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Bone Collecting by Brown Hyaenas *Hyaena brunnea* in the Central Namib Desert, Namibia

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Results are presented of bone accumulations at two dens utilized by brown hyaenas in the Namib Desert. Seventy-seven percent of 3500 bones could be identified representing 142 different food items. Fur seals accounted for 2/5 of the assemblages, other carnivores a quarter, ungulates only 1/20 and the remaining 1/5 avifauna. The results confirm that such assemblages can accurately reflect the composition of the vertebrate fauna from which brown hyaenas scavenge food.

Keywords: BONE COLLECTING, BROWN HYAENAS, NAMIB DESERT.

Introduction

All three species of hyaenas, *Hyaena hyaena, H. brunnea* and *Crocuta crocuta* have been implicated in accumulating bones at den sites (Sutcliffe, 1970; Skinner, 1976; Bearder, 1977; Mills & Mills, 1977; Owens & Owens, 1978; Skinner *et al.*, 1980; 1986). It is the two *Hyaena* species, however, which have been found to be the most important bone collecting agents. This is because group members carry food back to maternity dens where, over extended periods, cubs are raised from time-to-time. The resulting bone assemblages serve as important sources of data for archaeological research (Skinner *et al.*, 1980; Brain, 1981).

In the present paper, which forms part of a wider study on the behavioural ecology of hyaenas in the Namib Desert, information is provided on bone accumulations at two *H. brunnea* maternity den sites in the central Namib desert about 20 km south of Luderitz (26°39′S, 15°09′E). The environment is pristine and, apart from the annual culling of seal pups, has been undisturbed by man for 50 years (Figure 1). Each site was used by members of two different clans during the course of the study, but the accumulations were the result of decades of occupation and not just from the hyaenas presently occupying the den. Although *Crocuta* occur within 40 km of the Namibian coastline, they are prevented by extremely cold climatic conditions and other factors from operating along the coast south of Luderitz (Skinner *et al.*, 1984).

Materials and Methods

Coastal den

This den is situated 800 m from the coastline on the north-west facing slope of a low ridge of metamorphic sediments and lava of the Bogenfels Formations. The cave has been

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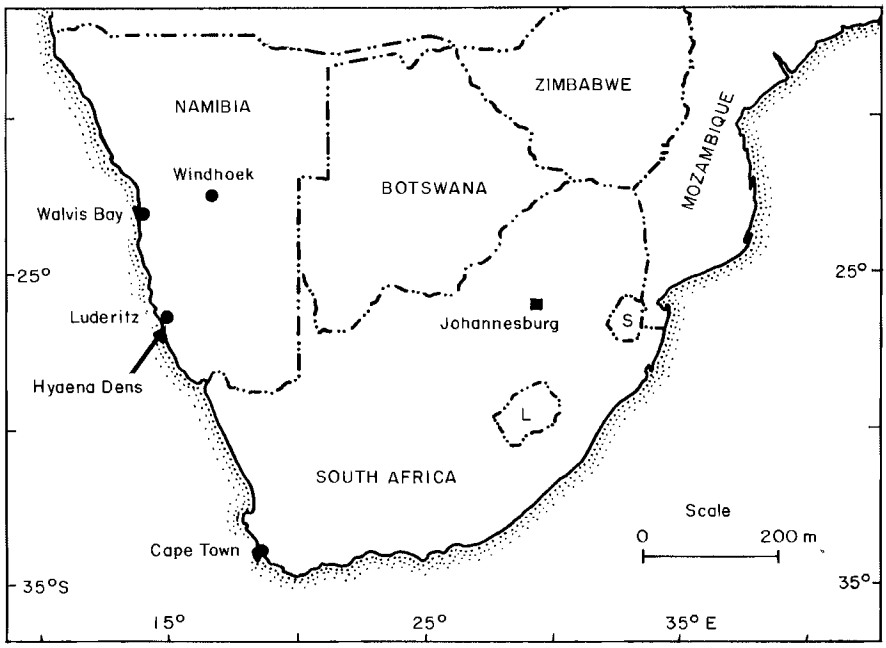

Figure 1. Outline map of southern Africa with location of den sites indicated on the west coast.

weathered out of the bedrock by a combination of water and wind action. The front part of the cavern roof had collapsed forming an uneven apron to a narrow entrance in the form of two vertical slits about 50 cm high. Behind these slits the cavern extended 5–7 m into the rock formation and the height of the ceiling varied from a few centimetres to 1·2 m. A litter of two cubs was raised in this den in 1982/3 and three adults were observed carrying food to them. The area immediately in front of the apron was used by the hyaenas as a playground and there was a shallow depression or gully descending from the playground to the bottom of the ridge. Bone, bone fragments, pieces of hide, hair and feathers were collected and placed in separate bags according to location: cavern, apron, playground, gully.

Inland den

This den is situated 8·2 km from the coast on the north-west facing slope of a granite gneiss outcrop. The cavern had been weathered out by wind action. The narrow entrance prevented inspection of the cavern. At least two adults used the cavern as a shelter and bones and bone fragments were collected for analysis from around the entrance. No cubs were born or raised here during the course of the study, although the den was occupied.

The bone collections from both sites were analysed in Pretoria against reference material and particular care was taken to establish the involvement of porcupines, *Hystrix africaeaustralis*, which are also important bone collecting agents in some regions (Brain, 1976, 1981).

Results

Sixty-eight percent of bones and bone fragments collected at the coastal den were taken from the inner cave, the remainder being scattered over the apron, playground and gully (Table 1). Identification was markedly affected by weathering and chewing and 29·7% of

Table 1. Species distribution of bones, bone fragments and loose teeth in and around the coastal maternity den of brown hyaenas in the Central Namib Desert (see text for a description of locations. Percentages in parentheses)

Species	No. of bones and bone fragments				
	Inner cavern	Apron	Play ground	Gully	Total
Arctocephalus pusillus	1225	193	139	71	1628 (51·2)
Canis sp.	209	56	25	12	302 (9·5)
Hyaena brunnea	4	0	0	0	4 (0·1)
Lepus spp.	5	0	0	0	5 (0·2)
Hystrix africaeaustralis	5	0	0	0	5 (0·2)
Dolphin	9	2	0	2	13 (0·4)
Whale	6	12	2	2	22 (0·7)
Bovid	21	3	1	0	25 (0·8)
Spheniscus demersus	76	16	12	12	116 (3·7)
Other birds	82	8	8	16	114 (3·6)
Unidentified	515	188	171	68	942 (29·7)
Total	2157 (67·9)	478 (15·1)	358 (11·3)	183 (5·8)	3176

Table 2. A quantitative list of food items present in and around the coastal and inland maternity dens of brown hyaenas in the Central Namib Desert

Food item	Minimum number of individuals				Total	
	Coastal den		Inland den		Minimum number of individuals	% contribution
	no.	%	no.	%		
Arctocephalus pusillus	37	38·5	21	46·6	58	40·9
Canis mesomelas	22	22·9	9	19·6	31	21·8
C. familiarus	1	1·0	2	4·3	3	2·1
Hyaena brunnea	1	1·0	1	2·2	2	1·4
Antidorcas marsupialis	1	1·0	2	4·3	3	2·1
Raphicerus campestris	0	0	2	4·3	2	1·4
Oryx gazella	0	0	1	2·2	1	0·7
Unidentified bovid	3	3·1	0	0	3	2·1
Hystrix africaeaustralis	1	1·0	1	2·2	2	1·4
Lepus spp.	2	2·1	1	2·2	3	2·1
Dolphin	1	1·0	1	2·2	2	1·4
Whale	1	1·0	0	0	1	0·7
Spheniscus demersus	16	16·7	1	2·2	17	11·9
Other birds	10	10·4	2	4·3	12	8·5
Struthio camelus eggs	0	0	2	4·3	2	1·4
Total	96	99·7	46	99·9	142	99·7

the 3176 bones collected at the coastal den could not be identified. Most of these were fragments of skulls and longbones. A significantly larger ($\chi^2 = 14{\cdot}64$, $P < 0{\cdot}001$) proportion of bones collected from outside the cave than those collected from within the protection offered by the cave, could not be identified.

Some 79% of the 3500 bones from the two dens could be identified, representing at least 142 different food items (Table 2). Most of these were *Arctocephalus pusillus*, while 23·9%

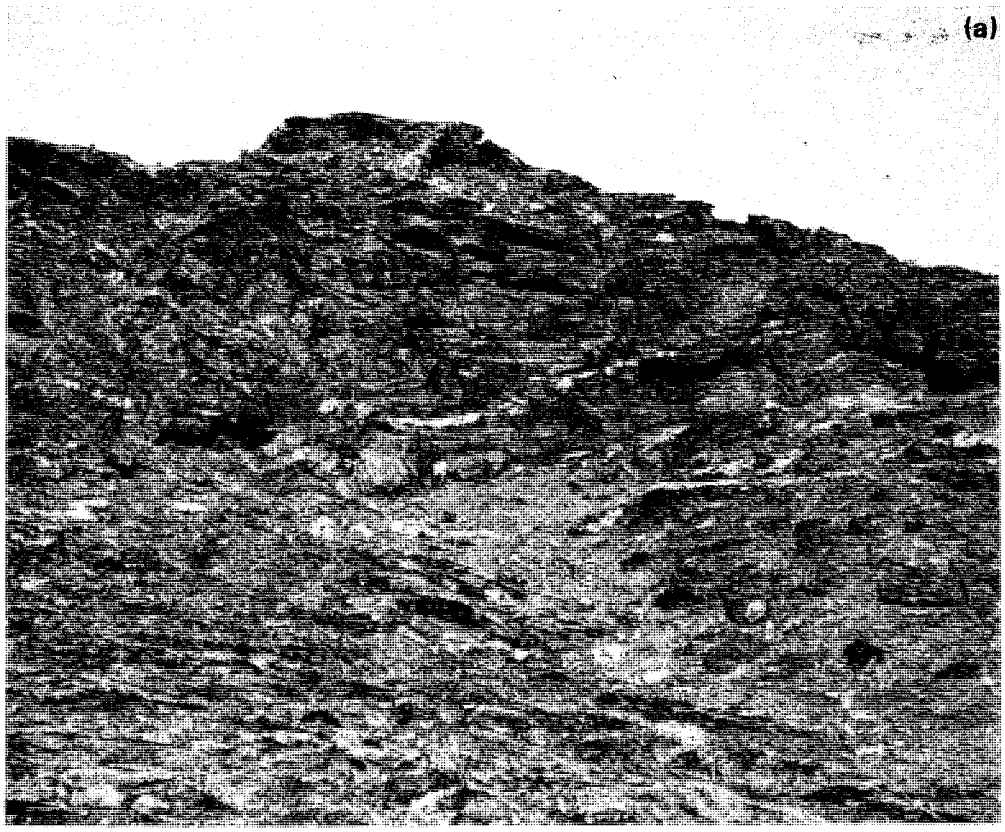

Figure 2. (a)

were *Canis*. The percentage *Arctocephalus* was greater inland while that of Aves was much lower, indicating, on the one hand, that seal bones survived the journey, and on the other, that birds may have been too small to merit the energy expenditure or their bones were too fragile to survive for long periods. There was a greater percentage of bovid bones in the inland cave, perhaps reflecting a greater presence away from the coast. Details of identifiable bones from the two caves are listed in Appendices A and B.

Discussion

The proportion of food items in Table 2 reflects the composition of the available vertebrate food items, as the territories of the two hyaena groups focused on a very large seal colony at Wolfsbaai and part of the coast where large numbers of seal carcasses wash up. About 30 jackals scavenged and, together with brown hyaenas, took young seal pups from this area. Indeed, all the vertebrates listed in Table 2 were seen during the course of observations in the study area, except porcupines which may have been devoured at the den by hyaenas at some previous time. No evidence was found of porcupine gnawing marks on any bones.

Fur seals made up 2/5 of the assemblages, other carnivores a quarter and ungulates only 1/20 of this, while avifauna accounted for 1/5 of identified food items. Bones from small mammals and birds would be under-represented as a large proportion was probably

Figure 2. (b)

Figure 2. (a) The coastal den site. (b) The inland den site.

swallowed and those remaining would be rapidly weathered. For example, a hyaena was observed to catch a gerbil and to take an ostrich egg after the hen left the nest with the hatched chicks, attempts to drive the hen off the nest having been unsuccessful.

There is no doubt that the accumulator of these bones was the brown hyaena and that the bones reflect prey taken to the dens within the last few decades. These results confirm other studies on *Hyaena* (Skinner, 1976; Mills & Mills, 1977; Skinner *et al.*, 1980) which identify this animal as a prime agent in the accumulation of bones, particularly at maternity den sites.

The present analysis of the bones accumulated is, moreover, very similar to an analysis of hairs from scats from hyaena latrines from Wolfsbaai undertaken during 1979 (Skinner & Van Aarde, 1981). Seal and jackal hair predominated in the scats, and hair from three species of small mammals not found in the bone assemblage was also present. On the other hand feathers, most of which belonged to the genus *Falco* were only present in 5% of scats.

The importance of brown hyaenas as accumulators of bones in archaeological sites has been discussed by Klein (1975) and Klein & Cruz-Uribe (1984). Their conclusions are based on circumstantial evidence, but the results from the present study confirm their conclusions, not only because of the large percentage of carnivore bones present, but also because *Canis mesomelas* predominated. This is not surprising as there is a close association between *C. mesomelas* and *H. brunnea* which invariably has a number of "satellite"

jackals in attendance when foraging. In addition, our observations have shown that *C. mesomelas* is avidly taken when used as bait (Skinner, unpubl.) so that jackals that make mistakes or become ill or decrepit could fall prey to hyaenas. Along the west coast *C. mesomelas* is the second most abundant mammal following seals and they occur in large aggregations near the seal colonies.

In Klein's (1975) study of the bone assemblage at Swartklip 1 on the False Bay coast, there are no bones from sea mammals or sea birds. Our results would indicate that these should have predominated, particularly as *H. brunnea* was called the "strandjut" or beach wolf by the early settlers and is a very effective scavenger along the coast (Skinner & Smithers, 1990). Klein (1975) states that his species list indicates quite a different environment from the "present" one and our results confirm his deduction that, at the time of the accumulation, Swartklip must have been a long distance from the coastline. Seventy percent of the prey animals at Swartklip were ungulates compared to only 6% at the Namib maternity dens, but with 41% seals replacing the ungulate component. At what stage *H. brunnea* changed its diet is unknown but, as a scavenger and not a hunter, this would not have been difficult. Moreover, Klein & Cruz-Uribe (1984) are correct in deducing that *Crocuta* were not implicated at their sites as remains of larger prey would have predominated, as would heavier bones.

We did not age remains of skulls in the Namib Desert dens so can make no meaningful statement other than that, from studies of their behavioural ecology, seal pups almost certainly would have predominated (Skinner & van Aarde, unpubl.).

The results of the present study confirm that brown hyaenas are indeed prime agents in the accumulation of bones. Moreover, the dietary evidence confirms that such bone assemblages can accurately reflect the composition of the vertebrate fauna of a region from which brown hyaenas scavenge food. The results also tend to confirm the opportunistic foraging behaviour of brown hyaenas and indicate how well they have adapted to life on the arid, cold west coast of southern Africa.

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Appendix A

Bones collected from the coastal den

Identifiable remains = 2234 bones

Unidentifiable remains = 942 bones

	(1) Seal				(2) Canid Jackal/hyaena feraldog*				(3) Penguin					(4) Other bird			(5) Bovid			(6) Dolphin			(7) Whale			(8) Hare		(9) Unk			
	A	B	C	D	A	B	C	D	A	A	B	C	D	A	B	D	A	B	C	A	B	D	A	B	C	D	A	A	B	C	D
Humerus																															
complete	28	9	4	1	2	2	—	—	—	5	3	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	22	10	2	1	5	—	—	—	—	1	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	11	2	1	1	2	—	—	—	—	1	—	2	2	—	1	—	1	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
proximal	7	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Femur																															
complete	14	8	2	2	2	—	—	—	—	5	1	1	—	5	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	23	—	—	—	1	1	—	—	—	3	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	5	—	—	—	1	—	—	—	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
proximal	—	—	—	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Radius																															
complete	31	4	5	—	2	—	1	—	—	—	—	3	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	14	1	1	—	3	3	—	—	—	3	—	—	—	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	5	2	—	2	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
proximal	3	—	—	—	5	—	—	—	—	—	—	—	—	—	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ulna																															
complete	20	2	2	—	1	1	—	—	1	5	3	—	—	5	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	9	5	—	—	3	1	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	6	—	2	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
proximal	5	—	3	—	6	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tibia																															
complete	13	—	3	2	3	—	2	—	—	6	2	—	1	6	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	10	4	3	—	3	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	—	—	3	—	3	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
proximal	2	1	—	—	1	1	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fibula																															
complete	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
shaft	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
proximal	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mandible	38	9	6	1	15	14	4	—	—	5	—	—	—	7	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	1	—	—
Loose teeth & fragments	92	13	4	2	2	4	4	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Skull fragments inc max and pal	271	42	41	14	10	9	3	1	—	—	—	—	—	2	—	—	1	—	1	—	—	—	—	—	—	—	1	31	22	7	1
Unidentified fragments	37	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	1	4	—	—	—	291	98	115	38
Phalanges																																	
proximal	35	7	3	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
distal	31	2	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
unknown	59	2	3	2	7	—	—	1	—	—	—	—	—	1	—	1	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Astragulus																																	
tarsal	2	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
calcaneum	5	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Carpals	4	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Metatarsals	6	—	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Metacarpals	—	—	—	—	9	—	—	—	—	2	—	—	2	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Metapodials	11	5	—	—	1	5	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tarso-metatarsus	—	—	—	—	—	—	—	—	—	1	—	1	—	4	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Ribs	171	12	20	18	50	5	6	5	—	—	1	1	—	13	—	—	6	1	—	—	—	—	—	—	—	—	—	158	66	48	29
Girdles																																	
Pectoral																																	
coracoid	—	—	—	—	—	—	—	—	—	12	—	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
sternum	1	—	—	—	—	—	—	—	—	2	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
scapula	53	21	3	3	4	1	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—
Pelvic																																	
complete	17	9	5	—	10	2	1	—	—	1	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ilium	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ischium	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
pubis	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ischium and pubis	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vertebrae																																	
complete	54	16	22	7	42	5	2	5	1	11	—	2	—	4	—	—	2	—	—	9	2	2	5	—	2	1	5	—	1	2	—
fragments	68	10	—	16	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	29	—	—	2
discs	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—
fused pelvic	—	—	—	—	—	—	—	—	—	3	1	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

In every case where bones could be identified as coming from the left or right side, the frequencies were approximately equal.
A Cavern
B Apron
C Playground
D Gully

Appendix B

Bones collected from the inland den

Identifiable remains = 436 bones

(1) Seal

18 Right humerus
13 Left humerus
17 Right radius
21 Left radius
6 Right ulna
10 Left ulna
7 Right femur
8 Left femur
8 Right tibia
13 Left tibia
2 Right fibula
4 Left fibula

13 Ribs

12 Right scapula
8 Left scapula
3 Right pelvic girdle
3 Left pelvic girdle

17 Right mandible
11 Left mandible
2 Right palate
2 Left palate
1 Complete palate
1 Unknown palate
8 Skull fragments

11 Left front phalanges
3 Right front phalanges
5 Left hind phalanges
5 Right hind phalanges
18 Unknown phalanges
1 Left carpal
1 Right carpal
3 Left calcaneum
1 Right calcaneum

15 Vertebrae
Total = 271 bones

(2) Jackal

2 Right humerus
4 Left humerus
3 Right radius
2 Left radius
5 Left ulna
2 Right ulna
2 Right femur
2 Left femur
6 Right tibia
7 Left tibia

1 Right scapula
2 Right pelvic girdle
3 Left pelvic girdle

9 Right mandible
8 Left mandible
5 Left palate
2 Complete palate

1 Left hind phalange
1 Left front phalange
2 Unknown
1 Right tarsal
3 Right metatarsal
2 Left metatarsal
2 Right metacarpals
1 Left metacarpal
1 Unknown metacarpal
13 Vertebrae
Total = 92 bones

(3) Feral dog

1 Left mandible
6 Vertebrae
2 Right humerus
2 Left humerus
1 Right tibia
1 Phalange

Total = 13 bones

(4) Hyaena
1 Palate
1 Mandible — Total = 2 bones

(5) Penguin
3 Right humerus
3 Right radius
1 Left radius
4 Right ulna
2 Left ulna
1 Right femur
4 Left femur
2 Right tibia
1 Left tibia

1 Right coracoid
2 Left coracoid
3 Right pelvic girdle
3 × Sacrum (fused sacral vertebrae)

2 Left tarsometatarsus
1 Left metacarpal — Total = 33 bones

(6) Other bird
2 Left radius
1 Left ulna
1 Right ulna
1 Left tibia
1 Right tibia
1 Right coracoid — Total = 6 bones

(7) Springbok
1 Vertebra
1 Left scapula
2 Right metatarsals
1 Left metatarsal
1 Unknown metacarpal
1 Right calcaneum
1 Phalange — Total = 8 bones

(8) Steenbok
2 Right mandible
1 Left mandible
1 Left horn — Total = 4 bones

(9) Gemsbok
1 Right pelvic girdle
1 Left pelvic girdle — Total = 2 bones

(10) Other
1 Lepus left tibia
1 Lepus phalange
1 Porcupine mandible
1 Dolphin vertebra — Total = 4 bones