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Goldsmith's: Preliminary Study of a newly discovered Pleistocene site near Sterkfontein.

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CHAPTER 3

The Goldsmith's Faunal Assemblage: Results

3. 1. Taxonomy

The faunal assemblage from Goldsmith's site comprises specimens of the Orders Carnivora, Primates and Lagomorpha, the Family Bovidae and members of the Class Aves. The sample consists of representatives of three Families of the Order Carnivora (Felidae, Hyaenidae and Canidae). Within the Order Primates, the sub-family Cercopithecidae is represented. The family Bovidae, in which two sub-families (Tragelaphinae and Alcelaphinae) were identified, represents the Order Artiodactyla. A single specimen represents the Order Lagomorpha while the Class Aves is the only non-mammalian class present in the assemblage.

3.2 Skeletal Part Representation and Minimum Numbers of Individuals

The Goldsmith's site faunal sample analysed consists of 2981 specimens, 25.8 % (771 specimens) of which, are identifiable to skeletal element and mammal size group; only 464 specimens were identified to Order. Appendix 1 provides a catalogue of the identified specimens. Two thousand two hundred and ten specimens (74.1% of the collection) bear no preserved diagnostic morphological features and are thus unidentified. Long bone shaft fragments that are 4 cm and longer comprise 4 % (N=123) of the assemblage. A total of twenty-two macromammalian individuals and two avian individuals were recovered from the assemblage.

3.2.1. Systematic Palaeontology

a. Order Primates

Genus *Papio or Parapapio*

Thirty-two specimens were identified as belonging to the Order Primates. These constitute 6% of the total faunal assemblage (tNISP). Thirteen cranio-dental specimens were identified. The dental specimens were however not distinguished between *Papio* sp. and *Parapapio* sp. Research on both genera has demonstrated that the overlap, in dental size and morphology, is frequently too great to readily distinguish between the two on isolated teeth only (Eisenhart 1974; Maier 1970; Brain 1981). The comprehensive Minimum Number of Individuals (cMNI) for Primates is 4 (16.6% of the total cMNI). These are represented by the following specimens:

A left incisor (GS 194); a right second upper incisor (GS 311); a left second incisor (GS 604); a left upper canine (GS 326); a right upper first molar (GS 601); two right second molars (GS 237 and GS 307); a second molar (GS 310); a left upper second molar (GS 602); an upper third premolar (GS 603); a left third molar (GS 228); a left lower third molar (GS 309); a maxilla with premolars and deciduous incisors (GS 528); three first phalanges (GS 119, GS 83 and GS 564); two complete first phalanges, a left (GS 562) and a right (GS 242; a right third metacarpal (GS 174); three femur condyles (GS 201, GS 217, and GS 406); a left distal radius (GS 450); a radius head (GS 539); a thoracic vertebra spine

(GS 642) and seven ulnae shaft fragments (GS 655, 656, 657, 658, 659, GS 660 and GS 663).

b) Order Carnivora

The total Number of Identified Specimens (tNISP) for carnivores is 318, constituting 68% of the assemblage. All carnivore specimens that could not be categorised to a specific carnivore family were simply classified to other categories such as small (≤ 30kg), medium (30 - ≤ 100kg) or large (≥ 100kg).

Small carnivores

Eighteen specimens belonging to the small carnivore category were identified. These included three specimens (0.6% of the total assemblage) representing the Family Canidae: a right proximal femur fragment (GS 5); a juvenile femur head (GS 292) and a juvenile right femur (GS 293). Two right astragali, GS 505 and GS 572, suggest the presence of two adult small sized carnivores. Therefore three (cMNI) small-sized carnivore individuals (12.5% of the total cMNI) are present in the assemblage.

Medium carnivores

One hundred and eighty-six medium carnivores were identified. Two families (Hyaenidae and Felidae) were identified under the category. The MNI for medium sized adult carnivores is 3. These are represented by three left naviculars (GS 641, GS 44 and GS 190). A left tibia (GS 594) represents a juvenile individual. Therefore the comprehensive Minimum Number of individuals for medium carnivores is four (16.6% of the total cMNI).

Family Hyaenidae

The Family Hyaenidae is represented by seven specimens (1% of the assemblage) four of which, could not be identified to species level. The four, which could not be identified to species level, are: a right second phalanx (GS 140); a left third metacarpal (GS 196); a left fibula (GS 304) and a right ulna (GS 278).

Crocuta crocuta.

Three specimens represent the species *C. crocuta*: an adult left fifth metacarpal (GS 34); an adult right fifth metacarpal (GS 49) and a left upper third premolar (GS 568).

Family Felidae

50 medium-sized specimens represent the family Felidae. These are specimens identified only to family level, Felidae, which were compared with modern *P. pardus* species and could not be positively matched with this cat species. Examples of these specimens are discussed later. Only one medium-sized species, *Panthera pardus*, belonging to the family Felidae was identified.

Species *Panthera pardus*

Nine specimens represent the species *Panthera pardus.* Two second incisors (GS 57 and GS 58) and seven post-cranial specimens: a right first phalanx (GS 8); a left external cuneiform (GS 27); a right proximal radius (GS 30), a right femur (GS 61); two left femora (GS 96 and GS 276) and a left second metatarsal (GS 632).

Large carnivores

One hundred and fourteen specimens were categorised under large carnivores, 53 of which are felids. Two large-sized carnivore species were identified, *Panthera leo* and *Dinofelis barlowi.* The MNI for large-sized carnivores is three (12.5% of the total cMNI). This value is derived from three right calcanea, two of which are complete (GS 156 and 157) and a proximal calcaneus (GS 69).

Species *Panthera leo*

The following specimens were identified as *P. leo*: one tooth, a right upper fourth premolar (GS 569), and thirteen post-cranial specimens: a left cuboid (GS 16); a left magnum (GS 53); a left fourth metacarpal (GS 64); a left third metatarsal (GS 67); a right calcaneum (GS 69); two left trapezoids (GS 60) and (GS 89); a left fifth metacarpal (GS 172); a left proximal radius (GS 209); a right proximal radius (GS 258); a right astragalus (GS 219); a right external cuneiform (GS 226) and a left distal tibia (GS 383).

Sabre-toothed Cats

Subfamily Machaerodontinae

Dinofelis barlowi

Six cranial specimens represent the extinct false sabre-toothed cat: a right section of a maxilla (GS 591) consisting of the portion just behind the orbit, with the section from the

post-orbital region and the mesial part of a right third premolar (Figure 27). The only dental specimen fully preserved on the skull fragment is an upper right fourth premolar.

Also present in the sample are: three complete and well-preserved canines, a left upper canine (GS 770, figure 28), a right upper canine (GS 626, figure 29), and a left upper canine (GS 108); an upper canine crown (GS 323); and a left upper fourth premolar (GS 590).

The elements share similarities with the *Dinofelis* specimens discovered at Bolt's farm (Cooke 1991). The canines are bucco-lingually flattened and are similar in size to Cooke's (1991) measurement of the *Dinofelis* upper canine from Bolt's Farm, which is 59-60 (anterior to posterior) in length. The Goldsmith's canine is about 94mm in length including the root (30 millimetres).

The maxilla is the same size as that of the Bolt's Farm cranium. The distance between the orbit and the nasal bone is, however, larger in the Goldsmith's cranium than the Bolt's Farm specimen. The infra-orbital groove is deeper and more pronounced in the Bolt's farm specimen as compared to GS 591, where the depression is relatively shallow and wider. These differ significantly from the modern felid (i.e. lion and leopard) crania, which lack such a groove on the lateral part of the maxilla. No anterior teeth are preserved. The right upper fourth premolar on the maxilla (GS 591) possesses a large main cusp and two accessory cusps, with the mesial one missing a large portion. The main cusp is almost angled backward, the case also observed on some *Dinofelis* specimens, for example M607, from Makapansgat (Collings 1973).

Within the Goldsmith's faunal assemblage there are 38 postcranial specimens that could not be classified as lion or leopard but which shared most similarities with felids. These are considered to represent *Dinofelis sp*. Twelve of these specimens are discussed below.

GS 474 (Figure 31), a left external cuneiform.

When compared to the modern *P. leo*, shows significant differences indicating that it belongs to a different species of a large cat. The proximo-distal length of the fossil cuneiform is shorter (28mm), but has the same width as that of the modern lion (32mm). The internal surface of the cuneiform, the side that articulates with the mid-cuneiform, has two articular facets. The anterior facet angles into the body of the cuneiform whilst that of a lion is oriented parallel to the body of the bone.

GS 279, a left external cuneiform.

This cuneiform was compared to a modern large lion (*P. leo*). This cuneiform possesses characteristics implying that it could be representative of an individual the same size as a lion, however with some morphological differences. The fossil specimen's proximo-distal length and width are consistent with the lion's. The facet on the caudal side is however different from the lion's external cuneiform. The fossil's facet's inclination is into the body of the bone contrary to that of a modern lion, which is aligned parallel to the body.

GS 624, a right magnum.

This fossil magnum is half the size of a modern *P. leo* and of approximately leopard size. However, the fossa on the lateral side is deeper than in either the lion or the leopard.

GS 208, a proximal section with shaft, left fourth metacarpal (Figure 32).

Comparison of this metacarpal bone with a modern adult male *P. leo* displayed differences in morphological traits. From a dorsal view, the proximal portion (base) of the fossil specimen is longer and narrower in comparison to the *P. leo* element. From the same view, a lion's fourth metacarpal is relatively wider and shorter while *P. pardus'* metacarpals are smaller than either a lion or the fossil specimen. From the proximal view, the lateral facet is separate from the medial facet and is rounded, larger and flattened on the fossil, while that of a lion extends from the medial facet which is bean-shaped, narrower and protrudes from the main body.

GS 332 (figure 33) and GS 478, two left first metacarpals, and GS 477 (figure 34) a right first metacarpal.

When compared to the modern male lion, the fossil specimens are stockier and more robust. *P. leo'*s first metacarpal is almost twice as long as it is wide and the fossils are almost half (31mm and 32mm) the size of a lion (60mm) and are broad (both are 18mm) relative to their length.

GS 94, a left proximal phalanx of the first digit (thumb) and GS 210: a right proximal phalanx of the first digit (thumb).

These two thumb bones are the same length as those of *P. leo* but with a more robust and wider appearance. The fossa on the palmar side of the phalanges is shallower than that of a lion, which is deep.

GS 275 (Figure 36) and GS 291, left third metacarpals.

The abovementioned metacarpals have shafts wider than that of lion (14mm) but shorter in length (70mm). Though only the shafts and the proximal portions are preserved, the fossil specimens are visibly shorter than that of a lion. The bases (proximal portion) of the fossils possess more articular facets when compared to the modern lion, which boasts a rounded, smoother appearance. The muscular attachments associated with a typical felid third metacarpal are more conspicuous in the modern specimen and less prominent in the fossils.

GS 239, a left third metatarsal.

This fossil specimen is lion-sized. The point of articulation with the external cuneiform (proximal view), however, is similar in size to the leopard and smaller than that of a lion. The lion is elongated plantar-dorsally, which is not the case with the fossil.

After completion of the bone analysis for this thesis an almost complete humerus (figure 30) was extracted from a breccia block, although its length is similar to a leopard it is much more robust with more muscular attachments. The specimens discussed above are consistent with descriptions of post-cranial materials belonging to *Dinofelis* species (Turner

1997). Their morphology is suggestive of a felid much shorter, stockier and more muscular than a modern lion. Therefore these remains, from Goldsmith's site, are most probably post-cranial remains of *Dinofelis*.

The cumulative MNI for carnivores is 10, 41.6% of the total cMNI for the Goldsmith's assemblage.

c. Order Artiodactyla

Family Bovidae

One hundred and two specimens were identified as bovid. The family Bovidae constitutes 21% of the total faunal assemblage from Goldsmith's.

Sub-family *Tragelaphinae*

Only one specimen, a right mandible (GS 116) was identified as a Tragelaphine.

Sub-family *Alcelaphinae*

Only one alcelaphine species*, Damaliscus dorcus,* was identified. It is represented by a second right incisor (GS 654) and a third right incisor (GS 4). A right proximal humerus (GS 62) was only identified to the genus *Damaliscus* but could not be classified to species level.

Seven individuals were recovered from bovid remains in the Goldsmith's assemblage. Two Size Class 1 individuals are represented by a juvenile humerus (GS 571), and an adult

humerus (GS 36). Two adult individuals belonging to Size Class 2 are represented by two right astragali (GS 394 and GS 494). One Size Class 2 juvenile individual is represented by two left unfused radii specimens, a proximal portion of a radius (GS 476) and a distal portion of a radius (GS 479). Seven Size Class 3-4 metapodial specimens (GS 29, GS 76, GS 136, GS 147, GS 335, GS 448 and GS 457) matching to four elements indicate the presence of two individuals, a juvenile and an adult. Therefore the combined cMNI for bovids is 7, 35% of the total MNI for the Goldsmith's assemblage.

d) Other taxa

Sixteen specimens represent the Class Aves. This constitutes 2% of the total NISP of the Goldsmith's assemblage. Three unsided femur elements were observed in the Class Aves, suggesting the presence of two individuals, constituting 8.3% of the total cMNI. A single lagomorph distal femur (GS 82) represents one possible hare individual, therefore comprising 0.1% of the total number of identified specimens assemblage and 4% of the total cMNI.

3.3 Bone Modification

a) Mammalian related damage

Most bone did not demonstrate signs of mammalian related damage. Only two bone specimens (Figures 22 and 23) illustrate the presence of carnivore modification. Figure 22 is polished in appearance and has smooth, randomly positioned pits on most of its surface,

thus indicating stomach acid etching on the bone. The second bone (Figure 23) fragment has score marks on the cortex. These are short parallel shallow incisions.

b) Weathering

Most of the bones display cracking and flaking of the cortex [Behrensmeyer's (1978) Stages 1 and 2]. Fifty-nine dental specimens were exempted from the weathering analysis as no comparable study has been undertaken to determine teeth weathering stages. Most of the identifiable specimens (92%) displayed a consistent Stage 1 type weathering. Fifty-one bone specimens were weathered beyond stage 1. Stage 2 weathering was observed on 29 bones (4%) while 2% (N=20) demonstrated characteristic Stage 3 weathering modifications. Only one bone (GS 107) is fibrous in appearance and 'rough in texture'—Behrensmeyer's (1978) weathering Stage 4. GS 664 is bone that is disintegrating and has lost its original bone shape due to weathering, therefore complying with stage 5.

c) Abrasion

All bones were studied for signs of abrasion. Only 65 bones display characteristics suggesting that they had been abraded, 8 having a smoothed and polished appearance. The rest of the abraded bones were scraped through recent friction, possibly during excavation.

d) Trampling

Only seven bones displayed shallow thin, randomly positioned scratchmarks, which are suggestive of possible trampling (Behrensmeyer *et al.* 1986; Olsen & Shipman 1988;

Shipman & Rose 1988). One of these marks is a recent slight incision on a rib shaft (GS 639).

e) Insect action

None of the bones from the Goldsmith's assemblage demonstrated insect action.

f) Sediment compaction

The presence of sediment compaction is ruled out. The bones are intact and displayed no evidence of crushing.

g) Burning

Indication of burning in the Goldsmith's fauna is absent. No bones are charred or calcined. Bones with a dark brown/black colour have been observed. The possibility that the colour change is the effect of burning is eliminated because the bones are only coloured on the outer surface, in an inconsistent manner and do not display signs of change in the macrostructure. They do not demonstrate the presence of carbon accumulations.

h) Staining

Manganese staining is very prominent on the Goldsmith's assemblage. Most of the bones (N=2806) were manganese stained and are thus dark brown (black) in colour. One hundred and sixty-nine bone specimens were white in colour with minimal staining (staining on less than half the portion of the bone surface). Six of the bones displayed a lighter shade of

manganese staining (i.e. GS 63-68). In the assemblage, staining is related to the absence of adhering matrix (see below).

i) Adhering matrix

Thirty-five bone specimens have adhering breccia, 18 of which were completely white and demonstrated no indication of staining. Only one block of breccia (with six specimens, GS 63, GS 64, GS 65, GS 66, GS 67 and GS 68) has slightly stained bones. Another point of interest concerning the bones still attached to or enclosed in breccia is that most are complete and display no distortion or crushing. This indicates that the bones were not subjected to impact and pressure from rock fall and much of the fragmentation of the bones occurred during the decalcification of breccia. It was also during the decalcification process that they became manganese stained.

j) Excavation Preparation and Damage

Some of the Goldsmith's fauna was enclosed in blocks of breccia. Encasement in breccia meant that subsequent to collection, most of these bones had to be processed for ease of identification. Removal of small chips of bone was the most common form of damage from excavation and preparation. Bones excavated from the decalcified earth also show some unavoidable excavation damage and bones from breccia blocks and, on occasion, show minor marks from chisels and air scribes. Any such damage is unavoidable even to the most skilled preparator.

3.4 Bone fragments and fracture attribute analysis

Bone fragments and long bone shaft fragments

Bone fragments were cross-checked against each other to establish fragments that re-fit. Four bone specimens were successfully refitted: a left proximal tibia (GS 594) fit to a left proximal tibia (GS 427). A canid femur head (GS 292) was fitted to a canid proximal femur without a head (GS 293) and demonstrated to be specimens from the same element.

Other bone elements which articulated together, suggesting that they belong to the same individual include a right large carnivore astragalus and right calcaneum (GS 155 and GS 156 respectively), and two juvenile bovid size class 2 lumbar vertebrae (GS 179 and 180) demonstrated the possibility of belonging to the same individual.

One hundred and forty-eight long bone shaft fragments ≥ 4cm were identified within the assemblage. However, only 122 fractures were suitable for attribute analysis. This is because only 122 of them demonstrated ancient fractures and 26 of the fractures were fresh. Fracture attribute state values are not indicative of the quantity of the long bone fragment sample but of the fracture attributes observed and suitable for analysis. For example, a long bone shaft fragment with breaks on both ends, one freshly broken and another fracture that occurred during the pre-fossilisation stage. Only the pre-fossilised break was considered for the analysis.

Out of a sample of 122 long bone shafts, the following fracture attributes were observed: 55 oblique, 105 right and 57 right and oblique fracture angles; 94 transverse, 54 curved and

V-shaped and 74 intermediate fracture outline; 50 smooth surfaces; 172 jagged surfaces; 89 shaft widths which are less than half the original circumferences; 14 of which are greater than half the original and 19 circumferences that are complete in at least a portion of the bone shaft.

Table 2. Computation of Fracture Attribute Analysis between Goldsmith's and three French sites.

Attribute states	Sarrians	Bezouce	Fontbrégoua	Goldsmith's
Fracture angle				
Oblique	22	27	114	55
Right	176	174	47	105
Right & oblique	71	52	13	57
Total	**269**	**253**	**174**	**217**
Fracture outline				
Transverse	193	144	92	94
Curved & V-shaped	74+32	59+23	42+92	28+26
Intermediate	59	61	35	74
Total	**358**	**287**	**261**	**222**
Fracture edge				
Smooth	111	158	163	50
Jagged	247	129	98	172
Total	**358**	**287**	**261**	**222**
Shaft circumference				
1) <50%	16	33	115	89
2) >50%	10	0	23	14
3) 100%	200	60	13	19
Total	**226**	**93**	**151**	**122**

Table 3. Goldsmith's Site Assemblage Fracture Angle cross-tabulation

Assemblage	Chi-square	Df	P
Sarrians	28.375	2	<0.0001
Bezouce	24.24	2	<0.0001
Fontbrégoua	66.461	2	<0.0001

Table 4. Goldsmith's Site Assemblage Fracture Outline cross-tabulation

Assemblage	Chi-square	Df	P
Sarrians	22.065	2	<0.0001
Bezouce	9.373	2	0.0092
Fontbrégoua	45.164	2	<0.0001

Table 5. Goldsmith's Site Assemblage Edge cross-tabulation

Assemblage	Chi-square	Df	P
Sarrians	4.917	1	0.0266
Bezouce	54.813	1	<0.0001
Fontbrégoua	77.587	1	<0.0001

Table 6. Goldsmith's Site Assemblage Circumference cross-tabulation

Assemblage	Chi-square	Df	P
Sarrians	186.6	2	0
Bezouce	58.129	2	0
Fontbrégoua	3.587	2	0.166

Goldsmith's assemblage is significantly different from all the three French sites in fracture angle at the 99% confidence level. It is not significantly different from the Bezouce assemblage in fracture outline. Bezouce is a site that possesses a large proportion of breaks caused by pick and shovel excavation of an amateur

archaeologist and the landowner. It closely resembles Sarrians in fracture edge. The Sarrians assemblage is a collective burial with bones broken in a dry state, *in situ*, by sediment compaction. The long bone shaft fractures from the Goldsmith's assemblage therefore suggest that the fauna was broken up post-depositionally and most probably during the process of decalcification as sediment compaction is ruled out.

Figure 4. Goldsmith's assemblage frequency of taxa, %NISP.

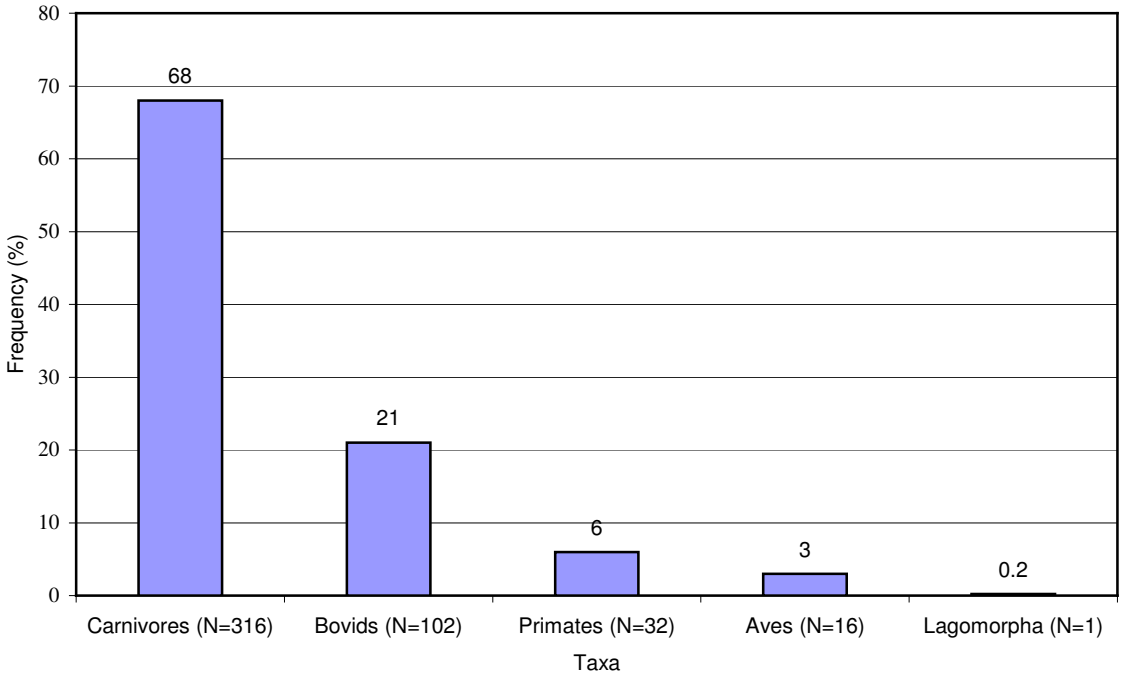


Figure 5. % cMNI of taxa, Goldsmith's assemblage

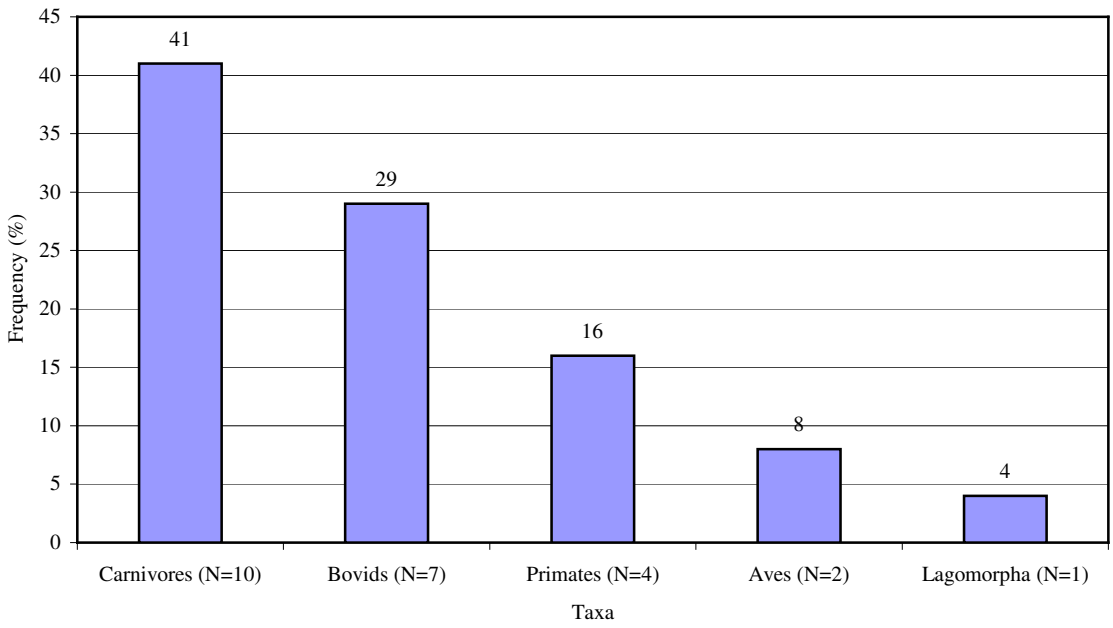


Figure 6. NISP of animal body sizes represented in the Goldsmith's faunal assemblage

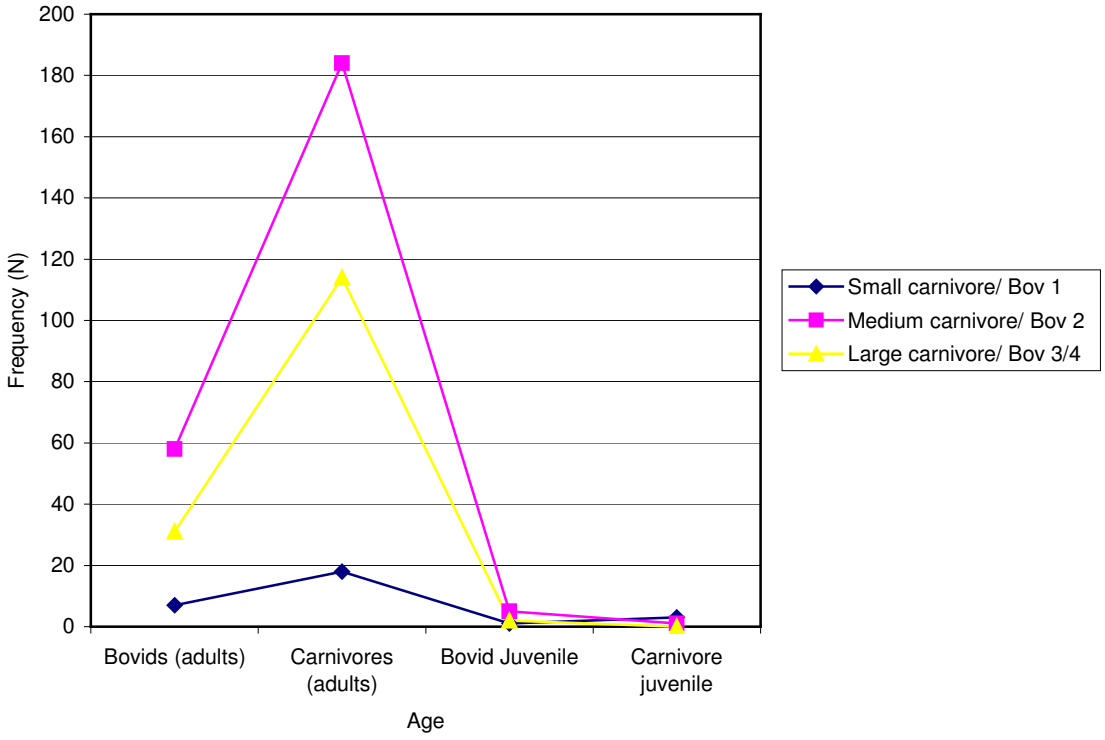


Figure 7. Comparison of Goldsmith's taxa with other fossil cave sites, %NISP

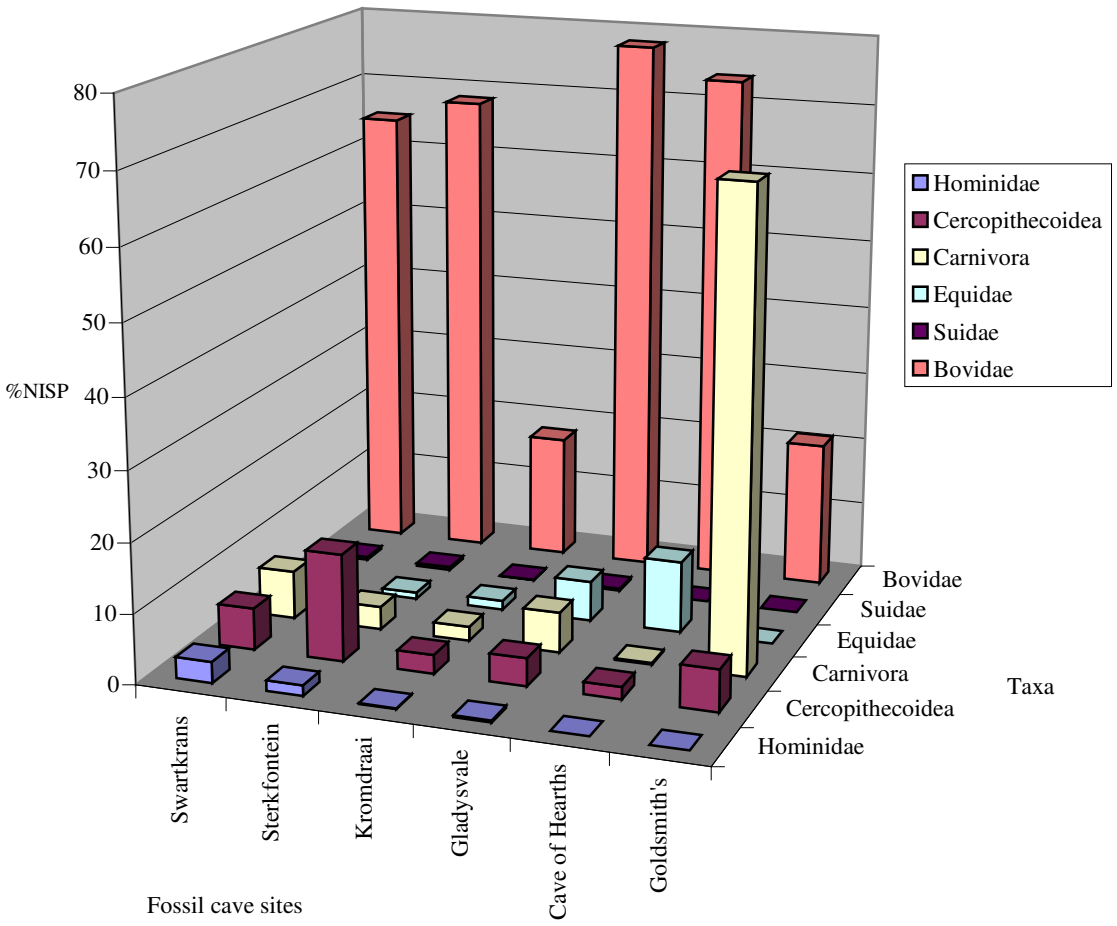
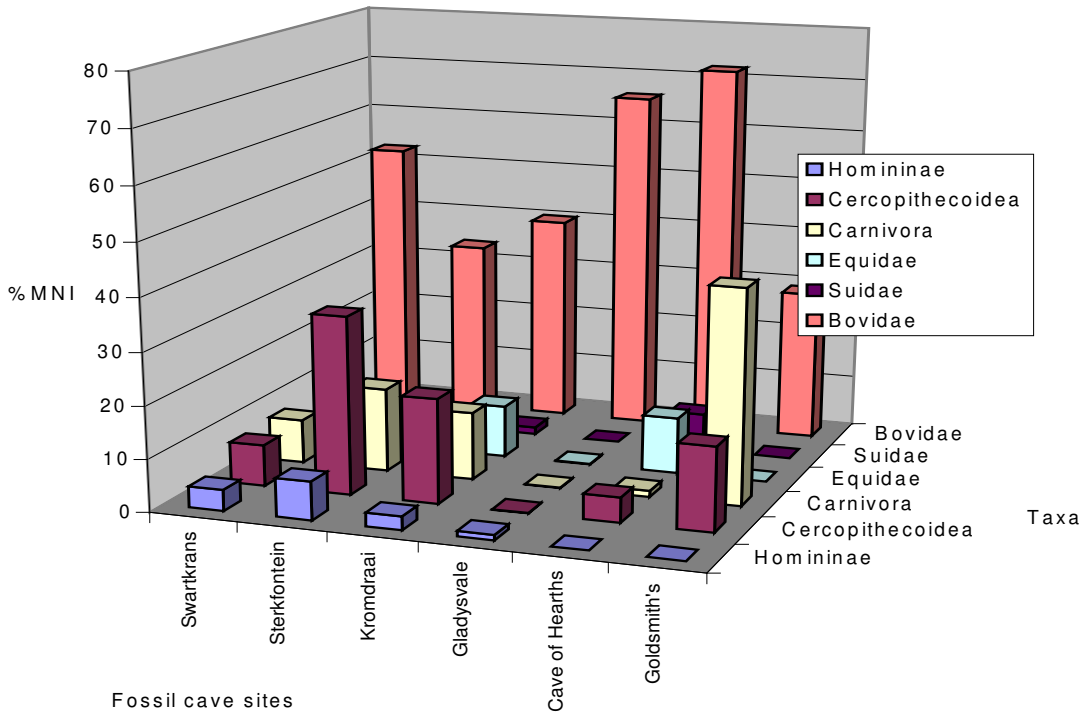


Figure 8. Comparison of Goldsmith's taxa with other fossil cave sites, %MNI



3.5. Interpretation and Discussion

3.5.1. Taxonomic Composition and Body Size Representation

Figures 4 and 5 demonstrate that carnivore remains dominate the Goldsmith's faunal assemblage. The percentage NISP and percentage MNI show that carnivores outnumber bovids and primates. Analysis of the range of body sizes (Figure 6) indicates that medium sized animals are more represented than large bodied animals. Small sized animals and juveniles of medium size groups are the least represented.

Fauna represented in the Goldsmith's assemblage is mostly of medium-sized adults whose NISP values are followed by large-sized animals. This could be a factor of the collecting bias of the accumulator. Leopard and hyaena are known to prey mostly on medium and small sized antelopes (Brain 1981, Vrba 1975, 1976). The majority of bovid faunal remains in the Goldsmith's sample are medium-sized. It is thus possible that these carnivores were involved in the accumulation of the bones. The possibility of carnivore accumulation of part of the faunal assemblage therefore, cannot be ruled out.

Comparison of Goldsmith's taxa frequencies with other fossil cave sites in South Africa demonstrated that the site is quite unique in its preservation pattern. The following sites' combined assemblages were considered, Swarkrans Members 1-5 (Watson 1993; deRuiter 2001); Sterkfontein Members 2, 4 and 5 (Brain 1981; Pickering 1999); Kromdraai A and B (Brain 1981); Gladysvale (Lacruz 2002) and Cave of Hearths (Mason 1988; Ogola 2003). The faunal patterns were compared and Goldsmith's proved to be different from the other sites. An analysis of the %NISP and the %MNI of the sites suggests that Goldsmith's

pattern, in which carnivores are the dominant taxa followed by bovids, is very peculiar. For all the other sites, bovids are the most represented.

Taxonomic composition of the Goldsmith's faunal assemblage suggests a scenario not usually observed from palaeontological sites representing the normal animal community in the environment. In an aven situation where animals accidentally fall down a shaft, it is expected that, in relatively open environments, carnivore and primate individuals will be less represented in the assemblage, with bovid remains represented in relatively larger numbers (Pickering 1999). Thus, various forms of taxa that exist in the natural biome should be reflected in the animal remains. However, in closed environments, where the existence of taxa is biased towards carnivores and primates and against bovids, a high representation of carnivores and primates is expected. Animals that are more agile such as carnivores and primates are usually more represented than ungulates in death trap assemblages of closed habitats (see Pickering *et al.* 2004) because primates and carnivores, due to their climbing abilities, tend to use caves as sleeping sites or dens. Baboons tend to roost and sleep in caves, while the presence of carnivores in the same caves suggests that they preyed on the primates and were sometimes trapped in the cavern or fell to their death. In the Goldsmith's assemblage, carnivores constitute 41% of the cMNI of the total collection. Therefore a death trap scenario is a possible mode of accumulation. A peculiar feature about the assemblage is that, contrary to expectation, bovid remains occur in a larger percentage than primates. This is unexpected for assemblages. For example at Sterkfontein Member 2 (Pickering *et al.* 2004) where most of the fauna preserved is of agile animals (both primates and carnivores), bovids are the least represented. The pattern

at Goldsmith's cannot be a factor of collection bias as all the breccia blocks with bone and all decalcified earth from the main dump were gathered. The collection method also ensured that all bone specimens larger than 2mm were retained for analysis. Further analysis of the Goldsmith's fauna yet to be developed and recorded from breccia blocks will possibly shed more light on whether this is a good sample of what is represented in the cave deposits.

3.5.2. Skeletal Element Representation

In a death trap situation, it is expected that complete skeletons will be represented when factors such as differential preservation of bone elements can be ruled out (e.g. Clarke 1998; Pickering *et al*. 2004). For example the Sterkfontein Oldowan infill is recognised as dominated by a death trap mode of accumulation because of the full range of skeletal elements in the assemblage, even though the bones have been broken and disarticulated by sediment load (Pickering 1999). Within the Goldsmith's assemblage, carnivores are represented by a full range of skeletal elements. This supports the presence of a death trap mode of accumulation of a portion of the faunal assemblage. A paucity of other skeletal elements and a large proportion of phalanges and metapodials (Figure 37) characterises the representation of other taxa within the assemblage. This could be a factor related to the density of the bones, which makes them less susceptible to breakage into smaller fragments. Which suggests the presence of a different mode of accumulation for some of the fauna and supports the possibility that the deposit has been disturbed.

3.5.3. Carnivore Involvement

Hyaenas and leopards are known to use caves as breeding areas, dens and places of retreat (Simons 1966; Skinner *et al.* 1980; Brain 1981; Lam 1992; Klein *et al*. 1999; Zuberbühler & Jenny 2002). The presence of hyaena coprolites is characteristic of breeding lairs and dens. Coprolites do not constitute part of the Goldsmith's assemblage collected thus far. One hyaena individual within the collection indicates that hyaenas were in the vicinity, and if conditions were right, the hyaenas could have used the site as a den. However that possibility is not supported by data, as there is no hyaena crunching of bone.

Hyaena and leopard accumulated assemblages are characterised by a high proportion of carnivores and primates (Simons 1966; Enloe *et al*. 2000; Pickering 2002). In leopard and hyaena collections, juvenile carnivores are also to be expected. Because hyaenas and leopards leave their young in dens when searching for food, it is expected that most mortality of cubs will occur at the den. According to Pickering (2002), the carcasses are rarely transported away. Moreover, brown hyenas (*H. brunnea)* tend to prey on small carnivores for their cubs and transport the food back to the maternity den (Brain 1981; Pickering 1999; Mills & Mills 1977). Because juvenile and small animal bones are easier to masticate than bones of larger mammals, hyaena cubs will thus be provisioned with smaller animals. Therefore, carnivore juvenile remains will form a significant amount of an assemblage collected by hyaenas and leopards. The Goldsmith's assemblage includes only two (one small sized and one medium sized) juvenile carnivore individuals. Moreover, these juvenile remains are not of hyaena. The use of the site as a hyaena-breeding lair is not supported by data. The fact that the majority of the faunal assemblage consists of carnivore

remains and that the majority of those carnivores are medium-sized adults suggests that they could have fallen into a death trap rather than representative of a denning situation.

Examination of the bone specimens for carnivore marks revealed that only two specimens displayed characteristics that could be attributed to carnivore modification. If carnivores were the accumulator of the faunal assemblage, then one would expect more than the two specimens out of a total of 2981 to indicate carnivore chewing or crunching. Recent research has demonstrated that foot and hand elements in a scat assemblage rarely bear modification marks as carnivores swallow them whole (with skin and ligaments protecting them) without chewing them and as a result there are little or no tooth marks (Pickering 1999). Leopards are known to impart defleshing marks on limb bone shafts (Simons, 1966; Carlson & Pickering 2003). However, felid accumulated assemblages display fewer tooth marks than the average hyaenid and canid derived assemblages. If the carnivore accumulated scenario was true for the Goldsmith's assemblage then it would be expected that other bone elements or fragments should bear signs of stomach acid etching or other carnivore modification on limb shafts and other skeletal elements. The paucity of carnivore-modified bones indicates that carnivores were not actively involved, at least to any significant extent, in the accumulation of the bones into the infill. However, the possibility of carnivore accumulation is not completely ruled out.

3.5.4. Hominid Involvement

Faunal data from Goldsmith's site does not suggest any hominid involvement in the accumulation of the material. None of the bones display signs of percussion marks, cut marks, or hominid-related breakage, even though stone tools form part of the Goldsmith's assemblage. This is also the case with Bolt's Farm caves (Cooke 1991). It is likely that the stone tools discovered in the Goldsmith's deposits derive from one or more infills separate from the bulk of the faunal remains. This is suggested by the fact that the artefacts were found mainly in one part of the dump and by the fact that no stone artefacts were found exposed in the *in situ* deposit. This does not necessarily suggest that no hominids existed in the area at the period of accumulation nor does it imply that a larger sample of the Goldsmith's fauna would not include hominids.

3.5.5. Post-depositional Destruction

Destruction caused by post-depositional factors manifests itself in alteration to the natural state of the bone. Most bones undergo chemical and or structural changes during burial. Bone density influences the manner in which a bone will respond to post-depositional processes (Brain 1981, Klein & Cruz-Uribe 1984). Relatively dense bones and dense bone portions survive post-depositional destructive forces caused by sediment pressure, water transport and trampling and abrasion better than the less dense bones or skeletal elements. A high proportion of dense bones (bones of the podials, metapodials and phalanges) characterises the Goldsmith's faunal assemblage. In the case of broken bones with no signs of hominid or carnivore involvement, post-depositional destruction can be inferred

(Marean 1991). Therefore, it is possible that post-depositional destruction, in the form of winnowing of at least a portion of the fauna, impacted on the faunal remains.

3.5.6. Bone Fracture and Fracture Attribute Analysis

The solid breccia within Goldsmith's preserves more complete skeletal elements (e.g. limb bones, teeth, jaw and skull portions), which are either white in colour or slightly stained. On the other hand bone specimens collected from the decalcified earth are highly fragmented, with the exception of bones of the manus and the pes (excluding bones which suffered breakage due to the lime mining operations and our own recent excavation) and are manganese stained. This implies that there is a correlation between decalcification, manganese staining and bone breakage. A possible scenario could be that, subsequent to the formation of breccia in the deposit and with bone still in its original colour, the process of decalcification led to manganese staining (as the protective matrix disintegrated) and destabilized the bone structure. The process of decalcification includes removal of calcium or calcium compounds. The breakage of bone during decalcification could thus be the result of removal of one of the bone stabilizers, the mineral calcium, which renders the bone more vulnerable to sediment pressure and compaction.

Bone breakage in the Goldsmith's fauna is different from that observed at other Sterkfontein valley sites such as Sterkfontein and Swartkrans. Within these sites, fossil bone fracture is attributed to crushing by sediments and the decalcification process has not fragmented the bones to the extent seen in the Goldsmith's assemblage (Kibii 2000; Pickering 1999). Furthermore fracture attribute analysis of the Goldsmith's long bone

fragments suggests that bone fracture in the assemblage occurred post-depositionally. This could be due to pressure from the deposit, as is the case at the French site, Sarrians (Villa & Mahieu 1991). A highly plausible explanation for the long bone fracture, however, is that they were fractured by the process of decalcification to a greater extent than has occurred at sites such as Sterkfontein.

3.5.7. Stratigraphy

The fauna from the Goldsmith's site, like much fauna from other cave sites, was compiled from mine dumps. This consisted of bones in the calcified matrix (in breccia) and in the decalcified earth. In the main dump (Dump 1) excavation, the top and the middle portions of the dump were a rich source of bones (with the top having a higher concentration of bones) and the lower part of the dump was almost sterile. This suggests that the sterile section was originally on the top of the infill and the middle portion, where bone concentration was reduced, was in the middle of the deposit, while the bone-rich part was originally at the bottom of the miners' excavation of the cave. This in turn suggests that the bone accumulation within the cave was initially at a high rate and most of the bones accumulated during that period. This period was followed by a reduction in the accumulation of the fauna and later colluvial overburden filled the cave.

The *in situ* material (Figure 3) suggests that bones were concentrated against the north-facing wall of the fissure and contained in both breccia and occasionally in flowstone. The fossil fauna shows two dissimilar appearances. Most of the bones display a brownish colour with specks of black. A small fraction of the bone is white in colour with no

indication of staining. These bones indicate that they experienced surface exposure in an open environment as Andrews (1995) suggests of bleached bone. This differential staining of bone could be due either to derivation from two infills representing different ages or from one infill that has been partially decalcified, resulting in the staining of some bones. However, there is no obvious difference in the taxonomic composition of both the breccia and decalcified material. Therefore it is plausible that the fauna originated from one infill, which was partially decalcified, resulting in the colour differences observed on the bones. Through the process of decalcification, most of the bone specimens were affected by manganese, hence the black/dark brown staining of bones that would have all been white in the original breccia.

3.5.8. The sabre-toothed cat, Dinofelis, in the African record

The sub-family Machaerodontinae was first recognized in Europe in sites dating back to the Upper Miocene (Dawkins & Sanford 1871). *Dinofelis* is one of the three sabre-toothed cats recognized in the African Plio-Pleistocene. It is known as a false sabre-tooth unlike *Homotherium* and *Megantereon,* which are recognized as true sabre-tooths (see Marean 1989). Koobi Fora, Kanam East, Ileret, Kromdraai, Sterkfontein, the Makapansgat limeworks and Bolt's Farm are some of the African fossil cave sites that have yielded the species*, Dinofelis* (Broom 1937, 1939; Ewer 1955, 1956; Leakey 1976). In Africa, the false sabre-toothed cat appears at around 4 Mya and becomes extinct around 1.4 Mya (Collings 1973; Marean 1989; Werdelin & Lewis 2001).

Most descriptions of the African remains of the sabre-tooths are based on cranial morphology as the post-cranial morphology of the African specimens is yet to be described (Marean 1989). The most defining feature of sabre-tooths is the elongated canines, which are flattened labio-lingually. *Dinofelis* however, has relatively shorter, straighter and broader canines, compared to *Homotherium* and *Megantereon,* rendering them more stress resistant (Marean 1989; Lewis 1997). The canines are long with sharp anterior and posterior crests, however without serrations as is the case with *Homotherium*. This has been observed with the canines discovered from Goldsmith's site (Figures 29 and 29). The upper second premolar is absent. The upper third premolar possesses a large posterior talon and the upper fourth premolar has a reduced protocone, and the lower carnassial has a protoconid longer than the paraconid (Collings 1973). The form of the skull is felid in nature; the occiputs are on the same line as the frontals and not raised, as is the case with the true sabre-tooths. The mastoid process is large with a large infra-orbital foramen and the coronoid process is smaller than in the Felinae (*ibid.*).

Postcranial proportions of *Dinofelis* remains suggest that the animal had morphology similar to Felinae (Marean 1989). Another line of research implies that African sabretooths could have been larger and more robust than modern leopards (Lewis 1997), a characteristic which fossils from Goldsmith's demonstrate. The fossils described (Figures 31-36) which share similarities with felines but which could not be positively matched to *P. leo* or *P. pardus,* suggest that the animals were larger than leopards, stockier than lion and leopard, but shorter than lion, thus supporting the assumption that these specimens represent *Dinofelis sp*.

According to the European and North American specimens, rotary capability and strength in the forelimb suggest that sabretooth's morphology made them amenable to grappling prey larger than their body size (Lewis 1997). Brain (1981) suggests that *Dinofelis*' prey could have included large primates and possibly hominids. Non-hominid primates and medium (Size Class 2) and large-sized (Size Class 3-4) bovids constitute part of the Goldsmith's faunal assemblage and could have been accumulated by *Dinofelis,* however there is not enough data to support that hypothesis.

3.5.9. Possible date for Goldsmith's

According to the presence of the extinct sabre-toothed cat, *Dinofelis*, the site could date from as early as 5 Mya. However, the taxonomic composition of the faunal assemblage does not provide support for such an early date. The Makapansgat Limeworks, which yielded *Dinofelis* specimens, accumulated between 3 Mya and 4 Mya (Collings 1973). The presence of *Dinofelis*, which became extinct at 1.4 Mya (Lewis 1997), indicates that Goldsmith's site predates this age.

3.5.10. Palaeoenvironmental reconstruction

According to the humero-radial index and habitat type analysis conducted by Marean (1989), all sabretooths demonstrate limb proportions with a predisposition for closed habitats with *Dinofelis* inhabiting dense forests. A study conducted on modern *P. pardus* and *P. leo* suggests that they are not habitat specific; *P. pardus* covers wide geographic ranges while *P. leo* inhabits both mixed (at least 20% cover) and closed habitats, greater

than 20% canopy cover (Gonyea 1976; Lewis 1997). The tribe Tragelaphini consists of species that are generally browsers with a preference for bushy or wooded environment (Brain 1981; Kappelman *et al.* 1997). The presence of primates in the sample also indicates that there was some tree cover in the area. According to the Goldsmith's faunal assemblage, including of *Dinofelis* and primates, it is thus logical to assume that during accumulation of the fauna the region had an amount of tree cover. The presence of *Damaliscus* sp. suggests that the area also had an open savanna environment in the vicinity.