

THE MAMMALIAN FAUNA FROM THE MIDDLE AND LATER STONE AGE (LATER PLEISTOCENE) LEVELS OF BORDER CAVE, NATAL PROVINCE, SOUTH AFRICA*

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Introduction

Border Cave (approximately 27°1'S 31°59'E) is located almost exactly on the international border between Zululand (Natal Province, South Africa) and Swaziland (Fig. 1). The nearest settlement appearing on most maps is Ingwavuma, situated roughly 13 km to the south of the cave. The site was excavated in 1934 by a party under the direction of Raymond Dart (unpublished), in 1941-2 by H. B. S. Cooke, B. D. Malan, and L. H. Wells (Cooke *et al.* 1945), and in 1971-2 by P. B. Beaumont (1973; also Beaumont & Boshier 1972).

Beaumont's work resulted in the most detailed account of the stratigraphy, as well as in the largest most complete samples of artefactual, faunal, and floral material. He excavated almost entirely in an area where the deposits overlying bedrock were between two and three metres thick, but he established

that other parts of the cave contained a metre or more of yet older sediments. In his main excavation he recognized fifteen more or less clearly defined layers (see Table 1) containing cultural remains which he assigned to five culture-stratigraphic units (from younger to older): Iron Age, Early Later Stone Age (LSA), Middle Stone Age (MSA) 3, MSA 2, and MSA 1.

The bed containing Iron Age artefacts (1BSupA of Table 1) is dated to between c. 200 and c. 800 B.P. and is immediately underlain by a culturally sterile zone (1BSupB) bracketed by ¹⁴C to between 2000 and 13 000 B.P. (Beaumont 1973 and pers. comm.) The sterile zone is less than 150 mm thick and Beaumont believes the spread of the dates probably reflects a very slow rate of accumulation. The sterile zone immediately overlies units (1BS1r and 1WA) with Early LSA artefacts and ¹⁴C dates in the 38 000 to 36 000 B.P. range. It remains unclear whether these are to be regarded as finite or minimum age

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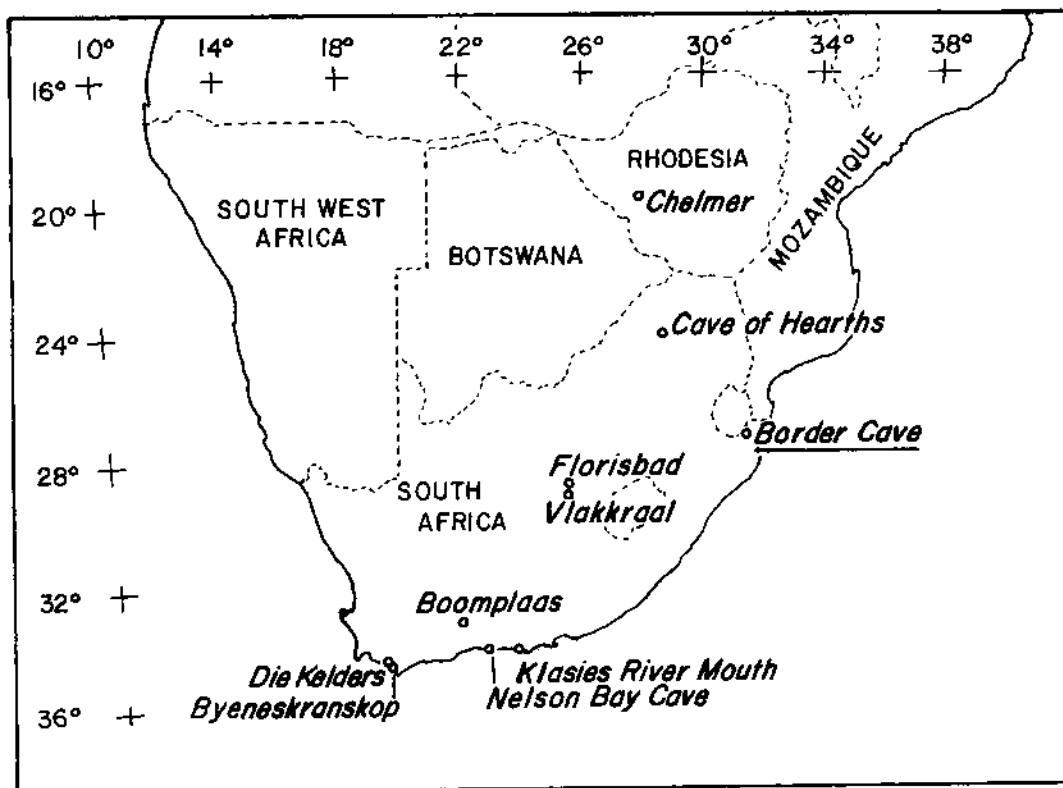


Fig. 1. The approximate locations of Border Cave and other southern African sites mentioned in the text.

TABLE 1. The minimum numbers of individuals by which different mammalian taxa are represented in the various levels of Border Cave (Excavation '3A Rear' of P. B. Beaumont.) The acronyms for the levels are based on fuller designations presented by Beaumont (1973). The cultural designations and indications of absolute age are based on Beaumont (1973 and pers. comm.) Level 1BSupB is not included in the table because it was devoid of diagnostic artefacts and larger mammal bones. In terms of the species list, small bovids include grysbok, oribi, and klipspringer; small medium ones mountain reedbuck, impala, bushbuck, springbok, and sheep/goat; large medium ones waterbuck, roan/sable, bastard hartebeest, hartebeest, wildebeest, kudu, and nyala; large ones eland and buffalo. There is some postcranial material which is perhaps derived from the blue duiker (*Cephalophus monticola*). This has been included with the small bovids.

	Iron Age	Early LSA (formerly 'Pre-Early LSA') (circa 38-36 000 B.P.)	MSA 3 (formerly 'Post-Final MSA') (>49 000 B.P.)			MSA 2 (formerly 'Final MSA' or 'Epi-Pietersburg')		MSA 1 (formerly 'Full MSA' or 'Pietersburg')				
			2BS up	2BS 1rA	2BS 1rB	2BS 1rC	3BS up	3BS 1r	3BS up	3BS 1rA	1GBS up	1GBS 1rB
<i>Papio ursinus</i> , chacma baboon	1	1	1	1	1	1	1	1	1	1	1	1
<i>Cercopithecus aethiops</i> , vervet monkey	—	—	—	—	—	—	—	—	—	—	—	—
<i>Mellivora capensis</i> , honey badger	—	1	—	—	—	—	—	—	—	—	—	—
<i>Panthera pardus</i> , leopard	—	—	—	—	—	—	—	—	—	—	—	—
<i>Lycan pictus</i> , hunting dog	—	—	—	—	—	—	—	—	—	—	—	—
Carnivora gen. et sp. indet.	—	—	—	—	—	—	—	—	—	—	—	—
Small (<i>Herpestes pulverulentus</i> -size)	1	1	1	1	1	1	1	1	1	1	1	1
Small medium (<i>Felis libyca</i> -size)	—	1	—	—	—	—	—	—	—	—	—	—
Hyracoidea (<i>Procavia capensis</i> and <i>Dendrohyrax arboreus</i>), hyraxes	1	2	2	1	—	—	—	—	—	—	—	—
<i>Loxodonta africana</i> , elephant	—	?	—	—	—	—	—	—	—	—	—	—
Rhinocerotidae gen. et sp. indet., rhinoceros	—	—	—	?	—	—	—	—	—	—	—	—
<i>Equus cf. burchelli</i> , Burchell's zebra	1	—	1	2	1	—	—	—	—	—	—	—
<i>Equus cf. capensis</i> , 'giant Cape horse'	—	—	—	—	—	—	—	—	—	—	—	—
<i>Potamochoerus porcus</i> , bushpig	1	1	1	—	—	—	—	—	—	—	—	—
<i>Phacochoerus aethiopicus</i> , warthog	—	1	1	1	1	—	—	—	—	—	—	—
Suidae—general, pigs	1	1	1	1	1	—	—	—	—	—	—	—
<i>Hippopotamus amphibius</i> , hippopotamus	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 1 (cont.)

	Iron Age	Early LSA (formerly 'Pre-Early LSA') (circa 38-36 000 B.P.)	MSA 3 (formerly 'Post-Final MSA') (>49 000 B.P.)			MSA 2 (formerly 'Final MSA' or 'Epi-Pietersburg')		MSA 1 (formerly 'Full MSA' or 'Pietersburg')					
			2BS up	2BS 1rA	2BS 1rB	2BS 1rC	2WA	3BS up	3BS 1r	3WA	IGBS up	IGBS 1rA	IGBS 1rB
<i>Raphicerus cf. campestris</i> , steenhok	—	1	1	1	1	—	—	—	—	—	—	—	—
<i>Ourebia ourebi</i> , oribi	—	1	2	—	—	—	—	—	—	—	—	—	—
<i>Oreotragus oreotragus</i> , Klipspringer	3	1	—	—	—	—	—	—	—	—	—	—	—
<i>Redunca fulvorufula</i> , mountain reedbuck	—	3	2	—	—	—	—	—	—	—	—	—	—
<i>Kobus ellipsiprymnus</i> , waterbuck	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Hippotragus</i> spp., roan/sable	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Aepyceros melampus</i> , impala	—	1	1	—	—	—	—	—	—	—	—	—	—
<i>Damaliscus cf. dorcas</i> , blesbok	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Alcelaphus buselaphus/Damaliscus lunatus</i> , hartebeest/bastard hartebeest	1	—	1	—	—	—	—	—	—	—	—	—	—
<i>Connochaetes taurinus</i> , wildebeest	—	—	1	—	—	—	—	—	—	—	—	—	—
<i>Antidorcas bondi</i> , Bond's springbok	—	—	3	—	—	—	—	—	—	—	—	—	—
<i>Tragelaphus sircisicerus</i> , kudu	—	—	1	—	—	—	—	—	—	—	—	—	—
<i>T. angasi</i> , nyala	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>T. scriptus</i> , bushbuck	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Taurotragus oryx</i> , eland	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Syncerus caffer</i> , Cape buffalo	?1	4	3	—	—	—	—	—	—	—	—	—	—
<i>Ovis aries/Capra hircus</i> , sheep/goat	1	—	—	—	—	—	—	—	—	—	—	—	—
Bovidae—general	—	—	—	—	—	—	—	—	—	—	—	—	—
small	2	3	3	2	1	2	1	2	1	2	1	2	1
medium	2	3	5	1	3	1	4	3	1	1	2	1	2
large	1	2	2	1	2	1	5	3	1	1	1	3	2
large	1	3	4	1	1	1	2	2	1	2	3	2	1
Lagomorpha (cf. <i>Lepus capensis</i> and <i>?Lepus crawshayi</i>), hares	7	4	8	2	2	2	2	1	2	2	1	3	3
<i>Hystrix africae-australis</i> , porcupine	—	—	—	—	—	—	—	—	—	—	—	—	—

estimates. The immediately underlying unit (2BSup) with MSA 3 artefacts has a ^{14}C date of > 49 000 years and there are comparable 'infinite' dates from lower units as well. It is therefore clear that the entire MSA sequence lies beyond the practical limit of radiocarbon dating as practised by most laboratories. The age of the oldest materials represented at Border Cave is difficult to gauge on present evidence, but sedimentological analyses undertaken by Butzer (in preparation) suggest that the initial occupation may have occurred in the Penultimate Glacial, prior to 130 000 B.P., while the fifteen-layer stratigraphic sequence recognized by Beaumont in his principal excavation (see Table 1) probably spans the Last Interglacial and the earlier part of the Last Glacial, overall from perhaps 130 000 B.P. to perhaps 35 000 B.P.

Among the materials Beaumont recovered from the various layers in his principal excavation were moderate quantities of faunal remains. He kindly offered me the opportunity to analyse them. This paper constitutes a summary of my results.

Counts and Identifications

Before the Border Cave bones were sent to me for study (at the South African Museum), the micro-faunal remains, believed to have been introduced in owl pellets, were removed for separate specialist study, so that my task consisted of analysing only those bones thought to have been introduced directly through human activity. I found most of these to be small, non-diagnostic fragments which I could identify to neither body part nor taxon. Among the remainder, a very small fraction belonged to reptiles, birds, and fish. I separated these, but a lack of appropriate comparative material and experience prevented me from identifying most of them to species. They will not be discussed further here.

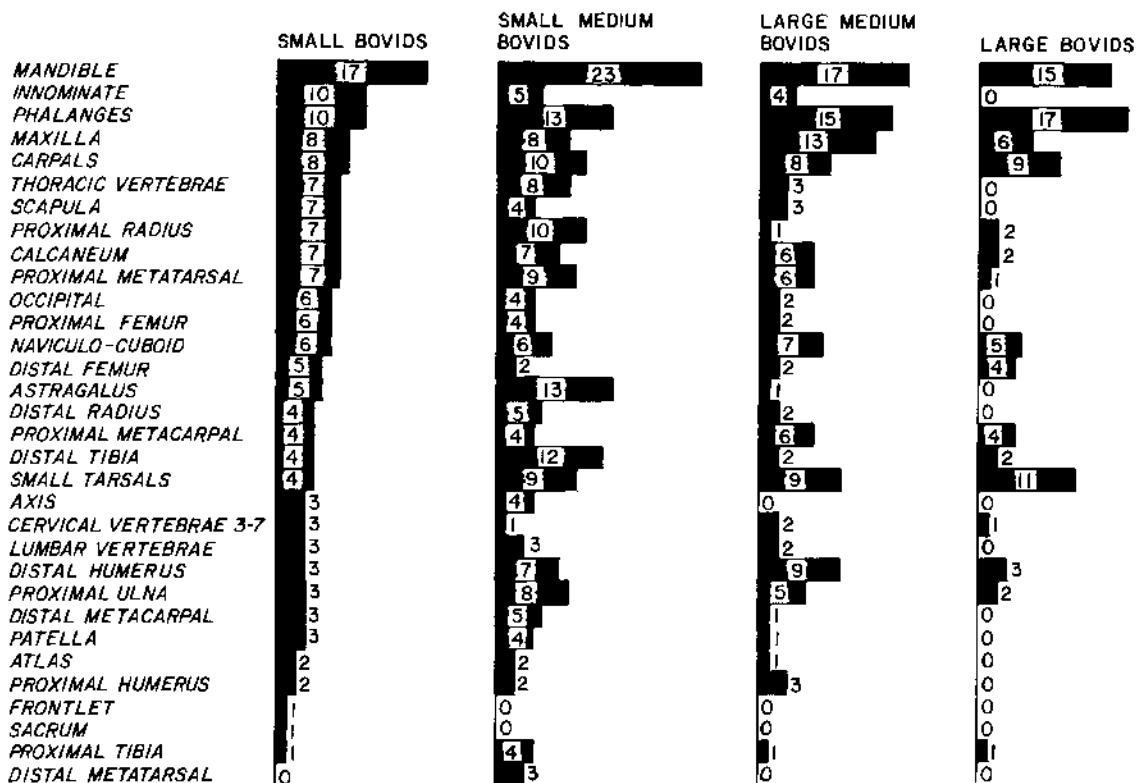
The overwhelming majority of the 'identifiable' bones belonged to various kinds of mammals and I undertook a detailed analysis of these. I especially recorded information which would permit calculation of the minimum number of individuals by which each mammal species was represented in each level. Wherever feasible, I sorted body parts into lefts and rights and took the larger sum (left or right) as the minimum number of individuals represented by that body part. I also assumed that fused and unfused epiphyses of the same body part (e.g. the distal tibia) of a taxon must come from different individuals, even if one epiphysis was left and the other right. I sorted phalanges, vertebrae (excepting atlases and axes which I counted separately), and for some taxa also metapodials into gross categories (e.g. thoracic vertebrae or left second phalanges) and calculated the minimum number of individuals represented by numerical division (for example, I divided by four to obtain the minimum number of individuals of a bovid represented by left second phalanges.) For teeth, almost all of which occurred as isolated specimens (rather than set in jaws with one or more additional teeth), I also recorded information on eruption and wear to allow calculation not only of the minimum numbers of 'mouths' from which the

teeth probably came, but also an idea of the ages of animals at time of death.

I was able to assign most reasonably complete Border Cave teeth and most non-bovid and non-suid postcranial elements to species or at least to genus. But I had less confidence in my ability to assign suid postcranial elements consistently to one or the other of the two species represented by teeth or to sort bovid postcranial elements accurately among species of similar size, especially since both the suid and bovid postcranial elements tended to be very fragmentary. Consequently, I established the frequencies of suid and bovid species solely on teeth and relegated the relevant postcranial material to more general categories—a single composite one for the suids and four separate ones based on size for the bovinds. The approximate specific content of the four bovid size categories (small, small medium, large medium, and large) is presented in the captions to Table 1 and Figure 2.

With a few additions, the species I identified are the same ones recorded by Cooke *et al.* (1945). The complete list, with the minimum number of individuals by which each species is represented in each layer of Beaumont's excavation, is presented in Table 1. Some of the more problematic identifications require special comment. It is probable that both roan (*Hippotragus equinus*) and sable (*H. niger*) are represented, but because these species are very difficult to distinguish on isolated teeth, I have conservatively assigned all relevant specimens to *Hippotragus* spp. Similarly, it is extremely difficult, if not impossible, to separate isolated teeth of hartebeest (*Alcelaphus buselaphus*) from those of larger species of bastard hartebeest such as the tsessebe (*Damaliscus lunatus*) which could well have been present near Border Cave in Stone Age times. I have therefore listed *Alcelaphus buselaphus* and *Damaliscus lunatus* together. I have tentatively assigned alcelaphine teeth significantly smaller than those of *A. buselaphus*/*D. lunatus* to the blesbok, *Damaliscus dorcas*, although it is conceivable they derive from a now extinct small bastard hartebeest, *Damaliscus niro*, which is known from like-aged (Upper Pleistocene) sites on the highveld and perhaps also in the southern Cape. Teeth that were significantly larger than those of *A. buselaphus*/*D. lunatus* I assigned to the blue wildebeest, *Connochaetes taurinus*. There were no alcelaphine teeth in the sample large enough to belong to the extinct 'giant hartebeest', *Megalotragus priscus*.

Most of the equid teeth match those of Burchell's zebra (*Equus burchelli*) in both size and morphology, but there is at least one tooth which is far larger than any homologous Burchell's zebra specimen I have ever seen, and I have assigned this tooth tentatively to the extinct 'giant Cape horse', *Equus capensis*, well-known from other Upper Pleistocene localities in southern Africa. Isolated teeth of the various species of *Raphicerus* (grysboks and steenbok) are impossible to assign to species, but the inferior margin of the mandible of one more or less complete jaw was relatively straight as in the steenbok (*R. campestris*) (see Klein 1976a: fig. 1). Since steenbok would be most likely on geographic grounds as well, I have tentatively assigned all the *Raphicerus*



BORDER CAVE. The minimum numbers of different sized bovids represented by various body parts.

FIG. 2. The minimum numbers of different-sized bovids represented by different body parts at Border Cave. (Small bovids include steenbok, oribi and klipspringer; small medium ones mountain reedbuck, impala, bushbuck, and springbok; large medium ones waterbuck, roan/sable, bastard hartebeest, hartebeest, wildebeest, kudu and nyala; and large ones eland and buffalo.)

Results of chi-square and Kolmogorov-Smirnov tests for the significance of frequency differences between different-sized bovids are presented directly below. Values that are underlined indicate a difference significant at the 0,05 level or below.

Chi-square					Kolmogorov-Smirnov				
Small	—				Small	—			
Small medium	24,99	—			Small medium	1,19	—		
Large medium	33,68	37,57	—		Large medium	0,80	1,01	—	
Large	63,65	62,47	31,17	—	Large	1,65	1,92	0,78	—
		Small	Small	Large	Large	Small	Small	Large	Large
			medium	medium			medium	medium	

teeth to *R. campestris*. There are at least two different hares present, a larger one which is almost certainly *Lepus capensis* and a smaller one which is possibly *Lepus crawshayi*. Since I was unable to separate the hare specimens consistently between the two species, I have conservatively lumped them for inclusion in the table. Finally, it is likely that there are two species of hyrax present—both the rock hyrax (*Procavia capensis*) and the tree hyrax (*Dendrohyrax arboreus*)—but again my inability to separate all parts consistently caused me to lump them for presentation in Table 1.

Palaeoenvironmental Implications of the Border Cave Fauna

With the prominent exception of the extinct species (Bond's springbok, the 'giant Cape horse', and possibly the small bastard hartebeest), the species listed in Table 1 were historic inhabitants of the eastern lowveld in which Border Cave is located. In a general sense then, the fauna suggests that throughout the time span represented in Beaumont's principal excavation, from perhaps 130 000 to 35 000 B.P., the environment was broadly similar to the present one,

with a persistent mosaic of dense, low thickets, particularly along watercourses, and large expanses of grassland and savannah (see the relevant sections of Acoccks 1953 for descriptions of lowveld vegetation).

A close examination of Table 1 will show that there is a tendency for creatures that prefer bushier environments (especially bushpig, Cape buffalo, tragelaphine antelopes and impala) to be relatively more common in the MSA 2 and Early LSA. In the intervening MSA 3 and underlying MSA 1, species preferring more open vegetation (Burchell's zebra, warthog, and alcelaphine antelopes) tend to be relatively more abundant. Unfortunately, as Table 2 shows, the numbers in Table 1 are not large enough to provide complete statistical support for the observed contrasts. In particular, statistical significance can be demonstrated only for the difference between the Early LSA (with a relatively high frequency of creatures preferring more closed settings) and the MSA 3 (with a relatively low frequency of such creatures).

Because the Border Cave bones are so highly fragmented, it is unlikely that even a considerable enlargement of the sample through further excavations would substantially increase the numbers in Tables 1 and 2. This is especially true for the suids and equids, the teeth of which tend to break up into small fragments which are identifiable to species, but not to position in the mouth, a vital datum if the minimum number of individuals is to be computed. It is therefore probable that the hypothesis that there were significant changes in the proportion of species preferring bushier vegetation versus those preferring grassier settings can be tested further only if another index of species frequency is adopted. There are two obvious possibilities. The first is the number of teeth

or tooth fragments assigned to a species in a given level. The second is the number of grid squares in which teeth of a species occur in any level. (Beaumont recorded all finds with regard to a grid of squares roughly one metre on a side.)

Each of the two indices of species frequency suggested in the last paragraph has clearcut drawbacks. The major difficulty with an index based on teeth or tooth fragments is that it will clearly overemphasize the importance of suids and equids, whose teeth are more prone to fragmentation than those of bovids. Theoretically, an index based on the number of squares in which teeth occur could also favour species whose teeth tend to fragment more easily. In fact, at Border Cave, dental fragments belonging especially to zebra and suids (particularly warthog) generally occur in clusters within a square, suggesting that most fragmentation occurred after the teeth reached their final positions within the site. At least at Border Cave then, the major problem with a frequency index based on the number of squares in which teeth of a species occur is that it assumes that the teeth of all species are about equally susceptible to dispersion across the surface of the site. This is a difficult, if not impossible, assumption to test, but I believe it is reasonable, at least with regard to the teeth of animals bushpig/warthog size or larger. Overall, in fact, in a fauna such as that from Border Cave, in which so many teeth are fragmented and not readily assigned to a place in the mouth, the number of squares in which teeth of a species occur might be a more accurate estimate of both its absolute and relative frequency within the excavated area than the more conventional minimum numbers presented in Table 1.

Table 3 presents the numbers of squares in which

TABLE 2. The minimum numbers of individuals by which bushpig, Cape buffalo, tragelaphine antelopes, and impala are represented in the major culture-stratigraphic units of Border Cave versus the minimum numbers of warthog, zebra, and alcelaphine antelopes in the same units. Cultural stratigraphy after Beaumont (1973 and pers. comm.). Frequency data from Table 1.

<i>The minimum numbers of individuals represented by:</i>	Early LSA (1BS1r & 1WA)	MSA 3 (2BSup- 2WA)	MSA 2 (3BSup- 3WA)	MSA 1 (1GBSup- 1GBS1rB)
Bushpig, Cape buffalo, tragelaphine antelopes, and impala	12(80%) ^a	12(39%) ^b	4(80%) ^c	8(57%) ^d
Warthog, zebra, and alcelaphine antelopes	3 ^e	18 ^f	1 ^g	6 ^h
	15	30	5	14

Chi-square values (Yates-Corrected)

- ab = 4,92, p = 0,05-0,02
- ef = 0,42, p = 0,7-0,5
- ac = 0,86, p = 0,5-0,3
- eg = 1,39, p = 0,3-0,2
- ad = 0,55, p = 0,5-0,3
- eh = 0,14, p = 0,8-0,7
- bc = 0,55, p = 0,5-0,3
- fg = 0,14, p = 0,8-0,7
- bd = 0,55, p = 0,5-0,3
- fh = 0,14, p = 0,8-0,7
- cd = 0,14, p = 0,8-0,7
- gh = 0,14, p = 0,8-0,7

teeth of zebra, suids, and bovids are represented in the various layers of Beaumont's principal excavation. Table 4, based on data extracted from Table 3, shows that the 'number of squares' estimates of species frequency bring out the contrast between the early LSA and immediately underlying MSA 3 more clearly than before and suggests in addition that there is a meaningful difference between the MSA 3 and the underlying MSA (once again the MSA 3 has a higher proportion of creatures preferring more open environments).

Table 5 provides the results of a multivariate statistical analysis of the frequency variation in the principal species (zebra, bushpig, warthog, hartebeest/tsessebe, blue wildebeest, kudu, and buffalo) on which Table 4 is based. The results must be regarded cautiously because the matrix from which they were derived (an appropriately reduced version of Table 3) is less than ideal for multivariate analysis, in large part because it includes some species (for example, kudu) which exhibit relatively little frequency variation. The analysis would also gain in power and reliability if it were somehow possible to increase the number of provenience units (layers). Even with these caveats in mind, however, the analysis suggests very strongly that the frequencies of at least zebra, warthog, and hartebeest/tsessebe are varying together systematically and independently of those of bushpig and buffalo which are also varying together. A matrix of bivariate (product-moment) correlation coefficients produced as an intermediate step in the multivariate analysis points to the same conclusion, as do in fact the raw frequencies in Table 3, when looked at with the results of the multivariate analysis in mind. In sum, at least using species frequency estimates based on the number of squares in which a species occurs, there is ample evidence in the Border Cave sequence for systematic fluctuations in the proportion of creatures preferring grassier vegetation versus those preferring bushier settings.

It would be difficult, if not impossible, to obtain reliable quantitative information on the frequencies of various ungulates in the eastern lowveld at time of historic contact. Still, data presented by Mentis (1970) on the recent history of ungulate frequency changes in the Umfolozi Game Reserve, located roughly 125 km south of Border Cave in a broadly comparable setting, suggest strongly that the climax fauna was one in which zebra and warthog were substantially more numerous than buffalo and bushpig and that the latter come to dominate mainly in situations where bush encroachment has been encouraged by human activity. Presumably, they would also become more numerous in situations where 'natural' environmental change encouraged the spread of bush. With the Umfolozi information in mind, it is possible to hypothesize that the Early LSA and at least a part of the MSA 1 and 2 deposits at Border Cave accumulated in periods when conditions were substantially different from modern ones (bushier), while the MSA 3 levels were laid down in an interval in which the vegetational setting approximated the historic one (relatively grassy). It seems reasonable to hypothesize that the times with bushier conditions reflect the periods of lowered temperatures

and changed atmospheric circulation patterns that characterized the later Pleistocene everywhere, including southern Africa (Butzer 1976). Butzer's (in preparation) analysis of the profile at the Klasies River Mouth MSA site in the southern Cape suggests that artefacts called 'Howieson's Poort' there may date from a marked cold oscillation within the later part of the Last Interglacial at about 95 000 B.P. The Border Cave MSA 2 is very similar to the Klasies 'Howieson's Poort' and may well be the same age. At least the uppermost part of MSA 1 (layer 1GBSup) perhaps belongs to the same cold interval since it contains a high frequency of bushpig and buffalo, while the MSA 3, with a much-reduced frequency of these creatures, would then date from a post-95 000 B.P. warm interval. Finally, the Early LSA, characterized once again by a high frequency of species preferring relatively closed habitats, would probably fall in the earlier part of the Last Glacial, after 75 000 B.P. It is unfortunate that absolute dates which could confirm this are probably not obtainable at Border Cave, but circumstantial corroboration may come from analyses of the sediments and pollen underway by Butzer and Horowitz respectively.

Subsistence Implications of the Border Cave Fauna

In the absence of published, independent evidence for climatic and vegetational change as the cause of the faunal fluctuations discussed in the last section, it is possible to argue that the fluctuations reflect only the changing hunting practices of the ancient inhabitants of Border Cave. However, in my opinion, it is difficult to understand why people would shift their focus in hunting from a set of species preferring more closed vegetational conditions to a set preferring more open ones and then back to the first set, unless the species themselves were fluctuating in frequency. Especially given the time spans over which the faunal fluctuations seem to have been taking place, I think that general environmental change must remain the fundamental explanation.

My analysis of several large Middle Stone Age and Later Stone Age faunas from sites in the southern Cape Province has suggested that in that area at least, MSA peoples took significantly more eland and significantly fewer suids than LSA peoples living under essentially similar environmental conditions (Klein 1975). I have hypothesized that this reflects MSA avoidance of especially dangerous prey (suids and eland would be on virtually opposite ends of a continuum from very fierce to relatively docile when attacked). From Tables 1 and 3, it is obvious that there are no significant differences between the Border Cave MSA and LSA levels in the abundance of eland. It is generally uncommon at the site, perhaps because it has always been an uncommon species in lowveld faunas. Table 6 shows that there is also no evidence for an increase in suids (versus bovids) in the Border Cave LSA. Perhaps documentation for such an increase would appear only in much larger samples, given that suids have probably always been much more common in the vicinity of Border Cave than in the southern Cape. Alternatively, it is possible that an increase in the suid/bovid ratio really only characterizes LSA cultures that are

TABLE 4. 'Number of squares' estimates of the frequency of bushpig, Cape buffalo, tragelaphine antelopes and impala versus that of warthog, zebra, and alcelaphine antelopes in the various culture-stratigraphic units of Border Cave. Based on frequency data in Table 3.

The minimum numbers of individuals represented by	Early LSA (1BS1r & 1WA)	MSA 3 (2BSup-2WA)	MSA 2 (3BSup-3WA)	MSA 1 (1GBSup-1GBS1rB)
Bushpig, Cape buffalo, tragelaphine antelopes, and impala	27(73%) ^a	14(22%) ^b	3(75%) ^c	17(70%) ^d
Warthog, zebra, and alcelaphine antelopes	10 ^e	50 ^f	1 ^g	7 ^h
	37	64	4	24

Chi-square values (Yates-corrected)

ab = 23,31, p < 0,001
 cf = 0,26, p = 0,7-0,8
 ac = 0,01, p = 0,95-0,90
 ad = 3,19, p = 0,10-0,05
 eh = 16,25, p < 0,001
 fg = 0,18, p = 0,7-0,5
 bc = 3,19, p = 0,10-0,05
 fg = 0,18, p = 0,7-0,5
 bd = 16,25, p < 0,001
 fh = 0,18, p = 0,7-0,5
 cd = 0,18, p = 0,7-0,5
 gh = 0,18, p = 0,7-0,5

TABLE 5. Varimax rotated principal components solution of the frequency variation in zebra, bushpig, warthog, hartebeest/tsessebe, wildebeest, kudu, and buffalo through the deposits of Border Cave. Only components with eigenvalues greater than 1 are included (the eigenvalue of the fourth initial component was 0,56). A species that has a loading of >0,71 on a component has more than 50% (>0,71 × 0,71) of its variation explained by that component. This means that species that have loadings of >0,71 on the same component are probably varying together in a systematic way. (A high negative loading, as in the case of wildebeest on component 2 below, implies a strong inverse frequency relationship with species that have high positive loadings on the same component.) The matrix submitted for analysis (an appropriately reduced version of Table 3) in fact exhibits too little frequency variation among too few provenience units to be totally appropriate for principal components analysis, but the results are still highly supportive of an inverse frequency relationship between species preferring bushier environments and those preferring grassier ones. For additional discussion, see the text. The analysis was performed on the University of Chicago's IBM 370/168 Computer using the method 'PA1' and appropriate options of the subprogram FACTOR from the *Statistical Package for the Social Sciences* (Nie *et al.* 1975).

	Components		
	1	2	3
Zebra	0,91	-0,23	-0,04
Bushpig	-0,40	0,72	0,08
Warthog	0,77	0,05	0,52
Hartebeest/tsessebe	0,96	-0,08	0,14
Wildebeest	-0,12	-0,84	0,15
Kudu	0,12	-0,07	0,94
Cape buffalo	-0,13	0,82	0,01
Eigenvalue of initial component	3,07	1,71	1,01
Percentage of variance explained	43,9	24,4	14,4

TABLE 6. The frequencies of suids and bovids in the Middle Stone Age and Later Stone Age deposits of Border Cave. Compiled from data in Tables 1 and 3.

	Frequency estimates based on the minimum number of individuals in different units.		Frequency estimates based on the numbers of squares in which teeth of different taxa occur in different units.	
	LSA	MSA	LSA	MSA
Suids	3(11%)	10(12%)	12(20%)	21(20%)
Bovids	25	73	49	86

TABLE 7. The frequencies of bovids in different dental age-states in the Stone Age deposits of Border Cave. I = dP4 erupting to erupted, but essentially unworn; II = M1 erupting to erupted, but essentially unworn; III = M2 erupting to erupted, but essentially unworn; IV = M3 erupting to erupted, but essentially unworn; V = P4 erupting to erupted, but essentially unworn; VI = P4 in early to mid-wear; VII = P4 in late wear.

	DENTAL AGE STATES						
	Younger						Older
	I	II	III	IV	V	VI	VII
Steenbok	—	—	—	1	—	4	1
Oribi	—	—	3	1	1	3	—
Klipspringer	—	—	—	3	—	5	—
Mountain reedbuck	1	—	—	1	2	7	—
Waterbuck	—	—	—	—	—	1	—
Roan/sable	1	—	—	1	1	—	1
Impala	—	—	1	3	2	—	—
Small bastard hartebeest	—	—	—	—	1	—	—
Hartebeest/tsessebe	—	—	1	3	1	3	—
Wildebeest	—	—	1	2	—	3	—
Bond's springbok	—	—	3	1	2	3	—
Kudu	—	—	—	2	—	1	—
Nyala	—	—	—	1	—	—	?1
Bushbuck*	—	—	—	—	—	—	—
Eland	—	—	?1	—	—	1	—
Buffalo	5	1	1	2	3	4	1

* no ageable teeth

TABLE 8. The percentages of buffalo in different dental age states in the Middle and Later Stone Age levels of Border Cave, the Middle Stone Age levels of Klasies River Mouth, and the Later Stone Age levels of Nelson Bay Cave. The Klasies MSA probably dates from between 130 000 and 60–50 000 B.P. (Klein 1975, 1976b). The Nelson Bay LSA is bracketed between 18 500 and 5000 B.P. by radiocarbon (Klein 1972). The dental states are defined in the caption to Table 7.

	Percentages							(N)
	Younger						Older	
	I	II	III	IV	V	VI	VII	
Border Cave	29	6	6	7	18	24	6	(17)
Klasies River Mouth	30	19	6	9	7	23	7	(70)
Nelson Bay Cave	25	18	4	11	7	25	11	(56)

substantially later than the Early LSA of Border Cave. In the southern Cape, the LSA faunas I have compared to MSA ones are at least 20 000 years younger than the youngest local MSA fauna and at least 15 000 years younger than the Border Cave Early LSA. The first southern Cape archaeological fauna known to fall in the time range of the Early LSA is only now being excavated by H. J. Deacon at Boomplaas Cave near Oudtshoorn.

The Border Cave fauna is similar to virtually all other archaeological faunas in the low frequency of carnivores (Table 1). This presumably reflects a mutual avoidance relationship between Stone Age man and at least the larger carnivores. The largest and most dangerous ungulates available—elephant and rhinoceros—are also poorly (and only questionably) represented at the site. They too were perhaps infrequently hunted, though, at least in part, the near absence of their remains at the site may reflect the difficulty of bringing home their heavy bones, even if a kill were made.

Some additional information on the way in which the inhabitants of Border Cave interacted with various prey species may be obtained from an examination of the ages of animals at time of death. Table 7 presents dental age distributions for the bovids, the only Border Cave species for which there are large enough samples of ageable teeth to establish such distributions. In evaluating Table 7, it is important to keep in mind that there may be preservational biases against teeth of very young animals, especially of the smaller species. However, contrasts within the table, at least between the age distributions of species with teeth of roughly comparable size, probably have palaeoecological significance. Particularly interesting in this regard is the relatively high frequency of very young animals (in dental states I and II) in buffalo and their absence or near absence among other species such as roan/sable, hartebeest/tsessebe, wildebeest, and kudu, whose deciduous teeth would probably survive destructive agencies about as well as those of buffalo. A similarly high

proportion of very young individuals characterizes buffalo age distributions in southern Cape Stone Age faunas I have examined. In fact, as Table 8 shows, the dental age distribution of buffalo at time of death is remarkably similar between Border Cave and the two southern Cape sites (Klasies River Mouth and Nelson Bay Cave) which have provided comparable quantities of buffalo remains. Further, the age distributions in Table 8 are probably very similar to those in lion kills in Kafue National Park, Zambia (Mitchell *et al.* 1965) and in lion/hyena kills in Kruger National Park, Transvaal (Pienaar 1969). Direct numerical comparisons are not possible because the Kafue and Kruger buffalo have been aged by somewhat different criteria than the archaeological buffalo and, at least in Kruger, most very young buffalo killed were probably totally eaten before discovery, preventing precise estimates of their numbers. The apparent similarity among the age distributions from three Stone Age sites widely separated in time and space (see Table 8) and between them and the distributions in Kafue and Kruger large carnivore kills suggests that, in Stone Age times at least, characteristics of buffalo behaviour, herd structure, etc., were probably more important in determining predation patterns than the particular characteristics of the predator.

The absence or near absence of very young wildebeest, hartebeest/tsessebe, etc., at Border Cave may mean that the Stone Age inhabitants were generally not in the vicinity when these species calved or that the species were migratory and the calves were born somewhere else. Unfortunately, the Border Cave dental samples are too small to test the hypothesis of seasonally restricted parturition and human occupation by determining, for example, if the crown height measurements of any species form equidistant clusters, like those used by Kurtén (1953) to demonstrate seasonal births and deaths in fossil Chinese bovids. Unfortunately also, with the exception of the buffalo, those species which occur at both Border Cave and in the southern Cape faunas I have analysed are represented in one place or the other by numbers that are too small to allow meaningful comparisons between age distributions.

The Implications of Border Cave Body Part Frequencies

Table 9 presents the minimum numbers of non-bovid individuals represented by different body parts at Border Cave. Figure 2 provides comparable data for the bovids, presented not by species but by size classes for reasons discussed previously. The order in which body parts are listed in the figure was determined primarily by their frequency of occurrence in small bovids. Where ties occurred, more proximal elements were listed first.

The data in Figure 2 may be used to illustrate what are probably the main determinants of body part frequency discrepancies at Border Cave. Supported by the results of significance tests in the caption, the figure implies that the patterns of body part representation are different between the smaller bovids and the larger ones. In particular, the number and magnitude of frequency discrepancies among body parts are greater for the larger bovids than for

the smaller ones, suggesting that the larger the bovid, the less likely it was to reach the site intact, that is, the more likely it was that only selected parts of it would be returned. With regard to the large bovids, a rapid examination of Figure 2 will show that they are represented almost entirely by parts of the skull and feet; their limb bones and vertebrae are very rare. The implication is that the inhabitants of Border Cave preferentially brought back large bovid skulls and feet, a pattern which also seems to have characterized the occupants of other Stone Age cave sites, for example, those of Klasies River Mouth Cave 1 as discussed by Klein (1976b).

Examination of Table 9 will show that suids and zebra are also characterized by patterns of body part representation in which foot and skull bones predominate heavily. It is possible that the emphasis on feet and skull has been exaggerated by the accidental assignment of some zebra and especially suid limb bone and vertebral fragments to the large medium bovid category. Very fragmentary zebra and suid limb bones and vertebrae can be very difficult to distinguish from homologous pieces of similarly sized bovids. Still, the number of mistakes cannot be great enough to alter the general conclusion that only selected portions of suid and zebra carcasses tended to reach the site.

The Border Cave bones are very highly fragmented, partly as a result of food preparation, but probably mainly as a result of repeated trampling, burning, etc., from which they were poorly protected by relatively slow sedimentation combined with relatively intensive occupation. Most of the discrepancies among the frequencies of smaller bovid body parts (and also some among the frequencies of larger bovid ones) almost certainly reflect the differential durability of different bones when subjected to intense pre- and especially post-depositional destructive agencies. As expected, if differential durability were playing an important role, the data in Figure 2 show that distal humeri tend to outnumber proximal ones, proximal radii distal ones, proximal femora distal ones, and distal tibiae proximal ones. (For a discussion of the durability characteristics that make these the expected results, see Brain 1969.)

Although the pattern of differences in body part representation among bovid size classes is roughly the same for the Border Cave sample as for other faunas I have analysed in a similar way (e.g. the Klasies River Mouth I fauna reported in Klein 1976b), comparisons I have not reported here generally reveal some significant differences between the frequencies in any Border Cave size category and those in the same category at other sites. The differences may be partly due to differences between Border Cave and other sites in the species and frequencies of species comprising each size category, but I think the principal reason for the differences is the relatively great post-depositional destructive pressure to which the Border Cave fauna has been subjected. This has led to a much higher degree of fragmentation at Border Cave than in most of the faunas I have examined.

It is probable that differential bone durability is largely responsible for body part frequency dis-

TABLE 9. The minimum numbers of non-bovid individuals represented by different body parts at Border Cave.

	Hare	Porcupine	Baboon	Vervet monkey	Honey badger	Leopard	Hunting dog	Indeterminate small carnivore	Indeterminate small medium carnivore	Hyraxes	Elephant	Rhinoceros	Zebra	Giant Cape horse	Suids	Hippopotamus
maxilla	23	1	1	1						4	21*	21	3	1	10	1
mandible	26		2					1	1	4			10	1		
atlas	2									2					1	
axis	2									1						
cervicals 3-7	3															
thoracic vertebrae	5															
lumbar vertebrae	9															
sacrum	2															
scapula	13									3						
proximal humerus	5							1		4						
distal humerus	14							1								
proximal radius	4														1	
distal radius	3												1			
proximal ulna	9								1	2			1		2	
distal ulna	8									2					4	1
carpals	-															
innominate	22							2		2						
proximal femur	11			1					1	2			1			
distal femur	10									1						
patella	2															
proximal tibia	6									1						
distal tibia	7												1			
astragalus	9									1			1		3	
calcaneum	20									1			1			
other tarsals	2									1			1		1	
metapodials	10		1										2		8	
phalanges	2		3										5		12	

* ivory fragments

crepancies in the hares and other small mammals included in Table 9. I plan to pursue this point further in the analysis of body part frequencies from sites in the southern Cape (Die Kelders and Byeneskranskop) in which small mammals are especially well represented.

Extinct Species in the Border Cave Fauna

Besides the 'giant Cape horse' and possibly the small bastard hartebeest mentioned previously, there is another extinct species in the Border Cave fauna—the hyperhypsodont Bond's springbok, *Antidorcas bondi* (Fig. 3) (*A. bondi* was formerly referred to as '*Gazella bondi*'. Vrba (1973) has presented compelling evidence that the species is best assigned to *Antidorcas*.) With a history extending back to at least the early Pleistocene (Vrba 1973), Bond's springbok was still widespread in the southern African interior

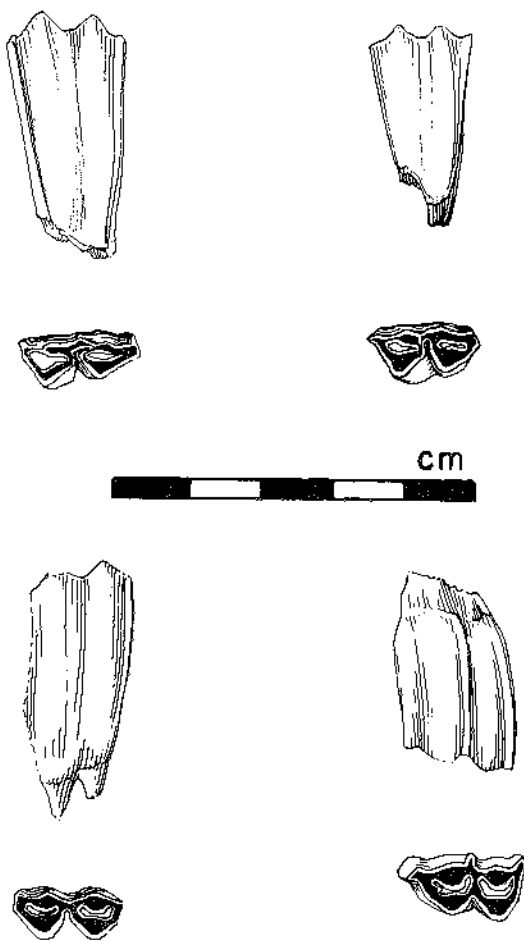


Fig. 3. Teeth of *Antidorcas bondi* from Border Cave. (Upper left & upper right from 2BS1rC sq. S24, lower left from 2BS1rC sq. S23, lower right from 2BS1rB sq. S21. Drawings by K. Scott.)

in the Upper Pleistocene, occurring at various sites (for example Florisbad and Vlakkraal in the Orange Free State, the Cave of Hearths in the Transvaal, and Chelmer in Rhodesia—Cooke 1963: table 7) where it was often accompanied by other extinct taxa—notably, the 'giant horse', the giant buffalo (*Pelorovis antiquus*), and the 'giant hartebeest' (*Megalotragus priscus*).

Evidence from the southern Cape suggests that the giant buffalo, 'giant hartebeest', and giant equid made their last appearance there in the terminal Pleistocene (Klein 1974 and unpublished). It is unclear whether they disappeared at the same time, earlier, or perhaps even somewhat later in the southern African interior. Similarly, the time of extinction of Bond's springbok remains completely unknown. Border Cave is so far the only site where the species has been recorded in a radiocarbon-dated context (in unit IWA with an apparent ^{14}C age in the vicinity of 38 000 years B.P.) and in association with a post-Middle Stone Age industry. Tables 1 and 3 show that the species is most prominent in those Border Cave horizons in which zebra, warthog, and alcelaphines predominate, suggesting that it preferred relatively open vegetational settings. This could also have been predicted from its extraordinarily hypsodont teeth and knowledge of its closest living relative, the extant springbok, *Antidorcas marsupialis*.

Conclusions

Study of the bones of larger mammals from P. B. Beaumont's excavations at Border Cave suggests the following conclusions:

1. A vegetational mosaic broadly similar to the present one persisted in the area throughout the long, probably earlier Upper Pleistocene interval (c 125 000 to perhaps 35 000 B.P.) when various MSA and Early LSA peoples brought back bones to the site. At the same time, changes in species frequencies through time indicate that there were significant long-term fluctuations in the relative amount of grass versus bush in the mosaic. I have hypothesized that times with more bush—that is, all or part of MSA 1 & 2 and the Early LSA—reflect climatic conditions significantly different from present ones, first during a marked cool oscillation in the later part of the Last Interglacial and subsequently in the early part of the Last Glacial. An intervening time with more grass—MSA 3—probably reflects climatic conditions more like present ones, possibly also in the later part of the Last Interglacial.

2. There is no evidence for differences in hunting practices between the Middle Stone Age and Later Stone Age inhabitants of Border Cave, although it is possible such differences, if they exist, would emerge only in larger samples.

3. Similar to comparable data from other sites, the Border Cave body part frequency data indicate that smaller animals tended to be brought back to the site intact, while only selected parts of larger ones were generally returned. Many, if not most, differences in body part frequencies between taxa represented at Border Cave and comparable taxa in other faunas I have analysed are probably due to the extreme

fragmentation of the Border Cave bones, reflecting the severe pre- and especially post-depositional destructive pressures to which they were subjected.

4. The Border Cave fauna contains at least two and possibly three extinct species, of which the most interesting is perhaps Bond's springbok, *Antidorcas bondi*. The species with which it is associated at Border Cave underline its preference for open vegetational settings, also inferable from its dentition. The evidence from Border Cave suggests that Bond's springbok survived until perhaps 38 000 B.P., if not later, and after the first Later Stone Age peoples had made their appearance at the site.

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