

5. DISCUSSION AND CONCLUSION

A total of 2700 micromammal specimens was recovered from Sibudu Cave. Although the level of organic preservation is very good at the site, the assemblage is highly fragmentary. Of the 2700 specimens recovered, only 1164 (43%) are diagnostic and the remaining 1536 (57%) are undiagnostic. This high frequency of undiagnostic bone found in the micromammal assemblage could be attributed to the size and brittle nature of microfaunal bone, as it is easily damaged through predator and post depositional processes (Andrews 1990). Of the diagnostic material found in the assemblage, 78% consists of post cranial elements and the remaining 22% consists of cranial material used in the species analysis.

5.1 SPECIES IDENTIFIED

The cranial material was used in this analysis and a total of 72 (62.7%) specimens were identified to species level. The majority of these identifications were made within the level Bu (59.5%), as this level contained the most cranial specimens. The next largest sample was found in RSp (7.3%) and LB MOD (6.6%) (See Table 4.5). Eleven different micromammal species were identified in the assemblage.

The collection did not have a wide species diversity and was predominately made up of *Otomys irroratus* (vlei rat), *Otomys laminatus* (lamine vlei rat) and *Mastomys natalensis* (Natal multimammate mouse). Other species identified included, *O. angoniensis* (angoni vlei rat), *Rhabdomys pumilio* (striped mouse), *Crycetomys gambianus* (giant rat), *Cryptomys hottentotus* (common molerat), *Georychus capensis* (cape molerat), *Myosorex varius* (forest shrew), *Elephantulus myurus* (elephant shrew) and *Rhinolophus clivosus* (Geoffroy's horseshoe bat).

The species analysis shows a dominance of three large rodent species throughout the assemblage, namely *Otomys irroratus*, *O. laminatus* and *O. angoniensis*. The lack of smaller species represented could be ascribed to the large mesh size used during screening, resulting in the skeletal elements of smaller species slipping through the screen. A smaller mesh size has been used in recent excavations. Andrews (1990)

suggests that it is imperative when recovering microfaunal remains that a 500 micron screen is used with wet sieving. It must be noted that the results from Sibudu Cave do not indicate poor recovery methods used at the site, as it is not possible to wet sieve due to the presence of other organic material.

5.2 SPATIAL ANALYSIS

The results from the spatial analysis show that the majority of the assemblage was recovered from squares D2 (28.1%), D3 (6.4%), E2 (24.3%) and E3 (21.0%) situated along the eastern and southeastern part of the excavation. The large number of micromammal specimens found within these squares could be attributed to these squares being positioned along the back wall of the cave, below possible raptor roosting sites. The remainder of the assemblage is distributed throughout the site (See Table 4.6).

5.3 MINIMUM NUMBER OF INDIVIDUALS

Two MNI analyses were performed for this study. The first MNI was based on the most numerous postcranial element, in this case the humerus. Out of a total of 78 specimens 35 were right, 27 left and 15 undiagnostic, indicating a minimum of 35 individuals in the sample. In this study, the analysis is based on species identified from cranial elements; therefore, it appeared necessary to calculate a second MNI based on the most numerous cranial element, in this case, isolated teeth, numbering 109 specimens. Within the cranial MNI, the total number of individuals was determined through the left M³ (the most numerous element). The postcranial and cranial MNI differed significantly from each other, with the postcranial numbering 35 individuals and the cranial numbering 13.

5.4 TAPHONOMY

The level of bone preservation throughout the assemblage is good and there is evidence for soil staining on a large number of the bone remains. The taphonomic analysis was based on the incisors and postcranial elements found within the collection. The incisors were examined for etching modifications. The results showed

evidence for pre-depositional breakage and damage associated with trampling, but there is very little evidence for digestion modification on any of the incisors. The pattern that emerges from these results shows similarities with the trampling patterns proposed by Andrews (1990), evident throughout the assemblage. There is a complete absence of skulls, few maxillae, a considerable loss of teeth leading to the large numbers of isolated teeth evident in the assemblage and considerable breakage of postcranial elements (Andrews 1990). Some of the incisors examined for etching marks can be categorised within category 1 and possibly category 2 as proposed by Andrews (1990) (cf) (See Table 1.1). Bones that fall within these categories are lightly fragmented and very few teeth show signs of digestion (Andrews 1990).

The taphonomic results suggest that the likely predators responsible for the micromammal assemblage at Sibudu Cave are the Barn owl (*Tyto alba*), the Marsh owl (*Asio capensis*), Grass Owl (*Tyto capensis*), and some of the African Eagle owls (*Bubo capensis capensis*, *B. africanus* and *B. lacteus*). The most prolific pellet producer is the Barn owl (Andrews 1990). The Barn owl has a world-wide distribution (Kemp & Calburn 1987) and is a small mammal specialist, taking a wide range of prey species by hunting in more diverse terrain than other species (Steyn 1982). This species requires a rocky ledge for roosting and nesting and frequently occupies caves (Levinson 1982).

Previous taphonomic studies of prey remains recovered from Barn owl roosting sites have provided different results in terms of bone representation (Denys 1985; Laudet *et al.* 2002; Matthews 2002). Bone loss is considered quite high for this species, despite the fact that the gastric juices of this owl are some of the least corrosive among birds of prey (Smith & Richmond 1972, cited in Skinner & Smithers 1990; Matthews 2002). These studies have shown that the presence or absence of only one or a few bones of a prey skeleton within some pellets may be attributed to the retention of certain skeletal parts in the stomach of the owl (Laudet *et al.* 2002). Lowe (1980) suggests that some bones, particularly those from the limbs are not necessarily rejected within the same pellet. Lowe (1980) mentions that some smaller bones from a single prey individual may be retained within the stomach and may not be rejected with the first rejection, but are rather rejected within the following pellet. A longer retention of these elements from the same prey individual in the stomach may explain

why heavily digested remains have been observed among isolated remains, whereas other prey remains found in a single pellet were not corroded (Laudet *et al.* 2002). In an archaeological context this may explain differential etching/digestion instead of implying the work of another predator.

Studies on bone surface modifications in southern Africa reveal that the Grass owl *Tyto capensis* and the Marsh owl *Asio capensis* leave very similar digestive action on bone as *T. alba* (Avery 2001). Avery (2001) suggested that it is difficult to distinguish between prey remains of the three species based on mechanical damage and Denys (1985) encountered the same problem between *T. alba* and *T. capensis*. These observations mean that the precise identification of nocturnal raptors responsible for bone accumulations should be made according to the region and the kind of prey found within that region (Laudet *et al.* 2002).

The micromammal assemblage from Sibudu Cave consists of isolated remains with very little evidence of digestive etching on the incisors. Based on these data, the high frequency of *Otomys* species and other smaller prey found within the assemblage, the little digestive etching found on the prey remains and the widespread distribution and habitat preferences of both prey (De Graaff 1981; Skinner & Smithers 1990; Mills & Hes 1997) and owl species (Steyn 1982; Kemp & Calburn 1987), suggest that *Tyto alba*, *Tyto capensis* and *Asio capensis*, are the most likely nocturnal raptors responsible for the accumulation of the micromammal assemblage at Sibudu Cave.

5.5 ENVIRONMENTAL IMPLICATIONS

Results show significant differences with regards to the frequency of micromammal remains found between the various stratigraphic layers within the site. The majority of micromammal remains were found in layer Bu (68.4%). Other layers, including RSp and LB MOD are also significant contributors to the overall assemblage. Each layer is considered individually and relevant information, such as OSL and/or ¹⁴C dates, soil descriptions, and other environmental data, is included when available.

Northern Stratigraphy:

5.5.1 Mottled (MOD)

The stratigraphic layer MOD, dated to $26\,000 \pm 420$ (^{14}C) and to about 50 kyr by OSL, contained 5.6% of the total species identified within the assemblage. This is the first MSA layer below the Iron Age occupations, which, is a mottled brown layer with fine sand flecks of white ash, black charcoal and orange brown sand (Wadley 2001). *Otomys irroratus* and *Otomys angoniensis* were the only micromammal species found within this layer. *Otomys irroratus* indicates grass-covered ground in proximity to streams and marshes (Skinner & Smithers 1990). *Otomys angoniensis* is generally associated with drier areas with wet vleis, swamps and swampy areas along rivers (Smithers & Wilson 1979 cited in Skinner & Smithers 1990). De Graaff (1981) included savannah woodland and grasslands. The Angoni vlei rat is found mostly amongst dense stands of reeds sedges or semi-aquatic grasses on the edge of permanent water sources (Rautenbach 1982).

The dominance of *Otomys irroratus* and *Otomys angoniensis* within this layer and vegetational evidence from charcoal and seed studies (Wadley 2004; Allott 2005) suggest that the Tongati River was flowing during this time in a riverine forest type environment.

5.5.2 Orange Mottled (OMOD)

The stratigraphic layer OMOD contained 2.7% of the total micromammal species identified within the assemblage. This layer, dated to 51.8 ± 2.1 kyr (OSL), is a thick unit comprising a number of hearths with orange brown, burnt earth lenses (Wadley 2001). OMOD shows similarities with MOD as only *Otomys irroratus* was identified within this layer.

5.5.3 Red Speckled (RSp)

The stratigraphic layer RSp, dated to $> 45\,000$ (^{14}C) 53.4 ± 3.2 kyr (OSL) contained the highest frequency of micromammal remains after Bu (6.1%). This layer consists

of a reddish-brown layer with white, chalk-like grains of gypsum and calcium carbonate (Wadley & Jacobs 2004). RSp is present in all but two squares excavated to date and is thus a good marker layer for the site (Wadley & Jacobs 2004).

The following species were identified in RSp (18% of total species identified): *O. irroratus*, *O. laminatus*, *M. natalensis*, *M. varius* and *R. pumilio*. The presence of these species in RSp suggests that the immediate environment around Sibudu Cave was very similar at 53.4 ± 3.2 kyr and 35.2 ± 1.8 kyr. Because *R. pumilio* is considered a broad niche species (Brooks 1974) and has been found in varying habitats it is not very useful for environmental reconstruction. It prefers grassland, but its habitat may include bushy and semi-arid vlei country as well as dry riverbeds (Mills & Hes 1997). The presence of *O. irroratus* and *M. varius* and *R. pumilio* supports the idea that RSp represents a complex mosaic environment with a body of water nearby (Allott 2005). Seed and charcoal analyses (Wadley 2004; Wadley & Jacobs 2004; Allott 2005) show evidence of evergreen and deciduous canopy species that appear to have filled many niches with other species indicative of a dry bushveld environment not known in KwaZulu- Natal today (Wadley & Jacobs 2004; Allott 2005).

5.5.4 Yellow Speckled (YSp)

YSp accounted for 2.7% of the total species identified in the assemblage. This layer, dated to between 53.4 ± 3.2 kyr (OSL) and 56.7 ± 2.3 kyr (OSL), comprises a yellow beige sandy silt with ash flecks (Wadley 2001). Two micromammal species were identified within this layer: *Mastomys natalensis* and *Otomys irroratus*. *Mastomys natalensis* is considered a broad niche species, eating a wide range of plants and is found in a variety of ecological zones (De Graaff 1981; Mills & Hes 1997) and as such is a poor indicator of a specific environment. The presence of *Otomys irroratus* indicates the presence a body of water nearby.

5.5.5 Brown Speckled (BSp)

BSp contained 1.4% of the total species identified within the assemblage. This layer consists of a brown sandy silt with black and white flecks dated to 56.7 ± 2.3 kyr

(OSL) (Wadley and Jacobs 2004). This layer contained two micromammal species namely: *Elephanturus myurus* and *Otomys laminatus*. *Elephanturus myurus* is completely rupicolous. It prefers large rock debris that offers abundant crevices and crannies for refuge (Rautenbach 1982; Mills & Hes 1997). The species can also be found on isolated rock outcrops on valley floors or plains and is a generalized species and is therefore not very useful in environmental reconstruction. *Otomys laminatus* prefers open grassland, submontane and coastal regions of South Africa.

5.5.6 Spotted Camel (SPCA)

This layer is currently undated but is found between layers Or (61.5 ± 2.2 kyr OSL) and BSp (56.7 ± 2.3 OSL) (See Table 2.1). SPCA contained 1.4% of the total species identified within the assemblage. SPCA shows similarities with MOD and OMOD as *Otomys irroratus* was the only micromammal species identified within this layer.

5.5.7 Orange (Or)

Or contained 2.7% of the total species identified within the assemblage. *Rhabdomys pumilio* and *Otomys irroratus* were identified within this layer. Brooks (1974) suggests that *Rhabdomys pumilio* occupies a wide variety of habitat types and may thus be considered a broad-niche species. It prefers grassland, but its habitat may include bushy and semi-arid vlei country as well as dry riverbeds (Mills & Hes 1997).

5.5.8 Mexican Yellow (MY)

The layer MY contained 4.2% of the total species identified. MY is a roof spall-rich deposit, compacted in patches and variously mottled and unfortunately this layer has not been dated. *Mastomys natalensis* and *Otomys laminatus* have been identified within this layer. The presence of *Mastomys natalensis* and *Otomys laminatus* seem indicative of a more open environment with larger tracts of grassland and riverine elements.

5.5.9 Grey (GR)

This layer has a preliminary OSL date of 62.4 ± 3.2 kyr (Allott 2005). GR contained 2.7% of the total species identified with *Rhinolophus clivosus* being the only species identified within this layer. This is predominantly a woodland species (Skinner & Smithers 1990) with a wide habitat tolerance (Mills & Hes 1997). Its absence from desert areas is probably related to the lack of suitable roosting sites such as caves and hollow trees (Skinner & Smithers 1990; Mills & Hes 1997). A related study done of charcoal from Sibudu, suggest that this layer contained plant taxa indicative of evergreen forest vegetation (Allott 2005). In addition to this forested environment some species of plant taxa provide evidence of a woodland savannah vegetation zone (Allott 2005). The plant taxa found within this layer suggest warm moist conditions where temperatures and humidity are high throughout the year (Allott 2005). This interpretation is supported by the presence of *Rhinolophus clivosus*.

5.5.10 Grey Sand (GS)

GS has a preliminary OSL date of 60.7 ± 2.3 kyr (Allott 2005) and contained 4.2% of the total species identified. Only two species of micromammal were identified within this layer: *Cricetomys gambianus* and *Rhinolophus clivosus*. GS shows environmental similarities with the layer GR (Allott 2005). Although *Cricetomys gambianus* (Giant Rat) is not considered a micromammal, this species was included in the analysis. This species seems to prefer savannah conditions, but ranges into humid, evergreen forests with an annual rainfall of more than 800mm and is not found in arid or semi-arid areas (Skinner & Smithers 1990; Mills & Hes 1997). The evidence from charcoal studies (Allott 2005) and the presence of these species within this layer seem to indicate a very moist and humid environment at this time.

5.5.11 Grey Sand II (GSII)

GSII contained 4.2% of the total species identified. These species include *Otomys irroratus* and *Otomys laminatus*. These species seem indicative of a more open grassland type environment with a riverine element nearby (De Graaff 1981; Skinner & Smithers 1990; Mills & Hes 1997).

5.5.12 Light Brown Grey (LBG)

LBG is one of the deeper layers excavated thus far and is part of a deep trial trench. It has a preliminary OSL date of about 77 kyr (Jacobs pers. comm. to Wadley, 2005). This layer contained 1.3% of the total species identified within the assemblage. This layer shows similarities with MOD, OMOD, SPCA and Co as *Otomys irroratus* was the only species identified within this layer.

5.5.13 Light Brown Grey II (LBGII)

LBG II is also one of the deeper layers exposed in recent excavations and is part of the above-mentioned trial trench. This layer contained 1.4% of the total species identified within the total assemblage. *Crycetomis gambianus* is the only species to date that has been identified within this layer. This species is indicative of savannah conditions but has been known to range into moist, humid forests (De Graaff 1981; Skinner & Smithers 1990).

Eastern Stratigraphy:

5.5.14 Coffee (Co)

This layer is undated but is the youngest MSA layer at the site. Co contained 2.7% of the total species identified within the assemblage. This layer shows a similar environmental interpretation with MOD, OMOD and SPCA as *Otomys irroratus* was the only micromammal species identified within this layer.

5.5.15 Buff (Bu)

The stratigraphic layer Bu, dated to $42\,300 \pm 1300$ (^{14}C) and 35.2 ± 1.8 kyr (OSL), contained the highest frequency of micromammal specimens found in the assemblage. Unfortunately the species identified within this layer do not help clarify which of the proposed dates is correct. Bu accounted for 68.4% of the total assemblage and forms part of the east stratigraphy of the site, comprising squares D2, D3, E2 and E3 and consists of light grey sandy silt with numerous tiny roof spalls (Wadley & Jacobs

2004). This layer is not found throughout the excavation and is a bowl shaped intrusion situated close to the back wall of the rock shelter. The high frequency of micromammal remains found in this layer could be attributed to the spatial positioning of Bu, situated against the back wall below possible raptor roosting sites.

This layer contained the highest number of species identified (31.9%). The layer was dominated by the otomyines, namely *Otomys irroratus*, *O. laminatus* and *O. angoniensis*. Other species identified were *Mastomys natalensis*, *Cryptomys hottentotus*, *Georychus capensis*, *Myosorex varius* and *Rhinolophus clivosus*.

Otomys irroratus is an open grassland species, preferring grass covered ground within proximity to water (De Graaff 1981). *O. laminatus* prefers grassland, submontane and coastal zones in South Africa (De Graaff 1981; Skinner & Smithers 1990; Mills & Hes 1997). *Otomys angoniensis* is generally associated with drier areas with wet vleis, swamps and swampy areas along rivers (Smithers & Wilson 1979 cited in Skinner & Smithers 1990). De Graaff (1981) included savannah woodland and grasslands. *Mastomys natalensis* has a wide habitat tolerance with generalized ecological requirements and occurs in various habitats from sea level to high-lying ground, but is absent from very dry and arid regions (De Graaff 1981; Mills & Hes 1997). *Cryptomys hottentotus* does not seem to be limited by any environmental factor other than soil type (Rautenbach 1982; Skinner & Smithers 1990). This species is limited to loose sandy soil, but some subspecies have been recorded in swampy areas. *Georychus capensis* occur in sandy coastal dunes as well as in unconsolidated soils along rivers (Skinner & Smithers 1990). *Myosorex varius* prefers moist conditions with dense grass cover (Rautenbach 1982; Skinner & Smithers 1990). *Myosorex varius* is highly dependant on permanent water on the highveld (Rautenbach 1982; Mills & Hes 1997) and moist misty conditions with low succulent bushes in drier areas (Skinner & Smithers 1990). *Rhinolophus clivosus* is predominantly a woodland species (Skinner & Smithers 1990) with a wide habitat tolerance (Mills & Hes 1997). Its absence from desert areas is probably related the lack of suitable roosting sites such as caves and hollow trees (Skinner & Smithers 1990; Mills & Hes 1997).

The presence of *O. irroratus*, *O. angoniensis*, *O. laminatus*, *M. natalensis*, *C. hottentotus* and *G. capensis* and *M. varius* within the level Bu show similarities with species found in the layer RSp. These species similarities indicate that the immediate environment around Sibudu Cave at 35.2 ± 1.8 kyr (OSL) was similar to that of the earlier period represented by RSp: a complex mosaic environment dominated by open savannah grassland, with a small woodland element. The presence of *M. varius*, *Georychus capensis* and *O. irroratus* is indicative of a large body of water close by as these species live within proximity of water.

A modern remnant population of *Georychus capensis* is found in the Nottingham Road area in the KwaZulu Natal midlands. The presence of *Georychus capensis* within Bu suggests that this species may have had a wider geographical distribution during the MSA.

5.5.16 Light Brown Mottled (LBM)

This layer is currently undated but lies immediately below Bu. LBM contained 3.7% of the total micromammal assemblage. It is a thin, light-brown lens with white flecks of gypsum and this lens does not reach the eastern section of the excavation (Wadley & Jacobs 2004). The following species were identified from LBM (9.7% of total species identified): *O. irroratus*, *O. laminatus* and *E. myurus*. The presence of these species within LBM suggests an environment similar to that of Bu. Although *E. myurus* has an eastern distribution in southern Africa (Rautenbach 1982) and prefers large rock debris that offers large crevices and crannies for refuge (Rautenbach 1982; Mills & Hes 1997), this species has been found to inhabit any rocky outcrop, even isolated outcrops on valley floors.

5.5.17 Light Mousse (LMou)

LMou contained 1.4% of the total species identified. *Mysorex varius* was the only species identified within this layer. This species prefers moist conditions with dense grass cover (Rautenbach 1982). *Myosorex varius* is highly dependant on very moist and humid conditions (Rautenbach 1982; Skinner & Smithers 1990).

5.6 CONCLUSION

A microfaunal study was undertaken on the recent excavations from Sibudu Cave in KwaZulu-Natal, South Africa. The aims of this study were to catalogue the assemblage, conduct a taphonomic study of the assemblage, examine spatial distribution within the site, examine species present in the collection, and consider the implications of these identified species for determining likely palaeoenvironments.

There were 2700 specimens representing 11 species of micromammals in the collection. Only the cranial elements were examined as species identifications were determined on tooth patterns. The two MNI counts conducted in this study show that if only cranial material is used, a low MNI is produced with deceptive results. To date, there is no key to determine species identifications based upon post-cranial elements. This inhibits identification of a large proportion of any microfaunal assemblage. Future microfaunal research requires a focus upon the creation of a post-cranial species identification key. This identification key could be derived upon the same criteria as used in identifying macrofaunal post-cranial elements.

The results of the spatial distribution study show that the majority of the micromammalian assemblage was recovered from the layer Bu, found within four units along the eastern stratigraphy, situated against the back of the cave. The high density of bone from this layer and these units suggest the possibility of a raptor roosting site. Additional excavations, adjacent to these units may reveal and delineate the extent of the potential raptor roosting site.

Species identifications made within the layers OMOD, MOD, SPCA, Co and LBG show similarities in the environment during the accumulation of these layers. The micromammal remains from these layers seem to indicate a moist environment with a large riverine element. Micromammal evidence from the layers LMou, GR, GS and LBGII suggest warm humid conditions. Species identifications made within the layers Bu, RSp and LBM suggest that the immediate environment around Sibudu Cave was very similar at 53.4 ± 3.2 kyr (OSL) and 35.2 ± 1.8 kyr (OSL), consisting of

a complex mosaic environment, dominated by open savannah grassland with a small woodland element. Vegetational elements found within Bu, RSp and LBM are representative of a drier environment than that of today (Allott 2005). The species identified within the layers BSp, MY and GSII show similarities with Bu, RSp and LBM, suggesting a drier, more open environment with large tracts of grassland interspersed with a woodland element. The remaining layers YSp and Or had very little evidence to support an accurate environmental interpretation.

Wadley and Jacobs (2004) suggest that some of the floral species found within the MSA are not present today, implying that more northerly vegetational elements once occurred in the region and that the local savannah was larger than that of the present day. Macrofaunal studies have shown a predominance of savannah type species, suggesting drier more open conditions than today, supporting the idea of extensive tracts of savannah during the Last Glacial (Plug 2004). Today the site is screened within a remnant forest patch that survives the encroachment of farmers, due to the rugged cliff, which is not useful for sugarcane cultivation (Wadley 2001). This vegetation type falls within the Indian Ocean Coastal Belt, specifically within the Tongaland-Pondoland regional vegetation mosaic (Wadley & Jacobs 2004). This regional mosaic consists of five main types of forest; described as undifferentiated lowland forest; sand forest; dune forest; swamp forest and fringing forest (Moll & White 1978). Sibudu falls within the undifferentiated lowland forest, called coastal forest by Lubke and McKenzie (1998), coastal bushveld-grassland by Low and Rebelo (1998), coastal forest by Acocks (1988) and coastal and riverine ecozones by Grant and Thomas (1998).

It should be noted that in this study a preliminary taphonomic assessment was completed on micromammal remains and further research should focus on the taphonomy and the identification of non-mammalian microfaunal remains. The results of the preliminary taphonomic assessment indicate that the level of bone preservation throughout the assemblage is good, although there is evidence for soil staining on a large number of the bone remains. Additionally, there was evidence for pre-depositional breakage and damage associated with trampling, but very little evidence for digestion modification on any of the incisors. These results suggest that the Barn owl (*Tyto alba*) is the primary accumulating predator of this assemblage.

Additional likely contributors include the Grass owl *Tyto capensis* and the Marsh owl *Asio capensis*.