4 RESULTS

This study, as explained previously, consisted of three stages. Stages 1 and 2 are independent of each other, while Stage 3 incorporated results from Stages 1 and 2.

1. STAGE 1 - FAUNAL ANALYSIS

Stage 1 comprised of the analysis of the faunal remains of Lower Kemp's Caves situated in the Ngonyama Game Reserve near Krugersdorp.

1.1 Introduction

The faunal sample excavated from Lower Kemp's Cave between 1992 and 1999 constituted more than 8000 individual elements. Most of these elements were individually catalogued and numbered prior to analysis. Elements lacking this data were allocated numbers during the identification process. Details such as date and provenance were also recorded.

All faunal material and artifacts were sorted. The stone artifacts, microfauna and archaeological specimens were removed and no identification was attempted in this study. Future analysis of Kemp's Caves may incorporate these elements.

The faunal sample was subdivided into two categories namely identifiable and non-identifiable bone pieces. These elements were dealt with separately. Approximately 11.5% of the sample was identifiable. Only 3% of these were identified to a specific species, while the rest was arranged into separate size classes. A total of 88% of the elements could not be assigned to any taxa with confidence. Table 4.1 is a summary of the faunal sample size.

TABLE 4.1: Summary of LKC Faunal sample size (n).

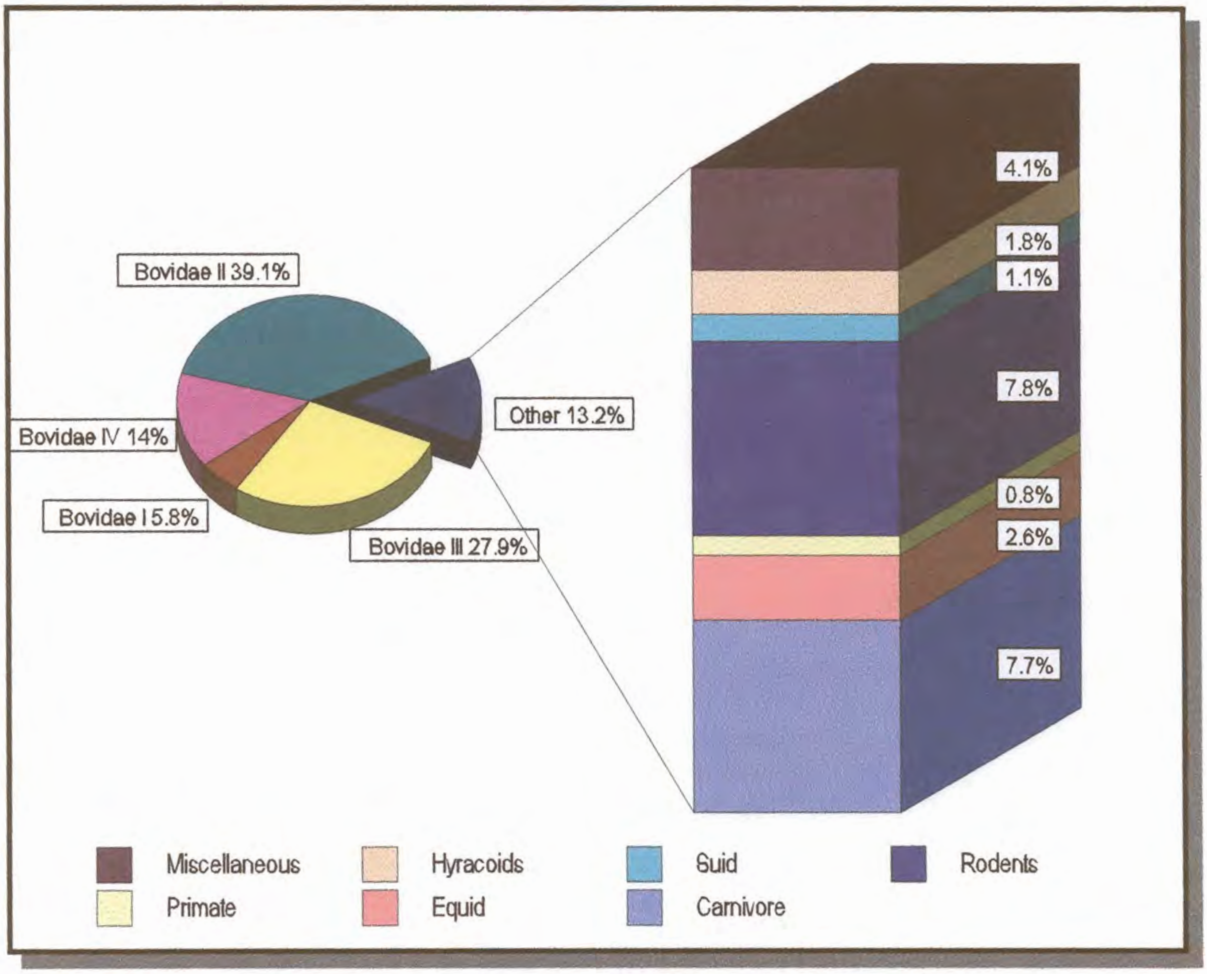
SKELETAL PART	GRID SYSTEM	NE EXTENSION	TOTAL
Bovid remains	439	207	696
Other remains	133	81	214
Total identifiable	**622**	**288**	**910**
Enamel fragments	380	335	715
Skull fragments	423	61	484
Vertebra fragments	73	44	117
Rib fragments	89	19	108
Miscellaneous	1 666	1 878	3 544
Bone flakes	1 526	658	2 184
Total unidentifiable	**4 157**	**2 995**	**7 152**
Total sample	**4 779**	**3 283**	**8 062**
Mass identifiable	8 378.0g	2 346.0g	10 724.0g
Mass unidentifiable	8 221.3g	5 361.1g	13 582.4g
Total mass	**16 599.3g**	**7 707.1g**	**24 306.4g**

1.2 Identifiable bones

Identifiable bones were assigned to skeletal part and where possible to genus and species. Figure 4.1 illustrates graphically the different Mammalian taxa identified in the sample as percentages of the total specimen count. Bovidae specimens accounted for most of the specimens with a percentage of 86.8%, while the other taxa included Primates (0.8%), Hyracoids (1.8%), Equids (2.6%), Suids (1.1%), Carnivores (7.7%) and Rodents (7.8%). Miscellaneous fauna like reptiles and birds contributed approximately 4.1% to the faunal assemblage.

Although most of the Aves class were represented by eggshell fragments, probably of the *Struthio* genus, there were a few osteological specimens of various bird class sizes. The reptilian population was represented only by shell fragments of the *Chelonian* genus.

FIGURE 4.1: Mammalian taxa representation (%).



The material recovered from LKC is listed and described below. Each specimen is defined with detail according to specific skeletal part, LKC number and provenance. Three major classes, Mammalia, Aves and Reptilia, are represented in the sample.

A) CLASS MAMMALIA

Mammalia indeterminate

➘ Five cranial and 7 postcranial specimens from a minimum of four individuals.

Material: Maxillary fragment: LKC/94/139 (5E 10N), Mandibular fragments: LKC/94/394 (5E6E 9N10N) + LKC/97/21.1 (NE Ex) + LKC/99/22E (NE Ex-AC), Os petrosum: LKC/92/154 (0E 5N) Glenoid cavity right scapula: LKC/93/61 (5E 9N10N), Distal left humerus: LKC/94/398 (5E6E 9N10N) + LKC97/4.1 (NE Ex), Femur head: LKC/98/16A (NE Ex-V), Femur shaft fragment: LKC/97/7.3 (NE EX) + LKC/99/30L (NE Ex-AE), Sesamoid: LKC/93/250 (2E 9N)

Order PRIMATES

Family HOMINIDAE

Homo sapiens (Human)

➘ Two cranial specimens representing a minimum of one individual.

Material: Left upper M2: LKC/92/69 (2E 5N), Upper P2: LKC/93/144 (5E 9N).

Family CERCOPITHECIDAE

Papio cynocephalus ursinus (Chacma baboon: Kerr, 1792)

➘ Five cranial specimens from a minimum of one aged and two adult individuals.

Material: Right upper I2: LKC/98/12M (NE Ex-U), Left lower canine: LKC/92/25 (0E 6N), Left upper M2: LKC/92/64 (2E 6N) +

LKC/97/47 (NE Ex), Right lower M3 fragment: LKC/98/12M (NE Ex-R).

Order CARNIVORA

Carnivore indeterminate

➘ Fourteen cranial and 6 postcranial specimens from a minimum of 1 small, 1 large and 2 medium sized individuals.

Material: Left mandibular fragment: LKC/97/56E (NE Ex), Left lower I2: LKC/92/59 (1E 6N), I3: LKC/94/399 (5E6E 9N10N), Left lower I3: LKC/92/61 (1E 6N), Canine: LKC92/26 (0E 6N) + LKC/92/43 (2E 6N) + LKC/93/157 (6E 10N) + LKC/94/1 (2E 3N4N) + LKC/97/5.1 (NE Ex), Premolar: LKC/93/228 (8E 7N) + LKC/94/210 (2W 2S), Lower P1: LKC/99/3D (NE Ex-W), Right upper P3: LKC/97/26 (NE Ex), Molar: LKC/94/62 (7E 9N). Right calcaneus: LKC/98/12I (NE Ex-U), Phalanx: LKC/93/26 (5E 9N), Proximal phalanx: LKC/93/220B (5E6E 9N10N) + LKC/98/12D (NE Ex-T), Intermediate phalanx: LKC/92/118 (0E 6N), Distal phalanx: LKC/98/19.3 (NE Ex).

Family FELIDAE

Felid indeterminate

➘ One postcranial specimen from one individual.

Material: Left 4th metatarsal: LKC/97/49A (NE Ex).

Subfamily Felinae

Panthera pardus (Leopard: Linnaeus, 1758)

➘ One cranial specimen from one individual.

Material: Maxillary fragment including Right P2: LKC/93/142 (5E 9N).

cf. *Panthera pardus* (Leopard: Linnaeus, 1758)

➘ One cranial specimen from one individual.

Material: Left lower I3: LKC/92/61 (1E 6N).

Felis serval (Serval: Schreber, 1776)

➘ One cranial specimen from one individual.

Material: Mandible fragment including right P1 and P2: LKC/97/91.2 (NE Ex).

Family HYAENIDAE

Subfamily Hyaeninae

Hyaenid indeterminate

➘ Two cranial specimens from a minimum of one individual.

Material: Right upper I3: LKC/97/6.2 (NE Ex), Molar fragment: LKC/94/228 (7E 5N).

Hyaena brunnea (Brown Hyaena: Thunberg, 1820)

➘ Five cranial specimens from a minimum of one individual.

Material: Right lower canine: LKC/93/156B (6E 10N), Right lower P2: LKC/94/86 (6E 10N), Right lower P3: LKC/97A (6E 10N), Right lower M1: LKC/156A (6E 10N), Right upper M3: LKC/92/47 (2E 6N).

cf. *Hyaena brunnea* (Brown Hyaena: Thunberg, 1820)

➘ Two cranial specimens from a minimum of one individual.

Material: Left lower I2: LKC/92/59 (1E 6N), Canine: LKC/94/126A (11E 5N).

Crocuta crocuta (Spotted hyaena: Erxleben, 1777)

- Three cranial specimens from a minimum of one juvenile and one adult individual.

Material: Mandibular fragment including P1, P2 and M1: LKC 93/156 (6E 10N), Maxillary fragment including right M1: LKC/98 5G (NE Ex-T), Left lower P1: LKC/98/3J (NE Ex-S).

Family CANIDAE

Canid indeterminate

- One cranial and one postcranial specimen of a minimum of one individual.

Material: Right upper canine: LKC/99/40 (NE Ex-AF).

Right ulnar fragment: LKC/92/327 (2E 9N).

Subfamily Caninae

Canis mesomelas (Black-backed jackal: Shreber, 1778)

- Fifteen cranial and four postcranial specimens from a minimum of two individuals.

Material: Left mandibular fragment: LKC/97/74 (NE Ex), Right lower I3: LKC/94/142 (5E 10N), Left upper canine: LKC/99/9B (NE Ex-AB), Right upper canine: LKC/99/30C (NE Ex-AE), Left lower canine: LKC/92/27 (0E 6N), Premolar fragment: LKC/94/358 (6E7E 11N12N), Right upper P1: LKC/97/30.1 (NE Ex), Right upper P2: LKC/98/3G (NE Ex-S), Left lower P2: LKC/99/14K (NE Ex-AC), Left lower P4: LKC/97/66C (NE Ex), Right upper M1: LKC/93/116 (5E 9N), Left upper M1: LKC/94/369 (6E 9N10N), Right lower M1: LKC/94/290 (5E6E 9N10N) +

LKC/99/38D (NE Ex-AF), Right upper M2: LKC/94/393 (5E6E 9N10N).

Distal articulation of right humerus: LKC/94/410 (6E7E 9N10N), Distal left humerus: LKC/93/161 (6E 10N), Acetabulum: LKC/94/116 (6E 10N), Left astralagus: LKC/93/192B (2E 4N5N).

cf. *Canis mesomelas* (Black-backed jackal: Shreber, 1778)

➘ Four cranial and one postcranial specimen from a minimum of one individual.

Material: Mandibular fragment including left P1: LKC/99/1 (NE Ex-V), Canine crown: LKC/93/152 (6E 10N), Left premolar fragment: LKC/94/386 (6E 9N10N), Left lower M2: LKC/99/30G (NE Ex-AE).

Metapodial fragment: LKC/94/67 (7E 9N).

Vulpes chama (Cape fox: Smith, 1833)

➘ One cranial and one postcranial specimen from a minimum of one individual.

Material: Right mandibular fragment: LKC/93/247 (2E 9N).

Proximal phalanx: LKC/94/174F (6E 9N10N).

Family VIVERRIDAE

Subfamily Viverrinae

Genetta genetta (Small spotted genet: Linnaeus, 1758)

➘ One postcranial specimen from one individual.

Material: Distal articulation & shaft left humerus: LKC/98/12H (NE Ex-U)

Subfamily Herpestinae

Mongoose indeterminate

- One postcranial specimen of one individual.

Material: Metapodial: LKC/97/72.1 (NE Ex).

Order HYRACOIDEA

Family PROCAVIIDAE

Procavia capensis (Rock dassie: Pallas, 1766)

- Twelve cranial and 2 postcranial specimens from a minimum of three individuals.

Material: Maxillary fragment including molar: LKC/94/209 (2W 2S), Right maxillary fragment including molar: LKC/92/124 (0E 6N, Left maxillary fragment including molars: LKC/92/234 (2E 9N), Mandibular fragment including molars: LKC/92/235 (2E 9N) + LKC/92/151 (2E 9N) + LKC/97/77 (NE Ex), Right mandible including molars: LKC/98/3D (NE Ex-S), Left mandible including molars: LKC/94/150 (6E 10N), Right upper I3: LKC/97/55 (NE Ex), Right upper M3: LKC/97/52F (NE Ex) + LKC/99/22D (NE Ex-AC) + LKC/99/22N (NE Ex-AC).

Distal articulation & shaft right humerus: LKC/99/22J (NE Ex-AC), Distal articulation & shaft left humerus: LKC/99/9E (NE Ex-AB).

cf. *Procavia capensis* (Rock dassie: Pallas, 1766)

- One cranial and one postcranial specimen from a minimum of one individual.

Material: Left maxillary fragment including molars: LKC/94/274 (5E6E 9N10N).

Left femur: LKC/92/401 (2E 7N).

Order PERISSODACTYLA

Family EQUIDAE

Equid indeterminate

- Five cranial specimens from a minimum of two individuals.

Material: Molar fragment: LKC/93/274 (5E 9N) + LKC/94/366 (6E7E 11N12N) + LKC/99/38I (NE Ex-AF), Right upper premolar: LKC/93/298 (5E 8N) + LKC/93/298A (5E 8N).

Equus burcelli (Burchell's zebra: Gray,1824)

- Eight cranial and 3 postcranial specimens from a minimum of two individuals.

Material: Left lower P2: LKC/94/205 (2W 2S), Left upper molar: LKC/94/177 (8E9E 7N9N) + LKC/99/38Q (NE Ex-AF), Left upper M1: LKC/94/43 (3E 5N), Right lower M1: LKC/99/9F (NE Ex-AB), Left lower M1: LKC/94/420 (No grid), Left upper M2: LKC/94/127 (5E 10N) + LKC/99/30A (NE Ex-AE).

Left astralagus: LKC/93/275 (5E 9N), Right calcaneus: LKC/93/371 (6E 9N10N), Left central tarsal: LKC/93/148A (5E 9N).

cf. *Equus burcelli* (Burchell's zebra: Gray,1824)

- One cranial specimen from one individual.

Material: Molar fragment: LKC/94/361 (6E7E 11N12N).

Equus capensis (Extinct Cape horse/zebra: Brain, 1909)

➘ Four cranial and two postcranial specimens from a minimum of one individual.

Material: Right upper I1: LKC/94/348 (5E 11N), Left upper P2: LKC/94/317 (5E6E 10N), Right P3: LKC/94/318 (5E6E 10N), Right lower M3: LKC/94/367 (6E7E 11N12N). Distal articulation & shaft left humerus: LKC/93/111 (No grid), Left humeral head fragment: LKC/93/112 (No grid).

Order ARTIODACTYLA

Family SUIDAE

Phacochoerus aethiopicus (Warthog: Pallas, 1766)

➘ Nine cranial specimens from a minimum of one juvenile and one adult individual.

Material: Canine: LKC/92/233 (2E 9N), Right upper canine fragment: LKC/92/37B (2E 8N), Upper premolar: LKC/94/129 (5E 10N) + LKC/94/197 (1E 5N), Premolar: LKC/92/39 (2E 6N), Molar fragments: LKC/93/113 (5E 9N) + LKC/94/58 (7E 9N) + LKC/94/89 (6E 10N) + LKC/94/149 (6E 10N).

Potamochoerus porcus (Bushpig: Linnaeus, 1758)

➘ One cranial and one postcranial specimen from a minimum of one individual.

Material: Left lower canine: LKC/94/59 (7E 9N). Right humerus shaft fragment: LKC/93/287 (5E 9N).

Family BOVIDAE

Subfamily Alcelaphinae

Alcelaphine indeterminate

➘ Two cranial specimens from a minimum of two individuals.

Material: Right lower I1: LKC/93/11 (5E 9N)+ LKC/93/10 (5E 9N).

Damaliscus dorcas phillipsi (Blesbok: Harper, 1939)

➘ One cranial and 10 postcranial specimens from a minimum of two individuals.

Material: Left lower M1: LKC/97/8.3 (NE Ex).

Distal right humerus: LKC/92/3 (No grid) + LKC/94/68 (7E 9N), Shaft right humerus: LKC/93/77 (5E 9N10N), Shaft left humerus: LKC/94/105 (6E 10N), Left radiocarpal: LKC/99/3A (NE Ex-W), Proximal articulation & shaft left metacarpal: LKC/94/111 (6E 10N), Distal articulation & shaft left tibia: LKC/93/70 (5E 9N10N), Left naviculocuboid: LKC/94/69 (7E 9N), Proximal articulation & shaft right metatarsal: LKC/92/34 (2E 8N), Distal articulation & shaft left metatarsal: LKC/94/328 (5E6E 10N).

cf. *Damaliscus dorcas phillipsi* (Blesbok: Harper, 1939)

➘ One cranial and four postcranial specimens from a minimum of two individuals.

Material: Right lower M3: LKC/94/101 (6E 10N).

Distal articulation & shaft left radius: LKC/93/72 (5E 9N10N), Proximal articulation & shaft left metatarsal: LKC/93/35 (5E 9N10N) + LKC/93/40 (5E 9N10N), Left intermediate phalanx:

LKC/92/158 (2E 9N).

Alcelaphus buselaphus (Red Hartebeest: Pallas, 1766)

➘ Seven postcranial specimens from a minimum of one individual.

Material: Left scapular fragment: LKC/94/112 (6E 10N), Proximal arcticulation & shaft left metacarpal: LKC/93/71 (5E 9N10N), Midshaft left femur: LKC/94/27 (6E 10N), Right proximal phalanx: LKC/97/16 (NE Ex), Left proximal phalanx: LKC/97/11 (NE Ex), Left intermediate phalanx: LKC/97/15 (NE Ex), Right intermediate phalanx: LKC/97/18 (NE Ex).

cf. *Alcelaphus buselaphus* (Red Hartebeest: Pallas, 1766)

➘ Four postcranial specimens from a minimum of one individual.

Material: Distal articulation & shaft left metacarpal: LKC/97/33 (NE Ex), Proximal phalanx: LKC/94/20 (6E 10N), Right proximal phalanx: LKC/94/195 (1E 5N), Left proximal phalanx: LKC/92/71 (0E 6N).

Connochaetes gnou (Black Wildebeest: Zimmerman, 1780)

➘ One cranial and three postcranial specimens from a minimum of one individual.

Material: Right lower M2: LKC/94/257 (5E6E 9N10N), Midshaft right radius and ulna: LKC/93/159 (6E 10N), Left astralagus: LKC/94/280 (5E6E 9N10N), Right calcaneus: LKC/94/326 (5E6E 10N).

cf. *Connochaetes gnou* (Black Wildebeest: Zimmerman, 1780)

➘ One postcranial specimen from a minimum of one individual.

Material: Right metacarpal: LKC/94/326 (5E6E 9N10N).

Connochaetes taurinus (Blue Wildebeest:Burchell, 1823)

➘ One postcranial specimen from one individual.

Material: Distal left radius: LKC/92/240 (2E 9N).

cf. *Connochaetes taurinus* (Blue Wildebeest:Burchell, 1823)

➘ One postcranial specimen from one individual.

Material: Right astralagus: LKC/92/14 (Deep in cave).

Subfamily Antelopinae

Antidorcas marsupialis (Springbok: Zimmerman, 1780)

➘ Six postcranial specimens from a minimum of two individuals.

Material: Distal right radius and ulna: LKC/92/4 (No grid), Left proximal phalanx: LKC/92/108 (1E 6N) + LKC/92/109 (1E 6N), Intermediate phalanx: LKC/94/137 (5E 10N), Distal articulation & shaft left tibia: LKC/92/38 (2E 6N) + LKC/99/9H (NE Ex-AA).

cf. *Antidorcas marsupialis* (Springbok: Zimmerman, 1780)

➘ Three postcranial specimens from a minimum of one individual.

Material: Left proximal phalanx: LKC/92/15 (Deep in cave), Left intermediate phalanx: LKC/99/8 (NE Ex-AA), Left distal phalanx: LKC/94/376 (6E 9N10N).

Raphicerus campestris (Steenbok: Thunberg, 1811)

➘ Two postcranial specimens from a minimum of one individual.

Material: Distal articulation & shaft metacarpal: LKC/92/107 (1E 6N), Right proximal phalanx: LKC/94/144 (5E 10N).

Subfamily Bovinae

Taurotragus oryx (Eland: Pallas, 1766)

➘ Five cranial and one postcranial specimen from a number of two individuals.

Material: Right upper M1: LKC/98/8A (NE Ex-T), Left upper M1: LKC/92/231 (2E 9N) + LKC/98/8B (NE Ex-T), Right upper M2: (92/227 (2E 9N), Right upper M3: LKC/97/39A (NE Ex).

Left astralagus: LKC/99/22 (NE Ex-AC).

cf. *Taurotragus oryx* (Eland: Pallas, 1766)

➘ One cranial and one postcranial specimen from a minimum of one individual.

Material: Left upper M2: LKC/93/54 (5E 9N10N).

Styloid process left ulna: LKC/92/321 (2E 9N).

Tragelaphus strepsiceros (Kudu: Pallas, 1766)

➘ Two cranial and one postcranial specimen from a minimum of one individual.

Material: Right I: LKC/93/8A (5E 9N), Left I: LKC/93/8B).

Left distal phalanx: LKC/94/372.

Bos taurus (Domestic cattle)

➘ Five postcranial specimens from a minimum of one individual.

Material: Distal left radius: LKC/94/308 (5E6E 9N10N), Right intermediate carpal: LKC/93/8C (5E 9N), Right 4th carpal: LKC/93/8D (5E 9N), Right ulnar carpal: LKC/93/8E (5E 9N), Right 2nd and 3rd carpal: LKC/93/123 (5E 9N).

Subfamily Hippotraginae

cf. *Hippotragus niger* (Sable: Harris, 1838)

➘ One postcranial specimen from one individual.

Material: Right radial carpal: LKC/93/205 (5E6E 9N10N).

Subfamily Aepycerotinae

Aepyceros melampus (Impala: Lichtenstein, 1812)

➘ Two postcranial specimens from a minimum of one individual.

Material: Distal right tibia: LKC/93/23 (5E 9N), Proximal articulation & shaft left metatarsal: LKC/93/126 (5E 9N).

cf. *Aepyceros melampus* (Impala: Lichtenstein, 1812)

➘ One cranial specimen of one individual.

Material: Right upper M3: LKC/93/301 (5E6E 9N10N).

Subfamily Peleinae

Pelea capreolus (Grey Rhebok: Forster, 1790)

➘ One postcranial specimen from one individual.

Material: Proximal articulation & shaft left metatarsal: LKC/98/10 (NE Ex-T).

Subfamily Reduncinae

Redunca arundinum (Reedbuck: Boddaert, 1785)

➘ One postcranial specimen from one individual.

Material: Left metatarsal: LKC/93/302 5E6E 9N10N).

Order LAGOMORPHA

Family LEPORIDAE

Lepus saxatilis (Scrub hare: Cuvier, 1823)

- Three cranial and 10 postcranial specimens from a minimum of three individuals.

Material: Left mandibular fragments including molars: LKC/92/286 (2E 4N5N) + LKC/99/5A (NE Ex-AA) + LKC/99/22C (NE Ex-AC). Right scapular fragment: LKC/92/57 (1E 6N) + LKC/92/402 (2E 7N) + LKC/94/119 (6E 10N), Proximal articulation & shaft radius: LKC/92/79 (0E 6N), Pelvic fragment: LKC/92/96 (2E 6N), Distal articulation & shaft right tibia: LKC/99/140, Right tibia and fibula fragment: LKC/94/120 (6E 10N), Right metatarsal fragment: LKC/99/9J (NE Ex-AB), Left metatarsal: LKC/92/44 (2E 6N) + LKC/92/98 (2E 6N).

cf. *Lepus saxatilis* (Scrub hare: Cuvier, 1823)

- One postcranial specimen from one individual.

Material: Left ulna: LKC/97/49C (NE Ex).

Pronolagus indeterminate

- One postcranial specimen from one individual.

Material: Right tibia and fibula: LKC/92/35 (2E 8N).

Order RODENTIA

Rodent indeterminate

➘ Ten cranial and 19 postcranial specimens from a minimum of four individuals.

Material: Maxillary fragments: LKC/93/27 (5E 9N) + LKC/94/344 (5E6E 10N), Mandibular fragments: LKC/92/28 (0E 6N) + LKC/92/236 (2E 9N) + LKC/94/31 (6E 10N), Incisor: LKC/92/24 (0E 6N) + LKC/92/45A (2E 6N) + LKC/97/87.2 (NE Ex) + LKC/22L (NE Ex-AC) + LKC/99/42 (NE Ex-AF).

Right scapular fragment: LKC/99/38T (NE Ex-AF), Left scapular fragment: LKC/99/30R (NE Ex-AE), Humeral fragments: LKC/99/30 M (NE Ex-AE) + LKC/99/34 (NE Ex-AE), Distal left humerus: LKC/92/94 (2E 6N) + LKC/97/35A (NE Ex), Phalanges: LKC/92/262 (2E 9N) + LKC/92/305C (2E 9N), Left femur: LKC/92/260 (2E 9N), Distal articulation & shaft fibula: LKC/92/116 (0E 6N), Metapodial fragment: LKC/92/117 (0E 6N) + LKC/92/261 (2E 9N) + LKC/94/383 (6E 9N10N) + LKC/97/22A (NE Ex) + LKC/14N (NE Ex-AC) + LKC/99/14W (NE Ex-AC) + LKC/99/22K (NE Ex-AC) + LKC/99/29B (NE Ex-AD) + LKC/99/30K (NE Ex-AE).

Family PEDETIDAE

Pedetes capensis (Spring hare: Forster, 1778)

➘ One cranial and one postcranial specimen from a minimum of one individual.

Material: Molar: LKC/99/30S (NE Ex-AE).

Pelvic fragment: LKC/97/36.6 (NE Ex).

Family HYSTRICIDAE

Hystrix africaeaustralis (Porcupine: Peters, 1852)

➘ Twenty-four cranial and two postcranial specimens from a minimum of one juvenile and three adult individuals.

Material: Maxillary fragment including incisor: LKC/99/29A (NE Ex-AD), Mandibular fragment including molars: LKC/92/89 (2E 6N) + LKC/93/154 (6E 10N) + LKC/94/121 (6E 10N) + LKC/99/22I (NE Ex-AC) + LKC/99/30L (NE Ex-AE) + LKC/99/30O (NE Ex-AE), Right upper I: LKC/92/36 (2E 8N) + LKC/93/53 (5E 9N10N), Left lower I: LKC/94/292 (5E6E 9N10N) , Lower I: LKC/97/36.7 (NE-Ex), Molars: LKC/92/32 (0E 6N) + LKC/92/121 (0E 6N) + LKC/93/150 (6E 10N) + LKC/94/152 (6E 10N) + LKC/94/163 (6E 9N10N) + LKC/94/208 (No grid) + LKC/94/320 (5E6E 10N) + LKC/97/5.4 (NE Ex) + LKC/97/80.2 (NE Ex) + LKC/97/85.2 (NE Ex) + LKC/98/1G (NE Ex-R) + LKC/98/5H (NE Ex-T) + LKC/99/14L (NE Ex-AC).

Shaft right humerus: LKC/98/12B (NE Ex-U), Distal articulation & shaft left humerus: LKC/99/22R (NE Ex-AC).

B) CLASS AVES

Avian indeterminate

- Five postcranial specimens from a minimum of two individuals.

Material: Longbone fragment: LKC/93/220A (5E6E 9N10N) + LKC/93/259 (2E 9N), Proximal phalanx: LKC/93/190 (2E 4N5N), Pelvic fragment: LKC/94/217A (No grid), Proximal articulation & shaft right tibia: LKC/92/75 (0E6N).

C) CLASS REPTILIA

Reptilia indeterminate

- Four carapace pieces from a minimum of one individual.

Table 4.2 provides a detailed summary of the taxa identified indicating the MNI (Minimum number of individuals) values and percentages, as well as the NISP (Number of specimens) values and percentages.

The NISP calculation counts the number of specimens attributed to each taxon. An individual animal which contributes more than one identifiable bone to the faunal sample will be counted several times. This might give an over-representation of that specific taxon [4].

An MNI value estimates the minimum number of individuals. It is based upon non- reproducible elements, thus an individual cannot be counted twice [4]. There are several other calculations for the analysis of faunal remains. Kemp's Caves are still yielding large quantities of faunal remains and further in depth analysis may be viable with a larger sample size of excavated specimens.

TABLE 4.2: Summary of species identified in LKC faunal sample.

SPECIES	GRID SYSTEM		NE EXTENSION		TOTAL	TOTAL	
	NISP	% NISP	NISP	%NISP	NISP	MNI	%MNI
Class MAMMALIA	615	99.0	288	100.0	904	98	97.03
Mammal indet.	6	0.96	6	2.08	12	4	3.96
Order Primates	4	0.64	3	1.04	7	4	3.96
Family Hominidae	2	0.32	-	-	2	1	0.99
Homo Sapiens Human	2	0.32	-	-	2	1	0.99
Family Cercopithecidae	2	0.32	3	1.04	5	3	2.97
Papio c. ursinus Chacma baboon	2	0.32	3	1.04	5	3	2.97
Order Carnivora	41	6.59	26	9.03	67	18	17.82
Carnivore indet	13	2.09	7	2.43	20	4	3.96
Family Felidae	3	0.48	2	0.69	5	3	2.97
Felid indet.	-	-	1	0.35	1	1	0.99
Subfamily Felinae	3	0.48	1	0.35	2	2	1.98
Panthera pardus Leopard	2	0.32	-	-	-	1	0.99
cf. *Panthera pardus* Leopard	1	0.16	-	-	1	-	-
Felis serval Serval	-	-	1	0.35	1	1	0.99
Family Hyaenidae	9	1.45	3	1.04	12	4	3.96
Subfamily Hyaeninae	9	1.45	3	1.04	12	4	3.96
Hyaenid indet.	1	0.16	1	0.35	2	1	0.99
Hyaena brunnea Brown hyaena	5	0.80	-	-	5	1	0.99
cf. *Hyaena brunnea* Brown hyaena	2	0.32	-	-	2	-	-
Crocuta crocuta Spotted hyaena	1	0.16	2	0.69	3	2	1.98
Family Canidae	16	2.57	12	4.17	28	5	4.95
Canid indet.	1	0.16	1	0.35	2	1	0.99
Subfamily Caninae	15	2.41	11	3.82	26	4	3.96
Canis mesomelas Black-backed jackal	12	1.93	8	2.78	20	3	2.97
cf. *Canis mesomelas* Black-backed jackal	2	0.32	2	0.69	4	-	-
Vulpes chama Cape fox	1	0.16	1	0.35	2	1	0.99
Family Viverridae	-	-	2	0.69	2	2	1.98
Subfamily Viverrinae	-	-	1	0.35	1	1	0.99
Genetta genetta Small spotted genet	-	-	1	0.35	1	1	0.99
Subfamily Herpestinae	-	-	1	0.35	1	1	0.99
Mongoose indet.	-	-	1	0.35	1	1	0.99

TABLE 4.2: Continue

Order Hyracoidea	8	1.28	8	2.78	16	3	2.97
Family Procaviidae	8	1.28	8	2.78	16	3	2.97
Procavia capensis Rock dassie	6	0.96	8	2.78	14	3	2.97
cf. *Procavia capensis* Rock dassie	2	0.32	-	-	2	-	-
Order Perissodactyla	19	3.05	4	1.39	24	5	4.95
Family Equidae	19	3.05	4	1.39	24	5	4.95
Equid indet.	4	0.64	1	0.35	5	2	1.98
Equus burcelli Burchell's zebra	8	1.28	3	1.04	12	2	1.98
cf. *Equus burcelli* Burchell's zebra	1	0.16	-	-	1	-	-
Equus capensis Cape zebra	6	0.96	-	-	6	1	0.99
Order Artiodactyla	500	80.39	207	71.88	707	51	50.50
Family Suidae	11	1.77	-	-	11	3	2.97
Phacochoerus aethiopicus Warthog	9	1.45	-	-	9	2	1.98
Potamochoerus porcus Bushpig	2	0.32	-	-	2	1	0.99
Family Bovidae	55	78.6	14	71.88	69	18	47.52
Subfamily Alcelaphinae	29	4.66	7	2.43	36	7	6.93
Alcelaphine indet.	2	0.32	-	-	2	1	0.99
Damaliscus dorcas phillipsii Blesbok	10	1.60	2	0.69	12	2	1.98
cf. *Damaliscus dorcas phillipsii* Blesbok	4	0.64	-	-	4	-	-
Alcelaphus buselaphus Red Hartbeest	3	0.48	4	1.39	7	2	1.98
cf. *Alcelaphus buselaphus* Red Hartbeest	3	0.48	1	0.35	4	-	-
Connochaetes gnou Black Wildebeest	4	0.64	-	-	4	1	0.99
cf. *Connochaetes gnou* Black Wildebeest	1	0.16	-	-	1	-	-
Connochaetes taurinus Blue Wildebeest	1	0.16	-	-	1	1	0.99
cf.*Connochaetes taurinus* Blue Wildebeest	1	0.16	-	-	1	-	-
Subfamily Antelopinae	9	1.45	2	0.69	11	3	2.97
Antidorcas marsupialis Springbok	5	0.80	1	0.35	6	2	1.98
cf. *Antidorcas marsupialis* Springbok	2	0.32	1	0.35	3	-	-
Raphicerus campestris Steenbok	2	0.32	-	-	2	1	0.99
Subfamily Bovinae	12	1.93	4	1.39	16	4	3.96
Taurotragus oryx Eland	2	0.32	4	1.39	6	2	1.98
cf. *Taurotragus oryx* Eland	2	0.32	-	-	2	-	-
Tragelaphus strepsiceros Kudu	3	0.48	-	-	3	1	0.99

TABLE 4.2: Continue

Bos taurus Domestic cattle	5	0.80	-	-	5	1	0.99
Subfamily Hippotraginae	1	0.16	-	-	1	1	0.99
cf. *Hippotragus niger* Sable	1	0.16	-	-	1	1	0.99
Subfamily Aepycerotinae	3	0.48	-	-	3	1	0.99
Aepyceros melampus Impala	2	0.32	-	-	2	1	0.99
cf. *Aepyceros melampus* Impala	1	0.16	-	-	1	-	-
Subfamily Pelinae	-	-	1	0.35	1	1	0.99
Pelea capreolus Grey Rhebuck	-	-	1	0.35	1	1	0.99
Subfamily Reduncinae	1	0.16	-	-	1	1	0.99
Redunca arundinum Reedbuck	1	0.16	-	-	1	1	0.99
Bovid size class I	35	5.62	16	5.56	51	5	4.95
Bovid size class II	249	40.0	92	31.94	341	14	13.86
Bovid size class III	149	23.95	84	29.17	233	10	9.90
Bovid size class IV	1	0.16	1	0.35	2	1	0.99
Order Lagomorpha	10	1.60	5	1.74	14	4	3.96
Family Leporidae	10	1.60	5	1.74	14	4	3.96
Lepus saxatalis Scrubhare	9	1.45	4	1.39	12	3	2.97
cf. *Lepus saxatalis* Scrubhare	-	-	1	0.35	1	-	-
Pronologus indet.	1	0.16	-	-	1	1	0.99
Order Rodentia	28	4.50	29	10.07	57	9	8.91
Rodent indet.	15	2.41	14	4.86	29	4	3.96
Family Pedetidae	-	-	2	0.69	2	1	0.99
Pedetes capensis Springhare	-	-	2	0.69	2	1	0.99
Family Hystricidae	13	2.09	13	4.51	26	4	3.96
Hystrix africeaustralis Porcupine	13	2.09	13	4.51	26	4	3.96
Class AVES	5	0.80	-	-	5	2	1.98
Avian indet.							
Class REPTILIA	1	0.16	-	-	1	1	0.99
Chelonia indet.	1	0.16	-	-	1	1	0.99
TOTAL	622	100%	288	100%	910	101	100%

Agents responsible for the accumulation of faunal samples are determined by a combination of information derived from the analysis of the accumulation. These aspects include the size of the prey species, animals represented and their age classes, skeletal part survival and carnivore damage to the bone specimens.

Soon after death, the body of an animal becomes disarticulated and is subjected to the characteristic mechanical and chemical brake down of a natural environment. The survival of these skeletal parts is due to two reasons. The first is that some parts of the skeleton have greater durability than others. The durability may depend on the age of the animal, whether a portion of the bone may still be cartilaginous, as well as the histological structure of the skeletal part. The humerus head, for example, has a thin wall of compact bone, whereas its shaft has a thicker more durable wall [2]. The second reason is that different carnivores utilise different parts of the skeleton. The carcass of leopard prey characteristically include the skull and long bones. The skeletal elements of hyaena prey would be almost completely consumed because of the hyaena's outstanding bone crushing capabilities [2].

Table 4.3 is a summary of the skeletal parts represented in the LKC faunal sample. The most represented skeletal part in all the faunal groups was teeth. This is probably due to the high durability of teeth. The various long bones of the fore- and hind-limb was well represented in the bovid, carnivore and rodent groups. The skeletal representation of the primate, equid, suid and hyracoid groups were dominated by tooth specimens.

TABLE 4.3: Skeletal part representation of LKC faunal sample (n).

Skeletal Part	Bovid	Carnivore	Primate	Equid	Suid	Rodent	Hyracoid	Total
Horncore	2	-	-	-	-	-	-	2
Skull Mandible	36	11	-	-	-	13	10	70
Teeth	282	42	7	19	9	24	4	387
Scapula	8	-	-	-	-	5	-	13
Humerus	22	3	-	2	1	6	2	34
Radius	34	-	-	-	-	1	-	35
Ulna	22	1	-	-	-	1	-	24
Pelvis	8	1	-	-	-	2	-	11
Femur	13	2	-	-	-	1	1	17
Tibia, fibula	37	-	-	-	-	4	-	41
Metacarpal	24	-	-	-	-	-	-	24
Metatarsal	32	1	-	-	-	3	-	36
Metapodial	59	2	-	-	-	9	-	70
Carpus	17	-	-	-	-	-	-	17
Tarsus	26	3	-	3	-	-	-	32
Sesamoid	6	-	-	-	-	-	-	6
Proximal phalanx	35	4	-	-	-	2	-	41
Middle phalanx	23	1	-	-	-	-	-	24
Distal phalanx	11	1	-	-	-	-	-	12
Hyoid	1	-	-	-	-	-	-	1
Total	698	72	7	24	10	71	17	896

Bovid analysis are extremely important in the interpretation of predator/prey evidence in accumulations [2]. Leopard and cheetah, for example, characteristically leave the skull and distal limb long bones behind, while hyaena is capable of the crushing and digestion of most skeletal parts.

Figures 4.2, 4.3, 4.4 and 4.5 give a graphic representation of skeletal part survival of the different bovid classes.

FIGURE 4.2: Bovid size class I Percentage skeletal part survival (%)

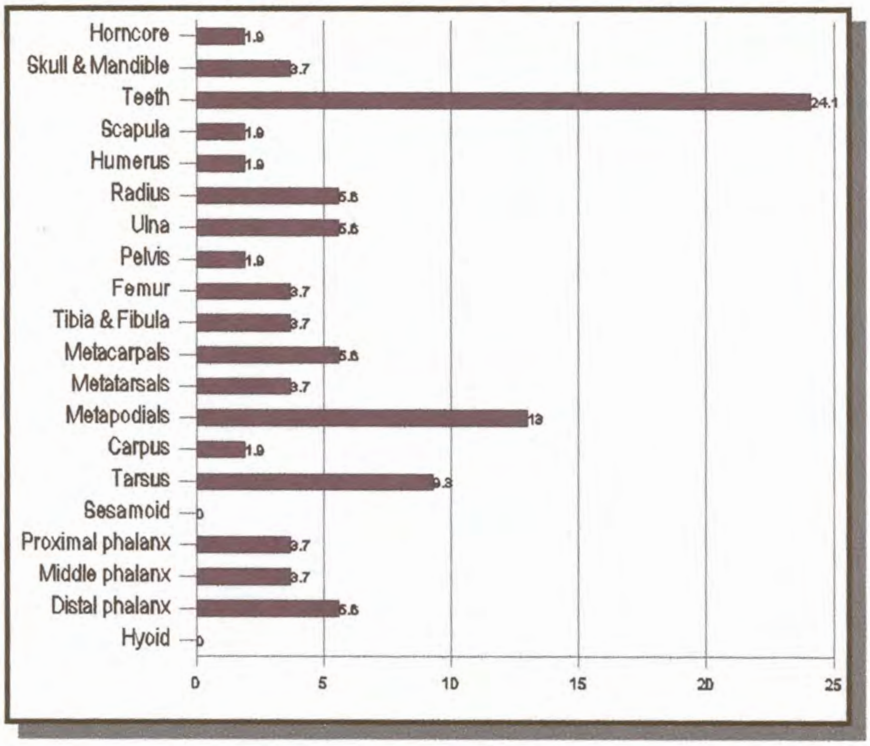


FIGURE 4.3: Bovid size class II Percentage skeletal part survival (%)

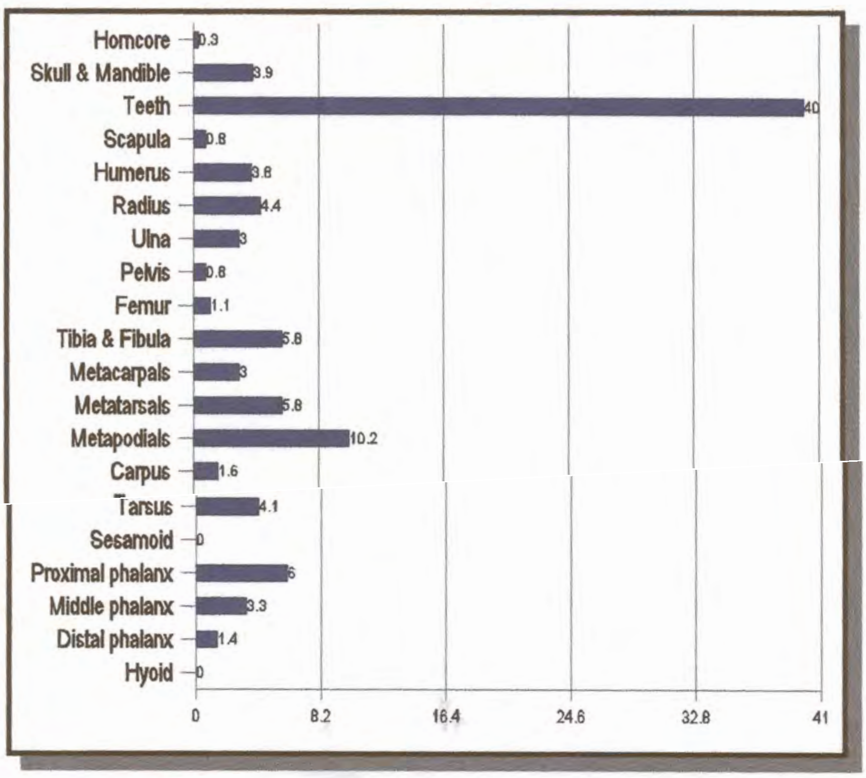


FIGURE 4.4: Bovid size class III Percentage skeletal part survival (%)

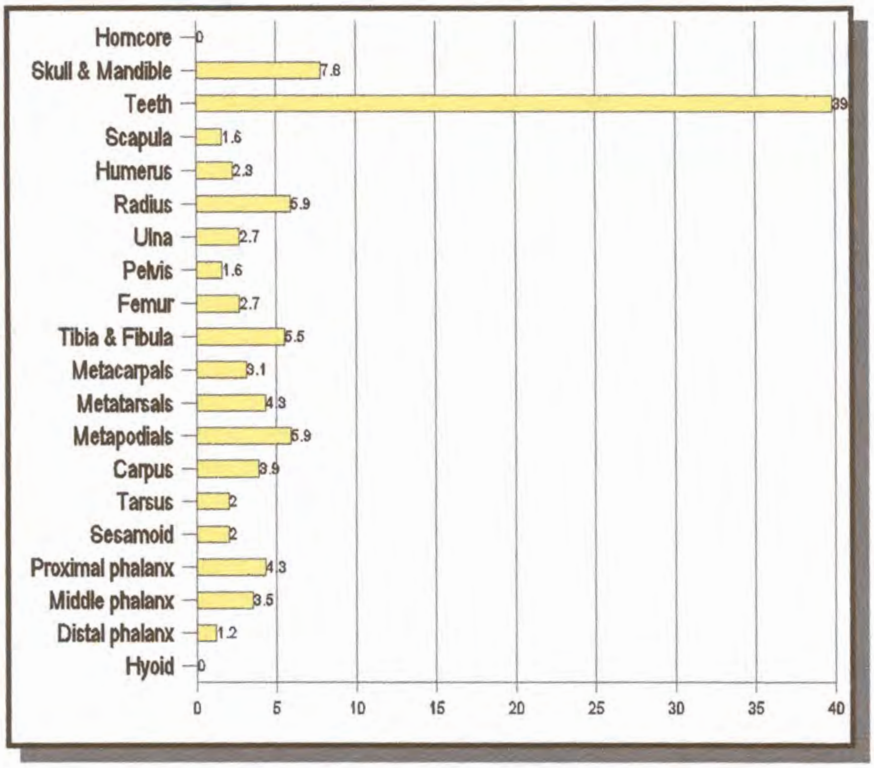
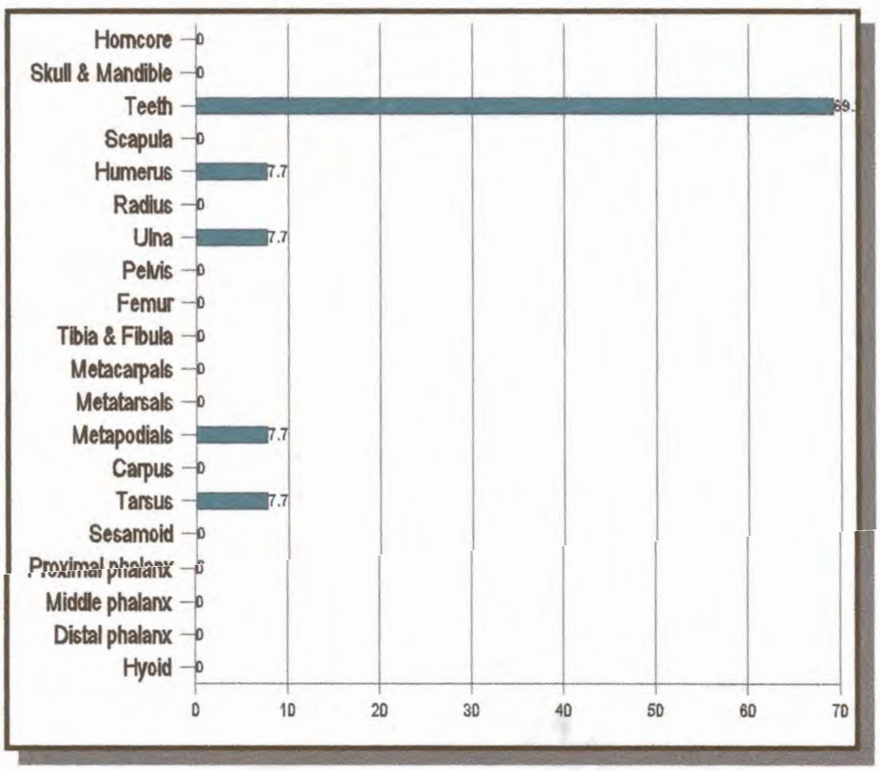


FIGURE 4.5: Bovid size class IV Percentage skeletal part survival (%)



As expected, all the bovid size classes were well represented by tooth fragments, due to its durability. Bov I, Bov II and Bov III showed high percentages of long bone survival. The metapodial specimens dominated the Bov I and Bov II classes, while all long bones were equally represented in the Bov III size class. This representation of the Bov I, II and III size classes may suggest leopard predation. The Bov IV class showed little skeletal representation which may be due to the fact that this size class were not preyed upon.

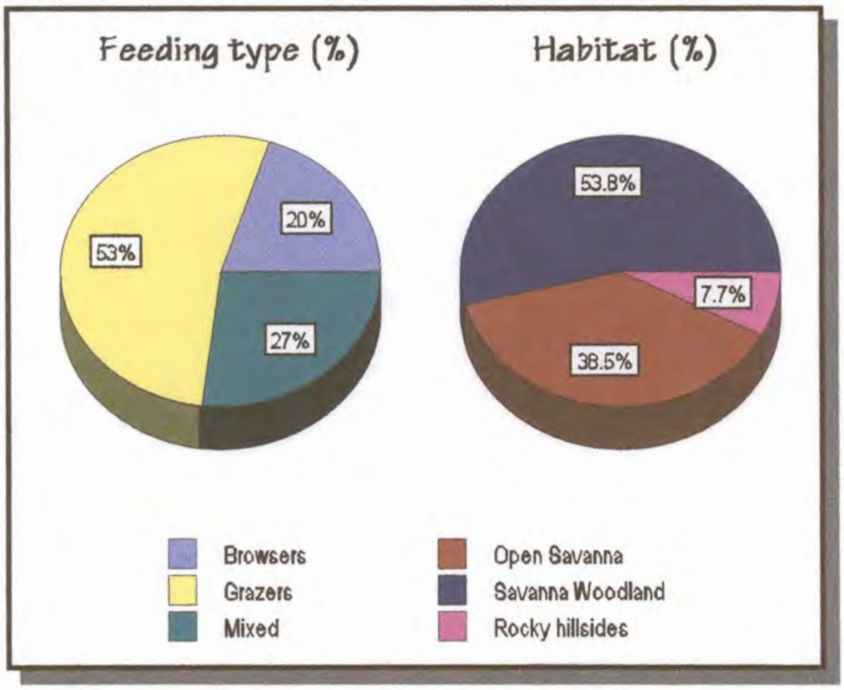
Characteristic features on the bone pieces indicated that the majority of the animals represented in the faunal sample were adult individuals. Very few separate epiphyses were identified and most of the dental specimens were permanent teeth within various stages of wear.

The habitat of any animal needs to meet the requirements of its feeding type. Both these aspects are needed for the survival of the species. The instant external factors, such as the environment and human encroachment, alter the habitat. The species representation of the area will be adjusted accordingly [51].

All extant bovid species fall in three habitat categories. They are 1) Open savanna, 2) Savanna woodlands with water and 3) Rocky hillsides [51]. Their food preference (feeding type) also classify bovids as of three groups namely grazers, browsers and mixed feeders [51].Their habitat and food requirements are inseparable. An open savanna will, for example, attract grazers, while browsers will occupy woodlands and rock hillsides. The habitat and food requirements of the species identified in the faunal sample may give an indication whether the climate and environment of Kemp's Caves have changed during its existence.

Figure 4.6 illustrates the ratio of the bovids represented in LKC according to their natural habitat, as well as the feeding type of the different species. From Figure 4.6 it can be seen that most of the bovids (53%), were grazers, while only 20% were browsers. The habitat of the different bovid species identified, showed that only a small percentage (7.7%) preferred rocky hillsides while the majority of species preferred either open savanna or savanna woodland. The feeding types clearly corresponds with the habitat preferences. The present habitat correlates with that of the species identified which may suggest no drastic change of environment.

FIGURE 4.6: Bovid habitat and feeding type representation (%).



1.3 Non-Identifiable bones

Non-identifiable bone pieces could not be identified to any species or class and were assigned to 5 different categories. These categories include enamel, skull, vertebra, rib, miscellaneous and bone flake fragments. The fragment's condition was noted and the pieces were weighed and documented. Table 4.4 is a summary of the number and weight of the non-identifiable bones recovered in every provenance.

TABLE 4.4: Non Identifiable bones recovered in LKC.

Provenance	Enamel	Skull	Vertebra	Rib	Misc	Bone flake	Total
0E 5N	5	2	-	2	4	45	58
Mass (g)	4.6	1.9	-	0.5	7.1	114.6	128.7
0E 6N	14	1	3	3	5	64	90
Mass (g)	11.3	1.5	6.0	2.7	17.0	216.7	255.2
1E 5N	-	-	-	-	-	2	2
Mass (g)	-	-	-	-	-	10.5	10.5
1E 6N	11	3	2	2	8	55	81
Mass (g)	16.2	3.1	4.4	2.9	13.2	130.6	170.4
2E 3N	-	-	-	2	15	9	26
Mass (g)	-	-	-	1.4	7.5	45.2	54.1
2E 6N	2	2	1	7	3	31	46
Mass (g)	0.7	1.3	72.9	8.8	0.8	96.7	181.2
2E 8N	-	-	-	-	-	3	3
Mass (g)	-	-	-	-	-	66.6	66.6
2E 9N	52	19	13	18	128	181	411
Mass (g)	25.5	20.2	78.2	16.1	103.4	104.1	347.5
3E 4N	-	-	-	-	-	4	4
Mass (g)	-	-	-	-	-	43.2	43.2
3E 5N	5	1	2	3	18	25	54
Mass (g)	3.1	1.3	2.1	3.4	10.5	199.7	220.1
3E 10N	3	-	-	-	-	30	33
Mass (g)	1.5	-	-	-	-	63.5	65.0
5E 8N	3	-	1	-	16	14	34
Mass (g)	2.1	-	70.2	-	34.4	96.1	202.8
5E 9N	16	5	5	4	22	35	87
Mass (g)	24.2	5.0	6.8	2.7	28.6	93.2	160.5
5E 10N	8	-	-	5	20	80	113
Mass (g)	6.2	-	-	5.1	10.2	322.5	344.0
5E 11N	8	-	-	-	27	39	74
Mass (g)	52	-	-	-	143.4	301.3	496.7
6E 10N	12	119	3	3	149	83	369
Mass (g)	8.5	76.1	1.8	17.1	83.1	288.8	475.4
7E 5N	-	-	2	-	41	16	59
Mass (g)	-	-	1.1	-	32.6	139.7	173.4

TABLE 4.4: Continue

7E 9N	15	10	1	-	35	37	98
Mass (g)	11.4	7.8	0.8	-	15.1	92.8	127.9
7E 14N	-	-	-	-	1	2	3
Mass (g)	-	-	-	-	1.3	77.1	78.4
8E 7N	3	3	1	-	15	19	41
Mass (g)	0.7	1.0	1.2	-	9.2	15.3	27.4
11E 5N	3	-	-	-	14	3	20
Mass (g)	6.5	-	-	-	12.0	58.1	76.6
1E 5N / 4E 5N	-	-	-	-	3	24	27
Mass (g)	-	-	-	-	6.8	25.8	32.6
2E 2N / 2E 3N	2	-	-	1	1	10	14
Mass (g)	0.7	-	-	16.9	3.7	18.7	40.0
2E 3N / 2E 4N	7	-	1	4	35	84	131
Mass (g)	26.3	-	1.2	2.6	39.0	255.5	324.6
2E 4N / 2E 5N	18	6	6	5	79	167	281
Mass (g)	12.8	10.1	11.4	9.7	96.5	168.6	309.1
3-6E5N / 3-6E6N	1	-	-	-	11	1	13
Mass (g)	0.5	-	-	-	83.5	85.1	163.1
5E 9N / 5E 10N	1	1	2	-	19	5	28
Mass (g)	0.5	4.4	21.3	-	108.6	109.6	244.4
5E 6E / 9N 10N	47	226	16	5	214	92	600
Mass (g)	27.5	173.4	35.9	7.7	193.8	409.5	847.8
5E 10N / 6E 10N	4	1	1	-	3	-	9
Mass (g)	1.4	0.1	6.3	-	3.7	-	11.5
6E 9N / 6E 10N	46	15	3	11	292	81	448
Mass (g)	30.9	25.3	5.6	16.5	214.3	207.0	499.6
6E 7E / 9N 10N	13	-	5	-	70	30	118
Mass (g)	12.9	-	1.4	-	59.8	62.0	136.1
6E 7E / 10N 11N	-	-	-	-	-	1	1
Mass (g)	-	-	-	-	-	35.4	35.4
6E 7E / 11N 12N	38	-	1	2	204	72	317
Mass (g)	18.0	-	0.4	1.8	425.9	415.0	861.1
8E 7N / 9E 7N	-	-	-	-	5	-	5
Mass (g)	-	-	-	-	3.1	-	3.1
8E 9E / 7N 9N	5	-	1	7	3	17	33

TABLE 4.4: Continue

Mass (g)	4.8	-	6.1	17.4	11.7	32.9	72.9
NE Ex	198	33	5	8	1114	315	1673
Mass (g)	163.1	91.4	8.9	10.2	528.1	1117.0	1918.7
NE Ex / R	5	1	-	-	12	12	30
Mass (g)	3.7	2.6	-	-	10.8	66.7	83.8
NE Ex / S	7	1	5	1	85	39	138
Mass (g)	12.5	3.3	11.8	1.5	66.1	197.6	292.8
NE Ex / T	9	-	3	-	23	35	70
Mass (g)	11.5	-	11.3	-	93.0	277.3	393.1
NE Ex / U	9	2	2	2	72	17	104
Mass (g)	14.3	5.3	2.0	6.1	111.8	113.9	253.4
NE Ex / V	5	-	1	-	31	14	51
Mass (g)	2.0	-	3.8	-	28.2	24.3	58.3
NE Ex / W	2	-	-	-	8	7	17
Mass (g)	1.9	-	-	-	8.3	20.7	30.9
NE Ex / AA	24	-	2	1	82	13	122
Mass (g)	29.3	-	1.1	6.7	61.2	73.5	171.8
NE Ex / AB	9	2	3	-	112	19	145
Mass (g)	11.4	4.1	9.4	-	141.5	82.0	248.4
NE Ex / AC	27	10	19	3	207	101	367
Mass (g)	52.6	20.6	32.2	4.3	351.9	631.7	1093.3
NE Ex / AD	3	-	-	-	-	1	4
Mass (g)	12.3	-	-	-	-	1.2	13.5
NE Ex / AE	31	7	2	3	104	39	186
Mass (g)	13.1	6.8	0.4	3.8	198.0	224.0	446.1
NE Ex / AF	6	5	2	1	84	46	144
Mass (g)	17.1	6.8	7.3	0.4	96.9	228.5	357.0
No Grid	38	9	3	7	154	210	421
Mass (g)	26.1	4.2	4.3	7.0	155.4	861.1	1058.1
Total	715	484	117	108	3544	2184	7152
Total Mass (g)	677.1	475.7	427.6	172.8	3623.9	8206.3	13582.4

Figure 4.7 illustrates the grid areas where the non-identifiable material were recovered from LKC. The green area represents the NE extension of the cave which is mostly composed of specimens transported by water from nearby locations.

FIGURE 4.7: Site map of Kemp's caves indicating excavated areas.

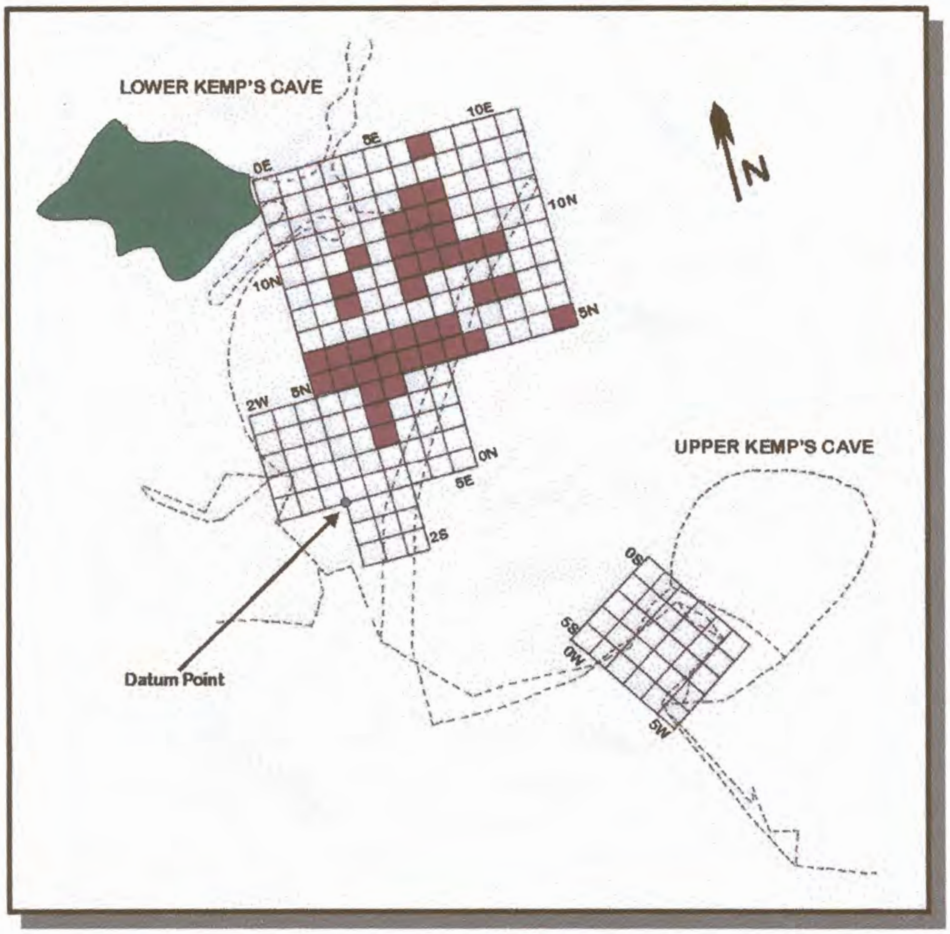
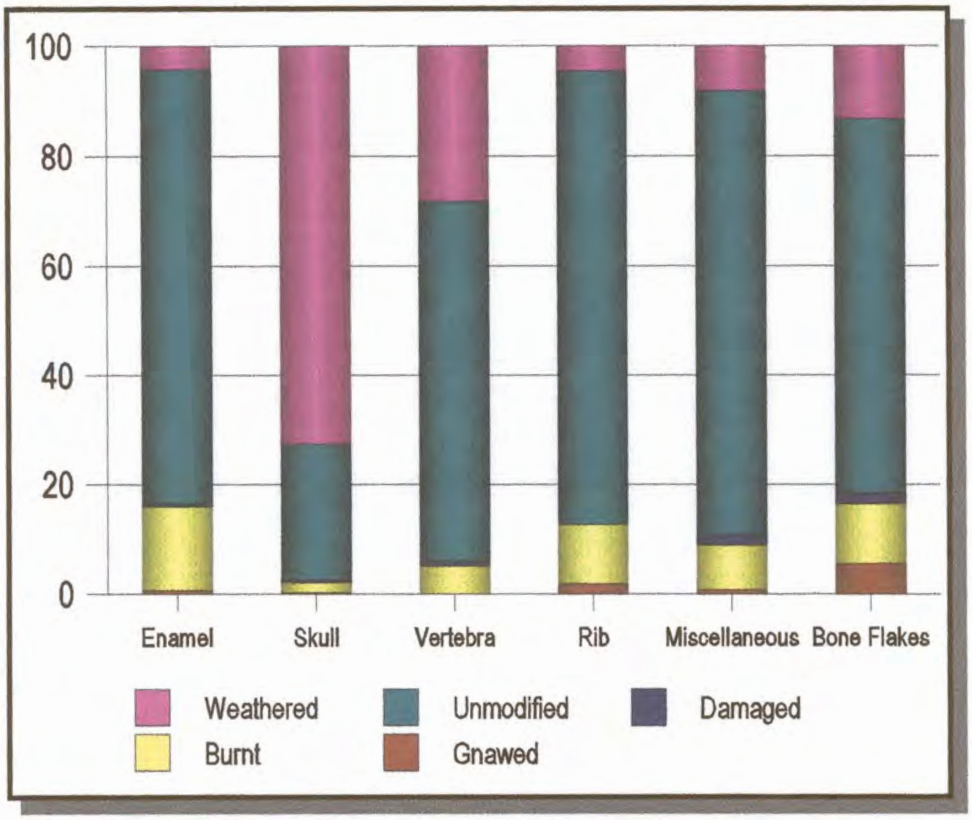


Figure 4.8 illustrates the ratios between the different conditions (damaged, burnt, gnawed, weathered or unmodified) of skeletal parts that were manifested on each non- identifiable fragment. A large amount of skull fragments were weathered. These weathered fragments were mostly from a single grid reference (6E 10N) and may represent only one individual. Most of the fragments, however, were unmodified. Only a small percentage of the fragments was recorded as being gnawed, which included mostly bone flakes. Gnaw marks which could be identified were chiefly the

result of *Hystrix africaeaustralis* (Porcupine) activity, although teeth marks of carnivores were also present. Almost no fragments were damaged. A total of 11% of the fragments were burnt which could indicate human activity. Burnt bone pieces were largely represented by enamel fragments.

FIGURE 4.8: Condition of non-identifiable bone fragments (%).



The provenances, 6E 9N10N and 6E7E 11N12N, contributed most of the bones that exhibited features that might have been related to archaeological damage during excavation or human activity. Most damage marks were not recently made, thus this might also indicate earlier human activity in the history of Kemp's Caves. Two closely related squares, 5E6E 9N10N and 6E 9N10N, accounted for 25% of the total pieces that showed evidence of burning. The NE Extension of the cave accounted for most of the gnawed bones. 5E 11N, 6E 9N10N and 6E7E 11N12N, were the dominant area for weathered specimens.

2. STAGE 2 - OSTEOMETRY

Stage two comprised of the determination and acquisition of the correct measurements of Southern African bovid species which could differentiate between the different species. The femur, tibia and metatarsal were measured. These raw measurements were then used in a data base to develop a computer programme which may assist in osteometric classification of bones.

2.1 Measurements

A total of 45 individual measurements were taken on the long bones of 30 Southern African bovid species. Two types of statistical analysis were performed to ascertain whether significant differences exist between the different species to justify and substantiate the developed computer program. The two statistical designs used were independent t-tests for each size class and measurement value, as well as regression analysis for measurement value analysis. Approximately 18 000 measurement values were recorded and statistically tested.

2.1.1 Inter-Bovid size class comparison

Brain [81] developed a class system to identify Southern African bovid species according to their size. Whenever there is not enough characteristic evidence present on a bovid skeletal specimen to confidently identify the fragment to a specific species, it is noted as belonging to one of the four bovid size classes. This is a relative elementary exercise for a trained eye. Therefore no attempt was made to compare the species of the different size classes with each other. Thus a species from Bovid class IV, for example Eland, was not statistically compared to a species belonging to size class I, for example Klipspringer, because of its obvious nature.

There are obvious size differences between the different bovid size classes, but not within them. Independent t-tests were, therefore, done to compare each species in a Bovid size class to all the other species within the same class. The t- and p- values of one of the species within a bovid size class were compared with the average of the t- and p-values of rest of the species in that group. In the case of Bovid size class IV, only one set of tests were done, as there are only two species within this size class. A separate t-test was done for each measurement taken on the femur, tibia and metatarsal. These t-test results display whether a species' bone measurements differ significantly from that of the other species (within the same bovid size class) combined, to be used in the database for identification purposes. A p-value of $\geq$0.05 was used as indication of significant difference.

Table 4.5 constitutes the key to the abbreviations used for the different species in the tables that follows. Raw measurement values of the three long bones, including their medians, means and standard deviations, can be seen in Appendices A to C. The sample sizes of each species can also be found in these appendices.

TABLE 4.5: Key to abbreviations to species (alphabetical).

Abbreviation	Species	Abbreviation	Species	Abbreviation	Species
BDU	Blue Duiker	BLA	Black Wildebeest	BLE	Blesbuck
BON	Bontebok	B	Buffalo	BUS	Bushbuck
BWI	Blue Wildebeest	CAP	Cape Grysbok	E	Eland
GDU	Grey Duiker	GEM	Gemsbok	GRH	Grey Rhebuck
IMP	Impala	KLI	Klipsringer	KUD	Kudu
LEC	Red Lechwe	MOU	Mountain Reedbuck	NYA	Nyala
ORI	Oribi	RDU	Red Duiker	REE	Reedbuck
RHA	Red Hartebeest	ROA	Roan	SAB	Sable
SIT	Sitatunga	SPR	Springbok	STE	Steenbok
SUN	Suni	TSE	Tsessebe	WAT	Waterbuck

Tables 4.6 to 4.8 provide the t- and p-values of all the bovid species from the different independent t-tests of the femur, tibia and metatarsal respectively. These values represent the average of the specific species in comparison to the average of all the species within the same Bovid size class. In order to better assess how many of the t-tests yielded statistically significant differences, graphic representation of the results were made. Figure 4.9 to 4.11 illustrate the significant values extracted from the results of the t-test of the femur, tibia and metatarsal respectively. Colour coding represents the different size classes. Different symbols specify the different portions of the bone, these being the shaft, proximal or distal measurements.

The Bovid I size class shows no significant differences between the individual measurements on the femur or the tibia. Only a few proximal extremity and shaft measurements, as well as most of the distal extremity measurements of the metatarsal were significantly different between the various species. These results show that there is a greater inter-species difference in the metatarsal than the other two long bones in this Bovid class. Almost all species in the Bovid I group was represented by only a few specimens in the different South African Museums. This may also attribute to the fact that there is little significant differences between species with the femur and tibia measurements.

The metatarsal measurements of Bovid class II displayed more significant differences than those of the femur and tibia, although several of them are significantly different. No pattern can be seen to identify whether one portion of the bone is more meaningful than another for distinguishing between the species. All three elements will therefore play a role in the identification of a Bovid class II species, but the metatarsal may be more accurate. The measurements, F(SBD), T(SBD), T(GDTN) and M(GLL) showed no significant differences in any one of the species. These measurements may therefore not have a positive contribution to osteometric identification.

Bovid III class showed significant differences in most of the measurements. *Damaliscus lunatus* (Tsessebe), however showed almost no significant differences within the Bovid III group. The only measurement expressed as being significantly different to the rest of the species within this group was the T(SDD). This measurement determines the smallest distance from the anterior to posterior points of the distal extremity of the tibia. Only one set of hind limb long bones was available in South Africa, thus no mean, median or standard deviation could be calculated for this species. This may contribute to the fact that there is almost no significant differences between the Tsessebe and the rest of the Bovid III class. A greater sample size of this species might provide positive results. The measurements, F(GBCF) and M(GML) showed little significant difference in the Bovid size class III and may therefore not contribute much to the osteometrical identification process.

Bovid IV shows distinctions in a wide variety of measurements in all three long bones. These tests actually showed the difference between the Eland (*Taurotragus oryx*) and the Buffalo (*Syncerus caffer*). In Figures 4.9 to 4.11 it can clearly be seen which measurements may not be as important in the osteometric analysis.

Species in the Bov I group therefore seem not to differ sufficiently to support osteometric identification and classification on either the femur or tibia, while species in the Bov II, Bov III and Bov IV classes differ substantially in all three bones. The measurement F(GBCF) and F(SBCF) show little significance in all four groups which may suggest that these measurements may not be useful in osteometric analysis.

TABLE 4.6: Bovid size class I - IV: Femur measurement t-test values.

Bovid species		F(GL)	F(GLH)	F(SBD)	F(SCD)	F(GL-GLH)	F(GBP)	F(GDH)	F(GBH)	F(GBD)	F(GLDD)	F(GMDD)	F(GBCF)	F(SBCF)	F(GBT)
SUN	t	-.25	-.25	-.22	-.23	-.22	-.23	-.22	-.23	-.23	-.23	-.23	-.22	-.22	-.22
	p	.802	.803	.824	.819	.826	.819	.824	.822	.820	.819	.818	.825	.825	.824
BDU	t	-.42	-.42	-.36	-.37	-.36	-.37	-.36	-.36	-.37	-.37	-.37	-.36	-.36	-.36
	p	.675	.678	.719	.710	.721	.711	.719	.717	.713	.711	.709	.722	.722	.718
CAP	t	-.85	-.84	-.86	-.87	-.87	-.87	-.86	-.87	-.87	-.87	-.87	-.86	-.86	-.87
	p	.399	.402	.390	.389	.386	.389	.390	.389	.389	.387	.385	.390	.390	.389
RDU	t	-.53	-.53	-.52	-.52	-.52	-.52	-.52	-.52	-.52	-.52	-.52	-.52	-.52	-.52
	p	.598	.598	.606	.608	.607	.603	.606	.605	.603	.605	.605	.606	.606	.604
KLI	t	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96
	p	.436	.436	.437	.437	.437	.437	.437	.437	.437	.437	.437	.437	.437	.437
STE	t	.81	.81	.83	.83	.83	.83	.83	.83	.83	.83	.83	.83	.83	.83
	p	.420	.421	.408	.411	.406	.408	.409	.409	.408	.409	.408	.407	.408	.408
GDU	t	-.64	-.64	-.68	-.67	-.68	-.67	-.68	-.67	-.67	-.67	-.66	-.68	-.68	-.68
	p	.527	.523	.500	.505	.500	.505	.500	.502	.506	.507	.511	.497	.498	.501
ORI	t	-.32	-.33	-.35	-.34	-.35	-.34	-.35	-.35	-.34	-.34	-.34	-.35	-.35	-.35
	p	.748	.744	.727	.732	.728	.733	.726	.729	.731	.731	.733	.725	.725	.728
SPR	t	-6.25	-5.75	-.92	-5.45	-6.81	-6.23	-3.63	-.96	-5.69	-6.39	-5.91	-1.77	-4.95	-3.01
	p	.000	.000	.357	.000	.000	.000	.000	.000	.000	.000	.000	.080	.000	.004
MOU	t	-2.71	-2.22	-.72	-3.23	-3.77	-12.2	-2.69	-8.41	-6.97	-11.8	-13.0	-.45	-.65	-4.92
	p	.008	.029	.472	.002	.000	.000	.008	.000	.000	.000	.000	.651	.516	.000
GRH	t	-3.44	-3.33	-.53	-3.11	-7.15	-12.1	-2.45	-8.07	-13.9	-9.71	-16.5	-.84	.56	-4.41
	p	.001	.001	.596	.002	.000	.000	.016	.001	.000	.000	.000	.402	.574	.000
BUS	t	.45	.52	-.16	1.02	-.30	-5.08	-.47	-2.25	-1.49	-3.41	-2.29	-.37	1.59	-2.40
	p	.652	.602	.876	.309	.762	.005	.639	.027	.138	.016	.024	.714	.115	.018
BLE	t	.60	-.73	-.11	4.73	2.70	8.08	1.51	4.44	4.57	4.36	8.59	.31	1.26	4.11
	p	.548	.468	.916	.000	.008	.000	.135	.000	.000	.000	.000	.757	.210	.000
BON	t	4.10	3.69	-.20	4.39	2.66	5.66	3.90	8.17	6.59	9.59	8.88	.24	1.35	9.78
	p	.000	.000	.844	.000	.009	.000	.000	.000	.000	.000	.000	.808	.182	.000
IMP	t	4.26	3.42	-.40	1.29	4.06	3.00	-.05	2.16	3.09	2.36	1.10	-.85	-.75	.90
	p	.000	.001	.688	.202	.000	.004	.963	.035	.003	.021	.275	.399	.457	.370
REE	t	4.42	5.54	1.05	-.18	.78	3.05	1.33	1.12	1.47	1.53	.82	1.38	3.97	-1.04
	p	.000	.000	.343	.865	.468	.016	.242	.265	.146	1.29	.416	.226	.000	.299

TABLE 4.6: Continue

LEC	t	-3.08	-1.91	-3.41	-3.12	-2.57	-3.83	-8.73	-3.15	-5.92	-8.17	-3.78	-5.93	-1.78	-3.20
	p	.009	.073	.001	.003	.012	.000	.000	.002	.000	.000	.000	.000	.079	.002
NYA	t	-2.56	-1.83	-4.11	-3.64	-7.99	-5.97	-9.68	-5.60	-12.8	-9.96	-13.3	-3.76	-3.49	-4.03
	p	.012	.071	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.003	.000
SIT	t	2.57	1.04	-2.19	-1.96	-2.90	-2.13	-1.63	-1.63	-1.98	-1.75	-2.67	-.39	1.47	-3.14
	p	.013	.304	.031	.054	.005	.037	.107	.106	.051	.085	.009	.698	.146	.002
TSE	t	-.59	-.41	-.42	-.92	-.91	-.71	-.55	-.91	-.97	-.48	-.47	-.72	-1.04	-1.24
	p	.554	.682	.678	.361	.364	.477	.581	.363	.337	.630	.642	.476	.301	.219
RHA	t	-3.07	-1.97	-4.17	-5.41	-4.26	-2.66	-3.05	-3.49	-5.69	-2.81	-3.41	-.25	-2.28	-5.35
	p	.004	.059	.000	.000	.000	.013	.004	.001	.000	.007	.001	.806	.026	.000
KUD	t	5.63	6.48	3.35	3.70	-1.72	1.53	4.63	3.44	4.73	4.43	2.47	5.22	5.76	1.46
	p	.000	.000	.001	.000	.090	.131	.000	.001	.000	.000	.016	.000	.000	.49
BLA	t	-8.16	-9.92	-1.46	-2.01	3.30	-.11	-3.79	-1.84	-.90	-2.42	.28	-.90	-2.12	.76
	p	.000	.000	.148	.048	.002	.914	.000	.069	.370	.018	.777	.369	.040	.449
WAT	t	3.22	6.23	8.81	9.55	3.05	6.36	5.42	9.45	9.18	5.03	5.01	.88	.16	7.42
	p	.002	.000	.000	.000	.013	.000	.000	.000	.000	.000	.000	.383	.875	.000
GEM	t	2.16	1.13	2.26	1.35	2.32	3.94	4.10	1.60	1.63	3.10	3.54	.49	.23	1.86
	p	.049	.276	.041	.181	.023	.003	.003	.113	.142	.008	.003	.628	.817	.066
SAB	t	4.54	4.04	2.52	2.39	.58	3.30	3.69	1.90	5.89	3.91	4.27	1.46	2.28	2.62
	p	.000	.000	.016	.023	.579	.005	.003	.079	.000	.001	.000	.149	.025	.011
BWI	t	2.62	1.22	3.15	7.38	2.17	3.07	4.97	3.11	6.06	5.63	7.32	.38	.44	3.18
	p	.024	.263	.002	.000	.033	.003	.001	.003	.000	.000	.000	.703	.658	.010
ROA	t	2.15	1.60	1.28	1.39	2.71	2.11	1.26	1.41	1.56	1.75	1.84	-.38	-.32	1.50
	p	.034	.113	.204	.169	.008	.038	.212	.163	.123	.084	.070	.705	.752	.137
E/B	t	.62	.33	-4.19	-2.63	1.00	-4.57	-4.66	-4.28	-4.07	-2.94	-2.29	1.43	.55	-2.39
	p	.545	.747	.000	.016	.329	.000	.000	.000	.001	.008	.034	.170	.600	.027

TABLE 4.7: Bovid size class I - IV: Tibia measurement t-test values.

Bovid species		T(GL)	T(GML)	T(GLL)	T(SBD)	T(SCD)	T(GBP)	T(GDP)	T(GDLC)	T(GDMC)	T(GDT)	T(GDTN)	T(SBIE)	T(GBD)	T(GDD)	T(SDD)
SUN	t	-.20	-.20	-.20	-.16	-.17	-.23	-.23	-.23	-.23	-.28	-.27	-.16	-.16	-.16	-.16
	p	.839	.840	.840	.874	.867	.820	.820	.822	.822	.784	.786	.876	.872	.873	.874
BDU	t	-.38	-.38	-.38	-.26	-.28	-.37	-.37	-.37	-.36	-.45	-.44	-.25	-.26	-.26	-.26
	p	.706	.707	.708	.797	.783	.713	.710	.715	.717	.655	.661	.801	.795	.795	.799
CAP	t	1.02	1.02	1.02	1.00	1.00	.73	.73	.73	.73	.25	.25	1.00	1.00	1.00	1.00
	p	.321	.320	.320	.328	.329	.466	.467	.465	.467	.807	.807	.328	.330	.329	.329
RDU	t	-.43	-.43	-.44	-.36	-.36	-.52	-.52	-.52	-.52	-.64	-.64	-.36	-.36	-.36	-.36
	p	.666	.666	.664	.717	.716	.606	.602	.602	.604	.522	.524	.718	.717	.717	.718
KLI	t	-.20	-.19	-.19	-.19	-.19	.96	.96	.96	.96	.93	.93	-.19	-.19	-.19	-.19
	p	.846	.847	.847	.850	.851	.076	.437	.437	.437	.452	.452	.850	.851	.851	.851
STE	t	-.55	-.55	-.55	-.57	-.58	-.82	-.81	-.81	-.81	.35	.35	-.57	-.57	-.57	-.57
	p	.584	.583	.584	.569	.567	.416	.419	.420	.418	.728	.728	.570	.571	.569	.569
GDU	t	-.41	-.41	-.42	-.47	-.46	-.67	-.67	-.68	-.67	-.83	-.84	-.48	-.47	-.47	-.47
	p	.682	.680	.678	.638	.648	.505	.506	.500	.503	.407	.403	.635	.642	.640	.638
ORI	t	-.18	-.18	-.18	-.24	-.23	-.35	-.34	-.35	-.35	-.43	-.43	-.25	-.24	-.24	-.25
	p	.855	.854	.854	.808	.816	.730	.732	.729	.728	.670	.666	.806	.811	.809	.807
SPR	t	-1.92	-4.14	-4.08	-.80	-3.33	-6.51	-3.27	-1.41	-6.29	-3.80	-1.20	-1.90	-2.65	-9.17	-9.21
	p	.058	.000	.000	.426	.001	.000	.001	.162	.000	.000	.234	.060	.009	.000	.000
MOU	t	-1.50	-2.87	-2.77	-.53	-3.58	-8.72	-9.40	-2.84	-15.4	-3.25	-.49	-1.12	-2.98	-7.96	-5.29
	p	.138	.005	.007	.596	.001	.000	.000	.006	.000	.002	.624	.263	.004	.000	.000
GRH	t	-1.45	-2.65	-2.67	-.48	-2.40	-11.1	-2.70	-2.05	-2.79	-1.44	.05	-1.48	-2.90	-12.1	-5.31
	p	.150	.009	.009	.631	.018	.000	.008	.043	.006	.153	.963	.143	.005	.000	.001
BUS	t	-1.29	-2.59	-2.61	-.20	-.50	-1.76	-1.31	-1.23	-8.49	-1.54	-1.01	-.30	-1.43	-1.90	1.43
	p	.199	.011	.011	.838	.619	.081	.192	.222	.000	.126	.314	.763	.155	.101	.199
BLE	t	.03	-1.41	-1.84	-.28	1.85	5.46	.41	-1.01	3.73	1.30	-.73	1.48	2.70	7.07	4.34
	p	.979	.165	.071	.780	.074	.000	.687	.315	.001	.198	.468	.142	.008	.000	.000
BON	t	2.38	3.70	3.68	-.45	4.61	6.54	1.26	.81	6.27	1.84	-1.39	-1.96	3.70	8.26	4.46
	p	.019	.000	.000	.650	.000	.000	.212	.417	.000	.069	.167	.052	.000	.000	.000
IMP	t	2.12	5.22	5.34	-.18	3.11	2.37	4.84	3.24	2.74	4.95	.98	.92	1.89	.53	2.06
	p	.037	.000	.000	.857	.002	.021	.000	.002	.009	.000	.328	.359	.062	.601	.046
REE	t	-.21	5.37	11.53	1.04	-.40	3.39	4.31	1.98	5.12	.58	1.68	2.24	-.06	2.67	3.30
	p	.841	.000	.000	.348	.707	.001	.000	.103	.000	.589	.154	.075	.954	.009	.001

TABLE 4.7: Continue

LEC	t	-2.73	-1.99	-2.32	-7.94	-2.88	-8.28	-2.49	-2.12	-2.98	-2.44	-2.13	-1.79	-10.9	-8.66	-1.92
	p	.013	.061	.032	.000	.005	.000	.015	.038	.004	.017	.071	.077	.000	.000	.059
NYA	t	-2.41	-2.17	-2.19	-3.20	-8.16	-4.53	-3.41	-5.28	-3.54	-3.45	-.32	-4.48	-10.4	-9.82	-1.95
	p	.018	.033	.031	.002	.000	.000	.001	.000	.001	.001	.747	.001	.000	.000	.055
SIT	t	1.50	1.66	1.69	-2.76	-2.16	-2.10	-.83	-1.84	-1.49	-.85	1.50	.42	-13.2	-1.37	-1.26
	p	.138	.100	.094	.007	.034	.039	.409	.070	.141	.397	.138	.678	.000	.176	.211
TSE	t	-.14	-.09	-.10	-.68	-.48	-.80	-.78	-.31	-1.15	-.75	-.67	-.85	-.59	-.75	-5.80
	p	.889	.928	.924	.497	.632	.426	.437	.758	.254	.453	.503	.399	.556	.457	.000
RHA	t	-.64	-.59	-.57	-2.96	-2.79	-4.61	-3.32	-1.66	-2.97	-4.55	-1.81	-3.43	-2.50	-1.63	-3.12
	p	.528	.563	.572	.007	.008	.000	.002	.109	.005	.000	.084	.001	.016	.118	.003
KUD	t	5.33	5.46	5.15	3.25	3.46	4.79	5.27	1.89	.38	5.74	6.92	6.78	3.97	5.81	5.27
	p	.000	.000	.000	.002	.001	.000	.000	.063	.708	.000	.000	.000	.000	.000	.000
BLA	t	-7.54	-7.82	-5.25	-2.89	-4.06	-1.01	-4.19	-1.90	.85	-2.18	-4.62	-3.59	-2.57	-3.59	-3.44
	p	.000	.000	.000	.005	.000	.314	.000	.062	.397	.033	.000	.001	.02	.001	.001
WAT	t	2.49	2.53	2.19	5.37	6.74	2.39	9.70	4.59	2.35	3.42	7.50	1.95	7.07	2.19	2.56
	p	.015	.013	.031	.000	.000	.019	.000	.000	.022	.001	.000	.054	.000	.032	.013
GEM	t	-.40	-.65	-.83	1.90	2.08	1.77	.08	.46	-.74	-.89	-2.03	.28	2.98	1.39	.84
	p	.692	.521	.413	.087	.067	.081	.937	.646	.459	.378	.046	.781	.016	.192	.403
SAB	t	1.06	.97	.78	4.48	4.98	4.36	3.05	3.84	2.78	1.82	-.06	1.10	3.08	5.12	1.40
	p	.297	.339	.440	.000	.000	.000	.007	.001	.007	.088	.956	.275	.010	.000	.165
BWI	t	1.27	1.12	1.18	8.53	2.77	5.40	3.13	1.71	2.38	1.20	.21	-.31	4.31	2.80	1.28
	p	.209	.267	.240	.000	.007	.000	.013	.091	.020	.235	.831	.763	.001	.023	.205
ROA	t	2.13	1.93	1.84	2.69	2.14	1.96	1.34	1.37	1.23	1.27	-.62	1.80	2.02	8.02	.79
	p	.037	.057	.069	.009	.036	.054	.186	.175	.221	.208	.538	.075	.047	.000	.431
E/B	t	1.74	2.25	2.58	-2.83	-3.08	-2.95	-2.70	-1.88	-4.17	-1.11	-1.09	-1.73	-4.60	-3.45	-4.66
	p	.096	.035	.018	.010	.006	.008	.014	.073	.003	.279	.311	.097	.000	.002	.000

TABLE 4.8: Bovid size class I - IV Metatarsal measurement t-test values.

Bovid species		M(GL)	M(GML)	M(GLL)	M(SBD)	M(SCD)	M(GBP)	M(GDP)	M(GLMA)	M(GBMA)	M(GLLA)	M(GBLA)	M(GBD)	M(GDD)	M(GMBC)	M(GBLC)	M(GBDE)
SUN	t	-.19	-.19	-.19	-2.56	-3.29	-3.38	-2.47	-.16	-.16	-.16	-.16	-3.82	-3.41	-3.61	-3.39	-.16
	p	.851	.852	.852	.012	.001	.001	.016	.874	.875	.875	.875	.000	.001	.001	.001	.875
BDU	t	-97	.97	-97	-7.04	-9.03	-24.8	-19.8	1.00	1.00	1.00	1.00	-9.03	-8.26	-9.39	-8.82	-.26
	p	.385	.385	.385	.000	.000	.000	.000	.375	.374	.375	.374	.000	.000	.000	.000	.799
CAP	t	-.63	-.63	-.63	-1.46	-.55	-2.02	-3.88	-.61	-.61	-.61	-.61	-.49	-.59	-.26	-1.78	-.61
	p	.533	.532	.531	.148	.584	.047	.000	.544	.546	.542	.546	.623	.560	.795	.079	.546
RDU	t	-.43	-.43	-.43	-.86	-.90	-.94	-4.59	-.36	-.36	-.36	-.36	-.217	-7.56	-2.12	-1.01	1.00
	p	.667	.667	.668	.393	.371	.355	.000	.718	.717	.718	.718	.033	.000	.037	.314	.344
KLI	t	-.21	-.21	-.21	1.17	1.79	.99	.45	-.19	-.19	-.19	-.19	1.73	2.07	1.10	1.73	-.19
	p	.837	.836	.836	.244	.076	.325	.655	.850	.850	.851	.850	.087	.041	.277	.087	.851
STE	t	-.56	-.56	-.56	-1.68	-.68	-1.77	.00	-.57	-.57	-.57	-.57	2.56	2.08	2.56	2.41	-.57
	p	.579	.580	.580	.098	.495	.081	.998	.569	.569	.569	.568	.012	.041	.012	.018	.571
GDU	t	-.38	-.38	-.38	5.73	4.12	12.83	12.67	-.47	-.48	-.47	-.47	4.85	6.43	5.09	5.56	-.48
	p	.707	.707	.707	.000	.000	.000	.000	.639	.636	.640	.637	.000	.000	.000	.000	.634
ORI	t	-.19	-.20	-.19	3.10	3.00	3.32	12.92	-.24	-.25	-.25	-.25	3.57	3.65	3.29	2.61	-.24
	p	.847	.845	.846	.003	.004	.001	.000	.808	.806	.806	.805	.001	.000	.001	.001	.807
SPR	t	2.49	3.05	-.30	-5.37	-7.19	-4.54	-1.97	-3.82	-4.43	-5.94	-7.24	-6.62	-2.44	-7.23	-7.07	-5.65
	p	.014	.003	.763	.000	.000	.000	.052	.000	.000	.000	.000	.000	.017	.000	.000	.000
MOU	t	-3.39	-13.7	-.60	-2.18	-8.36	-4.05	-15.8	-12.4	-7.24	-7.67	-3.89	-8.79	-4.31	-7.55	-10.5	-5.03
	p	.001	.000	.551	.032	.000	.000	.000	.000	.000	.000	.003	.000	.000	.000	.000	.000
GRH	t	-2.30	-3.69	-.44	-4.79	-9.43	-4.16	-20.8	-20.1	-9.90	-3.7	-6.31	-14.2	-3.76	-12.2	-15.7	-15.9
	p	.024	.000	.661	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000
BUS	t	-3.69	-5.82	-.56	.54	-1.53	-6.20	-3.67	-3.3	-5.29	-1.33	-4.48	-8.11	-5.29	-8.09	-9.14	-3.88
	p	.000	.000	.580	.590	.129	.001	.000	.001	.007	.187	.010	.001	.000	.001	.000	.000
BLE	t	-.22	-1.27	.98	3.60	1.90	4.12	3.05	5.57	5.03	5.79	3.51	6.11	1.27	6.15	5.29	8.33
	p	.826	.207	.346	.002	.070	.000	.004	.000	.000	.000	.002	.000	.212	.000	.000	.000
BON	t	1.05	.44	-.62	3.40	6.52	7.49	6.64	8.62	11.93	5.57	10.17	11.68	4.94	11.33	11.71	8.54
	p	.297	.664	.536	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
IMP	t	6.49	8.18	-.19	2.09	4.24	1.89	3.44	.51	-5.04	2.79	-3.39	-.84	5.89	-.44	-.62	-1.50
	p	.000	.000	.850	.039	.000	.067	.001	.612	.000	.007	.001	.404	.000	.662	.535	.142
REE	t	-.64	1.28	-.14	2.42	2.19	1.87	1.57	1.54	2.10	2.44	3.34	1.76	1.70	2.39	2.21	2.35
	p	.548	.204	.887	.017	.031	.064	.119	.127	.089	.017	.001	.131	.092	.052	.071	.056

TABLE 4.8: Continue

LEC	t	-5.60	-1.63	-5.63	-6.56	-5.32	-4.86	-11.7	-3.06	-7.95	-4.07	-1.80	-2.26	-7.78	-1.37	-1.34	-2.04
	p	.000	.177	.000	.000	.001	.000	.000	.003	.000	.000	.077	.027	.000	.175	.186	.045
NYA	t	-1.90	-1.16	-1.76	-7.79	-4.64	-4.32	-4.23	-8.59	-10.9	-4.36	-12.8	-8.43	-10.3	-19.0	-7.97	-18.1
	p	.061	.251	.082	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
SIT	t	-.16	.02	-.09	-3.90	-7.65	-1.30	-1.78	-1.62	-1.73	-1.82	-1.97	-1.66	-1.84	-1.93	-1.63	-2.15
	p	.873	.981	.925	.000	.000	.196	.080	.109	.087	.073	.053	.101	.070	.057	.106	.035
TSE	t	.46	.40	.47	-.72	-.82	-.33	-.07	-.5	-.26	-.40	-.90	-.08	.04	-.36	-.43	.25
	p	.645	.691	.639	.475	.412	.739	.945	.617	.797	.389	.370	.936	.972	.719	.671	.806
RHA	t	1.71	.77	1.76	-3.98	-3.90	-3.63	-2.79	-2.28	-2.06	-.91	-.73	-.68	-1.34	-1.03	-1.21	1.07
	p	.092	.445	.084	.000	.001	.001	.007	.029	.051	.370	.466	.499	.188	.308	.234	.289
KUD	t	5.42	4.22	5.42	3.16	2.44	2.34	3.34	2.27	1.81	2.82	2.43	-.12	2.35	-.06	.13	-1.62
	p	.000	.000	.000	.002	.017	.022	.001	.026	.074	.006	.018	.906	.022	.956	.896	.119
BLA	t	.06	.40	.05	-.41	-.42	.72	1.51	.00	-.19	.83	.29	-.96	-.05	-1.18	-1.41	-.78
	p	.949	.694	.960	.681	.673	.471	.136	.998	.851	.410	.774	.343	.960	.242	.163	.436
WAT	t	-3.51	-.88	-3.81	6.20	10.30	6.01	2.10	4.31	3.50	-.01	1.97	8.09	6.39	4.02	8.33	6.66
	p	.001	.381	.000	.000	.000	.000	.039	.000	.003	.991	.052	.000	.000	.000	.000	.000
GEM	t	-.66	-.39	-.69	1.71	1.22	1.58	-.10	.40	1.61	1.20	1.01	1.77	.69	1.49	1.69	2.14
	p	.509	.700	.494	.105	.255	.119	.923	.694	.112	.232	.314	.082	.495	.142	.096	.036
SAB	t	-3.40	-.75	-3.60	3.49	3.32	1.29	.20	1.22	3.38	2.39	1.25	2.01	2.33	1.77	1.93	5.44
	p	.001	.457	.001	.001	.002	.204	.846	.226	.002	.039	.215	.048	.027	.081	.057	.000
BWI	t	-.01	.10	-.02	.12	3.31	1.93	1.64	1.20	2.13	4.32	2.43	2.00	3.50	1.93	2.05	2.15
	p	.991	.924	.986	.907	.021	.057	.106	.235	.036	.001	.028	.049	.003	.058	.044	.035
ROA	t	.70	.59	.66	2.04	1.61	1.22	.70	1.38	2.21	1.67	.11	2.54	1.74	2.37	2.55	2.31
	p	.483	.557	.513	.045	.111	.225	.484	.171	.030	.099	.909	.013	.086	.020	.013	.024
E/B	t	10.51	13.33	13.45	-3.72	-4.69	-4.85	-1.34	-4.16	-2.18	-2.35	-1.50	-7.30	-4.26	-6.89	-6.81	-7.80
	p	.000	.000	.000	.001	.000	.000	.195	.001	.043	.030	.150	.000	.000	.000	.000	.000

FIGURE 4.9: Bovid size class I - IV: Femur measurement significance.
(All the dots, squares and asterisks indicate significant differences)

Bovid species	F(GL)	F(GLH)	F(SBD)	F(SCD)	F(GL-GLH)	F(GBP)	F(GDH)	F(GBH)	F(GBD)	F(GLDD)	F(GMDD)	F(GBCF)	F(SBCF)	F(GBT)
SUN														
BDU														
CAP														
RDU														
KLI														
STE														
GDU														
ORI														
SPR	■	■		■	■	✱	✱	✱	●	●	●	●	●	●
MOU	■	■		■	■	✱	✱	✱	●	●				●
GRH	■	■		■	■	✱	✱	✱	●	●	●			●
BUS						✱		✱		●	●			●
BLE				■	■	✱		✱	●	●	●			●
BON	■	■		■	■	✱	✱	✱	●	●	●			●
IMP	■	■			■	✱		✱	●	●				
REE	■	■				✱							●	
LEC	■	■	■	■	■	✱	✱	✱	●	●	●	●	●	●
NYA	■	■	■	■	■	✱	✱	✱	●	●	●	●	●	●
SIT	■		■	■	■	✱			●	●	●			●
TSE														
RHA	■	■	■	■	■	✱	✱	✱	●	●	●		●	●
KUD	■	■	■	■	■		✱	✱	●	●	●	●	●	
BLA	■	■		■	■		✱	✱		●			●	
WAT	■	■	■	■	■	✱	✱	✱	●	●	●			●
GEM	■		■		■	✱	✱			●	●			●
SAB	■	■	■	■		✱	✱	✱	●	●	●		●	●
BWI	■		■	■	■	✱	✱	✱	●	●	●			●
ROA	■				■	✱				●	●			
E/B			■	■		✱	✱	✱	●	●	●			●

Symbols indicating significance:
- ■ = Shaft measurements of femur
- ✱ = Proximal extremity measurements of femur
- ● = Distal extremity measurements of femur

Bovid size class indications:
- Blue = Bovid size class II
- Pink = Bovid size class III
- Green = Bovid size class IV

FIGURE 4.10: Bovid size class I - IV: Tibia measurement significance.
(All the dots, squares and asterisks indicate significant differences)

Bovid species	T(GL)	T(GML)	T(GLL)	T(SBD)	T(SCD)	T(GBP)	T(GDP)	T(GDLC)	T(GDMC)	T(GDT)	T(GDTN)	T(SBIE)	T(GBD)	T(GDD)	T(SDD)
SUN															
BDU															
CAP															
RDU															
KLI															
STE															
GDU															
ORI															
SPR	■	■	■		■	✱	✱		✱	✱		✱	●	●	●
MOU		■	■		■	✱	✱	✱	✱	✱			●	●	●
GRH		■	■		■	✱	✱	✱	✱				●	●	●
BUS		■	■			✱			✱					●	
BLE			■		■	✱			✱				●	●	●
BON	■	■	■		■	✱			✱	✱		✱	●	●	●
IMP	■	■	■		■	✱	✱	✱	✱	✱			●		●
REE		■	■			✱	✱		✱			✱		●	●
LEC	■	■	■	■	■	✱	✱	✱	✱	✱	✱	✱	●	●	●
NYA	■	■	■	■	■	✱	✱	✱	✱	✱		✱	●	●	●
SIT		■	■	■	■	✱		✱					●		
TSE															●
RHA				■	■	✱	✱		✱	✱	✱	✱	●		●
KUD	■	■	■	■	■	✱	✱	✱		✱	✱	✱	●	●	●
BLA	■	■	■	■	■		✱	✱		✱	✱	✱	●	●	●
WAT	■	■	■	■	■	✱	✱	✱	✱	✱	✱	✱	●		●
GEM				■	■	✱					✱		●		
SAB				■	■	✱	✱	✱	✱	✱			●	●	
BWI				■	■	✱	✱	✱	✱				●	●	
ROA	■	■	■	■		✱					✱	✱			●
E/B	■	■	■	■	■	✱	✱	✱	✱			✱	●	●	●

Symbols indicating significance:

- ■ = Shaft measurements of femur
- ✱ = Proximal extremity measurements of femur
- ● = Distal extremity measurements of femur

Bovid size class indications:

- Blue = Bovid size class II
- Pink = Bovid size class III
- Green = Bovid size class IV

FIGURE 4.11: Bovid size class I - IV: Metatarsal measurement significance.
(All the dots, squares and asterisks indicate significant differences)

Bovid species	M(GL)	M(GML)	M(GLL)	M(SBD)	M(SCD)	M(GBP)	M(GDP)	M(GLMA)	M(GBMA)	M(GLLA)	M(GBLA)	M(GBD)	M(GDD)	M(GMBC)	M(GBLC)	M(GBDE)
SUN				■	■	✱	✱					●	●	●	●	
BDU				■	■	✱	✱					●	●	●	●	
CAP						✱	✱								●	
RDU							✱					●	●	●		
KLI					■							●	●		●	
STE				■		✱						●	●	●	●	
GDU				■	■	✱	✱					●	●	●	●	
ORI				■	■	✱	✱					●	●	●	●	
SPR	■	■		■	■	✱	✱	✱	✱	✱	✱	●	●	●	●	●
MOU	■	■		■	■	✱	✱	✱	✱	✱	✱	●	●	●	●	●
GRH	■	■		■	■	✱	✱	✱	✱	✱	✱	●	●	●	●	●
BUS	■	■				✱	✱	✱	✱		✱	●	●	●	●	●
BLE				■	■	✱	✱	✱	✱	✱	✱	●		●	●	●
BON				■	■	✱	✱	✱	✱	✱	✱	●	●	●	●	●
IMP	■	■		■	■	✱	✱		✱	✱	✱		●			
REE				■	■	✱			✱	✱	✱		●	●	●	●
LEC	■		■	■	■	✱	✱	✱	✱	✱	✱	●	●			●
NYA	■		■	■	■	✱	✱	✱	✱	✱	✱	●	●	●	●	●
SIT				■	■		✱		✱	✱	✱		●	●		●
TSE																
RHA	■		■	■	■	✱	✱	✱	✱							
KUD	■	■	■	■	■	✱	✱	✱	✱	✱	✱		●			
BLA																
WAT	■		■	■	■	✱	✱	✱	✱		✱	●	●	●	●	●
GEM												●			●	●
SAB	■		■	■	■				✱	✱		●	●	●	●	●
BWI					■	✱			✱	✱	✱	●	●	●	●	●
ROA				■	■				✱	✱		●	●	●	●	●
E/B	■	■	■	■	■	✱		✱	✱	✱		●	●	●	●	●

Symbols indicating significance:

- ■ = Shaft measurements of femur
- ✱ = Proximal extremity measurements of femur
- ● = Distal extremity measurements of femur

Bovid size class indications:

- Yellow = Bovid size class I
- Blue = Bovid size class II
- Pink = Bovid size class III
- Green = Bovid size class IV

2.1.2 Regression analysis

Regression analysis was done separately on each size class to ascertain which measurements were predictors in the model. A step-wise analysis was done by entering the different measurement values of either the femur, tibia or metatarsal of all the species in a certain Bovid group into the statistical programme, Sigmastat. The programme then determined which measurements were predictors. It therefore calculates which measurements significantly differs between the species of a specific Bovid group.

In Table 4.9 the predictors in each size category are shown for each bone.

The Bovid I group test excluded almost all femur and tibia measurements except F(GL-GLH), T(GL), T(GDP) and T(GDT) and indicated that the metatarsal was most vital when differentiating species within this size group. This correlates with the results of the individual t-tests, which showed that only the metatarsal measurements of the species within the Bovid I group show significant differences.

Most of the femur, tibia and metatarsal measurements of both Bovid groups II and III appeared to be predictors, which also correlates with the t-test analysis. No specific bone, or part of bone seems to be more important osteometricaly than the other.

The regression analysis of the species in the Bovid IV group which indicates the osteometric differences between Eland and Buffalo, showed various measurements as predictors, but specifically excluded the distal tibial measurements. These results suggest that there might be no difference in the measurements, taken in this study, on the distal tibia of these two species. These measurements may therefore not be useful in an osteometric analysis.

TABLE 4.9: Bovid size class I - IV: Measurement predictors.

SIZE	FEMUR MEASUREMENTS			TIBIA MEASUREMENTS			METATARSAL MEASUREMENTS		
	Shaft	Proximal	Distal	Shaft	Proximal	Distal	Shaft	Proximal	Distal
I	F(GL-GLH)			T(GL)	T(GDP) T(GDT)		M(GL) M(SBD) M(SCD)	M(GBP) M(GDP)	M(GBD) M(GDD) M(GBMC) M(GBLC) M(GBDE)
II	F(GLH) F(SBD) F(SCD) F(GL-GLH)	F(GBP) F(GDH) F(GBH)	F(GBD) F(GLDD) F(GMDD) F(GBCF) F(SBCF) F(GBT)	T(GL) T(GML) T(GLL) T(SBD) T(SCD)	T(GBP) T(GDP) T(GDLC) T(GDMC) T(GDT) T(GDTN) T(SBIE)	T(GBD) T(GDD) T(SDD)	M(GL) M(GML) M(GLL) M(SBD) M(SCD)	M(GBP) M(GDP) M(GLMA) M(GBMA) M(GLLA) M(GBLA)	M(GBD) M(GDD) M(GBMC) M(GBLC) M(GBDE)
III	F(GLH) F(SBD) F(SCD) F(GL-GLH)	F(GBP) F(GDH) F(GBH)	F(GBD) F(GLDD) F(GMDD) F(GBCF) F(SBCF) F(GBT)	T(GL) T(GML) T(GLL) T(SBD) T(SCD)	T(GBP) T(GDP) T(GDLC) T(GDMC) T(GDT) T(GDTN) T(SBIE)	T(GBD) T(GDD) T(SDD)	M(GL) M(GML) M(GLL) M(SBD) M(SCD)	M(GBP) M(GDP) M(GLMA) M(GBMA) M(GLLA) M(GBLA)	M(GBD) M(GDD) M(GBMC) M(GBLC) M(GBDE)
IV	F(SBD) F(GL-GLH)	F(GBH)	F(GBCF) F(SBCF) F(GBT)	T(GL)	T(GDP) T(GDLC) T(GDTN) T(SBIE)		M(GLL) M(SBD)	M(GDP) M(GBMA)	M(GDD) M(GBDE)

2.1.3 Index calculation and analysis

Three indices were calculated to ascertain the degree of robusticity of the three hind limb long bones. In each instance the index was calculated as follows for the femur, tibia and metatarsal respectively:

Smallest circumference of shaft (SCD) / Greatest length (GL) X 100

Figures 4.12 to 4.14 give an indication of the minimum and maximum values of the indices of each bone for every bovid species measured. Figure 4.12 shows the overlapping of the femur index values for the different Bovid groups. The Bovid I group shows overlapping of all species. This correlates with the t-tests that showed no significant differences between the individual measurements used to calculate this index. The species in the Bovid II class also show large areas of overlap. The Mountain Reedbuck (*Redunca fulvorufula*) and Bontebok (*Damaliscus dorcas dorcas*) species respectively have the lowest and highest index values. At the Bovid III group level there is a visible difference between the values. The robusticity index of the Sitatunga (*Tragelaphus spekei*) shows no overlap with the species within this Bovid III group. If the Bovid class of a specimen measured is known, the femur index of the Sitatunga might be usable in identification. The sample size of Sitatunga, was however, very small and a larger sample might adjust these result. Bov IV shows no overlapping, thus indicating that there will be a clear distinction between the Eland (*Taurotragus oryx*) and Buffalo (*Syncerus caffer*) species on the femur index values. Therefore it would be possible to identify these two species purely on their robusticity indices.

The same tendency is seen in Figure 4.13 which shows the tibia indices. The close overlap of the tibial robusticity values between Bov I and Bov II, may render these values unusable for identification purposes. Bov III shows overlapping values within the group, but may be used to distinguish a specimen from Bov I and Bov II, with the exception of Nyala (*Tragelaphus angasii*) and Lechwe (*Kobus leche*). Again the Sitatunga shows no overlap within its Bovid group, thus the tibial indices may also assist in identifying tibial remains of this species. Bov IV shows little overlap, again being useful with identification.

Figure 4.14 shows overlapping of the metatarsal robusticity indices between all Bovid size groups, including the Eland species of Bovid IV. The Waterbuck (*Kobus ellipsiprymnus*) shows no overlap within the Bovid III group it belongs to. If the Bovid group of the specimen measured is known, it would be possible to identify a Waterbuck according to its meatarsal robusticity value. The Springbok (*Antidorcas marsupialis*) and Buffalo (*Syncerus caffer*), however, show no overlap with any of the other species. The Springbok have the lowest robusticity value, which indicates a thin, long metatarsal. The Buffalo has the highest value indicating a thick, short metatarsal. Thus, the metatarsals of these two species can be identified simply according to their metatarsal index values.

The Buffalo (*Syncerus caffer*) species interestingly enough, show almost no overlap with any other species. This indicates that the buffalo hind limb long bones are extremely robust, therefore short and thick. All three index values can therefore be used in osteometrical identification because of its distinguishable robustcity indices. All separate index values are available from the author.