utility body parts by the hyaenas was, in all probability, not the reason for the discrepancies in the skeletal part frequencies at HDP1.

The occurrence of reverse utility patterns in the small bovid size classes could be attributed to a critical observation made by Lyman (1985). He noted that many skeletal parts that rank high on utility, rank low on density (a measure of a bone's ability to withstand destructive forces) and that many parts that rank low on utility rank high on density (Lyman 1985). It is thus possible that the high utility bones could have been deleted out of the assemblage because their lower density made them more susceptible to being destroyed by hyaena gnawing. This observation, in conjunction with the fact that the relationship between the percentage minimal animal units (%MAU) and standardized food utility is both negative and not significant, makes it more likely that density mediated destruction, as opposed to differential transport, was responsible for the discrepancies in skeletal part frequencies.

7.4:2: Density mediated destruction

Postdepositional factors, such as leaching and weathering, as well as predepositional factors, such as hyaena gnawing, are major causes of bone fragmentation and eventual deletion from bone assemblages (Behrensmeyer 1978; Gifford 1981; Klein and Cruz-Uribe 1984). Cruz-Uribe (1991) and Klein *et al.* (1991) also suggest that the relatively soft juvenile bones, as well as the bones of smaller bovid species, are more likely to be consumed because they are not as strong as the bones of large ungulates.

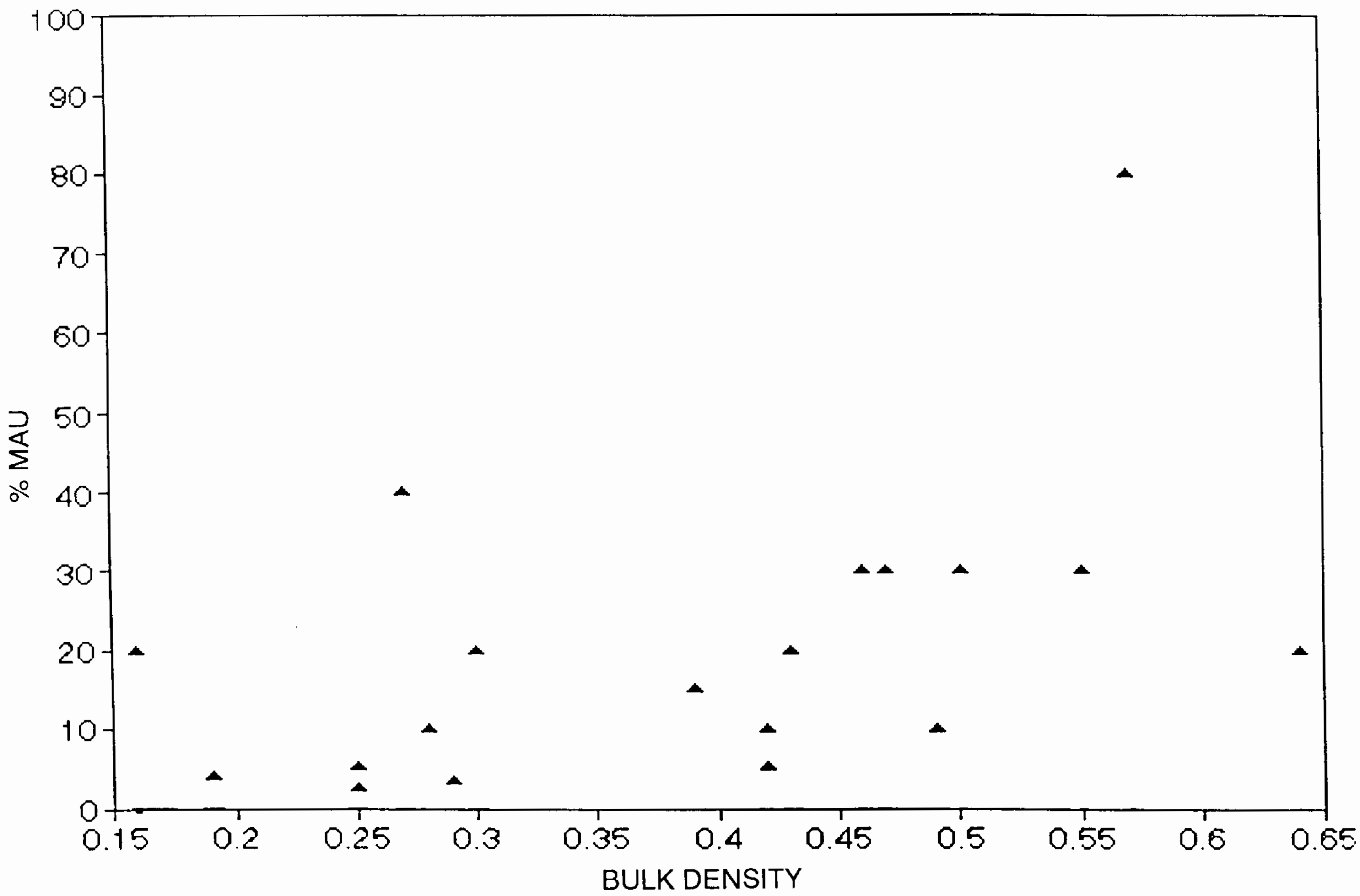
Certain bones and certain parts of bones are more likely to survive destructive forces than others (Lyman 1984, 1985). Lyman (1984) linked the density of bones to their ability to survive destructive pre- and postdepositional forces. He argued that the more dense a bone, the more likely it is to survive these destructive forces. By ranking each bone according to its density, Lyman (1984) produced an index which could predict which bones would have the best chance of survival in a bone assemblage.

When % MAU values are plotted against economic utility in assemblages that were affected by density mediated destruction (the destruction of the least dense bones), reverse utility curves often occur irrespective of whether the site was a kill/butcher site, or a site to which parts of high utility were transported. Grayson (1989) states that reverse utility curves are likely to emerge whenever an initial faunal sample has been subjected to any destructive force.

Grayson (1988) argues that reverse utility curves produced by destruction should be characterised by relationships between MGUI (a measure of economic utility) and %MAU (skeletal part frequency) that are not significant, but between bone density and %MAU that are both significant and positive. Whereas reverse utility curves produced by transport of skeletal parts should be characterized by significant negative correlations between MGUI and %MAU and insignificant correlations between bone density and %MAU.

I have already demonstrated that in the HDP1 assemblage, the relationships between the standardized food utility index and %MAU are negative and not significant in all four bovid size classes. In order for these reverse utility curves to have been the result of density mediated destruction, the relationship between %MAU and Lyman's (1984, 1985) bulk density should be both significant and positive. The relationship between %MAU and bulk density is indeed positive and significant in all four cases [(small bovids) (Fig. 7:9) Spearman's rho = 0.513, $P<0.05$; (small-medium bovids) (Fig. 7:10) Spearman's rho = 0.507, $P<0.05$; (large-medium bovids) (Fig. 7:11) Spearman's rho = 0.723, $P<0.01$; (large bovids) (Fig. 7:12) Spearman's rho = 0.698, $P<0.01$]. These results suggest that differential destruction of less dense bones by pre- and postdepositional destructive forces may have been the major cause of discrepancies in skeletal part frequencies within and between ungulate size classes at HDP1.

Figure 7:1, figure 7:2 and figure 7:4 indicate that the smaller bovids, as well as the large-medium bovids, are relatively well represented by cranial bones. However, in addition to cranial bones, large-medium bovids are also well represented by postcranial bones, unlike the smaller bovids. The statistical data indicate that there is a greater significant relationship between bone density and abundance in large and large-medium bovids than is the case in the smaller bovids. Smaller bovid postcranial bones are thus more likely to be destroyed than those of larger bovids, regardless of bone density. This could be attributed to the lower density of these bones compared



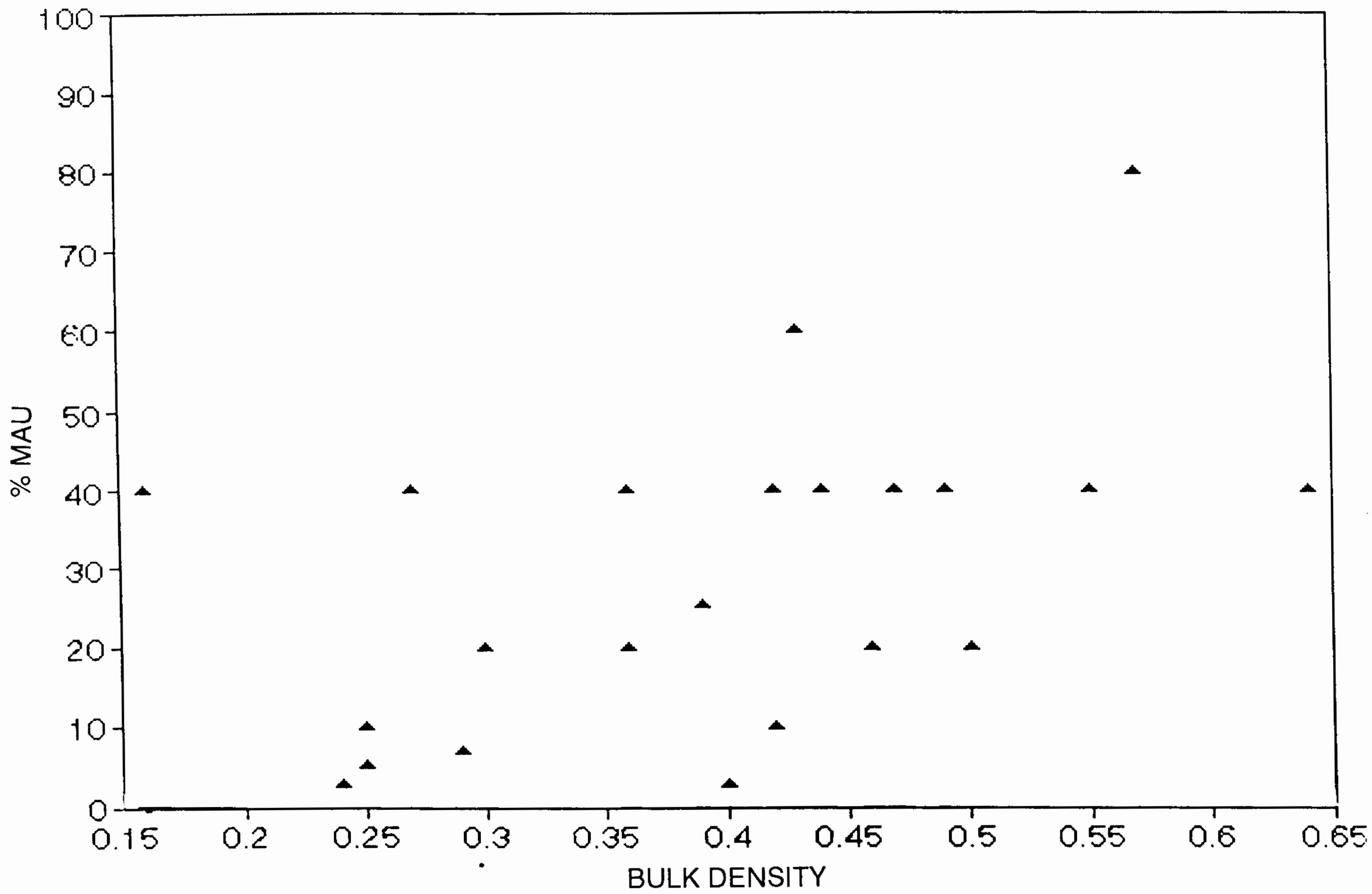
Note:

The bulk density estimates (Lyman 1984, 1985) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = 0.513; df=20; ($P < 0.05$)

Figure 7:9 :

The relationship between skeletal part density and skeletal part abundance in small bovids.



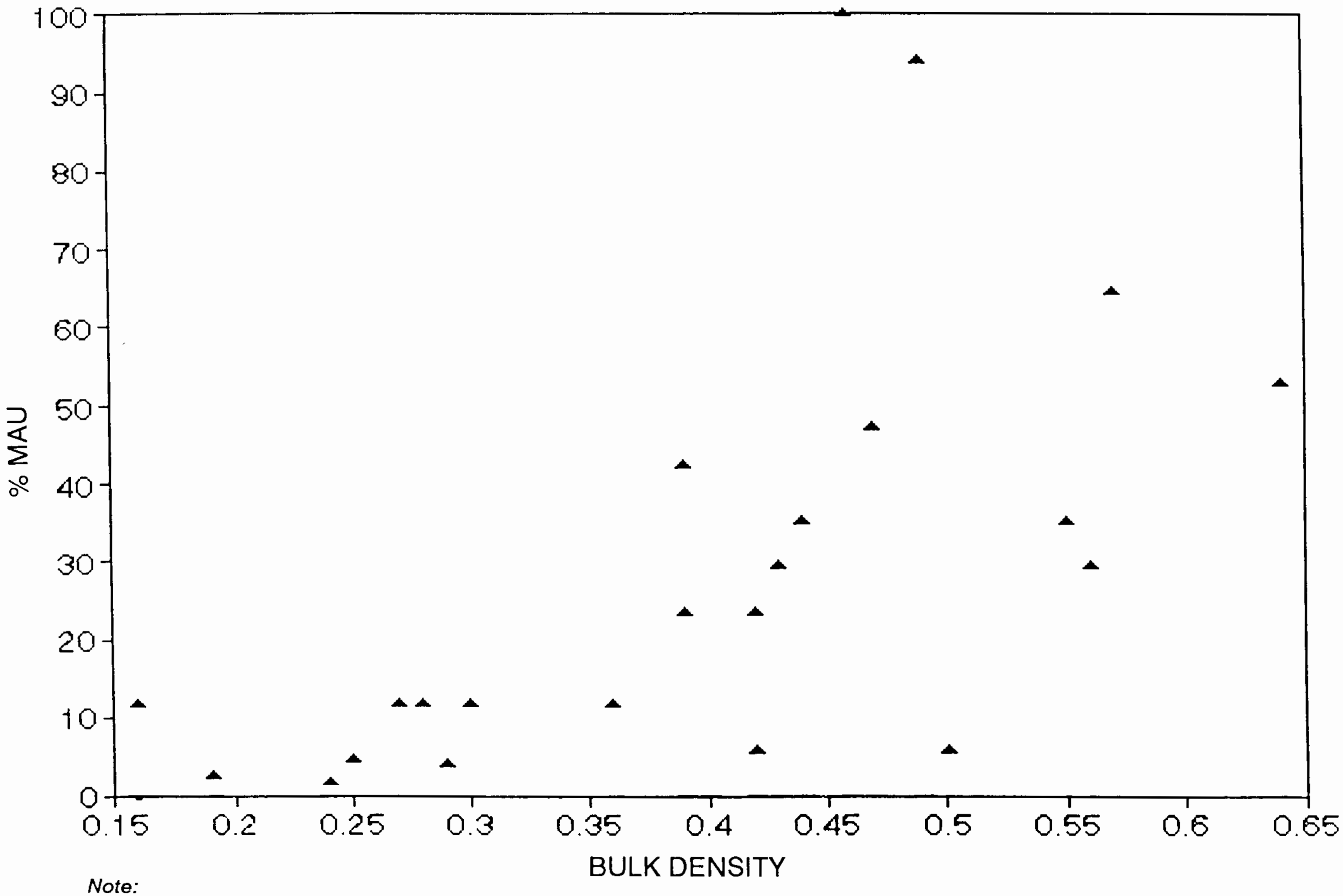
Note:

The bulk density estimates (Lyman 1984, 1985) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = 0.507; df=22; ($P < 0.05$)

Figure 7:10 :

The relationship between skeletal part density and skeletal part abundance in small-medium bovids.



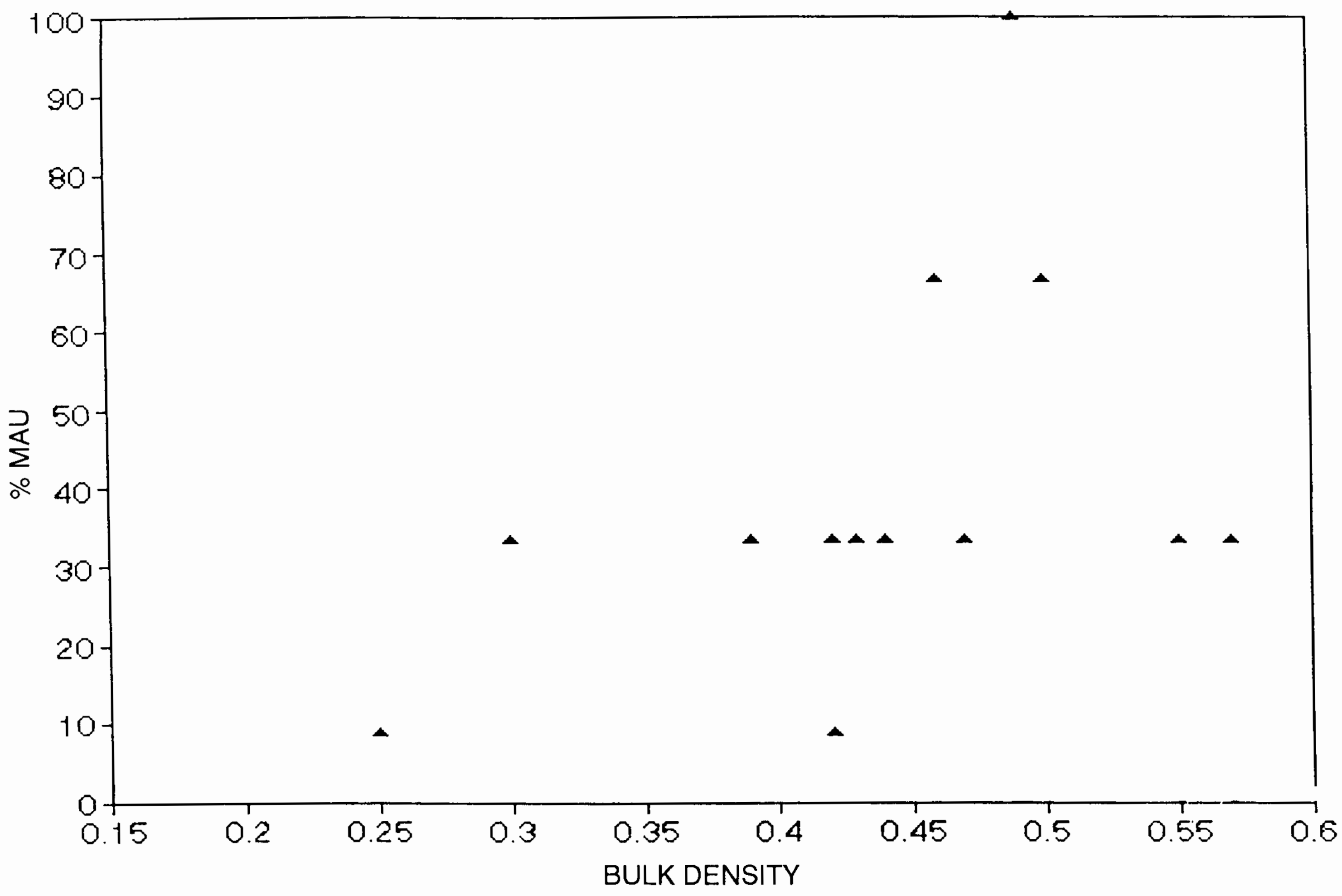
Note:

The bulk density estimates (Lyman 1984, 1985) were derived from anatomically similar, close relatives of the HDP1 species.

Spearman's r = 0.723; df=27; (P< 0.01)

Figure 7:11 :

The relationship between skeletal part density and skeletal part abundance in large-medium bovids.



Spearman's r = 0.698; df=16; (P< 0.01)

Note:

The bulk density estimates (Lyman 1984, 1985) were derived from anatomically similar, close relatives of the HDP1 species.

Figure 7:12 :

The relationship between skeletal part density and skeletal part abundance in large bovids.

to those of the larger bovids. This could also explain the high cranial/postcranial ratios in the smaller ungulate groups and the low ratios in the large ungulate groups.

7.5: Isolated teeth versus tooth rows

The effects that postdepositional destruction had on the assemblage, is reflected in the rarity of tooth rows at HDP1. Isolated teeth from all bovid size classes are much more common than teeth which are set in mandibles or maxillae. Table 7:1 indicates that teeth which are set in mandibles and maxillae, make up less than half of the total number of identifiable teeth from all bovid classes.

The mandibular and maxillary bones are often the first to be affected by postdepositional processes because they are extremely thin, especially the alveolar bone which surrounds the teeth. Teeth are easily separated from the tooth rows once the alveolar bone loses collagen and becomes fragile. This process is speeded up at sites where postdepositional pressures are more intensive.

7.6: Measuring the effects of pre- and postdepositional destruction

I have already determined that density mediated destruction of less dense bones by pre- and postdepositional factors was in all likelihood, the major cause of the disparities in skeletal part frequencies in the HDP1 palaeontological site. It is now important to gauge the magnitude of the destruction to determine to what extent the sample assemblage may differ from the deposited assemblage. This is important, as an assemblage which is severely affected by postdepositional

Table 7:1 :

The number of teeth set in mandibles or maxillae in the excavated sample from the HDP1 palaeontological site.

SPECIES	NUMBER OF TEETH SET IN MANDIBLES OR MAXILLAE	TOTAL NUMBER OF TEETH PRESENT IN THE SAMPLE	% NUMBER OF TEETH SET IN MANDIBLES OR MAXILLAE
Antidorcas australis	15	48	31.25%
Tragelaphus strepsiceros	5	14	35.71%
Pelea capreolus	0	5	0
Raphicerus sp.	42	105	40%
Redunca arundinum	3	9	33.33%
Damaliscus dorcas	1	6	16.67%
Taurotragus oryx	0	3	0
Connochaetes/ Alcelaphus	3	75	4%

factors, could lead to a biased interpretation of the assemblage. Determining the extent of postdepositional destruction is especially important when investigating the environmental implications of the fauna.

Marean (1991) suggests that a "completeness index" for compact bones provides a means whereby the magnitude of postdepositional destruction can be measured. This "completeness index" is independent of both differential fragmentation and differential transport by the bone collector, as well as quantification variations between researchers. Therefore it satisfies the requirements for a measure of postdepositional destruction (Marean 1991).

The method involves selecting all ungulate compact bones, such as carpals and tarsals. These are usually not affected by marrow and grease processing by hyaenas, nor by differential transport. So fragmentation is usually the result of severe postdepositional destructive forces. A completeness value is assigned to all compact bones that lack gastric etching and tooth marks. For each bone and body size group, the completeness values are summed, divided by the NISP and multiplied by 100.

Marean (1991) suggests that this method may be less effective on carnivore accumulations. Compact bones are inclined to be rare because hyaenas are inclined to swallow them. However, as I have noted earlier, this does not seem to have been the case in the HDP1 accumulation as small, compact bones are common.

Marean (1991) suggests that the compact bones most sensitive to postdepositional destruction are the largest, such as the astragalus and the naviculo-cuboid. He also suggests that the size of the bovid tends to influence the relative fragmentation of the carpals and tarsals. Those from smaller bovids tend to fragment less than those from larger bovids. Table 7:2 indicates that this is the case at HDP1 as well. Astragalus and naviculo-cuboid completeness values are greater in the small and small-medium bovid size classes than in the large bovid size class. The data obtained from the large-medium and large bovid size classes are the most obvious indication of the effect that postdepositional destruction had on this assemblage. Apart from the astragalus and naviculo-cuboid values from the large bovid size class, the completeness values are all over 50% for all compact bone types. Thus suggesting that, although postdepositional destruction had a marked effect on the assemblage, it did not destroy the assemblage.

Discussion and conclusion

Density mediated destruction seems to have been the major cause of the differences in skeletal part frequencies evident in the four bovid size classes. Destruction seems to have been strongly related to density in especially the large-medium and large bovid size classes, while there is a weaker relationship in the small and small-medium bovid size classes. This may be attributed to the fact that hyaenas are more likely to destroy small bovid bones regardless of their densities, while having difficulty doing the same to the bones of larger species.

Postdepositional destruction, especially the growth of salt crystals in bones (because of the proximity to the ocean) and root growth, also seem to have had a major effect on the assemblage. This is demonstrated by the high number of isolated teeth, compared to tooth rows which are present in the assemblage. A completeness index of the compact carpals and tarsals from the site suggests that density mediated destruction did affect the assemblage, but the

Table 7:2 :

Completeness indices for bovid compact bones in the excavated sample from the HDP1 palaeontological site.

BONES	SMALL BOVIDS	SMALL-MEDIUM BOVIDS	LARGE-MEDIUM BOVIDS	LARGE BOVIDS
Astragalus	90%	96.67%	90.67%	46.50%
Naviculo-cuboid	75%	60%	67.44%	41.67%
Cuneiform	100%	100%	96.21%	100%
Distal fibula	100%	100%	81.78%	80%
Magnum	-	90%	74.33%	80%
Unciform	100%	-	94.80%	100%
Lunate	100%	100%	57.57%	90%
Scaphoid	100%	100%	86.67%	-
Pisiform	-	-	-	-
Sesamoid	100%	99.91%	97.89%	90%

Note:

Completeness indices are derived by estimating for each specimen, the fraction of the original compact bone that is present, summing the values, and dividing that by the total number of specimens ascribed to that bone and bovid size group (after Marean 1991). Each bovid size category is composed of the same species as those in table 5:4 (Chapter 5).

destruction did not destroy the assemblage. The fossil assemblage is therefore still a good reflection of the death assemblage, and contains enough information to reconstruct the palaeoenvironmental conditions and palaeoclimatic conditions which prevailed when the assemblage was being accumulated.

CHAPTER EIGHT

PALAEOENVIRONMENTAL IMPLICATIONS OF THE FAUNA

Klein (1980, 1983) has shown that during the later half of the Quaternary, the large mammal fauna of the Cape ecozone changed systematically in response to changing global climatic conditions. The fauna from the Middle Pleistocene and earlier Late Pleistocene indicate that grasses played a more important role in the ancient environment than they did historically or do play in the present environment (Klein 1983).

The species composition of the HDP1 palaeontological fauna also suggests a grass dominated environment. More than that however, the diversity of grazing ungulates in the sample, suggests a productive grassland which had the capability of carrying a variety of grazing species. The presence of fewer browsing species suggests that relatively little bush or thicket was present in this environment. In addition to being dominated by grazing ungulates, the palaeontological faunal sample also has a marine component. Although this component is small, the presence of Jackass Penguins (*Spheniscus demersus*), which are offshore breeders, dolphins and seals in the sample, suggest that the ocean was within reach of the hyaenas when the assemblage was being accumulated.

Although the archaeological horizons have only been sampled, it is clear that the fauna in these horizons differ markedly from that in the palaeontological horizons. More small animal bones are present, and there are fewer bovid and carnivore bones. The marine component appears to be large. Apart from relatively high numbers of penguin bones in the sample when compared to the palaeontological sample, there are also large amounts of shellfish. These differences suggest strongly that this assemblage was accumulated under radically different conditions to those that prevailed when the palaeontological assemblage was accumulated. In this chapter I attempt to reconstruct these palaeoenvironmental conditions.

8.1: The palaeoenvironmental implications of the palaeontological faunal assemblage

8.1:1: The ecology of modern grassland habitats

Although grass is not a major component in the Cape fynbos vegetation today (Klein 1980), the grass species which do occur here, are characteristically of the type that occur in the highveld and the tropical moist Savanna Biome of the eastern parts of South Africa, rather than of the type that occur in the arid savanna and desert grasslands of the western parts of the country (Heydorn and Tinley 1980). The presence of a large variety of grazing ungulate bones in the HDP1 assemblage as well as in other Pleistocene assemblages from the Cape ecozone, suggests that these grasses were even more prominent in the vegetation mosaic at the time.

The species list (Table 4:1) indicates that the vast majority of species in the HDP1 sample are grassland and open woodland adapted species. Although grasslands do not occur in the south-western Cape today, large parts of Africa south of the Sahara are still covered by grasslands and open woodlands. Many of these areas still support large multi-specific herds of ungulates and other large mammals. By studying the ecology of these modern grassland areas, it is possible to gain insight into ancient grassland environments.

The combination of grassland and open woodland environments are frequently referred to as savanna. Delany and Happold (1979) however, state that the term savanna has defied uniform definition by various authors. This has been mainly due to uncertainty as to the range of plant communities that should be included under this common name. Delany and Happold (1979) recognise it as encompassing most grassland, bush, scrub and woodland types including the extension of these various vegetation types into semi-arid areas. The particular combination of each vegetation type varies from area to area. Thus some areas have more grass and less bush/woodland and vice versa.

Delany and Happold (1979) distinguish between a moist and a dry savanna. Moist savannas have an annual rainfall of more than 900mm. The high rainfall produces a rich diverse vegetation, with woodlands ranging from being open to being quite dense. This diversity in turn results in a diverse fauna. The dry savanna has an annual rainfall below 900mm, resulting in more arid conditions. Vegetation can be quite sparse, with ground cover varying considerably from one season to another. The less rich and diverse vegetation of the dry savanna results in a reduction in faunal variety (Delany and Happold 1979).

8.1:2: The food and feeding habits of modern savanna ungulate species

The open structure of savanna vegetation results in greater production of ground vegetation in the form of grasses, herbs and shrubs, than any other type of habitat. This has been one of the major factors in the evolution of the vast array of ungulate species, both grazers and browsers, that characterise this type of vegetation (Delany and Happold 1979).

Simply dividing ungulates into grazers and browsers, is however inadequate. On the basis of stomach structure, Hofmann and Stewart (1972), were able to group ungulates into three main types of feeders: a) bulk and roughage eaters (i.e., grass eaters); b) selectors of juicy, concentrated herbage; c) intermediate feeders which could adapt at different seasons or in different areas to type a) or b). "Bulk and roughage eaters" have in common a subdivided, capacious rumen which permits the maximum delay of coarse, fibrous food. Several finer structural differences allows a further distinction within this type into "roughage grazers" (eg. red hartebeest), "fresh grass grazers dependent on water" (eg. black wildebeest), and "dry region grazers" (eg. gemsbok). The "selectors of juicy, concentrated herbage" have a relatively small, simple rumen adapted to a quick turnover of food and a high turnover rate. Specialising involving the rumen blindsacs allows a further division within this type into "tree and shrub eaters" (eg. kudu) and "fruit and dicotyledon foliage selectors" (eg. grey duiker). In the case of the "intermediate feeders," both their feeding habits and morphological features are intermediate between those of "bulk and roughage eaters" and "selectors of juicy, concentrated herbage". Two subdivisions of this type exists, namely "intermediate feeders preferring grass" (eg. impala) and "intermediate feeders preferring forbs and shrub or tree foliage (eg. steenbok) (Hofmann and Stewart 1972).

8.1:3: Animal-plant interaction

McNaughton (1985) states that regular, systematic "mowing" of grasslands by large herds of ungulates in the Serengeti enhances the concentration and quality of available food. Thus high levels of primary production are the result of the maintenance of grasslands in a rapidly growing state. Plants which are continually cropped are kept in a more juvenile state and as a result offer higher protein content and greater digestibility (Lewin 1985; McNaughton 1985). Experiments by Lewin (1985) show that continual grazing can cause dwarfing in many grass species as well. In addition, grazing has the effect of increasing species diversity of the vegetation and thus of the herbivores feeding on the vegetation. There is thus a mutually beneficial relationship between animals and vegetation in modern savanna ecosystems.

8.1:4: Grazing succession

The large variety of grazing and browsing species that live in savanna regions can only survive if each species occupies a specific niche in the environment. Thus, as discussed earlier, there are various types of grazers and browsers that live on different plant species, and on different parts of plants. Here too there is a mutually beneficial relationship between large and small ungulate species. Large animals usually eat the coarse, older parts of plants, while the smaller species eat the new growth which result after the plant has been grazed by the larger species. The succession which results when larger animals precede smaller ones by the trampling and grazing of vegetation, is called a grazing succession (Fig. 8:1) (Vesey-Fitzgerald 1960; Bell

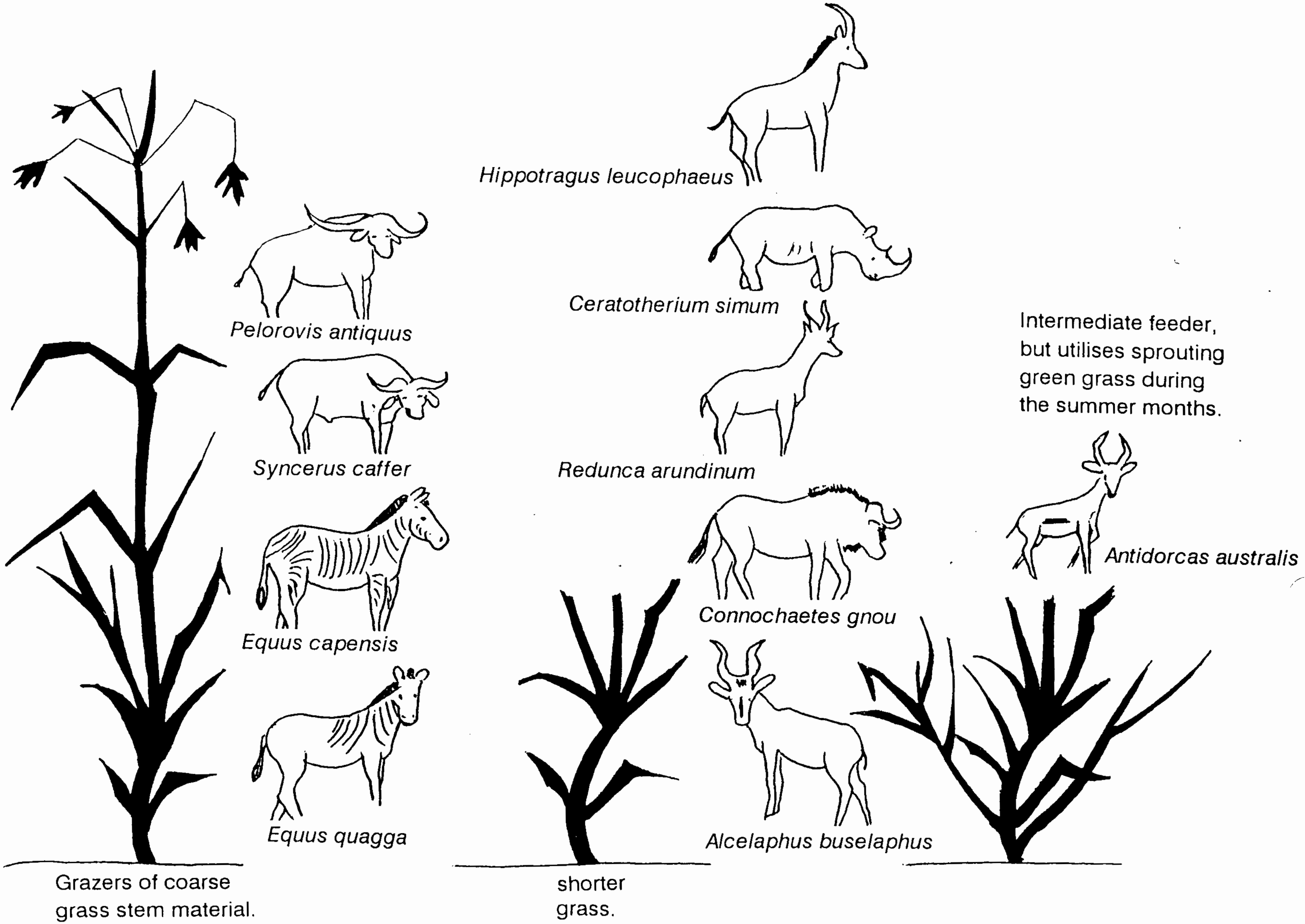


Figure 8:1 :

A model of the HDP1 palaeontological site grazing succession.

(Based on a similar illustration in Brink 1987)

1971).

8.1:5: The feeding niches of the HDP1 ungulate species

Grazers: bulk and roughage eaters

Roughage grazers

Family Equidae

Equus quagga

Equus capensis

Equus quagga is a grazer of coarse grass (Hofmann and Stewart 1972), as was probably *Equus capensis*. Zebras have been seen to select not only the most fibrous part of a plant, but also the tallest (i.e., oldest) strands (Bell 1969, as quoted in Janis 1976). Brink (1987) suspects that the extinct large bodied *E. capensis*, probably had a lower basal metabolic rate than extant equids, enabling it to cope with a greater quantity of low quality coarse grass relative to the extant species.

Family Bovidae

Pelorovis antiquus

Bell (1971) states that a ruminant metabolism provides certain limits on the amount of low quality food an animal can ingest. It is conceivable that *P. antiquus*, which was a very large ruminant with a low metabolic rate, was also probably a specialized coarse grass grazer.

Syncerus caffer

Skinner and Smithers (1990) state that, in comparison to other wild ruminants, buffalo have the most efficient system to digest fibrous food. The habitat requirements of the buffalo include a plentiful supply of old grass, shade and water. It is thus unlikely that they would be present on open plains with few trees for cover. This is an important species in the grazing succession, as it opens up stands of old grass and makes new grass available to smaller species (Skinner and Smithers 1990).

Alcelaphus buselaphus

The Cape hartebeest is one of the two smaller roughage grazers present in the HDP1 sample which grazes on shorter grass than the aforementioned species. This species occurs on grasslands of various types, from floodplain grassland to semi-desert bush savanna (Skinner and Smithers 1990).

Damaliscus dorcas dorcas

The bontebok is another roughage grazer which prefers to feed on short grass (Skinner and Smithers 1990).

Fresh grass grazers

Family Rhinocerotidae

Ceratotherium simum

The white rhinoceros is the only rhinoceros species present in the sample. It prefers short grass, and is dependant on water near its feeding grounds. Adequate bush cover is required for protection against the sun (Skinner and Smithers 1990).

Family Bovidae

Connochaetes gnou

The black wildebeest is a species of the open plains. Skinner and Smithers (1990) state that this species shows a distinct preference for short grass and is dependant on water.

Redunca arundinum

The reedbuck has two essential habitat requirements: tall grass cover, reedbeds or herbaceous cover and water (Skinner and Smithers 1990). This species also prefers grazing short grass.

Hippotragus leucophaeus

The blue antelope which is extinct today, was an open woodland species, and occurred especially in the southern Cape (Skinner and Smithers 1990).

Browsers: selectors of juicy, concentrated herbage

Tree and shrub foliage eaters

Family Bovidae

Tragelaphus strepsiceros

The kudu is a savanna woodland species (Skinner and Smithers 1990). It is predominantly a browser, although a small amount of green grass is eaten on occasion.

Fruit and dicotyledon foliage eaters

Family Bovidae

Raphicerus melanotis

The grysbok is predominantly a browser. It is often associated with dense cover such as thick scrub or bush and is present in the area today (Skinner and Smithers 1990).

Intermediate feeders Preferring forbs, shrub and tree foliage

Family Bovidae

Taurotragus oryx

The eland being primarily a browser, eats grasses mainly when new growth is available. This species can occur in open arid habitats as well as savanna woodlands (Skinner and Smithers 1990).

Pelea capreolus

The grey rhebok is associated with rocky hills, rocky mountain slopes and mountain plateaux with sufficient grass cover (Skinner and Smithers 1990). This species is predominantly a browser (Beukes 1988) with a tendency to being mixed feeders (Hofmann 1973).

Antidorcas australis

This extinct springbok species is morphologically similar to the extant springbok in its dentition. It is thus conceivable that it may have been an intermediate feeder preferring forbs, shrub and tree foliage like the extant species.

Raphicerus campestris

The steenbok occupies open country and does not occur in forests or thick woodlands (Skinner and Smithers 1990). It is a mixed feeder preferring forbs and shrub foliage and is present in the area today.

8.1:6: The habitat preferences of non-ungulate species

ORDER CARNIVORA

Most of the carnivores which are present in the HDP1 sample occur in a variety of habitats. Unlike ungulates, carnivores are less bound to a specific type of habitat (Klein 1980) and are thus less useful for reconstructing palaeoenvironments. Presence in an area is governed by the presence of prey species. As many carnivores are independent of water, this is not a limiting factor (Skinner and Smithers 1990).

Lycaon pictus (wild dog) is one species present in the sample which requires relatively open country to hunt because it relies on sight rather than smell when hunting (Skinner and Smithers 1990). The presence of lakes, rivers and/or swamps in the palaeoenvironment, is reflected by the presence of *Aonyx capensis*, (Cape clawless otter) in the sample.

All the large carnivore species are absent from the area today. The largest species which are present are the black-backed jackal (*Canis mesomelas*), and the caracal (*Felis caracal*).

ORDER LAGOMORPHA

Both *Lepus capensis* (Cape hare) and *Lepus saxatilis* (scrub hare) occur in grassland, scrubland and woodland areas (Skinner and Smithers 1990).

ORDER HYRACOIDEA

The rock hyrax occurs in areas where there are plenty of rocky outcrops. Bushes and trees are also required to provide browse (Skinner and Smithers 1990).

ORDER RODENTIA

All the rodent species which occur in the sample, are present in the area today. Generally, most are adapted to a variety of habitats ranging from grasslands to arid regions. Most need rocky outcrops, or sandy soil in which to live. Species associated with moist habitats such as *Otomys irroratus* (vlei rat) and *Otomys saundersiae* (Saunders's vlei rat) are also present (Skinner and Smithers 1990). These species are further indication that freshwater sources were present in the area.

ORDER INSECTIVORA

The only insectivore identified in the sample, is *Myosorex varius* (forest shrew). This species is common on Cape coastal mountains where there is continuous cover of low succulent bushes (Skinner and Smithers 1990).

ORDER CHIROPTERA

Rhinolophus clivosus (Geoffroy's horseshoe bat) is the only bat species represented in the sample. This is predominantly a savanna woodland species, but can occur in other habitats as well (Skinner and Smithers 1990).

The avifauna

Most of the marine and non-marine bird species which are represented in the sample, are present in the area today. The species are wide ranging and occur in a variety of habitats ranging from arid semi-deserts to savanna woodland areas.

8.1:7: A reconstruction of the palaeoenvironment

The abundance of grazing species present in the HDP1 palaeontological assemblage is indicative of open grasslands. This and the fact that most of the grasses present in the area today are similar to tropical savanna grass species (Heydorn and Tinley 1980), suggest that an ecosystem which operated in a similar manner as modern East African savanna woodlands do (Gwynn and Bell 1968; Bell 1971), may well have been present in the Saldanha-Langebaan area at the time of site formation. Although taxa characteristic of the fynbos region shrublands were present in the Cape ecozone at least by the Early Pliocene, this type of vegetation was not as widespread during the Pliocene and Pleistocene as it is today (Hendey 1983b).

The presence of an extremely productive grassland, as well as the existence of glacial conditions, are indicated by the wide range of grazers which are present in the assemblage. Extinct large-bodied forms such as *Equus capensis* and *Pelorovis antiquus* have not been replaced in modern grassland systems. These species were extremely large roughage grazers and would have required a grassland that was high in primary production to survive (Brink 1987). The above mentioned species, in addition to *Equus quagga* (Janis 1976; Brink 1987), occupied the niche of coarse grass grazers, eating the upper parts of the old stalks of grass plants (Fig. 8:1) (Brink 1987). *Syncerus caffer*, which Skinner and Smithers (1990) regard as having an extremely efficient system for the digestion of fibrous food, also falls into the coarse grass grazer category.

These species prepared the way in the grazing succession for the roughage grazers and fresh grass grazers which preferred to graze on shorter stalks. This group consists of *Alcelaphus buselaphus, Damaliscus dorcas dorcas, Ceratotherium simum, Connochaetes gnou, Redunca arundinum,* and *Hippotragus leucophaeus.*

This environment however, lacked a small specialist grazer such as the extinct *Antidorcas bondi,* which is present in Late Pleistocene sites in the interior. This species is thought to have utilized the newly grown parts of grass plants at ground level. Once larger species had established a grazing lawn, this species helped to maintain it (Brink 1987). It is likely that intermediate feeders such as *Antidorcas australis* could have filled this niche to an extent. The modern springbok (*Antidorcas marsupialis*), despite being an intermediate feeder preferring forbs, shrubs and tree foliage, often utilises sprouting grass during the summer months (Bigalke 1972).

Despite the absence of a specialist small grazer, the grassland had to be productive to have been able to maintain the diversity of grazing species that were present. A well developed grazing succession of species must have been in place. This maintained the grassland in peak condition and in so doing, must have maintained, or even increased the species diversity among the grasses as well as among the grazers over time. The presence of large-bodied grazers suggest that the productivity of these ancient grasslands must have been higher in primary production than modern ones.

The only large browser identified in the sample is the historically absent kudu (*Tragelaphus strepsiceros*). This species often accompanies the grazing species in extraregional modern settings (Grine and Klein 1993). This is a savanna woodland species that does not occur in desert, forest or open savanna (Skinner and Smithers 1990). The other browsing species represented in the sample, is the small grysbok (*Raphicerus melanotis*). The presence of only two species of browsers in the sample, suggest that the grassland must have had a woodland and bush component, however, this was probably limited. Large-bodied browsers such as the giraffe (*Giraffa camelopardalis*) are totally absent. This indicates that trees were rare in the area.

The spread of grasslands, are thought to be promoted by cooler temperatures (Klein 1980, 1983; Deacon and Lancaster 1988). This is demonstrated at sites such as Boomplaas and Nelson Bay Cave (Klein 1980, 1983), where Late Pleistocene and Holocene faunal assemblages were found. Because the material in these sites are not beyond the range of radiocarbon dating, it was possible to separate those stratigraphic horizons that were accumulated under warm interglacial conditions (Holocene) from those that were accumulated under cold glacial conditions (Late Pleistocene).

It was found that the Late Pleistocene horizons were dominated by large grazing ungulates such as black wildebeest, while the Holocene assemblages were dominated by browsers such as bushbuck and grysbok. Based on the high number of grazers in the HDP1 palaeontological assemblage, it is highly likely that this assemblage was also accumulated under glacial conditions.

Freshwater source

The presence of the Cape clawless otter (*Aonyx capensis*), the two vlei rat species (*Otomys irroratus* and *Otomys saundersiae*) and the Egyptian goose (*Alopochen aegyptiacus*) suggest that a freshwater source must have been situated within range of the hyaenas that had accumulated the bones at HDP1. There is no natural freshwater source situated near the site today.

8.1:8: The marine component

Like the Sea Harvest and the Old Hoedjiespunt samples (Klein 1983), Hoedjiespunt 1 (palaeontological and archaeological assemblages) also has a marine component. The marine component from the palaeontological site is however extremely small when compared to the rest of the fossil sample from this site. Marine animals (seals, cetaceans and marine birds) only constitute 4.17% of a combined category of identified large mammal and bird bones in the HDP1 palaeontological sample. Bovids on the other hand constitute 44.17%, and carnivores (excluding seals) 30.83% of this category.

Skinner and van Aarde (1991) who studied two brown hyaena dens in the Namib Desert, one located on the coast, and the other located inland, about 8.2 km from the coast, found that marine animals were dominant in both assemblages. In the coastal sample (Appendix C, Table 1), marine animals (seals, cetaceans, penguins) constitute 57.29% of a combined category of identified mammal and bird bones from this sample, while in the inland sample (Appendix C, Table 2), marine animals constitute 50% of a similarly composed category.

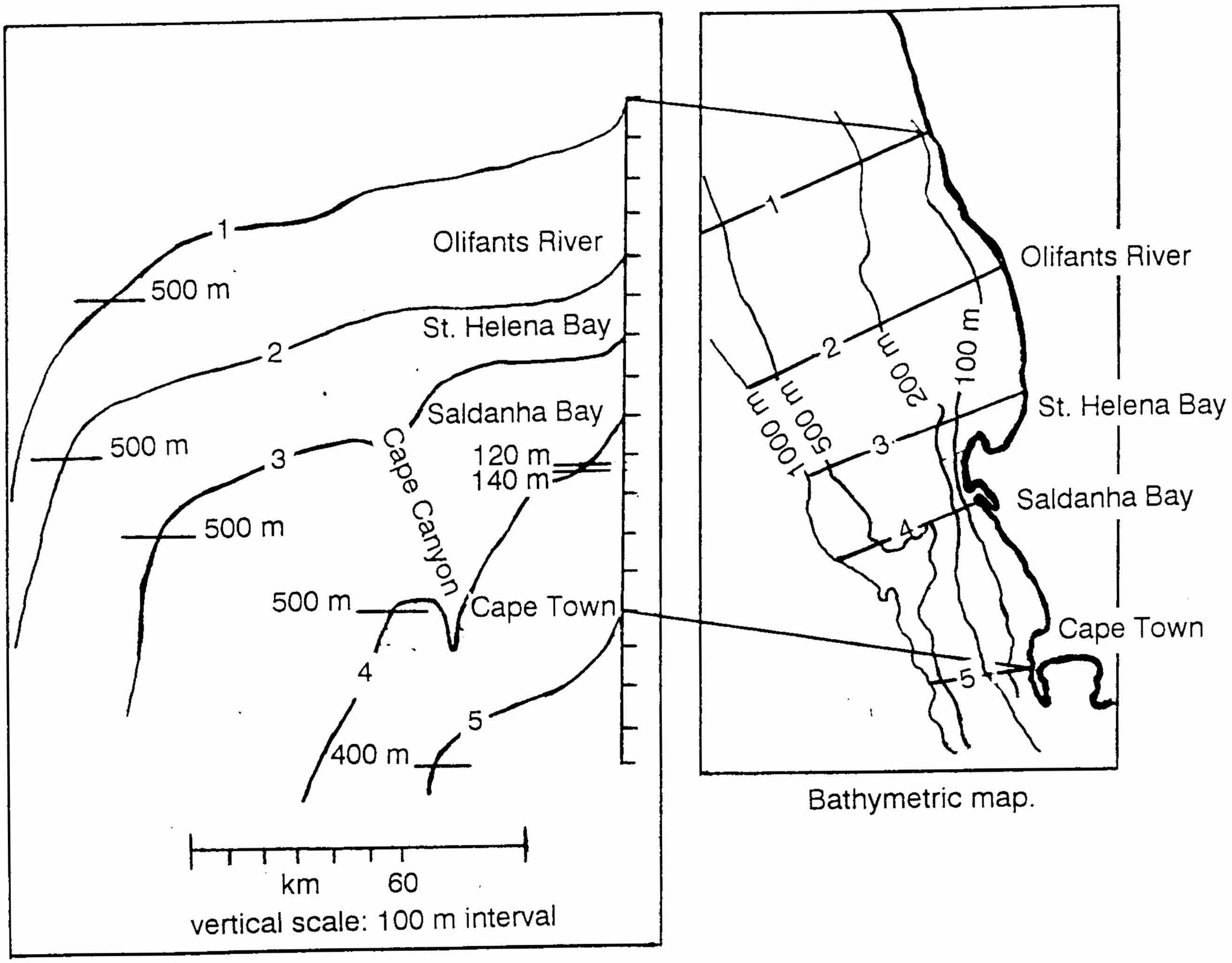
In both samples seals dominated because the hyaenas focussed on a very large seal colony at Wolfsbaai (Skinner and van Aarde 1991). Bovids (4.17%) and carnivores (25%) were less well represented in the coastal sample. In the inland sample however, bovids (10.87%) and carnivores (26.1%) were better represented, reflecting their greater presence away from the coast.

As illustrated in the Skinner and van Aarde (1991) study, hyaena dens which are situated on the coast, or relatively close to the coast, usually contain a high percentage of marine vertebrate bones. This is especially true if the den is situated near a large coastal food source, such as a seal colony. High numbers of marine animals in dens situated close to the coast is even more likely when it is considered that brown hyaenas often patrol beaches in search of food (Skinner and van Aarde 1991; Woodborne 1996). Historical accounts also support this beachcombing behaviour of hyaenas and the name "strandjut", or beach wolf, given to it by early settlers, is indicative of this behaviour.

Although Pleistocene hyaena accumulations which contain high numbers of seal bones are rare, these sites do exist. Seal bones constitute more than 75% of the total bone assemblage at the Pleistocene hyaena assemblage of Boegoeberg 1 (Klein and Cruz-Uribe 1996). Since the coast is presently situated only a few metres away from HDP1, the low percentage of marine animals in combination with the high percentage of terrestrial animals in the palaeontological site, suggest that this assemblage may have been accumulated during a marine regression. Under these circumstances terrestrial animals would have been a more accessible food source than marine animals. This provides further support for the existence of glacial conditions at the time of site formation.

Dingle (1973) reports that the maximum depth reached by the sea along the Cape West Coast during any of the Pleistocene regressions, was about 140 metres below its present level. During the regression of the Last Glacial Maximum, the sea fell about 120 metres below its present level (Dingle and Rogers 1972). According to Dingle (1973), these levels would have exposed relatively small areas of the Luderitz-Cape Town shelf. The continental shelf off Saldanha Bay would probably have been one of the least exposed areas during the Pleistocene. This is demonstrated by the bathymetric profile of this part of the continental shelf (Fig. 8:2). Compared to other areas further up the coast, the continental shelf off Saldanha Bay is extremely steep. The bathymetric profiles from Dingle (1973), suggest that at 140 metres below current sea level, the coast would have been about 15 kilometres away from Saldanha Bay, and at 120 metres below current sea level, it would have been about 12 kilometres away.

As hyaenas are known to travel long distances of up to 30 kilometres in 12 hours (Owens and Owens 1978), the coast would never have been out of the reach of any hyaenas living in the Saldanha Bay area for most of the Pleistocene. The distance of the coast from HDP1 during marine regressions would however have precluded it from being the hyaenas' primary food procurement area. This is reflected by the small marine animal component in the faunal sample from the site. It is far more likely that the immediate environment around the den, which was extremely productive, and supported many prey species, would have provided the hyaenas with



Bathymetric profiles

Bathymetric map.

Figure 8:2 :
Bathymetric map and profiles of the continental shelf from just north of the Olifants River, to Cape Town.

(From Dingle 1973)

sufficient food resources. This is not the case at Skinner and van Aarde's (1991) inland hyaena den, which is situated in a desert, an area poor in food resources. Here the large seal colony serves as the main food source for all hyaenas in the area, resulting in high numbers of seal bones occurring even at the inland site.

8.1:9: The mean individual size of jackals in the HDP1 sample

Bergmann's rule (formulated by Bergmann in 1847) states that, all things being equal, individuals of a species will be larger in colder climates (Klein and Cruz-Uribe 1984). A possible explanation for this, is that the volume of an animal (correlated with heat producing capacity) increases at a more rapid pace than surface area (responsible for dissipating heat). Larger animals tend to produce more heat and lose less, which is an advantage in colder climates (Dayan *et al.* 1989).

Klein and Cruz-Uribe (1984) found that carnivores in general, and the black-backed jackal (*Canis mesomelas*) in particular, seem to obey Bergmann's rule. Jackal mean sizes were found to increase with decreasing temperatures as known in modern environments or as inferred from sedimentary evidence in fossil contexts. By measuring the lower first molar (M1) lengths of modern jackals from across Africa and determining means, Klein and Cruz-Uribe (1984) found that the largest jackals occurred farthest from the equator, in the Western Cape Province of South Africa, and the smallest occurred in equatorial East Africa. Fossil jackal remains are also larger in sites where sediments or other aspects of the fauna indicate very cool conditions during bone accumulation (Klein and Cruz-Uribe 1984, Klein 1986).

The mean length of the HDP1 jackal M1s (Fig. 8:3 and Table 8:1) were found to correlate closely with the means of the jackals in the Old Hoedjiespunt sample as well as with those in the Sea Harvest sample. In addition, like the Cape and Namibian jackals, the HDP1 jackals tend to be substantially larger than ones from East Africa. This is to be expected if Bergman's Rule was in operation. The Cape and Namibia is significantly colder than Equatorial East Africa. Although not significantly larger than modern Cape jackals, the relatively large sizes of the HDP1 jackals do suggest that the average temperatures at the time of site formation, may not have been high. This is further support for the existence of glacial conditions.

8.2: The palaeoenvironmental implications of the archaeological faunal assemblage

As was mentioned earlier, the fauna from the archaeological horizon has only been sampled and because of this, it is extremely small. It is likely that collector behaviour had a lot to do with the composition of species in this assemblage.

Apart from abundant shellfish- mostly limpets- the bulk of the fauna consist of small vertebrates such as tortoises (*Chersina angulata*), dune molerats (*Bathyergus suillus*) and rock hyraxes (*Procavia capensis*). Jackass penguins (*Spheniscus demersus*) are also extremely common in the sample. Only three bovid species, namely *Raphicerus* sp., *Redunca arundinum* and *Tragelaphus strepsiceros* have been identified. Identifiable bovid bones are however rare, with each of the three species only having a MNI of one. The only carnivore species represented in the sample is the black-backed jackal (*Canis mesomelas*).

Table 8:1 :

The mean anteroposterior diameters ("basal crown length") of black-backed jackal lower M1s in south-western Cape fossil hyaena assemblages.

SITES	MEAN	STANDARD DEVIATION	NUMBER OF SPECIMENS
Elandsfontein (Bone circle)	21.05	0.82	4
Elandsfontein (other)	18.77	1.13	22
Sea Harvest	19.76	1.28	10
Old Hoedjiespunt sample	18.93	0.63	4
Swartklip 1	20.90	1.12	16
Hoedjiespunt 1 (HDP1)	19.47	0.97	7

Note:

The mean value for jackal M1s from HDP1 excludes deciduous teeth. The mean values for jackal M1s from the other sites are from Klein (1983).

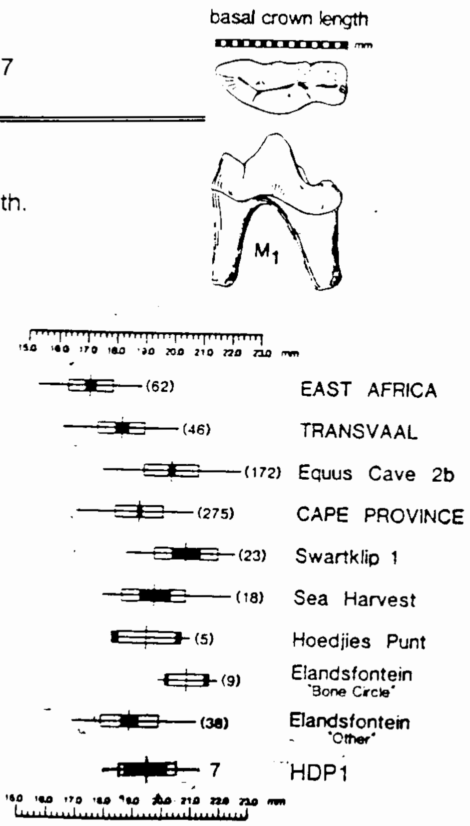


Figure 8:3 :

The anteroposterior diameter ("basal crown length") of black-backed jackal lower M1s in modern and fossil samples. In each case, the mean is indicated by a vertical line, the observed range by a horizontal line, the standard deviation by a solid bar, and the 95% confidence limits of the mean by an open bar.

NOTE:

(ILLUSTRATION FROM KLEIN AND CRUZ-URIBE 1984)
HDP1 ADDED BY THE AUTHOR.

Although the sample is not very large, it is clear that the range of species present in the palaeontological sample is not present here. The emphasis also seems to be on different species. It is thus very likely that the archaeological fauna would be biassed, and not very representative of the animals which were present in the environment at the time. This is because, unlike the hyaena, people only exploit specific prey species in an environment. Thus, for example, carnivores are scarce in archaeological assemblages, while being very common in assemblages accumulated by hyaenas (Klein and Cruz-Uribe 1984; Cruz-Uribe 1991).

Despite its small size and the possibility that the assemblage could have been biased by collector behaviour, the archaeological assemblage still contains interesting information. Firstly, penguin are extremely common in the sample. The penguin MNI for the archaeological sample (MNI=4) is interestingly enough, higher than the penguin MNI for the whole palaeontological sample (MNI=1). This is a sure sign that the ocean was closer to the site during the formation of the archaeological assemblage. Based on the large quantities of limpets, it is likely that the sea may have been as close as a kilometre from the site (J. E. Parkington, pers. comm.), reflecting a period of marine transgression or "interglacial". In addition, the limpets are substantially larger than those excavated and measured from nearby LSA shell middens (J. E. Parkington, pers. comm.), confirming the impression of Volman (1978) at the nearby Sea Harvest site.

Unlike the palaeontological assemblage, there is only one pure grazer in the sample. The rest are mixed feeders and browsers. This may be a sign that grass was playing a less important role at the time, further confirming the possible existence of an "interglacial" when the archaeological assemblage was accumulated.

8.3: The implications for the Sea Harvest site

As mentioned in the introduction, Grine and Klein (1993), suspected that the shell midden at Sea Harvest was deposited during the Last Glaciation (global isotope stage 4), sometime between 74 000 years and 60 000 years ago. The palaeontological assemblage on the other hand, was said to have been deposited during the Last Interglacial, most probably during the last pronounced cold spell (global isotope substage 5b), about 92,000 years ago (Klein 1983; Grine and Klein 1993).

Viewed in the light of the fauna retrieved from the archaeological horizons at HDP1, there is a strong case for arguing that the shell midden at Sea Harvest may not have been deposited during a "glacial" period, but rather during an "interglacial" period although it is unclear which "interglacial" it would have been. Considering the similarity in the limpet sizes from HDP1 and Sea Harvest (J. E. Parkington, pers. comm.), which are substantially larger than those excavated and measured from nearby Later Stone Age shell middens, there is a good chance that the HDP1 and Sea Harvest archaeological horizons were deposited at more or less the same time.

Based on the myriad species of grazing ungulates, the small marine component, and the large jackal sizes, the HDP1 palaeontological assemblage most probably accumulated during a period of lowered sea level, or "glacial". This assemblage compares favourably to the Sea Harvest assemblage which is dominated by grazing ungulates and contains very few marine animals (Appendix A. Table 1). The similarity of these two assemblages makes it conceivable that they were deposited at more of less the same time. It is however not possible to determine whether these faunas were deposited during the Last Glacial, or a "glacial" before the Last Interglacial. At

Sea Harvest, Grine and Klein (1993) based their date for accumulation, largely on Butzer's (as quoted in Grine and Klein 1993) interpretation of dune formation. Based on this interpretation, the entire stratigraphic sequence at Sea Harvest was deposited during the colder intervals of the Last Interglacial.

It is however extremely likely that the dune sediments in which the palaeontological material is deposited, predates the material by several hundred thousand years. This seems to have been the case at HDP1, were the palaeontological assemblage was deposited in already existing dune sediments (Chapter 6). U series and luminescence dates from HDP1 (Woodborne, pers. comm.; Vogal, pers. comm.; McMillan, pers. comm) suggest that the sediments in the palaeontological horizons were most probably deposited during the Middle Pleistocene. It is thus possible that the bones could have been deposited during a "glacial" before the Last Interglacial at HDP1 as well as at Sea Harvest. Dating methods which date the material in these horizons directly are required to shed light on this issue.

Summary and conclusion

The dominance of historically absent grazing species in the Hoedjiespunt 1 palaeontological sample suggests that grasses played a much more prominent role in the Western Cape environment at the time that these bones were accumulated than during historic times, or at present. The wide range of grazers, suggest that the grassland had to have been highly productive and in all probability functioned in a similar way as described for the modern East African savanna woodlands (Gwyn and Bell 1968; Bell 1971). However, the fact that the two extremely large-bodied grazing ungulates (*Equus capensis* and *Pelorovis antiquus*) which are present in the HDP1 sample do not have modern equivalents, suggest that the palaeoenvironment was different to modern savanna woodlands.

Primary production had to be higher in this environment to have been able to support these species (Brink 1987). These large ungulates were important for the survival of the smaller grazing species because they opened up stands of old grass, making new grass available to the smaller species. Species diversity was thus encouraged. The grazing lawn which was established by the grazing succession of species, in turn encouraged species diversity among the grass species, thus making the grassland more productive (Lewin 1985). The presence of extensive grasslands, also indicate that cold and possibly dry climatic conditions prevailed at the time which are indicative of glacial periods.

The fact that marine animals constitute only a small part of the palaeontological fossil bone assemblage, suggests that the ocean must have been some distance away from the site at the time. This is an indication of lowered sea levels and provides further support for the existence of a "glacial" at the time of bone accumulation. Based on the bathymetric profile of the continental shelf off Saldanha Bay, and the maximum depth below current sea level that was reached by the ocean during the Pleistocene, it can be argued that the coastline may never have been further than about 15 kilometres away from Saldanha Bay during the Pleistocene. At this distance, the coast would have been within range of the HDP1 hyaenas, but would have been too far for them to be able to exploit coastal resources on a constant basis. As a result, the marine component is extremely small when compared to the terrestrial component from this assemblage.

Further support for the existence of glacial conditions is provided by the mean size of black-backed jackals in the sample. The mean is comparable to other samples with a dominance of grazers, and is greater than the mean for modern black-backed jackals from Equatorial East Africa.

Although small, the archaeological sample does contain more penguin remains than the entire palaeontological sample, signalling that the ocean had to have been much closer to the site at the time. Shellfish remains, especially those of limpets, are also plentiful in the archaeological layers, reflecting a period of marine transgression or "interglacial". Based on the high numbers of limpets, it is possible that the coast may have been as close as a kilometre away f rom the site at the time. The number of pure grazers also seems to have declined by this stage, suggesting that grasses were less important in the environment, further supporting the existence of an "interglacial".

Based on these observations, the archaeological and palaeontological accumulations could not have been accumulated at the same time. The presence of a large marine component in the archaeological assemblage, suggests that this assemblage was accumulated during an "interglacial". Although the Last Interglacial is a possibility, the difficulty experienced with the dating of the material, makes this impossible to determine at this time. It is also still unclear whether the palaeontological assemblage was accumulated during the Last Glacial, or an earlier glacial.

CHAPTER NINE

SUMMARY AND CONCLUSIONS

Hoedjiespunt 1 is one of several known archaeological and palaeontological sites on the Hoedjiespunt Peninsula and in the surrounding area. These assemblages are contained within the Langebaan Limestone, a series of partly cemented aeolian sands that cap earlier beach deposits and granite bedrock. Generally, the upper two metres of the sands are covered by a calcrete capping. At the base of this capping, there are numerous shell midden lenses which contain MSA stone tools, ostrich eggshell fragments, ochre, marine shell and animal bones. At some locations, these archaeological assemblages are stratified above palaeontological assemblages. This is the case at HDP1, HDP2 and the Sea Harvest site, which is situated about 1.2 kilometres away from the Hoedjiespunt Peninsula, but still in the same geological formation. These palaeontological assemblages do not contain any artefacts, but do contain large carnivore coprolites and gnawed bone. Human remains have also been found in these assemblages at HDP1 and Sea Harvest.

9.1: The analysis of the HDP1 fauna

9.1:1: The composition of the faunal sample

The palaeontological sample from HDP1 is dominated by grazing ungulates and carnivores. Both categories display a high diversity of species. Browsers are scarce, and the only large-bodied browser that is present in the sample, is the kudu (*Tragelaphus strepsiceros*). Large herbivore families such as Elephantidae, Giraffidae and Hippopotamidae are absent, with the largest herbivore being the white rhino. The palaeontological assemblage also contains a diverse micromammalian assemblage and a small bird assemblage.

By contrast, ungulates and carnivores are rare in the archaeological horizons of HDP1. Here small animals such as the dune molerat, the rock hyrax and the tortoise are common. Marine birds such as penguins and the Cape cormorant are also common. The abundant shellfish in these horizons are dominated by limpets.

The palaeontological and archaeological faunas are modern overall. Only five extinct species (*Antidorcas australis*, *Pelorovis antiquus*, *Equus capensis*, *Equus quagga* and *Hippotragus leucophaeus*) and possibly a sixth (*Tragelaphus strepsiceros* sp.), are present in the palaeontological assemblage. Non occur in the archaeological assemblage. Of the extinct species in the palaeontological assemblage, two (*H. leucophaeus* and *E. quagga*) were recorded in historical times (Skead 1980). Large grazers such as *P. antiquus* and *E. capensis* however, died out during the Terminal Pleistocene-Early Holocene (Klein 1980). Based on the extinctions of these two species, the palaeontological assemblage has to be older than ± 10 000 B.P. No strictly Middle Pleistocene species were recorded in this assemblage, suggesting that it most probably postdates the Middle Pleistocene. Based on the species which are present in the palaeontological assemblage, it was most probably deposited sometime during the Late Pleistocene. Because the faunal sample from the archaeological assemblage is so small, and also because the species represented in the sample are all still extant, it was not possible to date this assemblage based on the fauna.

The species which are present in the palaeontological assemblage are typical of the fauna from the Cape ecozone (Klein 1980). Endemic species include the bontebok (*Damaliscus dorcas dorcas*), the extinct blue antelope (*Hippotragus leucophaeus*) and the small kudu (*Tragelaphus strepsiceros* sp). Of these, only the bontebok is extant.

9.1:2: The agent responsible for accumulating the palaeontological assemblage

The bones in the palaeontological assemblage were almost certainly accumulated by hyaenas. Apart from circumstantial evidence, such as the presence of hyaena coprolites, gnawed bones, and the lack of artefacts in this assemblage, the bone sample from here also generally reflects several of Klein and Cruz-Uribe's (1984) and Cruz-Uribe's (1991) criteria for distinguishing between hyaena-accumulated bone assemblages and humanly accumulated assemblages.

As is the case at other hyaena assemblages, the palaeontological assemblage at HDP1 has a high carnivore-ungulate ratio. Although gnaw marks do occur, they only occur on a few bones. According to Cruz-Uribe (1991), this is the case at other sites as well, and may be attributed to bad surface preservation. The cranial-postcranial ratio at HDP1 also decreases with ungulate size. Most bones from HDP1 lack at least one of their epiphyses. However, unlike other hyaena assemblages, bones which lack both epiphyses are uncommon here. Small, hard bones are common in the HDP1 assemblage. These are usually uncommon in hyaena accumulated assemblages. Because there are too few bovid lower third molars and deciduous lower fourth premolars present in the sample, age profiles could not be constructed, however, the vast majority of large-medium bovid teeth in the sample were deciduous, hinting that an "attritional profile" may exist in the assemblage.

Circumstantial evidence, such as the sheer quantity of bones present at the site, and the high number of small-medium sized bovids in the assemblage, suggest that the brown hyaena was the most likely accumulator. The brown hyaena is also suspected of accumulating both the Sea Harvest (Grine and Klein 1993) and the Old Hoedjiespunt samples (Klein 1983).

9.1:3: The contexts in which the bones were accumulated

At HDP1, most of the dates on sediments have suggested that deposition occurred during the later Middle Pleistocene. Preliminary luminescence dates on the sediments at HDP1 suggest that these were deposited about 300 000 years ago (S. Woodborne, pers. comm.). After analysing the foraminiferal assemblage from the lower shelly sand horizons at HDP1, McMillan (pers. comm.) suggested that these sediments were most likely deposited about 480 000 years ago. U series analysis of the calcrete capping which stretches over most of the dune, suggests a date of about 300 000 years. Although these dates reflect the ages of the dune sediments, they may not necessarily reflect the ages of the archaeological and palaeontological assemblages contained within them. Stratigraphic observations and the spatial distribution of bones at HDP1 suggest that these assemblages may postdate the sediments in which they occur.

Stratigraphic evidence suggest that the dune sediments were already in place before the palaeontological assemblage was deposited. The consolidated fine-grained material above the bone-bearing horizons bear a resemblance to calcretized horizons often found in partially consolidated dunes which are present in the area today. Cavities are often formed when the softer sediments around these horizons are weathered away. It is likely that these blocks above the fossil-bearing horizons, are the remains of a roof of such a cavity, and that hyaenas used the cavity as a den. The sediments below these blocks exhibit evidence of disturbance. Although tunnels are not present, the presence of partially consolidated pillar-like structures in association with unconsolidated sediments, suggest that these sediments could have been burrowed into. The main fossil-bearing horizon, namely HOMS, consists of both fossil-bearing sediments (unconsolidated) and non-fossiliferous, partially consolidated sediments (pillar-like structures).

Grain-size analysis carried out on these sediments, indicate that the fossil-bearing sediments are finer-grained than the non-fossiliferous sediments, and are also less well sorted (D. Roberts, pers. comm.). It is likely that these finer, fossil-bearing sediments were layed down, when the hyaenas burrowed into the partially consolidated non-fossiliferous sediments in HOMS, mixing the finer grained sediments at the base of the roof, with the coarser-grained sediments below. Bones eventually became incorporated into these sediments, thus forming the fossil-bearing sediments in HOMS.

Further evidence that the bones were deposited in a den, and not in the open, is provided by the spatial distribution of bones in the fossil-bearing horizons below the blocks. The bones are distributed in these horizons, in a manner reminiscent of the spatial patterning of bones in modern hyaena dens (Skinner *et al.* 1980).

Two bone clusters have been identified, one in the HOMS horizon, and the other in GUFI, a gully below HOMS. These clusters resemble the feeding areas of hyaenas in modern den situations. Not only are large numbers of bones concentrated in an area, but most of the bones are those of large animals (Skinner *et al.* 1980). The cluster in the HOMS horizon was shown to contain significantly more large animal bones than the rest of the HOMS horizon. GUFI on the other hand, contained proportionally more small bovid and carnivore bones than the bone cluster. This could have been a feeding area of hyaena cubs. Cubs are known to consume more small bovids and carnivores than adult hyaenas (Mills and Mills 1978). In addition, more coprolites occur outside of the bone cluster in HOMS. Hyaenas are known to use certain areas in their dens as latrines. The bones of micromammals and small-mammals are also more common outside of the HOMS bone cluster. These bones and coprolites exhibit similar distribution patterns in the HOMS horizon, suggesting that they may have been deposited in the coprolites.

It is also highly likely that the archaeological assemblage postdates the dune sediments in which it occurs. The presence of tools manufactured out of calcrete in these horizons, indicate that the calcrete capping was already in place before the archaeological assemblage was deposited.

Because the palaeontological and archaeological assemblages most likely postdate the sediments in which they occur, dates on these sediments cannot be used to date these assemblages.

9.1:4: Discrepancies in skeletal part frequencies

Density mediated destruction seems to have been the major cause of the differences in skeletal part frequencies evident in the fossil bone sample from HDP1. These discrepancies are especially evident in the numerically superior bovid class. Destruction is strongly related to the density of bones in the large-medium bovid size class, while weaker relationships exist in the small and small-medium bovid size classes. This may be attributed to the fact that small bovid bones are not as dense as those of large bovids. Hyaenas are thus more likely to destroy small bovid bones regardless of their densities, while having difficulty doing the same to the bones of larger species.

Postdepositional destruction, especially that caused by the growth of salt crystals in bones, as well as plant root growth, also affected the assemblage. The effects of postdepositional forces on the assemblage is demonstrated by the high number of isolated teeth which are present, compared to teeth in tooth rows.

Although density mediated destruction did affect the assemblage, a completeness index of compact bones from here, suggests that density mediated destruction probably did not alter the assemblage a great deal. Since there is a good chance that the fossil assemblage does not differ much from the deposited assemblage, the faunal remains from this site could provide a relatively accurate idea of the palaeoenvironmental and palaeoclimatic conditions that prevailed at the time.

9.1:5: Palaeoenvironmental implications of the fauna

The dominance of historically absent grazing ungulates in the HDP1 palaeontological sample, suggest that grasses played a much more prominent role in the Western Cape environment at the time. The wide range of grazers suggest that, not only were grasslands widespread, but they were extremely productive, functioning in a similar manner to what the East African savanna woodlands do today.

The presence of large bodied grazers such as *E. capensis* and *P. antiquus*, suggest however that the grasslands at that time, differed from modern grasslands. These grasslands had to be higher in primary production to be able to support these large species. The presence of a high number of grazers in the palaeontological assemblage, is also an indication that "glacial" conditions prevailed when this assemblage was accumulated (Klein 1980; Klein 1983).

The low numbers of marine animals in the palaeontological assemblage is an indication of the existence of lowered sea levels at the time. This further supports the existence of "glacial" conditions. Based on bathymetric profiles of the continental shelf off Saldanha Bay (Dingle 1973), and the maximum depth below current sea level reached by the ocean during the Pleistocene regressions (Dingle 1973), it is likely that the coast may never have been further than about 15 kilometres from Saldanha Bay during most of the Pleistocene. Hyaenas that occurred in the Saldanha area would therefore have had access to marine resources even during glacial periods, although the distance would have prevented them from exploiting these resources on a consistent basis.

Further support for the existence of glacial conditions, is provided by the HDP1 jackals, which are significantly larger than their modern counterparts.

By contrast, the fauna from the archaeological assemblage suggests that it was accumulated during a period of marine transgression, or "interglacial". The fauna in this assemblage is dominated by small animals such as rock hyraxes and dune molerats. Marine animals are common. In addition to penguins and other marine birds, the archaeological horizons are also packed with shellfish. There also seems to be a decline in the bones of grazing ungulates, further supporting the existence of an "interglacial". Based on the large quantities of limpets which are present in these horizons, it is likely that the sea may have been as close as a kilometre away from the site at the time (J. Parkington, pers. comm.).

The palaeontological and archaeological assemblages at HDP1 thus could not have been accumulated at the same time. The archaeological assemblage is consistent with the Last Interglacial ages indicated by the U series date on ostrich eggshell fragments from the archaeological horizons at HDP1 (S. Woodborne, pers. comm.) and the ESR dates on the marine shell from the midden at HDP3 (Yoshida 1996). However, it is still uncertain whether the palaeontological assemblage was accumulated during the Last Glacial, or a "glacial" before the Last Interglacial. Although a date of 100 000 ± 50 000 B.P. was obtained on ostrich eggshell fragments from this assemblage (S. Woodborne, pers. comm.), the large size of the human teeth from here, is not consistent with a Last Glacial date. This assemblage could well date from a "glacial" during the late Middle Pleistocene.

9.2: Implications for the Sea Harvest and the Old Hoedjiespunt samples

This study has called into question Grine and Klein's (1993) interpretation of the geological associations and ages of the Sea Harvest archaeological and palaeontological assemblages.

9.2:1: The origins of the Old Hoedjiespunt fossils

The fact that so few small-mammal bones occur in the Old Hoedjiespunt fossil sample, while grazing ungulates and carnivores dominate, suggest that this sample most likely came from a palaeontological assemblage. It is possible that these bones were part of the assemblage that is currently being excavated at HDP1, but this is unlikely. G. Avery (pers. comm.) states that these bones were being exposed in a cliff face about 10 metres away from where excavations are currently being conducted.

9.2:2: The ages of the Sea Harvest assemblages

Based on Butzer's (as quoted in Grine and Klein 1993) stratigraphic and sedimentological observations at Sea Harvest, Grine and Klein (1993) suggested that the archaeological and palaeontological assemblages were deposited at more or less the same time as the dune sediments that surrounded them. According to Grine and Klein (1993), the shell midden at Sea Harvest was most likely deposited sometime during the Last Glacial (isotope stage 4) between 74 000 and 60 000 years ago. The palaeontological material on the other hand was thought to have been deposited during one of the colder intervals of the Last Interglacial, most probably during isotope substage 5b (± 92 000 years B.P.) (Klein 1983; Grine and Klein 1993).

In the light of the stratigraphic observations and spatial distribution of bones at HDP1, as well as the fact that Sea Harvest is situated in the same fossil dune landscape as HDP1 is, it is highly questionable whether the palaeontological and archaeological assemblages at Sea Harvest were deposited at the same time as the surrounding sediments. It is more likely that these assemblages postdate the sediments in which they occur.

Based on the analysis of the fauna from the HDP1 archaeological horizons, it is also doubtful whether the shell midden at Sea Harvest was deposited during the Last Glacial. The abundant shellfish rather suggests accumulation during an "interglacial", possibly the Last Interglacial, based on the dates obtained for the HDP1 archaeological horizons and the HDP3 shell midden.

The similarity in taxonomic composition of the Sea Harvest and HDP1 faunas, suggest that the palaeontological assemblages from these two sites were deposited at more or less the same time. Although it is possible that these two assemblages could have been deposited during the colder interval of the Last Interglacial (isotope substage 5b) - otherwise referred to as the early Last Glacial by some (eg. Stringer and Gamble 1994) - this is not a certainty, as the sediments at both sites were probably deposited during the Middle Pleistocene, making deposition during an earlier "glacial" possible.

9.3: Concluding remarks

The analysis of the faunal sample from HDP1 helped shed light on several issues of uncertainty. In particular, it helped determine that the archaeological and palaeontological sites were in all probability not connected in any way, other than being stratified one above the other. The humans who accumulated the archaeological assemblage and those represented by the fossils found in the palaeontological assemblage, may therefore have been from two totally different populations. This study has also contributed to the realisation that the archaeological and palaeontological assemblages may in all probability postdate the sediments in which they occur. Dates on these sediments therefore cannot be used to date the assemblages which are contained within them. The need to review the current interpretation of the geological associations and ages of the assemblages at the Sea Harvest site was also highlighted.

The fauna retrieved from HDP1 also allowed me to reconstruct the environment in which, and the climatic conditions under which the two assemblages at HDP1 were accumulated. In doing so, it provided information about the resources that were available to people at the time.

Klein and Cruz-Uribe's (1984) criteria for distinguishing a hyaena-accumulated assemblage from a humanly accumulated assemblage, were also generally confirmed in this study. In addition, this study made a contribution to our current knowledge of fossil hyaena accumulations, by determining that behavioural information may be present in the spatial distribution of bones within them.

Although this study was able to address several issues of uncertainty, it is not the last word on the site, as excavations are still ongoing. In addition, there are also a number of other analyses underway. These studies may be able to shed light on issues that this study was unable to address. There is however no doubt that HDP1, and other similar sites in the area have tremendous potential, and with the aid of further excavations and analyses, these sites could contribute a great deal to our current knowledge of a little-known, but critical time period in human evolution.

Appendix A : Table 1 :

The species of large mammals represented in the excavated sample from the Sea Harvest site.

SCIENTIFIC NAMES	COMMON NAMES	NISP	MNI
Lepus saxatilis,	scrub hare	234	8
Lepus capensis,	Cape hare	17	3
Bathyergus suillus,	dune molerat	1284	47
Hystrix africaeaustralis,	porcupine	5	1
Homo sapiens,	people	2	1
Papio ursinus,	chacma baboon	1	1
Canis mesomelas,	black-backed jackal	251	13
Vulpes chama,	Cape fox	39	3
Lycaon pictus,	wild dog	21	2
Ictonyx striatus,	striped polecat	2	1
Mellivora capensis,	honey badger	20	2
Aonyx capensis,	clawless otter	10	1
Arctocephalus pusillus,	Cape fur seal	172	4
Lobodon carcinophagus,	crab-eater seal	1	1
Genetta tigrina,	genet	4	2
Herpestes ichneumon,	Egyptian mongoose	17	3
Galerella pulverulenta,	Cape grey mongoose	22	2
Crocuta crocuta,	spotted hyaena	2	1
Hyaena brunnea,	brown hyaena	52	6
Hyaenid-general		91	6
Felis libyca,	wildcat	44	3
Felis serval,	serval	48	3
Panthera leo,	lion	20	2
Panthera pardus,	leopard	59	3
Acinonyx jubatus,	cheetah	1	1
Orycteropus afer,	aardvark	5	1
Procavia capensis,	rock hyrax	836	74
Loxodonta africana,	elephant	1	1
Equus quagga,	plains zebra	33	2
Equus capensis,	"giant" Cape zebra	57	4
Ceratotherium simum,	white rhinoceros	4	1
Rhinocerotid-general		6	1
Hoppopotamus amphibius,	hippopotamus	1	1
Phacochoerus aethiopicus,	warthog	3	1
Suid-general		4	1
Taurotragus oryx,	eland	13	2
Tragelaphus strepsiceros,	greater kudu	6	1
Hippotragus leucophaeus,	blue antelope	21	4
Redunca arundinum,	southern reedbuck	36	4
Pelea capreolus,	vaalribbok	13	4
Connochaetes gnou/ Alcelaphus buselaphus,	black wildebeest/ Cape hartebeest	89	9
Damaliscus dorcas,	bontebok	14	4
Antidorcas australis,	springbok	65	10
Sylvicapra grimmia,	grey duiker	6	2
Oreotragus oreotragus,	klipspringer	4	1
Raphicerus campestris,	steenbok	2	2
Raphicerus melanotis,	Cape grysbok	10	5
Bovini ben. et sp. indet.	buffalo	9	3
Bovid-general			
small		302	12
small-medium		398	12
large-medium		966	22
large		132	5
Delphinidae gen. et sp. indet.,	dolphin	9	2

Note:

Data from Grine and Klein 1993.

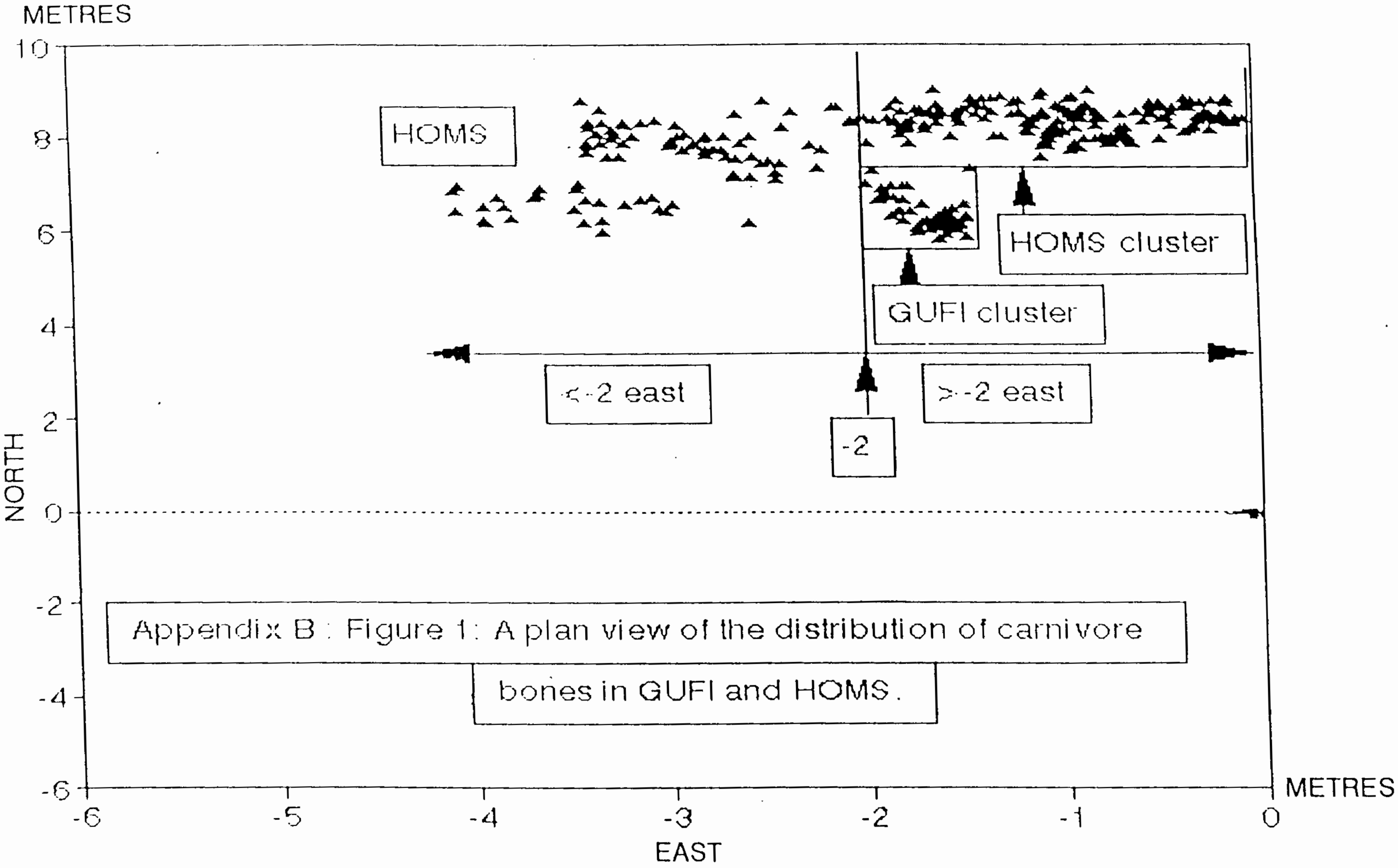
Appendix A : Table 2 :

The species of large mammals represented in the Old Hoedjiespunt sample.

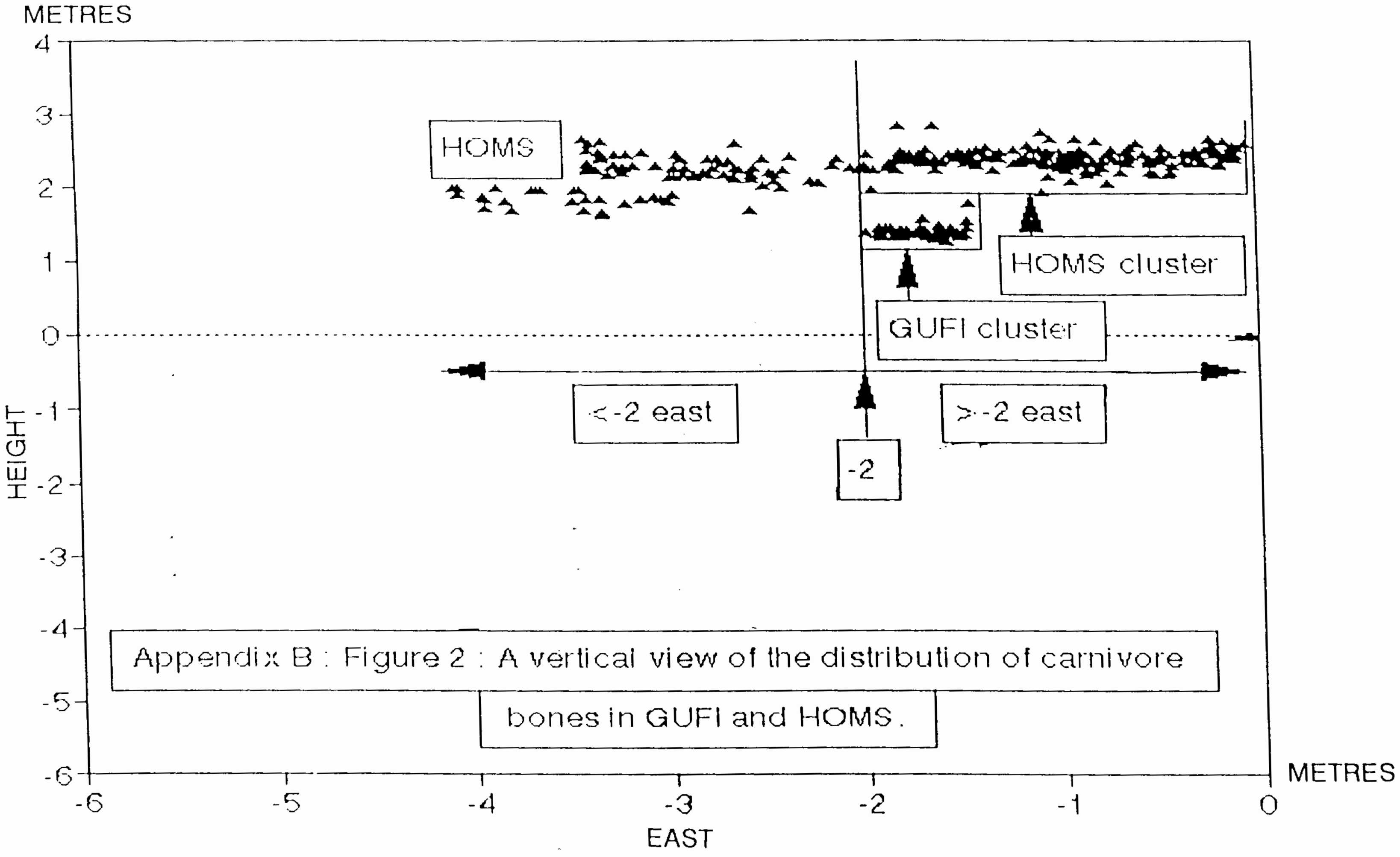
SCIENTIFIC NAMES	COMMON NAMES	NISP	MNI
Pelorovis antiquus,		3	1
Pelea capreolus,	vaalribbok	5	1
Megalotragus priscus,		1	1
Redunca arundinum,	southern reedbuck	23	2
Tragelaphus strepsiceros,	greater kudu	13	1
Equus capensis,	"giant" Cape zebra	8	1
Syncerus caffer,	Cape buffalo	1	1
Raphicerus melanotis,	Cape grysbok	20	2
Antidorcas australis,	springbok	65	4
Connochaetes gnou/ Alcelaphus buselaphus	black wildebeest/ Cape hartebeest	300	11
Hippotragus leucophaeus,	blue antelope	1	1
Rhinocerotid-general		2	1
Procavia capensis,	rock hyrax	8	2
Panthera pardus,	leopard	13	1
Panthera leo,	lion	1	1
Felis caracal,	caracal	1	1
Felis libyca,	wildcat	3	1
Hyaena brunnea,	brown hyaena	7	2
Crocuta crocuta,	spotted hyaena	1	1
Herpestes ichneumon,	Egyptian mongoose	5	1
Suricata suricatta,	suricate	1	1
Mellivora capensis,	honey badger	3	1
Ictonyx striatus,	striped polecat	1	1
Canis mesomelas,	black-backed jackal	102	3
Lycaon pictus,	wild dog	3	1
Arctocephalus pusillus,	Cape fur seal	7	2
Lobodon carcinophagus,	crab-eater seal	1	1
Hystrix africaeaustralis,	porcupine	2	1
Bathyergus suillus,	dune molerat	11	4

Note:

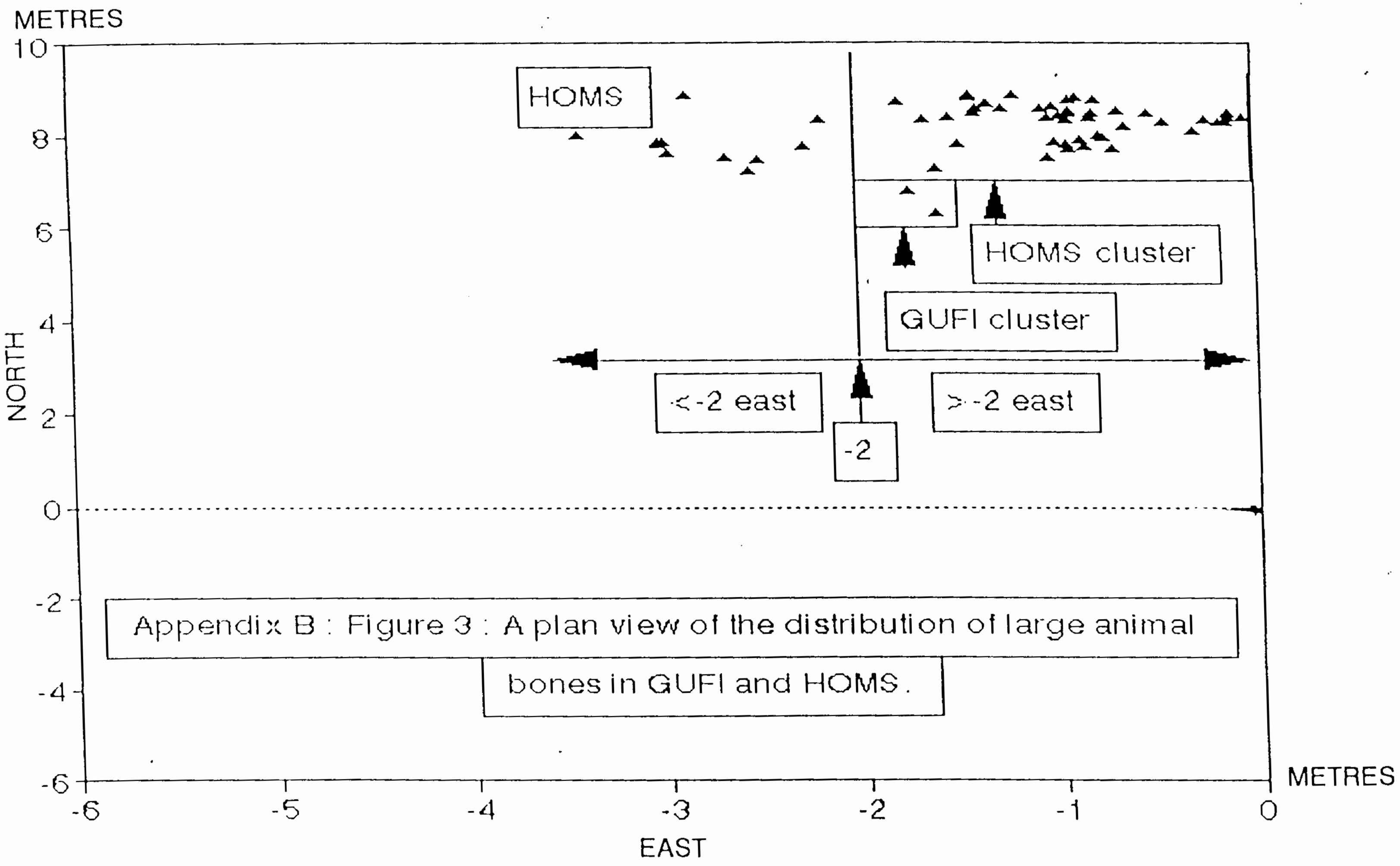
Data from Klein 1983.



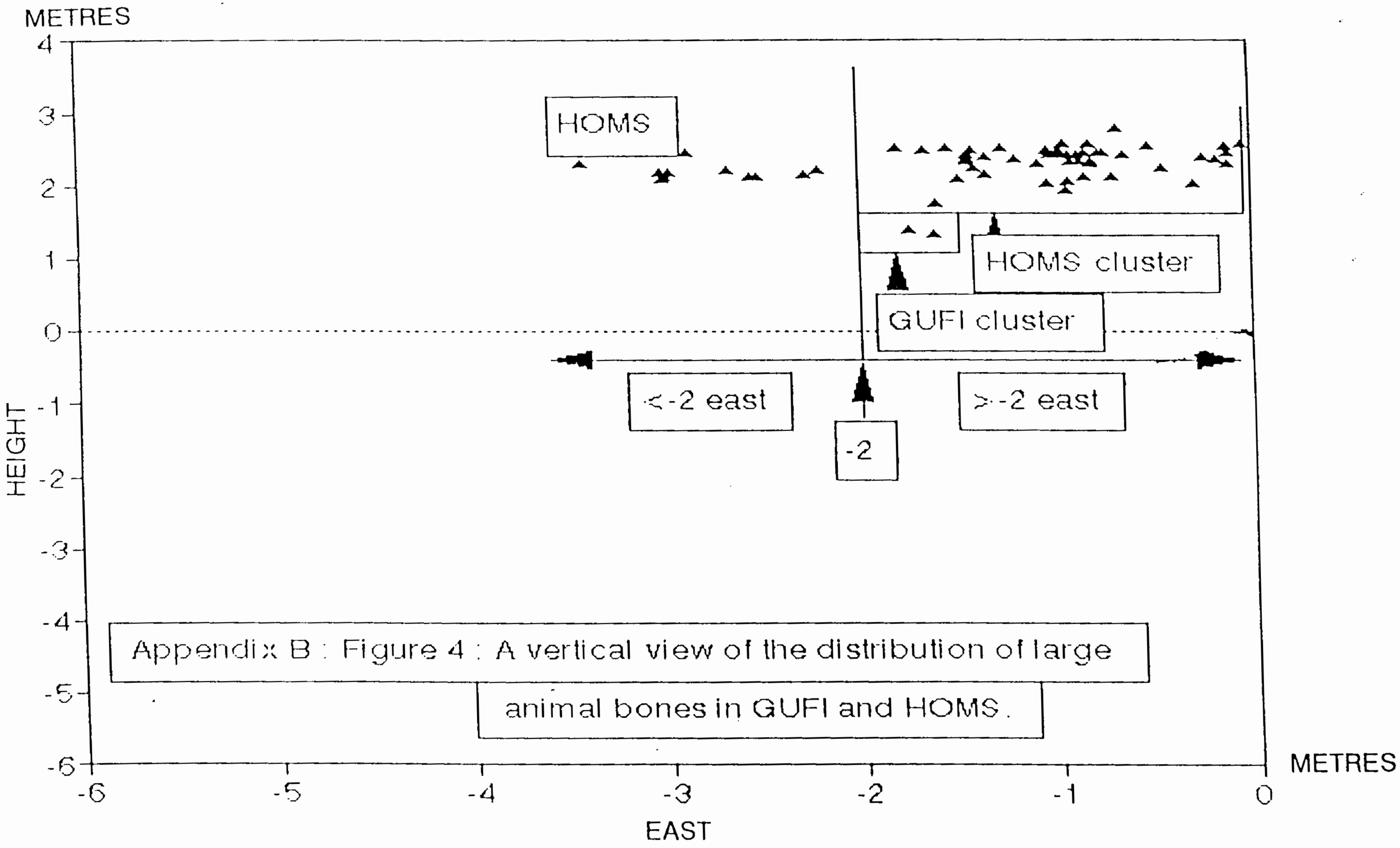
Appendix B : Figure 1: A plan view of the distribution of carnivore bones in GUFI and HOMS.



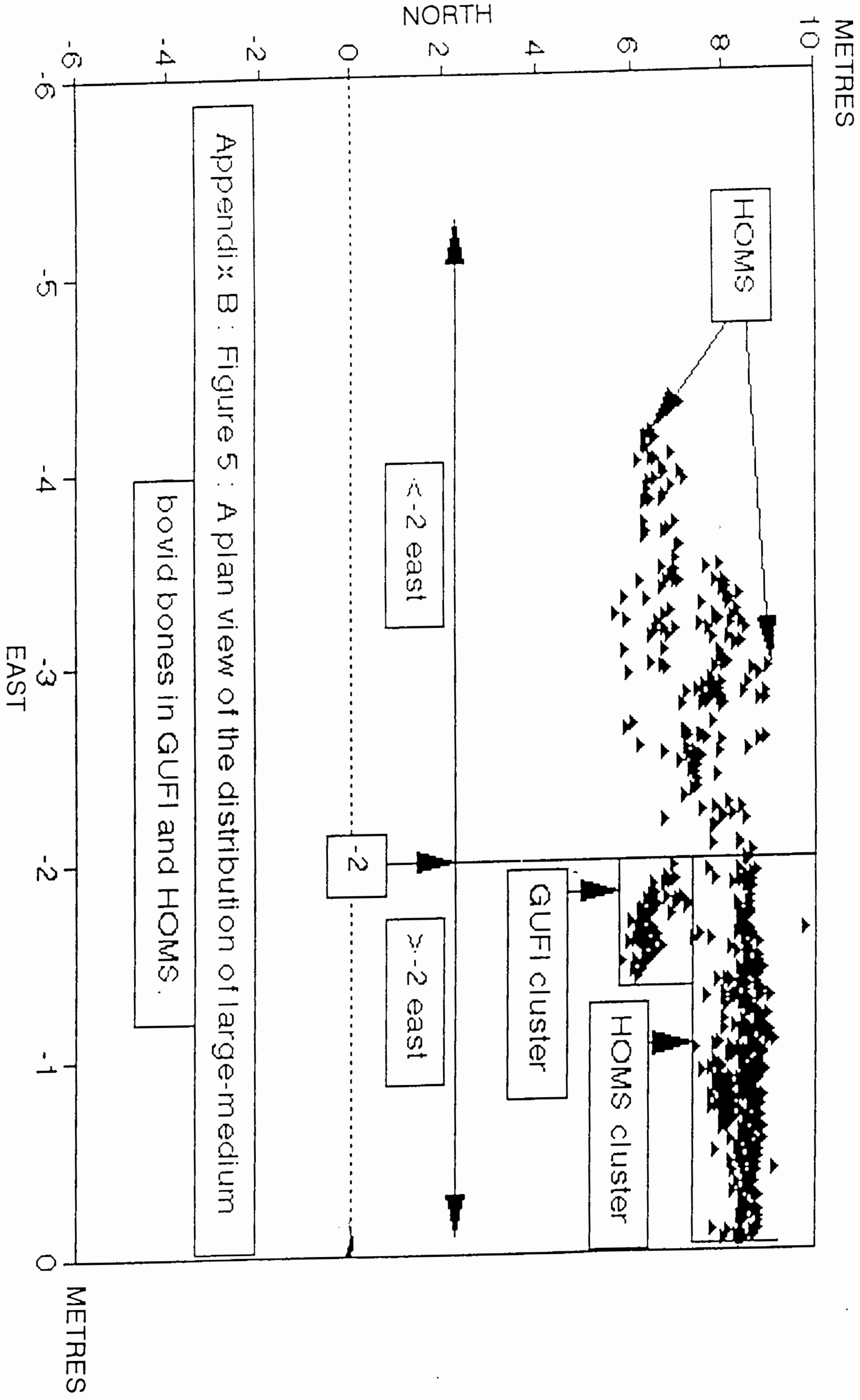
Appendix B : Figure 2 : A vertical view of the distribution of carnivore bones in GUFI and HOMS.



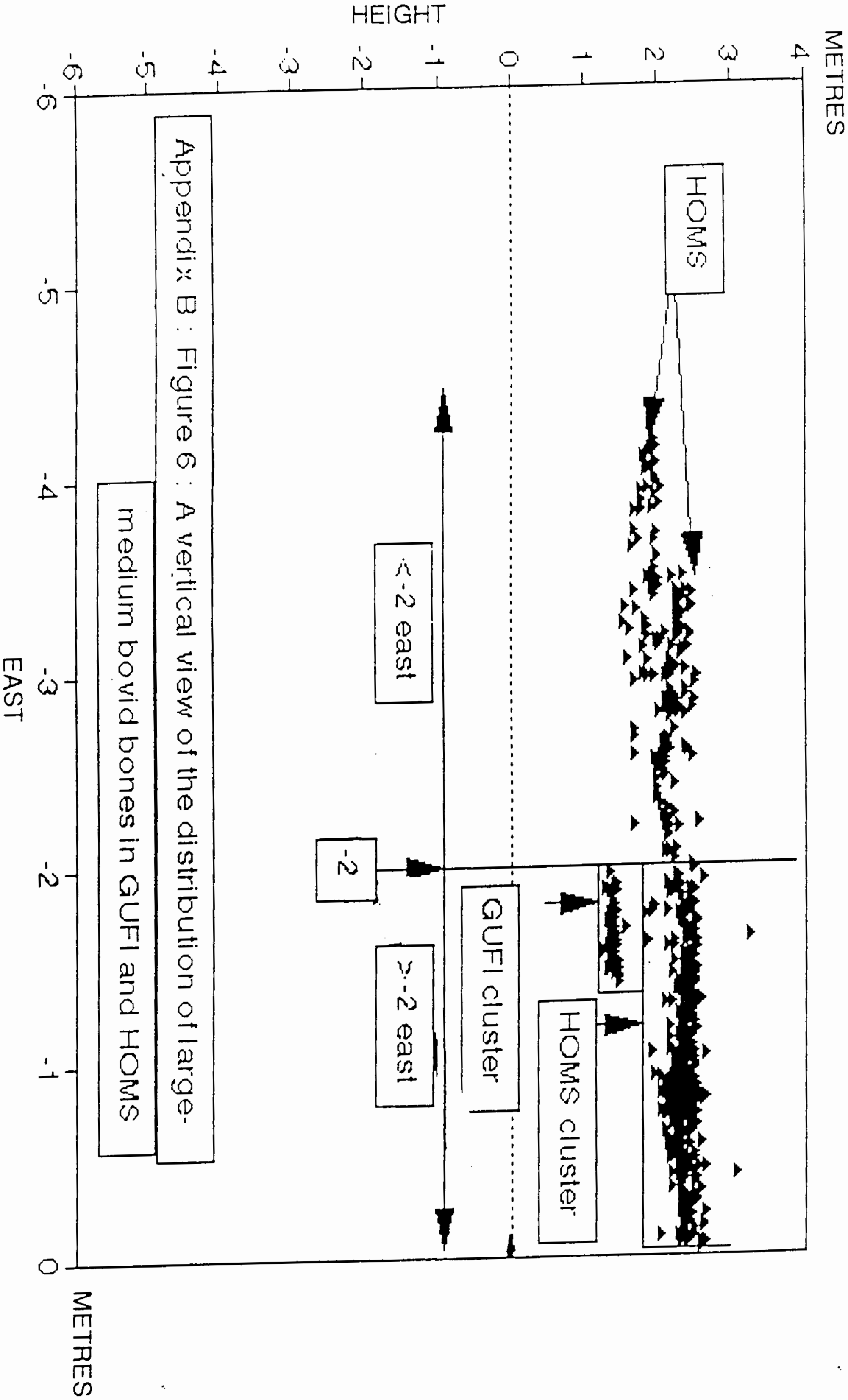
Appendix B : Figure 3 : A plan view of the distribution of large animal bones in GUFI and HOMS.



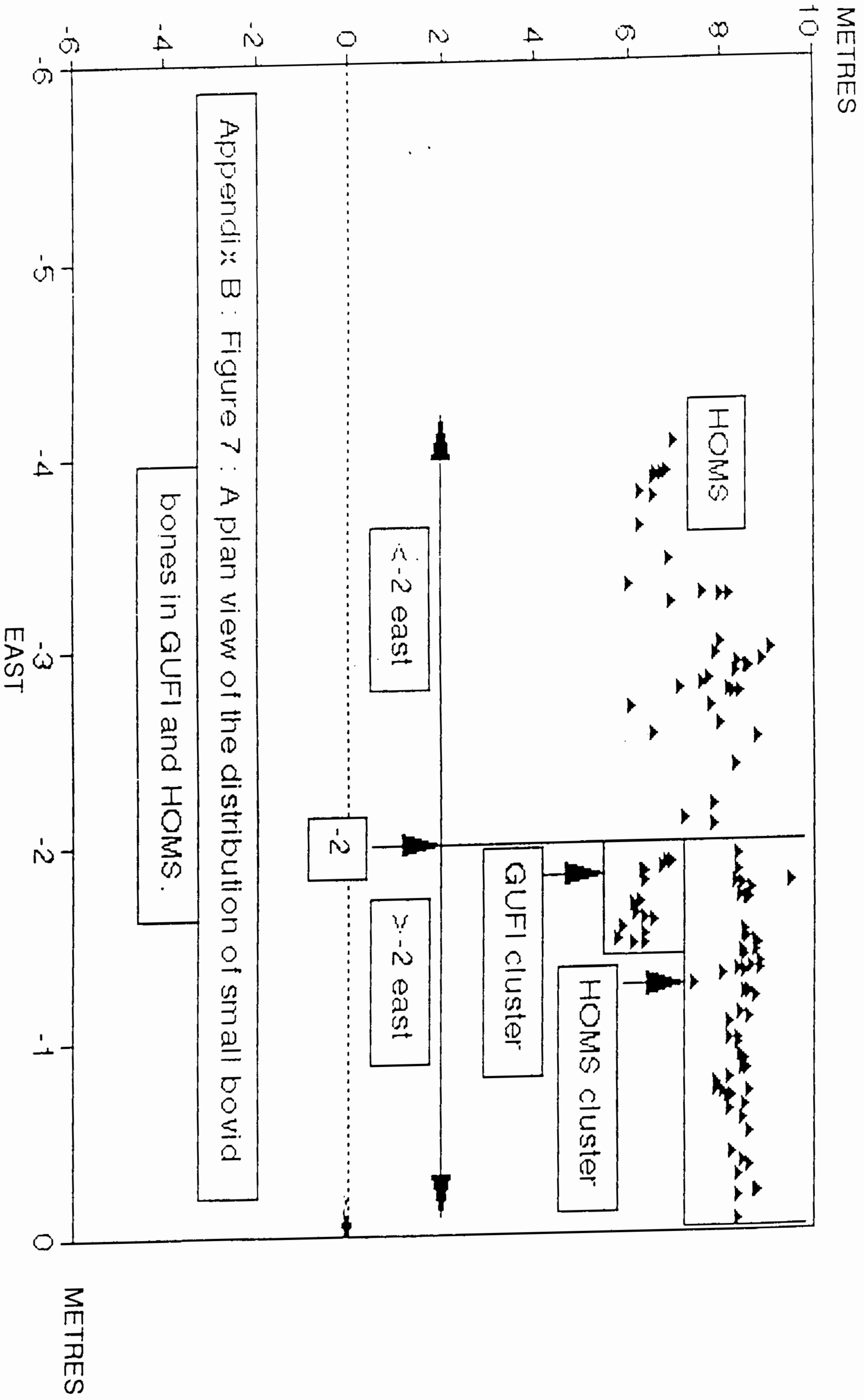
Appendix B : Figure 4 : A vertical view of the distribution of large animal bones in GUFI and HOMS.



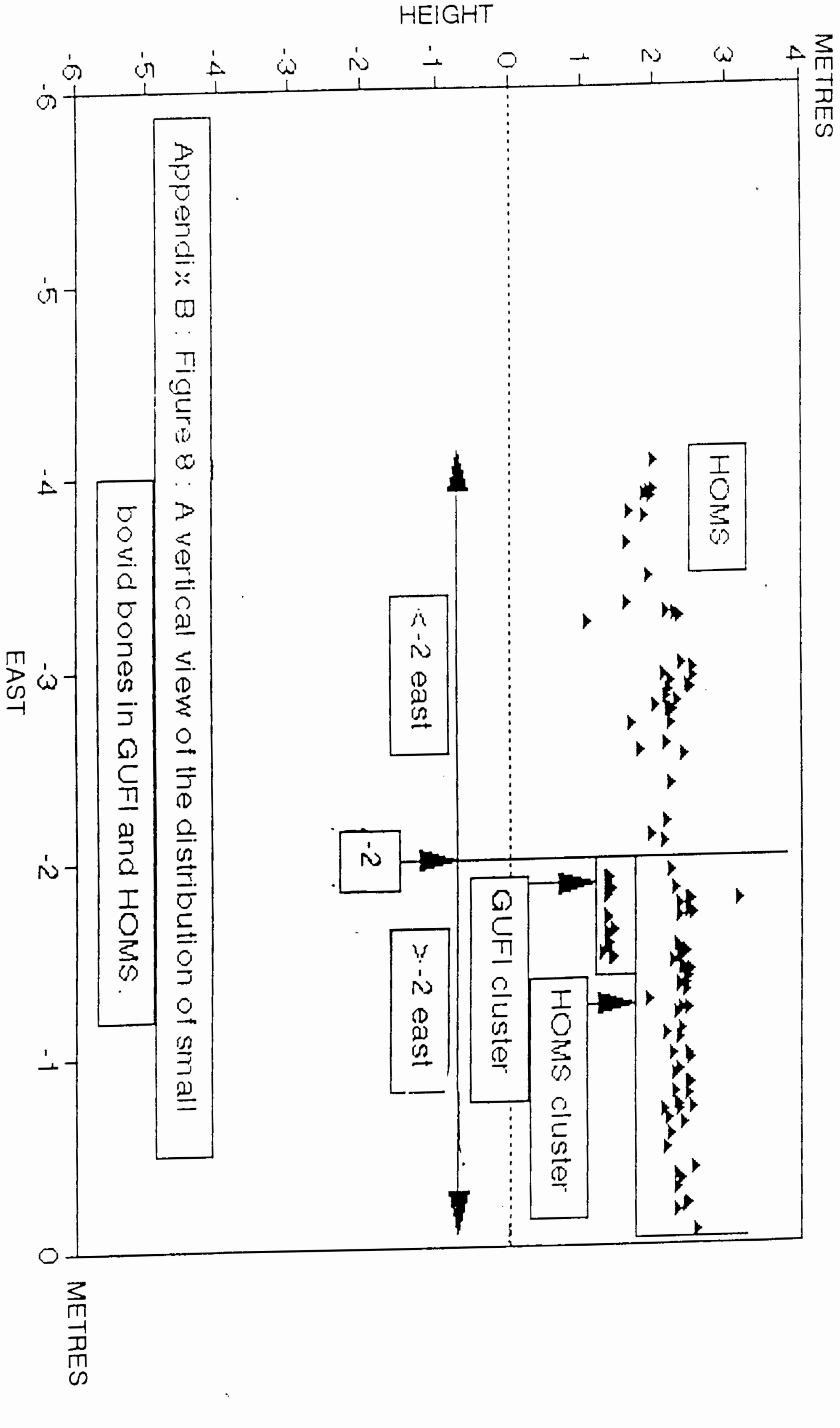
Appendix B : Figure 5 : A plan view of the distribution of large-medium bovid bones in GUFI and HOMS.

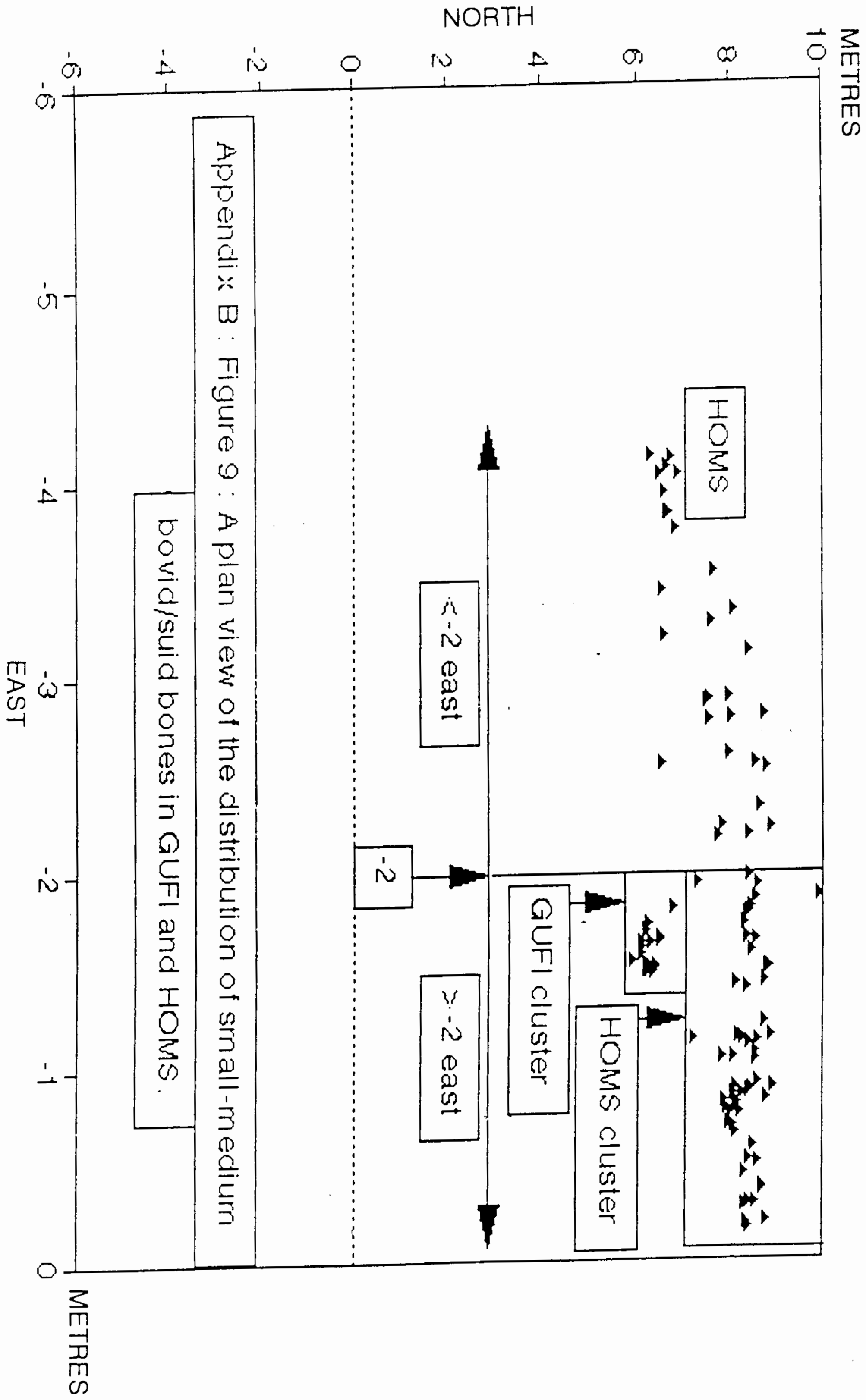


Appendix B : Figure 6 : A vertical view of the distribution of large-medium bovid bones in GUFI and HOMS

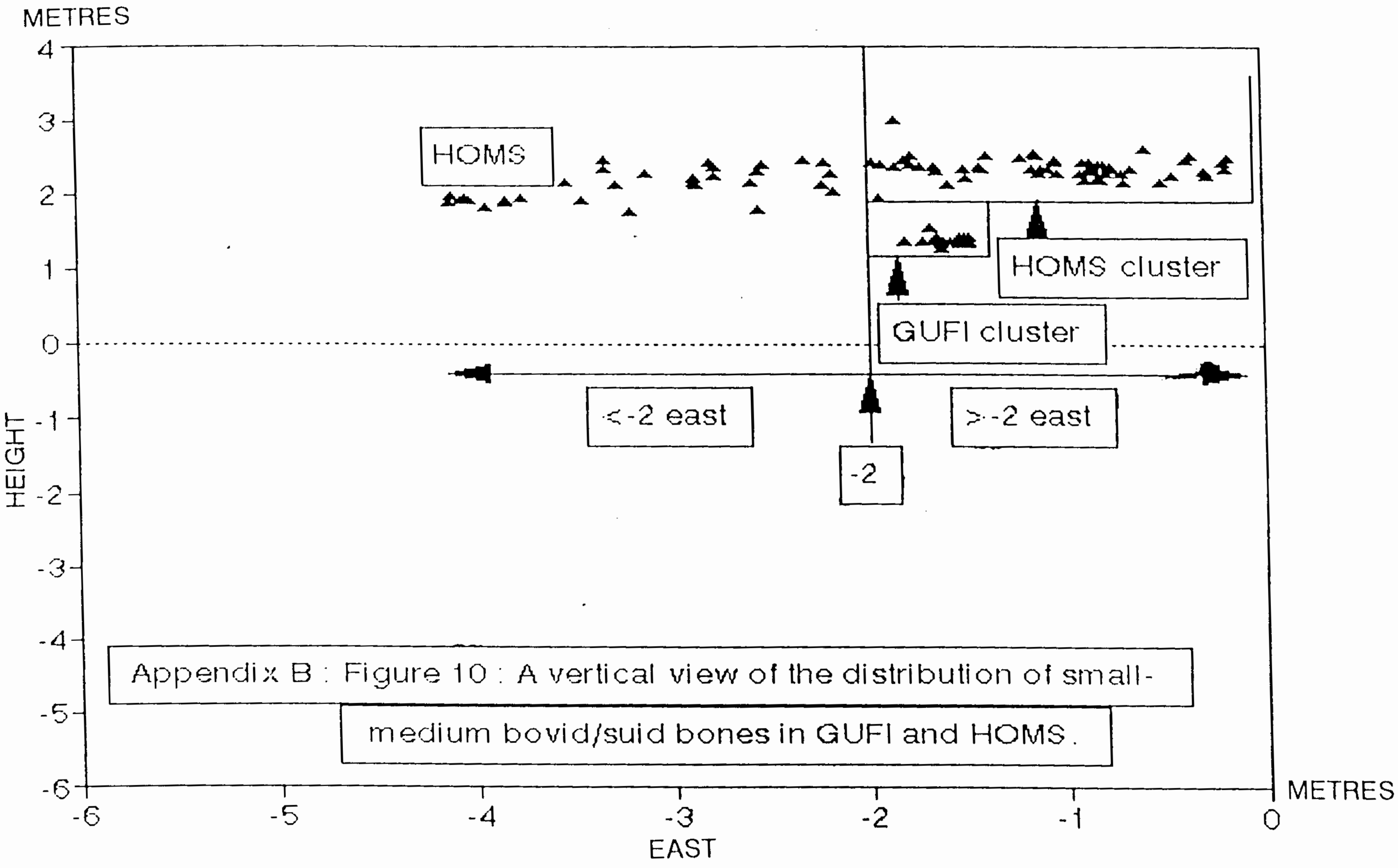


Appendix B : Figure 7 : A plan view of the distribution of small bovid bones in GUFI and HOMS.


Appendix B : Figure 8 : A vertical view of the distribution of small bovid bones in GUFI and HOMS.



Appendix B : Figure 9 : A plan view of the distribution of small-medium bovid/suid bones in GUFI and HOMS.



Appendix B : Figure 10 : A vertical view of the distribution of small-medium bovid/suid bones in GUFI and HOMS.

Appendix C, Table 2 :

A list of food items present in and around Skinner and van Aarde's (1991) brown hyaena inland den. (Central Namib Desert).

FOOD ITEMS	MINIMUM NUMBER OF INDIVIDUALS NO.	%
Arctocephalus pusillus	21	46.6
Canis mesomelas	9	19.6
Canis familiarus	2	4.3
Hyaena brunnea	1	2.2
Antidorcas marsupialis	2	4.3
Raphicerus campestris	2	4.3
Oryx gazella	1	2.2
Hystrix africaeaustralis	1	2.2
Lepus spp.	1	2.2
Dolphin	1	2.2
Spheniscus demersus	1	2.2
Other birds	2	4.3
Ostrich eggs	2	4.3
Total	46	99.9

Note:

Data from Skinner and van Aarde (1991).

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Appendix C, Table 1 :

A list of food items presentin and around Skinner and van Aarde's (1991) brown hyaena coastal den (Central Namib Desert).

FOOD ITEM	MINIMUM NUMBER OF INDIVIDUALS	
	NO.	%
Arctocephalus pusillus	37	38.5
Canis mesomelas	22	22.9
Canis familiarus	1	1.0
Hyaena brunnea	1	1.0
Antidorcas marsupialis	1	1.0
Unidentified bovid	3	3.1
Hystrix africaeaustralis	1	1.0
Lepus spp.	2	2.1
Dolphin	1	1.0
Whale	1	1.0
Spheniscus demersus	16	16.7
Other birds	10	10.4
Total	96	99.7

Note:

Data from Skinner and van Aarde (1991).

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