APPENDICES

Appendix A1 EVOLUTIONARY THEORY

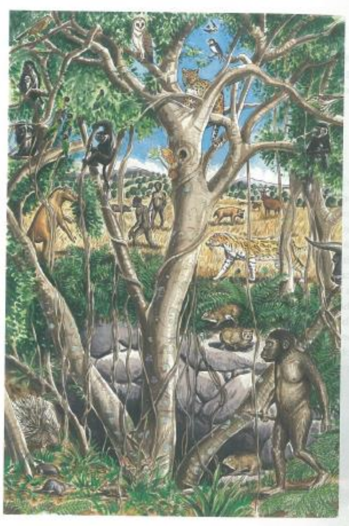


Figure A1.1: An example of an artist's environmental reconstruction of mixed habitats for Sterkfontein, 2.4 Ma (Esterhuysen 2007). Considerable scientific progress has been made since the original assumptions of expanding grasslands (Dart 1925).

A1.1 Macro-scale Evolution

Evolutionary form has been viewed in two distinct ways, punctuated equilibrium and phyletic/phylogenetic gradualism. Although originally seen as opposites, they are now both seen to occur and the question currently is which is more prevalent (Preothero and Heaton 1996)? Punctuated gradualism (Malmgren et al. 1983) had been put forward as a means to combine the two but has not been widely accepted.

PUNCTUATED EQUILIBRIUM: The concept of punctuated equilibrium, put forward by Eldredge and Gould (1972), dictates that evolutionary stasis occurs, with small scale adaptations and evolution occurring but with major evolutionary events confined to distinct times, disrupting the balance of equilibrium (Prothero and Heaton 1996).

PHYLOGENETIC GRADUALIASM: In contrast to punctuated equilibrium, phyletic or phylogenetic gradualism operates over a long time period, gradually progressing. Speciation occurs more gradually and no clear speciation event is discernible. This contrasts to punctuated equilibrium where the majority of evolutionary events are seen to occur in a relatively rapid episode and a speciation event occurs where two distinct species are clearly apparent (Eldredge and Gould 1972).

CO-ORDINATED STASIS: Brett and Baird (1995) suggested relative ecological stability and evolutionary stasis, punctuated by extreme faunal changes over brief intervals. This theory was based on marine invertebrate macrofossils and perhaps does not translate to a terrestrial platform. Co-ordinated stasis is indicated by recurrent assemblages with virtually identical species composition, abundance, distribution and intra-specific morphology occurring in different geographic locations and stratigraphic levels within a particular region. These apparently stable ecosystems have been observed in the fossil record over hundreds to millions of years (Miller 1996). However, it has been argued (e.g. Holland 1996) that the apparent stasis may be simply and artefact of sampling and fossil preservation (Baumiller 1996).

ALLOPATRIC SPECIATION: Allopatric speciation, proposed by Mayr (1963), occurs when populations become separated. Geographically isolated populations can rapidly evolve independently from other populations (Maslin et al. 2015).

SYMPATRIC SPECIATION: Conversely, sympatric speciation based on sexual selection (Maslin, Shultz and Trauth 2015) refers to new species evolving within the same region. Via (2001) argues that sympatric speciation can occur, although it has been contested in the past, largely since Mayr's articulation of the allopatric speciation model.

GLEASONIAN AND CLEMENTSIAN RESPONSES: Away from palaeoanthropological research, the ecologist community refer to similar concepts with differing vocabulary. How plants and plant communities respond differentially to environmental stimuli and changes has a direct impact on the herbivores relying on those plants for nutrition.

The issue of non-analogue communities has been previously researched (Stewart 2009). Perhaps we will not see major faunal turnover due to individualistic rather than community level responses to climate change? Individualistic (Gleasonian) response to climate change rather than community (Clementsian) response to climate change (Stewart 2008) would presumably result in taxa evolving at differing rates in response to climatic change stimuli and therefore not result in a mass turnover of many faunal species in a given area. The full evolutionary implications of individualistic responses are only beginning to be understood. It is possible that different populations of a species may respond differently to similar climatic conditions. This can be due to microclimatic factors, responses to new neighbours (new species within the community) or other confounding variables.

Alternatively, this has been addressed as 'concerted' (community) versus 'independent' (individualistic) responses to environmental fluctuations in the phylogeographical literature.

In response to major habitat loss (often due to climatic changes), refugia may be sought. A species has preferred vegetation for nutritional requirements and predation cover as well as water requirements; these needs vary according to species. Therefore, refugia will be different based on the species individual needs and need to remain as the 'stable' ecosystem in was in the previous habitat.

In times of repeated climatic oscillations or climatic instability, communities are potentially reshuffled many times, which may lead to an evolutionarily progressive effect (Stewart 2008). For example, we are likely to see marked differences according to whether faunas lived in glacial or interglacial periods (Stewart 2008).

A1.2. HYPOTHESES

Evolutionary theories and hypotheses are summarized in Table A1.1 below.

> "After 1859, naturalists began to envision evolutionary scenarios in which organisms were strongly influenced by climatic and environmental changes" (Bender et al. 2012, p.8).

Since the Origin of species (1859) and the Descent of Man (1874) were published, research has flourished surrounding the key evolutionary questions. The concepts brought into the public consciousness by Darwin and others are those that continue to be tested today. Darwin (1871) and Lamarck (1809) first alluded to the idea that became the savannah hypothesis.

It may seem that we have come a long way since Darwin and his finches (1859). To a certain extent, this holds true. However, as pointed out (see Bennett 2004), the main debates still remain (Lyell vs. Darwin) and are still to be conclusively tested. Additionally, as shown in the section below, much of the thinking that underpins palaeoanthropological research today has its roots in Darwin's era and from his research.

Table A1.1: A summary of some of the main evolutionary theories proposed.

HYPOTHESIS	AUTHOR	YEAR	EXPECTED OUTCOME
Red Queen	Van Valen	1973	Gradual and constant rate of evolution (almost) regardless of environmental conditions. Biotic factors/ competition as the driver of evolution.
Turn-over pulse	Vrba	1985	Evolutionary events at clear time intervals (e.g. 2.8, 1.7my) due to an evolutionary response to environmental change.
Traffic light & relay	Vrba	1995	Climate-induced habitat movements (traffic light) and long-term vicariance as a precedence to evolutionary events (relay).
Court Jester	Barnosky	1999/2001	Abiotic factors driving evolution. Evolutionary events should be seen as a response to climate change.
Variability Selection	Potts	1998	Evolution in response to Milankovitch-scale climatic oscillations. Should see a adaptive traits evolving if experiencing variable environments over a substantial time period.
Habitat	Vrba	1992	Interspecific competition plays a part in evolutionary events.
Savannah Hypothesis	Darwin	1874	Evolution of species following the spread of grassland. In particular, the evolution of hominids.
Niche incumbency	Valentine; Walker and Valentine	1980; 1984	Species are dependent on the stasis of their niche and aspects within it, therefore, adaptations are necessary as a response to climate induced changes in niches.
Adaptive raditation	e.g. Alroy	1996	Rapid diversification due to environmental changes across faunal communities and geographic separation.
Co-ordinated stasis	Brett & Baird	1995	Lack of turnover during stasis intervals
Co-evolutionary disequilibrium	Graham & Lundelius	1984	(Model of extinction) Dependent on the magnitude of environmental change-greater scale environmental change leads to unpredictability within ecosystems and thus, makes extinction events more likely to occur.
Stability	Stenseth & Maynard Smith	1984	Evolution in response only to a change in the physical environment
Tiers of Time	Gould	1985	Levels of evolution (microevolution at the individual level, macroevolution at the species level and mass extinctions at the faunal/ community level).
Punctuated equilibrium	Eldredge & Gould	1972	General stasis with rapid evolution of species with allopatric speciation
Phyletic gradualism	e.g. Gingerich	1976	Slow, uniform and gradual evolution. The sudden appearance of new species is due to gaps in the fossil record.

Savannah hypothesis

The savannah hypothesis essentially attributes much of our evolutionary trajectory with the spread of savannahs. With the spread of grasslands, hominins adapted to occupy this new niche, becoming habitually bipedal, which consequently freed their hands (from clinging to branches). Cognitive adaptations and advancements are seen to have emerged as a result. As climatic changes caused forested areas to become sparse, in favour of an expansion of open plains, animals (including hominins) were forced to adapt (Bender et al. 2012). Similarly, the 'vigilance hypothesis' (following from Lamarck's (1809) 'Tower hypothesis' uses the basis of the savannah hypothesis to argue for predation as an evolutionary pressure (Bender et al. 2012).

Lamarck (1809) and Darwin (1871) first linked human bipedalism with an external, environmental factor-climate or a change in dietary preference (Hopley 2004). Based on "the principle ecological adaptations of early hominins" (Hopley 2004 p.8).

In 1925, Raymond Dart provided the fossil evidence to support this theory with his discovery of *Australopithecus africanus* in South Africa.

Climate change is often attributed to being the causal factor behind bipedalism. Despite originally being heavily cited, the savannah hypothesis has since been questioned and tested. Tests (e.g. Kingston et al. 1994 and see Hopley 2004) highlighted that there was no evidence to show that vegetation changed from closed forest to open savannah, the fundamental focus of this hypothesis. Yet, this hypothesis has not been conclusively disproven (Hopley 2004). In spite of a lack of a dramatic and sudden shift to open savannah, the gradual vegetational changes that led to increased mosaic environments and eventually, an increase in savannah habitats, could have played a crucial role in human bipedalism and hominin evolution. The theory has been modified many times (e.g. Leakey and Harris (2003). Whilst the savannah hypothesis may have lost favour recently in explaining hominin divergence from other apes, there is perhaps more weight to this theory when attempting to understand the evolution of early *Homo* and stressing the importance of grasslands therein (Bobe and Behrensmeyer 2004).

Regardless of the legitimacy of this theory, it was one of the earliest ways in which palaeoanthropologists established the idea that human evolution is intrinsically linked to climatic and environmental changes (Bender et al. 2012). Thus highlighting the significance of climatic and habitation changes on evolution.

Aridity hypothesis

As a refinement to the savannah hypothesis, the aridity hypothesis states that the long term trend of increased aridity and savannah expansion was a key driver in hominin evolution (Maslin et al. 2014). DeMenocal (1995; 2004) refers to a marked shift towards more arid conditions in Africa post 2.8Ma, with further steps at 1.7Ma and 1.0Ma, implying evolutionary events around and just after this time may have been climatically induced. Speciation mainly occurs during periods of dryness with low resources and a rapid onset of extremely dry conditions would be required for major evolutionary events to occur (Maslin, et al. 2015).

TURNOVER PULSE HYPOTHESIS (TPH)

Brain (1981), Vrba (1985), Denton (1985) and others all discussed the concept of faunal turnover associated with change in the physical environment (Potts and Behrensmeyer 1992) but it was Vrba (1985) who placed the phrase "Turnover-pulse" into a structured hypothesis.

Vrba's (1985) Turnover pulse hypothesis can be summarised as 'climatic change force evolutionary events' (Potts and Behrensmeyer 1992). Speciation, extinction and long term migrations can be classified as 'evolutionary events'. The Turnover Pulse hypothesis, put forward by Vrba (1985, 1990, 1993b) attributes major diversification in faunal communities in a 'pulse' to a response catalysed by large scale environmental changes. Whilst organisms interact with physical and biotic aspects within a habitat, physical change is necessary for the initiation of faunal evolution (Vrba 1993b). These changes, according to this hypothesis can only occur when environmental changes create fragmentation of habitats leading to vicariance (Potts and Behrensmeyer 1992).

Turnover in the fossil record should be in tune with changes in the physical environment Turnover pulses may be small, involving only a few species or in a restricted geographic location up to major global events (Bennett 2004). Vrba later refined the explanation of this theory in 1987, to propose that habitat specialists are more likely to be affected by climate and habitat change than generalists. Thus, in this case, we would expect to see *Antidorcas recki* (browser) and *Antidorcas bondi* (grazer) preferentially targeted by climatic shifts than *Antidorcas marsupialis* (mixed feeder).

Major speciation events for bovids were suggested at 2.8Ma and 1.8Ma (Vrba 1995), perhaps caused by aridifcation and grassland expansion (deMenocal 2011). However, this was largely based on hypsodonty and morphological features supposedly indicative of grazing (Bobe and Behrensmeyer 2004), issues with this are discussed in the main data chapters.

Potts and Behrensmeyer (1992) suggest pulses at 5Ma, 2.5Ma and 0.9-0.7Ma whereby faunal turnover corresponds with global climate change, with hominin speciation events seeming to also coincide with these events (Vrba et al. 1989; Prentice and Denton 1988). Vrba (1993a) suggests we see evidence of 'explosive' radiation among hominins after 2.5Ma. Hominin evolutionary events are considered in the 'hominins' chapter.

The Turnover Pulse Hypothesis is one of the most tested hypotheses of recent years, as it will be in this research. This trajectory of environmental change postulated by Vrba has been scrutinized using various methodologies (e.g. Luyt 2001; Lee-Thorp et al. 2007). In southern Africa, issues of precise stratigraphic dating do not lend well to testing this theory accurately, therefore the majority of research has been in the more dynamic landscapes of East Africa. Turnover pulses have not been conclusively found in East Africa to date. For example, Behrensmeyer et al. 1997 see no evidence for a major faunal turnover in east Africa at the time proposed by Vrba, ~2.5Ma to coincide with major climatic change.

Barry et al. (1985, 1990) contrast with Vrba's TPH emphasis on the causal relationship between climatic forcing and evolutionary events (Potts and Behrensmeyer 1992).

Vrba's proposed Palaeoclimatic transition, allowing for the assumption of taxonomic uniformitarianism (Luyt 2001; Sponhemier et al. 1999), was one of a wooded environment around 3Ma (Makapansgat Limeworks), towards a more open, grassland around 1.4Ma (Swartkrans Member 2) (Vrba 1975, 1982). As research progresses and moves away from the original assumptions made, particularly of taxonomic uniformitarianism, we will gain the ability to conclusively test the TPH.

Gentry suggests three ‘boundary lines’ for the ‘flow of African bovid evolution’, one of which at the end of the Sterkfontein sequence (as was known in 1978) in South Africa, at the end of the Pleistocene (Gentry 1978). Yet care must be taken when stating last appearances (extinctions) of a species due to the nature of sampling densities (based on the number of specimens and localities over time). For instance, although we no longer see *Antidorcas bondi* after ~7000years ago (Brink and Lee-Thorp 1992) at the Cradle of Humankind (for the sites currently investigated), it may be this is only a small scale last appearance (for these sites in this area of South Africa).

According to the TPH, Environmental change is a prerequisite for evolutionary events. However, we are failing to see regular turnover associated with Milankovitch-scale climatic oscillations (Bennett 2004), certainly in terms of speciation. Changes in distribution and abundance (as we would expect as an initial reaction to climate change) are perhaps less visible in the fossil record though. Thus a lack of conclusive evidence so far for the Turnover Pulse Hypothesis in southern Africa may be simply an artefact of the dating, preservation and differential taxonomic identification for the fossil record.

Based on recent models aimed to test this theory in vertebrates, the idea of evolution occurring in pulses has re-gained support (Landis and Schraiber 2017). Landis and Schraiber found that many vertebrate species were well fitted to Lévy models whereby long periods of evolutionary stasis are intermittently disrupted by pulses of rapid evolutionary change.

Yet the Turnover Pulse hypothesis has limited support in East Africa, where mammalian evolution does not neatly correspond with major ecological changes (Bibi & Kiessling 2015). However, the TPH (1998) is perhaps correct in linking hominin and faunal evolution to climatic events but in East Africa, at least, pulses appear to have occurred on a smaller, more numerous scale, than the single pulse initially suggested (Bobe and Behrensmeyer 2004).

Appendices

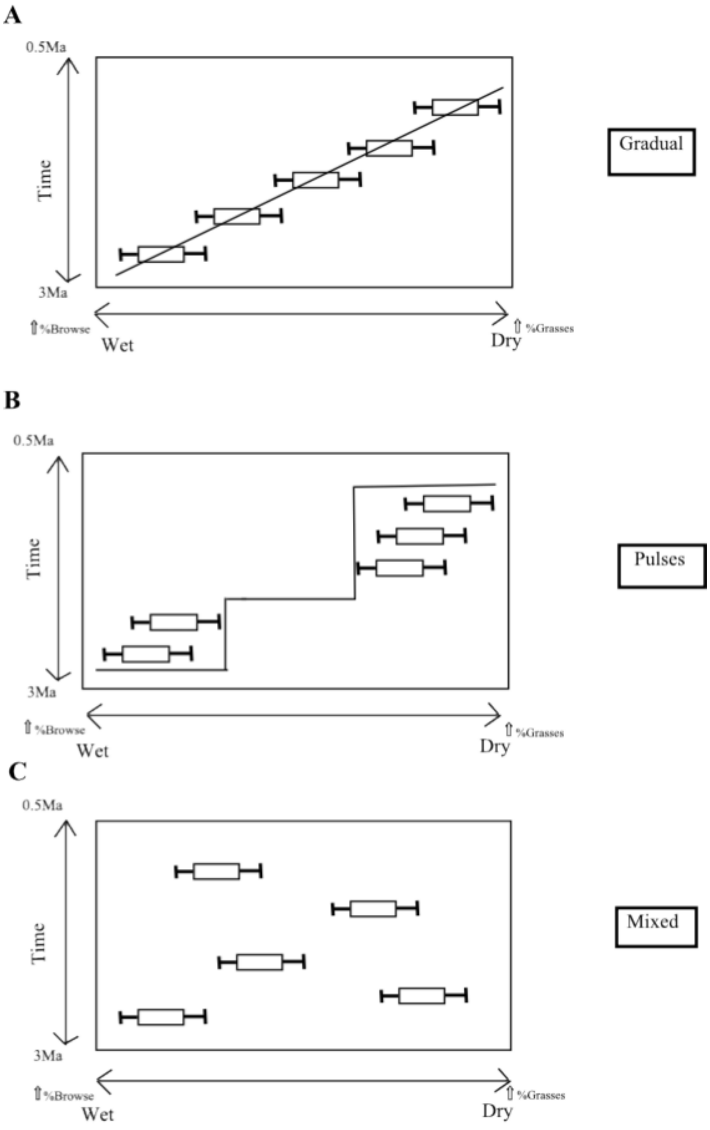


Figure A1.2: Hypothetical vegetation change patterns indicative of the pace and severity of change. A) Gradual shift from closed and wet to open and dry environments. (Antidorcas analyses show a gradual shift from wet, predominantly browse in diet to a diet high in grasses found in a drier environment). B) Turnover Pulses. Clear turnover pulses with speciation events occurring in distinct phases due to environmental changes. C) No clear correlation between environmental changes and Antidorcas morphology, habitat and diet. Mixed mosaics implied.

VARIABILITY SELECTION HYPOTHESIS

Developed by Potts (1996; 1998), this theory is a means to explain hominin's ability to adapt to changing environmental conditions.

The main argument is that change was not caused by any particular environment or environmental trend but rather by heightened environmental instability. An increase in the gene pool occurred due to heightened variability in environmental conditions. Thereby increasing the adaptability of organism to its surroundings (as there are more options in the gene pool) acting as a species population buffer. That is, there is more intraspecific variation (Potts and Faith 2015).

Directional environmental change results in specialisation for those specific conditions; we might expect to see *Antidorcas marsupialis* (as a mixed feeder) increasing the percentage of grass in its diet with the spread of grassland for example. However, if variability selection is at play, we would expect more adaptability within species and increases in less specialised species. Thus we might expect an increase in *Antidorcas marsupialis*, as species tolerant of many environments (though now arid adapted, it is capable of surviving in an array of habitats, preferring low grassland and low altitude) as environments fluctuate.

This research will test this hypothesis with a focus on southern Africa, away from the typically more dynamic landscapes of East Africa. Thus, we should be able to deduce that fluctuating environments are the result of fluctuating climates (and not of smaller scale impacts on environmental variation) and consequently, the role of *climate* and climate variability as an evolutionary driver.

> "Hominin species seem to differentially originate and go extinct during periods of extreme climate variability."
> (Maslin and Christensen 2007, p. 443).

Some studies have shown support for this theory, such as a more marked environmental variability in the Omo Valley post-2.5Ma noted by Bobe et al. (2002). However, Hopley (2004) suggests that it would be difficult to prove this theory and set it apart from Natural Selection, as well as accusing this theory of being anthropocentric.

Periods of extreme environmental variability, alternating between wet and dry have been documented for East Africa and linked to hominin evolution (Potts 1996, 1998), wet/dry alternating periods have been reported in the African Plio-Pleistocene (e.g. Campisano and Feibel 2007; Hopley et al. 2007; Kingston et al. 2007; Lepre et al. 2007; Trauth et al. 2007), which would have a significant impact on the regional climate and vegetation. These alternating periods are caused by precession (Deino et al. 2006; Kingston et al. 2007; Maslin and Christensen 2007). During precessional orbital forcing, periods of <2000 years witness 60% of the total variation in daily insolation and seasonality occurs at the equators, followed by 8000 years of relatively little change in daily insolation, thus creating short periods of rapid, intense forcing followed by relatively weak forcing.

This theory has subsequently been modified by Maslin and Trauth (2009) and Maslin et al. (2014), to include East African palaeolakes activity and is referred to as the 'Pulsed Climate Variability Hypothesis'.

PULSED CLIMATE VARIABILITY HYPOTHESIS

This hypothesis suggests that hominin speciation, dispersals and encephalisation were driven by punctuations in the long-term drying trend in East Africa. Punctuated episodes of short, alternating periods of extreme aridity and humidity leading to climatic variability in 400 or 800kyr cycles driven by the eccentricity maxima (Maslin et al. 2015). Despite being put forward to explain hominin evolution in East Africa, with specific reference to the advancing and contracting palaeolakes in the Rift Valley, there is little that occurs in isolation, it could be argued that similar scenarios or knock-on effects could be experienced elsewhere in Africa.

Maslin et al. (2014, 2015) propose this conceptual framework (Pulsed climate variability framework) as a means within which to examine other evolutionary theories. For example, Maslin et al (2015) show how the framework can be used to interpret Vrba's (1985) Turnover Pulse Hypothesis and how the TPH scenario would operate under proposed extreme climatic cycles (see Maslin et al. 2015, p.5, Fig.5).

The framework operate for macro-scale events such as phyletic gradualism and punctuated equilibrium as well as species-level (hominin evolution level), including allopatric speciation, aridity hypothesis, TPH, variability selection hypothesis, Red Queen hypothesis and sympatric speciation based on sexual selection. It is proposed that each of the differing evolutionary mechanisms hypothesised could have been acting on hominins (and other species) during episodes of climatic instability, resulting in a range of different traits, ultimately leading to the emergence of new species (Maslinet al. 2015).

Smooth model, threshold model, or extreme climate variability model

A 'smooth model', with prolonged periods of wet and long periods of dry environmental conditions, with a smooth transition between each supports Red Queen or TPH as possible catalysts of evolution. Whereas, a 'threshold model' with rapid and extreme environmental variability supports Potts' (1998) VSH. An 'extreme climate variability' model is a more extreme version of the threshold model, whereby, extreme climatic variability occurs during transitionary phases between periods of extreme wet and extreme dry environmental conditions. The fourth possibility posited by Maslin and Christensen (2007) is of prolonged, extreme wet periods occurring could encourage speciation events in a high competition/ high-energy environment that such wet environments promote. Prolonged wet environments appear to be limited, at least for East Africa, but this model lends support to the Red Queen hypothesis (Van Valen 1973). As one group succeeds, other co-evolving groups must adapt alongside the successful group, or be outcompeted.

Environmental/Climate Forcing Hypothesis

This theory postulates that global climate is the key evolutionary driver and is necessary for evolutionary events to occur. Following on from the Turnover pulse hypothesis, in which Vrba (1985) proposed that climatic changes is the driver of major pulses of speciation and extinction in African mammals (Bobe et al. 2002). It promotes the idea that there is a direct relationship between environmental change and speciation but unlike the TPH, the change does not necessarily occur in pulses. It may be difficult to test this theory using faunal turnover due to the constraints of the fossil record (preservation bias etc.) (Behrensmeyer et al. 1997; Bobe et al. 2002). There are many factors which may initiate climatic changes, usually linked to either variations in the Earth's orbit or tectonic activity (Potts and Behrensmeyer 1992). This theory is supported by findings in the Omo valley (Bobe and Eck 2001) where changes in bovid abundances appear closely related to African climatic shifts.

> "Climate change caused significant shifts in vegetation....and is a plausible explanation for the gradual ecological change" (Bobe et al. 2002, p.475).

Threshold

The threshold concept is an interesting one. The idea that there is a critical value below which major evolutionary events cannot be catalysed. For example, Bobe et al. 2002. (p.18) established a working hypothesis relating to the concept of a threshold beyond which instability makes areas more vulnerable to changes. Species are more vulnerable to evolutionary events as a consequence of environmental and climatic change. Bobe et al. (2002)'s hypothesis was based on observed transformations in the Omo valley, which was postulated to have crossed a threshold at 2.5Ma whereby the regional climate was no longer sufficient to buffer the impact of larger-scale climatic cycles. There is the potential that the Omo valley is not isolated in this experience and similar could hold true for southern Africa. Major changes have been cited by numerous researchers (e.g.

deMenocal 1995) around 2.5 and 1.7Ma in southern Africa, it would be worth investigating the potential of a threshold being crossed at this times which initiated environmental and evolutionary change.

There are many different climatic and environmental factors at play which can or may need to reach a threshold either independently or combined with other factors. For example, mean annual precipitation threshold (Sankaran et al. 2005). Above ~650mm MAP, savannas become unstable and wooded canopy enclosure is possible without the intervention of disturbances such as fire or herbivory. With disturbances, the coexistence of trees and grasses can occur and mosaic habitats can emerge. The fact that herbivory has the potential to alter the dynamics of the ecosystem highlights that animals are not simply victims of their environmental conditions or vice versa, but there is actually a complex interaction within the ecosystem.

Similarly, a temperature threshold for photorespiration can determine the relative abundances of C_3/C_4 plants (Hopley et al. 2007). Primary photosynthetic pathways of the vegetation of any given environment is tied to the climate and thereby susceptible to change under climatic changes. A temperature threshold is required for a major change in the dominant photosynthetic pathway and therefore, vegetation type, of an environment.

Court Jester hypothesis

Proposed by Barnosky (2001), otherwise referred to as extrinsic forcing (Hopley 2004). This hypothesis proposes that factors external (extrinsic) to the community are responsible for species' ecological changes within. Physical and environmental factors (such as climatic changes) are the most important drivers of evolutionary change (Barnosky 2001).

Species diversity being predominantly driven by abiotic factors, such as climate, is supported by palaeobiological studies (Benton 2009) as well as by some palaeoanthropological research (Vrba 1985, 1992, 1993b, 1995b; Janis 1989, 1993, 1997; Janis and Wilhelm 1993, Webb et al. 1995; Webb and Opydyke 1995 and Barry et al. 1995).

Red Queen hypothesis

Proposed by Van Valen (1973), otherwise referred to as intrinsic forcing, evolution is controlled by processes intrinsic to species (such as intra- and inter-specific competition) (Hopley 2004). In contrast to the Court Jester hypothesis, the Red Queen hypothesis places the emphasis on change being due to internal changes. That is, biotic, within community changes are the main force driving species ecology, interplay and adaptation.

Continued adaptation is required to allow species to keep up with competitors in the community which are constantly evolving (Maslin et al. 2014, 2015), or as Lewis Carroll puts in, “It takes all the running you can do to keep in the same place” (Carroll 1960, p.345). If one group within the community succeeds, others must also adapt to meet the increased competitive demands over a relatively long time period (Maslin and Christensen 2007). Support for the Red Queen hypothesis is given by van Valen (1973), Alroy (1996, 1998), Prothero and Heaton (1996) and Prothero (1999).

Court jester and Red Queen models may operate preferentially over different spatial and temporal scales, with biotic factors (Red Queen) shaping local ecosystems over short timescales and abiotic factors (Court Jester) shaping larger-scale patterns regionally and globally over longer timespans (thousands/millions of years) (Benton 2009). The Red Queen hypothesis and the Court Jester hypothesis together demonstrate the two extremes of evolutionary hypotheses (Hopley 2004). Few would discount the impact of either intrinsic or extrinsic factors on shaping evolution but may be swayed one way or another as to the relative impact and necessity of each. It is most likely that both are at play with abiotic and biotic factors switching between playing the more or less dominant role according to numerous factors.

Shifting Heterogeneity Model

Oscillating climatic conditions result in increased and ever-changing habitat heterogeneity. This causes a state of continual flux for the resident fauna and flora. Species are likely to migrate into new habitats (e.g. refugia) which may create isolating mechanisms for populations. Differential selection pressures would act on these 'new habitats' that cumulatively lead to adaptive change. Speciation would ultimately occur due to selective pressures induced by repetitive cyclical environmental perturbations and oscillating local environments (Kingston 2007).

Autocatalytic hypothesis

Mckee's (1999) hypothesis uses a Red Queen, i.e. intrinsic factors-focused, microeveolutionary approach. McKee emphasises the importance of intrinsic events at the individual level, such as social status and degree of parental nurturing. The role of environmental factors in evolutionary events is acknowledged but not seen as essential for evolutionary change to occur. McKee notes that most change is induced by internal feedback loops rather than external environmental stimuli (Kingston 2007).

Niche incumbency

Local interactions between species, inter-specific competition can shape species distribution (Algar et al. 2012). The nice incumbency model, whereby interspecific interactions dictate the success and distribution of given species within a niche, was outline by Valentine (1980) Walker and Valentine (1984) (Alroy 1996).

This is potentially what may be seen with the introduction of impala into the same niche as springbok, although perhaps the distinction is somewhat blurred when dealing with mixed feeders. It is possible that impala outcompeted springbok, in spite having the ability to adapt their diet, animals will preferentially feed and be more successful on their preferred food type. It is possible that impala and springbok negatively interacted, leading to ecological niche incumbency and limiting the distributions of one or both species.

Adaptive radiation

Adaptive radiation is a (series of/) dispersal(s) of descendants of a common ancestor leading to morphologically diverse forms (Foley 2002). The hominin record shows a series of adaptive radiations throughout its evolutionary trajectory (Foley 2002), for example. Robinson (1963) proposes an adaptive radiation of *Australopithecus africanus*. This specific case may have been questioned but nonetheless, the presence of adaptive radiations throughout hominin evolution shows that speciation events can be accelerated when a limited number of individuals colonize a 'new' habitat (Turelli et al. 2001).

The Traffic Light Model

This theory, proposed by Vrba (1995a, p.27) is based around migratory patterns. The idea that there is a window of opportunity for migrations to occur across what are periodically barriers, such as when sea levels fall to allow passage across what would otherwise be a body of water or simply an area with vs. an area without palatable vegetation or shelter. Red is when 'nothing' can cross, amber is when some can but divides groups and green symbolises the area being free to roam for ‘all’. The ‘habitat corridors’ open and close subject to climatic changes. The traffic light is seen as bias in favour of movements in one direction than another (Barnosky 2001).

The Relay Model

Likened to runners in a relay race, Vrba (1995a, p.29), suggested that speciation and extinction events occur differentially according to their specific habitats. Timings of vicariance and speciation as a result of climate change are dependent on habitat type. Different habitats have differing “vicariance thresholds” beyond which speciation and most extinctions can occur and “optimal ranges” between the upper and lower constraints of any given habitat (Vrba 1995, p.230).

Habitat Theory

Vrba (1992) suggested that changes in the physical space a species inhabits are required for evolutionary change to occur. This theory combines a set of compatible hypotheses to offer an alternative to others that place more emphasis on competition as the leading cause of extinctions (Vrba 1992).

Stationary Model

Stenseth and Maynard Smith (1984) offered a theoretical alternative to the Red Queen Model (a steady rate of evolution) in the stationary model. That is, evolutionary stasis with no speciation or extinction unless they are in response to changes in the physical environment (Barnosky 2001).

Tiers of Time

Evolutionary processes occur on at least three different scales (Gould 1985), the first is the ecological scale (operating over tens to thousands of years), then the geological scale (operating over millions of years) and the final tier is represented by catastrophic events that dramatically alter the physical environment (Barnosky 2001). An additional tier was included by Bennett (1990, 1997), to incorporate cyclical climate changes caused by Milankovitch orbital variations.

A1. 3 THEORETICAL APPROACH

Like any anthropological question, the theoretical approach of the researcher should be considered. Although perhaps not as influential as with archaeological theory, the background and stance of the researcher should still be borne in mind.

A geologists training and viewpoint will differ slightly from that of an anthropologist when considering climate. An ecologist will consider questions differently to a physicist. A variety of approaches to the same research question or a collaboration would be of most benefit but is rarely achieved.

Particularly when considering speciation events, being a ‘Lumper’ or ‘splitter’ can have bearing on when speciation events are seen to occur, as well as the extent of variation present within an ecosystem. The stance taken can influence interpretations, one might lump many species together and another, see all as separate species. On balance, the author would tend towards lumping species together, likely to see a range of variation present intra-specifically rather than to highlight variation as a species differentiator.

Appendix A2. Vegetation of South Africa

Description of the main vegetation types (White 1983)

http://unesdoc.unesco.org/images/0005/000580/058054eo.pdf

Regional Vegetation

Forest A large area, dominated by trees with a continuous stand of trees, at least 10 metres tall, with interlocking crowns (branches and leaves above ground).

Woodland A low-density forest, with an open stand of trees, at least 8 metres tall, with a >40% canopy cover, the ground level is usually dominated by grass.

Bushland An open area of bushes 3-7metres tall with a >40% canopy cover. Remnant vegetation is supported after disturbance (e.g. fire)

Thicket A closed / dense area of bushes and climbing vegetation, 3-7 metres tall.

Shrubland An area of shrubs less than 2 metres tall (open / closed) often including grasses, herbs and geophytes. Synonymous with scrubland or brush.

Grassland An area dominated by grasses. Also supports herbs and less than 10% woody plants.

Wooded grassland Land covered with grasses and other herbs but supporting 10-40% woody plant cover.

Desert An arid landscape with sparse plant cover. The lack of vegetation exposes the underlying substrate.

Afroalpine vegetation Mixed vegetation occurring at high altitude, where night frost can occur throughout the year. An archipelago-like floristic region of extreme floristic impoverishment (White 1983, p.169).

Local vegetation

Savanna (savannah) A mixed area with both woodland and grassland with an open canopy.

Scrub forest Intermediate between forest and bushland / thicket.

Transition woodland Intermediate between forest and woodland

Shrub woodland Stunted woodland, less than 8m tall and/or vegetation intermediate between woodland and bushland.

Riverine forest Supported/ produced by a nearby water source.

APPENDIX A3: CRADLE OF HUMANKIND SITES FURTHER BACKGROUND INFORMATION

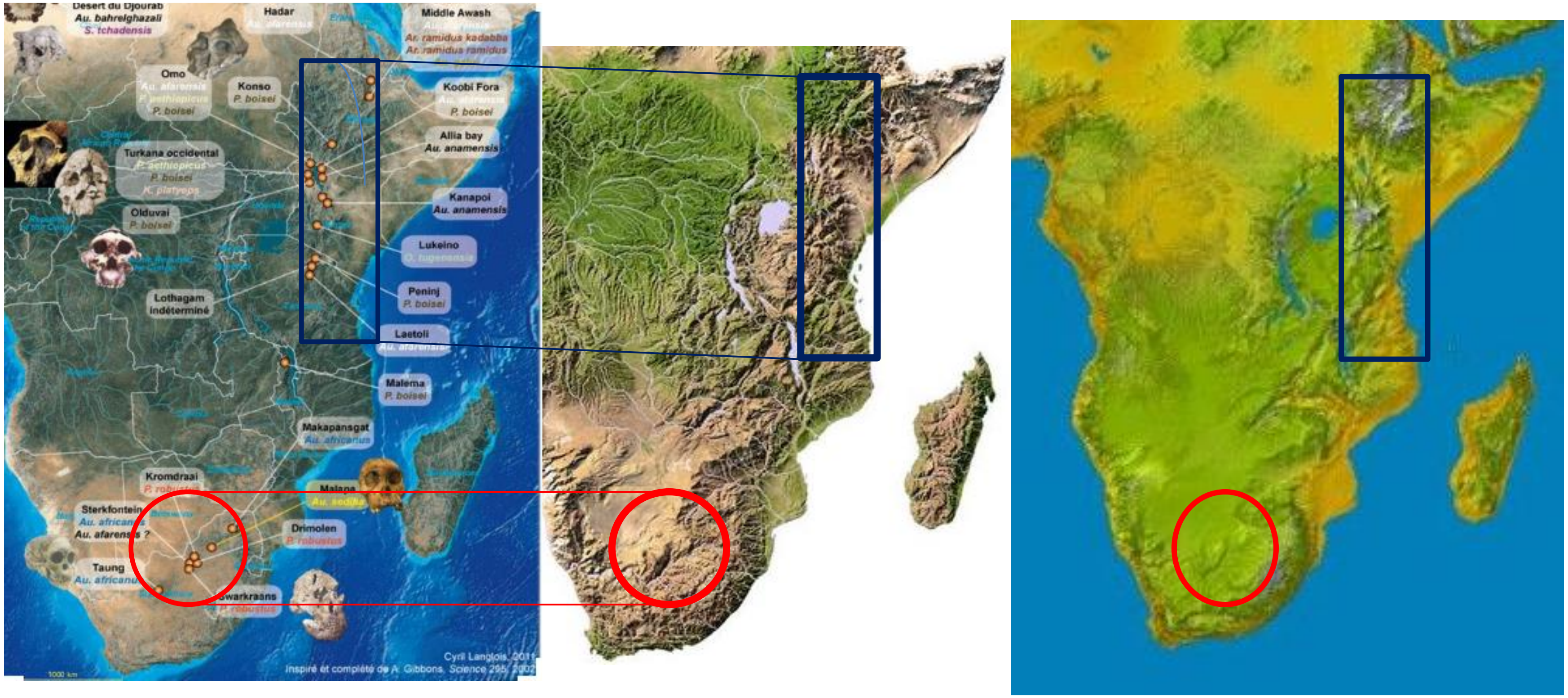


Figure A3.1: Topographical maps of Africa to visually indicate why southern Africa was chosen as the area of interest. The image on the left shows the key hominid sites in East (blue rectangle) and Southern Africa (red circle). The image in the middle gives an idea of the relief and the similar image on the right shows another topographical view of the same area to highlight the different habitats and topographical features impacting ecosystems in these areas. (Edited images from sources: Image 1: http://planet-terre.ens-lyon.fr/article/Australopithecus-sediba.xml . Copyright of original image held by Cyril Langlois 2011. Image 2: http://www.findtripinfo.com/africa-map.html. Image 3: Topographical Map of Africa, photo credit:NASA. http://goafrica.about.com/od/africatraveltips/ig/Maps-of-Africa/Topographical-Map-of-Africa.htm)

A3.1 SITE STRATIGRAPHY, ASSEMBLAGE FORMATION, TAPHONOMY

STERKFONTEIN

Sterkfontein [26.0317S, 27.7350E] located within the Sterkfontein Valley Dolomitic cave in the Mote Cristo Formation (Zipfel & Berger 2009), in the Cradle of Humankind World Heritage Site (Gauteng Province, South Africa) lies on a hill overlooking the Blaaubank River, surrounded by numerous other fossil-rich sites (including Swartkrans, Kromdraai, Drimolen and Cooper's Cave). Lying within the narrow pre-Cambrian Malmani dolomite formation, the caves contain sedimentary infills of limestone breccia, dating from c. 4 Ma. These deposits record palaeoenvironmental information relating to hominin evolution from c. 2.6 million years until the Upper Pleistocene (Broom 1936; Brain 1981; Kuman 1994a; Reynolds & Kibii 2011; Granger et al. 2015; Val and Stratford 2015; Stratford 2017), and through to the Holocene (Reynolds and Kibii 2011). Sterkfontein remains one of the most important fossil hominin and Earlier Stone Age (ESA) sites, both within Africa, and universally.

The main Sterkfontein stratigraphic units considered here are Member 4 and Member 5 (West, East and Stw Infill) and to a lesser extent, PM6/ L63 Infill. The *Antidorcas* (and supplementary species) materials were obtained by focusing on selected blocks, representative of these Members, as outlined in Figure A3.2 below.

Taphonomy and site accumulation

SK M4 is important, due mainly to the large sample of *Australopithecus africanus* specimens recovered from this Member (Lockwood and Tobias 1999; Pickering et al. 2004b; Moggi-Cecchi et al. 2006; Clarke 2013 and others). The ESR, palaeomagnetism and U-Pb dates yielded suggest that Member 4 formed over a long time period, perhaps as much as 600 ka (2.6-2.0 Ma) (Reynolds & Kibii 2011). Sterkfontein Member 4 (SK M4) is the earliest deposit used in this chronological sequence. Study of bone surface modification suggests that the Member 4 fossils were accumulated by carnivore activity, natural death trap accumulations and slope wash (Brain 1981; Kibii 2004). These processes may have taken place at different times and different points of entry may have existed. The majority of all fossil bovid modified bones is carnivore-induced (84%), however, the recovery of low structural density skeletal elements, such as ribs and vertebrae (including juveniles) without signs of carnivore modification but with abrasion, indicate that some of the carcasses, and/or carcass parts were brought in naturally (by slope-wash, or death-trap) (Kibii 2004).

Member 4 contains the largest numbers of *Australopithecus* specimens, co-occurring with a large carnivore guild (14 carnivore species). Skeletal element representation, in addition to bone modification, suggests that carnivores contributed significantly to the hominin and faunal assemblage (Brain 1981; Lockwood and Tobias 1999; Kibii, 2004; Pickering et al. 2004a; O' Regan and Reynolds 2009).

By Member 5 (StW 53 infill, Member 5 East and West), virtually all large extinct carnivores are absent. Pickering (1999) suggested medium and larger-sized carnivores such as lions (*Panthera leo*), leopards (*Panthera pardus*) and several species of hyaenas used the cave as a denning site.

Further, cut marks on the StW 53 hominin cranium (on the zygomatic arch, despite no stone tools being preserved in the StW 53 deposit (Pickering 1999; Pickering et al. 2000; Kuman and Clarke 2000)) suggests that hominins were also using the site during early Member 5 times, both as a lithic manufacture site and for certain butchery activities (Pickering et al. 2000; Caruana 2017). This is corroborated by an abundance of Oldowan (M5E) and Acheulean (M5W) stone tools in the other Member 5 infills (Kuman and Clarke, 2000) and Member 5 yielded the only bone tool documented thus far at Sterkfontein (Val and Stratford 2015; Val et al 'in prep'.). However, the lack of butchery of bovid bones argues against a significant role for hominins in Member 5 faunal accumulation (Pickering, 1999).

The StW 53 infill has quite a small bone sample with relatively low numbers of biotically-modified bones.

Member 5 East (Oldowan) appears predominantly to have accumulated from a natural death trap, complemented by a few specimens having been washed in from the surrounding landscape (Pickering 1999). This is supported by skeletal element representation and few carnivore-modified bones (0.6% of faunal assemblage) (Pickering 1999). The low numbers of hominin- and carnivore-modified bone (0.615% of the assemblage, Pickering, 1999) suggest the remainder of the fauna were accumulated through slope-wash action via a narrow aven (Pickering 1999; Kuman 1994a,b) in the location of rows Q and R of the main Sterkfontein excavation (Figure 2).

Member 5 West's relatively high incidences of carnivore damage (such as tooth scores and gnaw marks) suggest serial denning and contrasts with that of the later L/63 sample. The possibility exists that during the formation of the Member 5 West deposit, collapse within the site had created talus slopes of debris, which provided access for animals into the caves (Clarke 1994). Whatever the reason, the data indicates the Member 5 West area was a shelter for animals during the time of deposit formation (Pickering 1999). The main accumulation-agent in Member 5 West was likely hyaena activity, specifically, the brown hyaena (*Parahyaena brunnea*) and supplemented by other accumulating agent such as porcupines.

Val and Stratford's (2015) assessment of the Western Talus in the **Name Chamber** faunal assemblage (n=5738 identifiable bone fragments) indicate both mixed origins of sediments (redeposited from their original location) and that multiple abiotic (natural death trap and fluvial action) and biotic (predatory accumulation) taphonomic agents were responsible for the assemblage. Evidence of carnivore damage (1.6%) and hominin-linked bone surface modifications (n=16) appeared on the bovid-dominated (83%) assemblage. The assemblage is suggested to be dominated by sediments **originally from Member 5 East (Oldowan) and to a lesser extent, from Member 4** (Robinson 1962; Clarke 1994; Stratford et al. 2012; Val and Stratford 2015).

Through Member 6 and Post Member 6 (L/63 and Lincoln Cave), the only carnivores recovered in the deposits are small carnivores (e.g. black-backed jackal (*Canis mesomelas*) and bat-eared fox (*Otocyon megalotis*)). And some porcupine activity (O' Regan et al. 2011).

The exact relationship of the Members and of the provenance of some of the blocks represented here (Figure A3.2) are the subject of ongoing research (e.g. Kuman and Clarke 2000; Val and Stratford 2015; Stratford 2012, 2015, 2018).

Excavation history and stratigraphy

Due to the nature of cave stratigraphy, with various depositional, erosional and infill episodes, certain areas in Sterkfontein are open to debate regarding their relative dates and relationship to one another, such as those in the area in Figure A3.2 This diagram and reference was used to assign provenance to specimens. Samples from these blocks may have been assigned to differing dates in the literature. Kuman and Clarke (2000) suggested that some specimens previously assigned to Member 4 should be reassigned to Member 5. These reinterpretations are extremely valuable if we are to be able to confidently provide interpretations that are reliant on the context of specimens.

Broom and Robinson’s (Transvaal Museum) original excavations at Sterkfontein efforts focused initially on the Member 4 australopithecine-bearing deposits. Subsequent focus shifted to Member 5’s Extension site with its stone tool-bearing breccias (Robinson 1962; Kuman and Clarke, 2000). The 1966 excavations by Phillip V. Tobias and Alun R. Hughes’ (University of the Witwatersrand) aimed to establish the relationship between the Member 4 and Member 5 deposits (Clarke 2012). Further research by Ronald Clarke and Kathleen Kuman concentrated on understanding the cave deposits as a whole. Specifically, excavation and analyses of the Member 5 has shown that three separate infills are present, largely differentiated by presence or absence of Earlier Stone Age artefacts (Kuman 1994a, b, Clarke 1994; Kuman and Clarke 2000).

Recent investigations by Dominic Stratford and colleagues aims to further understand the relationship of Member deposits, particularly in the Name Chamber (Stratford 2008, 2011, 2015; Stratford et al. 2012; Val and Stratford 2015; Partridge and Watt 1991; Clarke 2006; Avery et al. 2010), which currently shows a mixed assemblage from a combination of the other Members (e.g. Stratford et al. 2012).

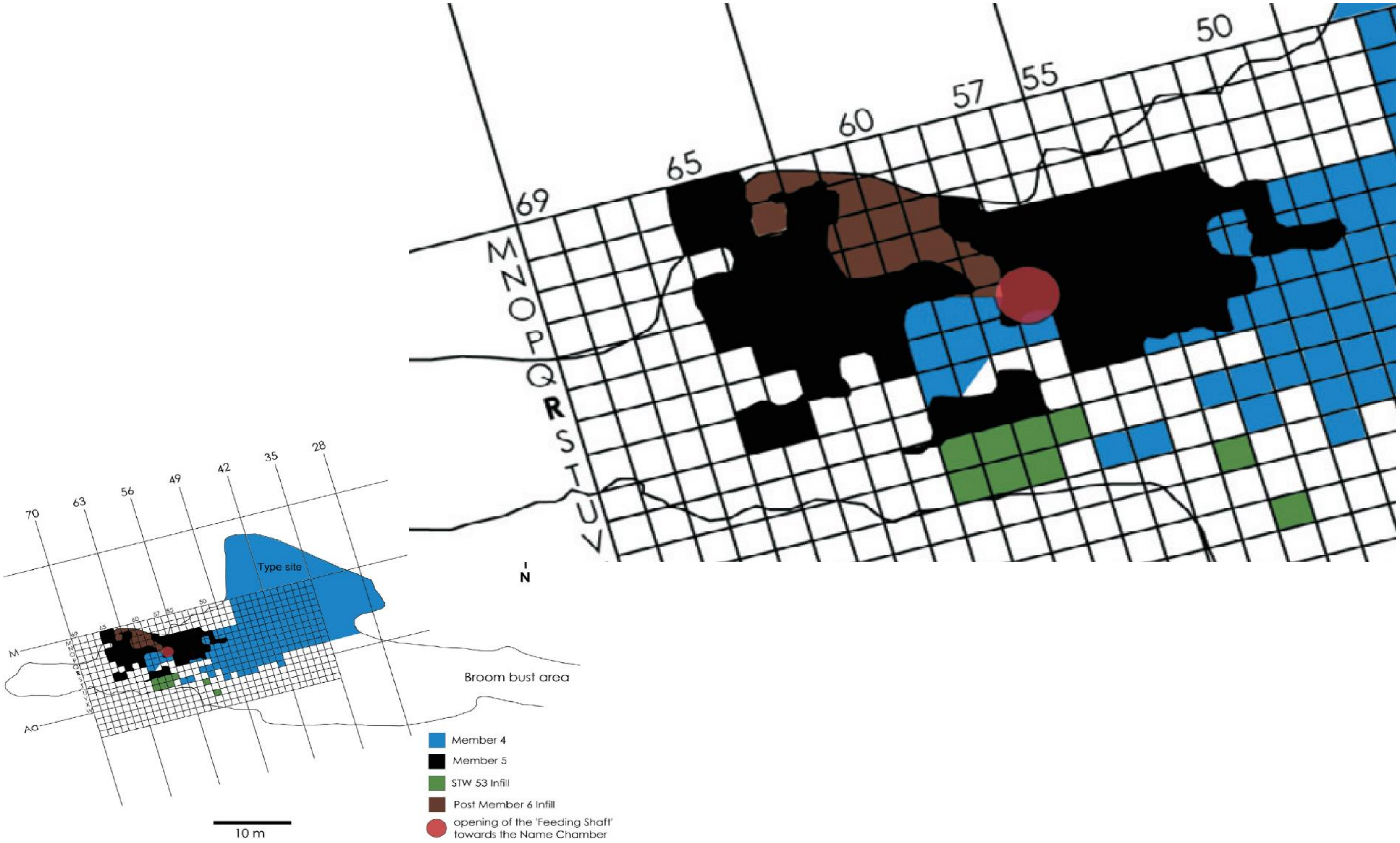


Figure A3.2: A focus on the Sterkfontein blocks and the stratigraphic unit they represent, adapted from Val and Stratford 2015 (Figure 1).

SWARTKRANS

Swartkrans is located roughly 1km away from Sterkfontein, in the Sterkfontein Valley is a dolomitic cave in the Monte Cristo Formation (Malmani Subgroup, Transvaal Supergroup) [26.0167S, 27.7239E] (Zipfel & Berger 2009). Like the majority of caves in the Cradle of Humankind, Swartkrans lies on an intersection of two fault lines (East-West and North-South) (Brain 1993a; Partridge 2000).

The Swartkrans stratigraphic units considered here are Member 1 (Lower bank and hanging remnant), Member 2 and Member 3.

Assemblage formation, deposition and taphonomy

A combination of depositional agents have been attributed to Swartkrans assemblage accumulations, including hominin and carnivore activity and alluvial deposition (Nigro et al. 2003; Lee-Thorp 2000). Brain (1995) suggested the alternating episodes of sediment accumulation (deposition) and non-deposition occur due to changing climatic conditions during glacial and interglacial cycles. Increased precipitation and lower vegetational cover would leave soils more vulnerable to erosion and therefore, more deposition into the caves would be more likely to occur during interglacials (Brain 1995). Brain (1993a) suggested there may be little temporal difference between the M1 HR deposits and the M2 and M3 deposits, based on faunal similarities (de Ruiter 2003).

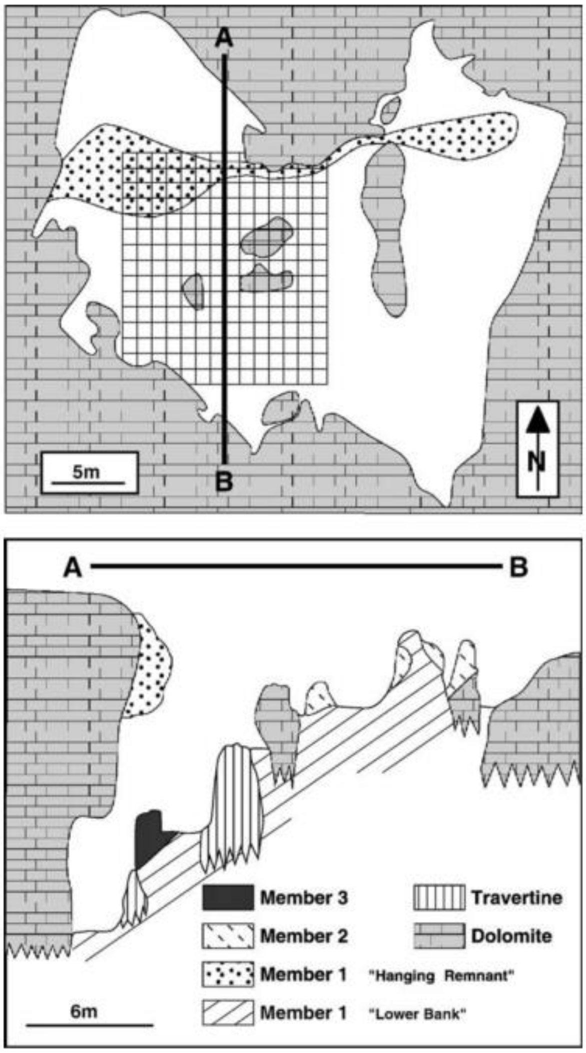


Figure A3.3: Plan (top) and cross-section (bottom) of the Swartkrans deposits. Figure from Balter et al. 2008 (redrawn from Brain 1993a).

Excavation history and stratigraphy interpretation

The hominin-bearing deposits of Swartkrans were first discovered in 1948 by Robert Broom. Initial excavations began at Swartkrans in 1948 by Broom (to 1951) and Robinson (to 1953) (Broom, 1949; Broom and Robinson 1952; Brain 1993a; Brain 1981; Watson 1993; de Ruiter 2001). *Paranthropus robustus* was discovered during these initial excavations. Excavations resumed by Brain in 1965-1986 (Brain 1981, 1993a; Clark 1993; Field 1999; Brain and Shipman 1993; Backwell and d'Errico 2001, 2003, 2008; d'Errico and Backwell 2009), yielding *Paranthropus* and *Homo* remains as well as many stone and some bone tools. Excavations since 2005 have focused on the younger deposits of Member 4 and 5 (Sutton et al. 2009). The Swartkrans deposits have yielded the largest South African sample of *Paranthropus*, along with multiple specimens attributable to *Homo* and over 400.000 faunal specimens (Brain 1958, 1993, Brain and Shipman 1993). At the original cave entrance of Swartkrans Member 3, evidence of repeated burning and burnt bone was suggested to be one of the earliest evidence of the controlled use of fire by hominins in SKX M3 (c. 1.0 Ma) (Brain and Sillent 1988; Brain 1993d).

The stratigraphy of the Swartkrans cave was not immediately apparent and has been revised many times (Brain 1981, 1993a; Partridge 1978, 1979). Swartkrans cave consists of 5 Members (Members 1-5), formed of 7 stratigraphic. Swartkrans Member 1 (divided into the hanging remnant and the Lower Bank), Member 2, Member 3, all yielded hominin remains (*Paranthropus* and, or *Homo*) (de Ruiter 2003). Two further Members, 4 and 5, were discovered but are beyond the temporal range for this research.

A degree of mixing of deposits appears to have occurred at Swartkrans. For example, suggestions have been made that the bone and stone tools in the Hanging Remnant may have been reworked into the Lower Bank (Backwell and d'Errico 2003) and that Members 2 and 3, contain small samples coming from the M1 Hanging Remnant (Brain and Shipman 1993; Backwell and d'Errico 2001, 2008).

KROMDRAAI

Recently (since 2014), extensive work has been carried out on the Kromdraai deposits, originally investigated following the discovery of the first robust Australopithecines by a 15-year-old (Gert Terblanche) in 1938 (Broom 1938). Located in the Sterkfontein Valley Dolomitic cave in the Monte Cristo Formation [26.0106S, 27.7503E] (Zipfel & Berger 2009), 2 km East of the Sterkfontein caves on the southern site of the Blauubank River. The site was first reported by Broom & Schepers (1946).

Taphonomy and site accumulation

Previous interpretations of Kromdraai taphonomy should now be viewed with caution following the refinement of the site's stratigraphy (Braga et al. 2017; Fourvel et al. 2018). Kromdraai deposits are most likely to have been accumulated by several primary (e.g. leopard) and secondary (e.g. hyaena) predatory action and the site used as a carnivore lair (Fourvel et al. 2018). Kromdraai Member 2 for example, (oldest Kromdraai deposit) is viewed as predominantly carnivore-accumulated, due to the mortality profiles, tooth/gnaw-mark frequencies and anatomical element fragmentation patterns of the faunal assemblage. Coupled with high species diversity, scavengers (or secondary predators) are also implicated as site deposit accumulators and modifiers.

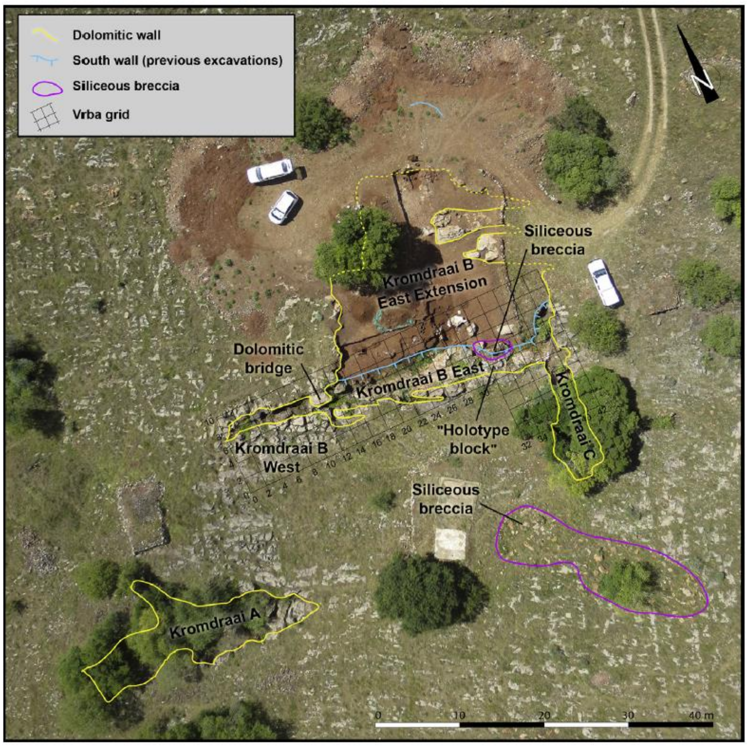


Figure A3.4: Aerial photograph of Kromdraai excavation site and recent extensions viewed (Bruxelles et al. 2018, p.6-7).

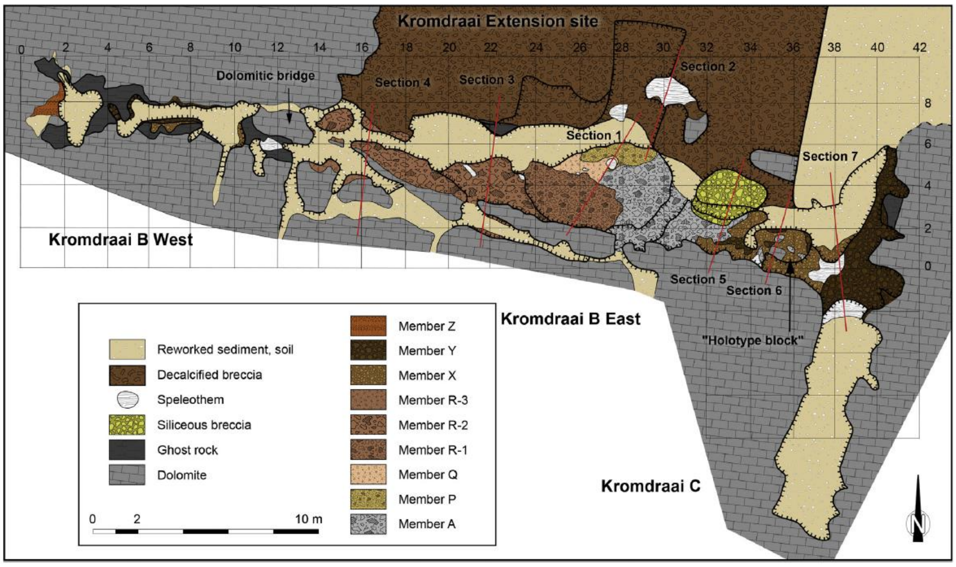


Figure A3.5: Kromdraai stratigraphic formations (from Bruxelles et al. 2018, p.6-7).

Table A3.1: Kromdraai stratigraphic units as differentially described by Brain (1958) and Partridge (1982), alongside the most recent revised stratigraphy of Bruxelles et al. (2016).

Brain (1958)	**Partridge (1982)**	**Bruxelles et al. 2016**
Stony breccia	Member 1	Member 1
Pink breccia	Member 2	Member 2
	Member 3	Member 3
		Sub-Member 4.1
	Member 4	Sub-Member 4.2
	Member 5	Sub-Member 4.3
	Member 1 (KB West formation)	Member 5
	Member 2 (KB West formation)	Member 6
	Member 3 (KB West formation)	Member 7

Stratigraphy and chronology

Kromdraai has been recently re-evaluated in light of new stratigraphic evidence and represents more of a stratigraphic sequence; yet aligning the assemblages from previous excavations to those of the more recent excavations still presents a problem. The Kromdraai site is formed of a single talus cone interbedded with flowstones, representative of multiple successive depositional and mineralisation as well as deminerlisation and erosion cycles (Bruxelles et al. 2016; Braga et al. 2016). All known Kromdraai deposits tie in with the earliest part of the stratigraphic sequence of Members 1 to 3.

Both KA and KB yielded evidence of hominin presence, KA via c. 100 early Acheulean / Oldowan artefacts (Kuman et al. 1997) and *Paranthropous robustus* (Broom 1938a,b, 1942, 1943) and other hominin fossils found in KB (Thackeray et al. 2001; Braga et al. 2013). Hominins recently discovered when reassessing KB Members 1 and 2, extend the known timespan of hominins at Kromdraai, necessitating re-evaluation of hominin evolution relative to East African hominins (Braga et al. 2017).

Since excavations commencing in 2014, thousands of new fossils have been added to the collection and the site is now thought to represent a single stratigraphic succession, (with no distinction between KA, KB and KE localities (Braga et al. 2017)), albeit remaining discontinuous and without clear temporal delineations. Braga and Thackeray (2018), were able to revise a considerable degree of Kromdraii stratigraphy as well as stretching the timespan covered by the site and enable re-evaluations of previous interpretations.

Dating for Kromdraai is ongoing, following a recently revised stratigraphy of the site by Bruxelles and colleagues (2016) and all suggested dates are currently subject to confirmation and further excavation. Originally, the deposits from Kromdraai A (KA), Kromdraai B (KB) and then KB Extension (KE), were considered a single unit, roughly contemporaneous with Sterkfontein Member 5 deposits (McKee et al. 1995). However, it is now recognized that at least 5 distinct stratigraphic units (Members) are present at Kromdraai (Bruxelles et al. 2016; Braga et al. 2016, 2017, see Table A3.1).

In this research study when using KA/KB/KE material and although tentatively placed within the chronology (Table 1), based primarily on previous interpretations, it is acknowledged that this placing be taken cautiously. The Members are often combined but by combining the deposits, it is acknowledged that only a time and climate-averaged signal is obtainable (Braga et al. 2017; Bruxelles et al. 2016). The KB samples are derived from at least 3, distinct depositional phases which are securely tied in a stratigraphic context (Braga et al. 2013, 2017).

Re-evaluation of fossils known to be from Members 1 and 2 within the Kromdraai stratigraphy could now be used to replace the 'KB' fossils originally used as it is believed that Kromdraai Member 1 and 2 corresponds to this interim temporal period, previously believed to be covered by 'KB' (Braga et al. 2017). Member 2, the oldest fossiliferous deposit at Kromdraai [1.95-1.78 Ma (Thackeray et al. 2002)] (Bruxelles et al. 2016) corresponds to that acknowledged by Partridge (1982) and as "pink breccias" by Brain (1958). Kromdraai Member 3 is hypothesized as being relatively contemporaneous with Sterkfontein Member 5 (Braga et al. 2017; Bruxelles et al. 2016) (see Table A3.1).

Herries et al.'s (2009) date range of c. 1.8-2.6 Ma appears to be a misinterpretation of the measurements cited by Thackeray et al. (2002) (see Braga et al. 2017). Preliminary conclusions on chronology at Kromdraai place Members 1 and 2 pre-dating Sterkfontein Member 4, with Sterkfontein Member 5 and Swartkrans Member 1 being roughly contemporary with Kromdraai Member 3 (Braga et al. 2017). Kromdraai A and Members X and Y from Kromdraai B would be contemporaneous with Sterkfontein Member 5 and Swartkrans Member 1 (Bruxelles et al. 2018). Yet the central breccias from the KB formation appear to represent a temporal period unrepresented by Sterkfontein (due to erosional unconformity) (Bruxelles et al. 2018).

The KB Extension bovid material is fragmentary and has a lack of cranial and horncore specimens with which to identify fauna to lower taxonomic levels. However, KB Member 2 is a homogeneous fossil record, dominated by Alcelaphines. This assemblage is suggestive of dispersal corridors between East and Southern Africa due to some of the proposed taxa present that are similar to those seen in contemporaneous East African assemblages (this is in contrast to the endemism proposed for the later mid-late Pleistocene mammalian faunas in southern Africa (Brink 2016; Fourvel et al. 2016). The bovid assemblage from Member 2 is reminiscent of Plio-Pleistocene bovid assemblages from Kenya and oldest Olduvai levels (Harris et al. 1988; Harris 1991; Gentry and Gentry 1978; Gentry 2010), as well as the South African, Makapan Limeworks Members 3 and 4, also dated to the end of the Pliocene/ early Pleistocene (Gentry 2010). The Alcelaphini taxa in particular support the idea of an eastern-southern African biogeographic dispersal corridor being present during this temporal range (Fourvel et al. 2016).

The KA locality is younger than KB (McKee et al. 1995) and was previously known as the 'faunal site' (Braga et al. 2016), with many time-sensitive bovid taxa characteristic of the 'Cornelia Faunal Span' or Cornerlian Land Mammal Age (LMA) of southern Africa (Cooke 1974; Hendey 1974; Brink 2005; Brink et al. 2012) (c. 1.1-0.7 Ma) (Brink 2005), (see section 3.2.8). Additionally, the presence of the believed descendant *Dinofelis piveteaui* in KA supports the KA assemblage as representing a younger temporal range than Swartkrans Member 1, where the ancestral *Dinofelis barlowi* is found (Cooke 1991; Braga et al. 2016).

The sediment from KA was remarked to be similar to Member 6, when compared to the stony breccia excavated by Brain (1958). Although considerable research has been recently carried out, both revising the stratigraphic sequencing (Braga et al. 2016) and then subsequently, on the fossil material based on the revised stratigraphy of KB (e.g. Fourvel et al. 2016), the KA locality does not appear to have been scrutinised to the same extent as yet.

CAVE OF HEARTHS

Situated outside of the geographic range of the Cradle of Humankind, nearby the Strydpoort Mountains the Cave of Hearths still yields evidence of hominins, largely through lithics. The Makapan Cave of Hearths, located on the southern side of the Makapan valley (previously Makapansgat or Mwaridzi Valley) in the Malmani Dolomites in the Limpopo province of South Africa [24.1500S, 29.1831E] (Zipfel & Berger 2009) was first reported by Robert Broom in 1937. Located within a group of fossil cave remnants, comprising of Hyaena Cave (Hyaena mandible cave) to the west (down-valley) and Rainbow Cave (via Gwaŝa/ Historic Cave) to the east (up-valley) (McNabb et al. 2009), the Cave of Hearths preserves faunal, hominin and cultural remains from a lengthy stratigraphic sequence (Maguire 1980a; Mason 1988; Ogola 2009) yet is treated largely as a single, mixed Early Stone Age (ESA assemblage). The deposits from the Cave of Hearths span a time period from the ESA to the Iron Age (Mason 1988; Maguire 1998a).

Cave of Hearths assemblage accumulation and taphonomy

It is thought that deposits were accumulated by fluvial action, with sediments entering the cave through progressive collapse of the entrance, and washed down the talus cone slope further into the cave by surface run-off (Herries and Latham 2009). Carnivores are believed to be responsible for the accumulation and modification of the majority of the faunal assemblage (Klein 1988, 2000; Mason 1962, 1988) due to the bovid abundance. The bone assemblage, analysed by Cooke (1988), Dart (1948), de Graaff (1988), Ewer (1988) and Wells (1988), shows bovid dominance (over 59% of the assemblage) (Ogola 2009), at similar levels to that seen at other Pleistocene sites that are accumulated by carnivores, hominins and other agents; such as Sterkfontein and Makapan Limeworks (Maguire et al. 1980; Pickering 1999; Vrba 1974, 1975, 1980, 1982).

Dating and stratigraphy

The archaeology (hominin technology presence) of the Cave of Hearths is younger than 780 ka, based on magnetic polarity (Brunhes-Matuyama magnetic reversal boundary). Although a magnetic polarity excursion has potentially been identified in the basal sequence of the Cave of Hearths, likely dating to the Middle Pleistocene. Despite its name, there is no convincing evidence of hearths (hominin-controlled fire) present (Herries and Latham 2009).

Excavations by Mason in 1953-4 in the dolomitic cave remnant showed the Cave of Hearths to be comprised of a succession of 11 beds (Beaumont & Vogel 2006).

Mason (1988) was unable to distinguish between Beds 1 and 2, so the ESA material is often treated as a single, time-averaged assemblage (McNabb 2009). A progression from Bed 1 to 3 was suggested based on lithic assemblages in these deposits with a strong similarity between handaxes and cleavers from all of the beds (Mason 1988). Beds 1-3 represent ESA, Beds 4-9 represent MSA (Middle Stone Age), Bed 10 LSA (Late Stone Age) and Bed 11 Iron Age material (McNabbet al. 2009).

GONDOLIN

Situated outside of the Sterkfontein Valley, in the NorthWest Province of South Africa, Gondolin is positioned between mixed bushveld and rocky highvels grassland biomes on the Skurweberg mountain range (Low and Robelo 1996). The geology of the Eccles dolomite (which is different to the Sterkfontein area) and the topography (more elevated than Sterkfontein) impact upon the cave development and subsequent infill, determining the depositional sequences and taphonomic processes that may occur. 1.9-1.5 Ma (http://www.thecradleofhumankind.net/[accessed 26/03/2018]).

Taphonomy and site accumulation

Watson (1993) interpreted the faunal assemblages as having been carnivore accumulated, contemporaneously to Swartkrans Member 1, around 1.6 Ma (de Ruiter 2003; Curnoe et al. 2001). *Homo* and *Paranthropus* have been identified here (Kuykendall and Conroy 1999; Menter et al. 1999; Tobias 2000).

GD1 material appears to have entered the paleocave via a vertical shaft (Menter et al. 1999) and is heavily weathered and fragmentary, suggesting prolonged surface exposure prior to introduction to the cave (Adams 2006), entering the cave most likely due to fluvial action such as a low-energy stream (Herries et al. 2006). There are several phases of deposition interpreted for GD1 as the deposits contain weathered chert and large clasts (requiring substantial force to move material of such a size), enables conclusions of relatively high-energy (e.g. flash-flooding) with heavy run-off from the hillside (Adams et al. 2007).

GD2 however, harbours relatively complete and well-preserved fossil specimens with evidence suggesting fossil entrance to the cave was achieved via water form an entrance collapse scenario (Herries et al. 2006) and a lower-energy hydrological system (Adams et al. 2007). The composition of the faunal assemblage suggests primarily leopard accumulation through denning and caching (Adams 2006).

Excavation history and stratigraphy

Two distinct deposits are known from this location, GD1 (Adams et al. 2007) and the slightly earlier, GD2 dated to just before 1.78 Ma (Herries et al. 2006). In Skurweberg, Dolomitic cave in the Mote Cristo Formation [25.8303S, 27.8635E] (Zipfel & Berger 2009), first reported by Watson (1993). The two main fossil-bearing localities (GD1 on the northwest corner of the cave and GD2 on the eastern edge of the cave) are stratigraphically discontinuous. Heavy mining in the Gondolin site resulted in limited preservation of the palaeocave deposits (Herries et al. 2006).

The palaeocave was excavated initially by Vrba and Panagos in 1979 (Watson 1993) on the GD2 deposits and excavations are ongoing in the GD1 locality (Adams 2006; Herries et al. 2006).

GD2 is postulated to be contemporaneous with Swartkrans Member 1 and at least partially contemporaneous with Kromdraai B Member 2 (Thackeray et al. 2002), all dated to roughly 1.8 Ma.

GLADYSVALE

Located around 13km North-East of Sterkfontein, Swartkrans and Kromdraai (the Sterkfontein Valley) in the John Nash Reserve [25.9000S, 27.7000E], within the geological context of the Dolomitic Cave, Eccles Formation (Zipfel & Berger 2009).

Taphonomy and site accumulation

Varying spatial patterns for the believed assemblage-accumulators induced damage, that of, carnivore and porcupine damage to specimens was not evident, indicating post-depositional admixture occurring (Lacruz et al. 2002).

Palaeoenvironmental reconstructions at Gladysvale obtained using stable isotopes (carbon and oxygen) suggest higher proportions of C_4 vegetation existed during the early Pleistocene, with associated cooler, drier conditions. A shift towards C_3 vegetation-dominance is apparent during the middle Pleistocene (towards the temporal limit of this research c. 0.8-0.5 Ma). C_4 grasses were more abundant during clastic sedimentation, restricting clastic sedimentation (cave sediment rock formation) to short arid-phases (Pickering et al. 2007). That is, the deposits are highly episodic, restricted to cooler, drier conditions, making arid-adapted species likely to be overrepresented in the deposits (Pickering et al. 2007). The same has been suggested for other cave deposits in the CoH region.

Excavation history and stratigraphy

The Gladysvale cave system consists of multiple chambers and surface deposits (exposed by erosion and collapse), dating from the Late Pliocene to the Late-Mid Pleistocene (Berger et al. 1993). Gladysvale represents one of the most continuous and extensive temporal sequences for South African hominin localities (Lacruz et al. 2003). The Gladysvale Internal Deposit dates to c. 0.57-0.007 Ma (Pickering et al. 2007) and External Deposits to 0.8-0.58 Ma (Lacruz et al. 2003).

Reported by Broom & Schepers (1946), Gladysvale was initially excavated in 1936 (Berger et al. 1994), but the site was not associated with hominins until Australopithecines were eventually discovered in 1992 (Berger 1992) and *Homo* in 1997 (Schmid and Berger 1997) yet hominin finds remain rare from Gladysvale cave deposits.

Alcelaphines dominate the bovid assemblage and bovid genera that are not often found in hominin deposits are also present, such as *Aepyceros* (impala) and *Syncerus* (buffalo).

The region lies in the modern summer rainfall area, with over 90% of mean annual rainfall falls in a concentrated timeframe of the summer months between October and April (http://www.weather.co.za) Modern vegetation in the area ranges from open grassland, with scattered trees and bushes to densely wooded valleys (Acocks 1953), with the cave itself located on the edge of mixed savanna (Scholes 1997) and grassland (O'Connor and Bredenkamp 1997) biomes. The cave lies on the eastern side of the valley, sheltered b trees with the presence of shrubs and grass whereas the higher ground is dominated by grassland (Pickering et al. 2007).

PLOVERS LAKE

Plovers Lake is located to approximately 6km NE of Sterkfontein and Swartkrans [25˚58'38"S, 27˚46'37" E] and contains 2 main fossiliferous deposits. The first, external deposit, dated to c. 1 Ma (Thackeray and Watson 1994) and the second, internal deposit dated to the Middle Stone Age (MSA) c. 62.9-88.7 Ka (de Ruiter et al. 2008a) formed of two discrete faunal assemblages from an in situ and ex situ component (de Ruiter et al. 2008s). There appears to be no direct association between the two deposits (de Ruiter et al. 2008a). The MSA palaeoenvironment is reconstructed as predominantly grassland (de Ruiter et al. 2008a) with similar woodland as is present today (Brophy et al. 2014).

Taphonomy and site accumulation

Carnivores, likely brown hyeana (*Hyaena brunnea*) appear to be the dominant accumulating agent (de Ruiter et al. 2008a). The site adheres to Pickering et al (2007)'s model for cave deposition development in the area, of episodic clastic deposition interspersed with flowstone deposition, according to climatic conditions (Pickering et al. 2007; de Ruiter et al. 2008a).

3.2.6.2 Specimens used

Specimens used come from the two distinct deposits. The specimens used are comparative to the main assemblages used from the previous sites (Sterkfontein, Swartkrans and Kromdraai). At c. 0.08 Ma, the internal deposit of Plovers Lake is beyond the youngest limit considered for this research and are used here primarily as relatively ‘modern’ comparisons for fossil *Antidorcas* palaeoecology. Faunal assemblages are curated at the ESI, University of the Witwatersrand. Sample size: *Antidorcas* N=32 (*Antidorcas recki* n=5; *Antidorcas bondi* n=16; *Antidorcas marsupialis* n=11).

Cornelian LMA

As referenced above (in ‘Kromdraai’ section), the Cornelian Land Mammal Age, type site of Cornelia-Uitzoek, located in the eastern free state of South Africa, 160 Km southeast from the Cradle of Humankind regional, marks a change in typical faunal composition, to incorporate both archaic connections with East African fauna, as well as the beginnings of southern endemism. Alongside the fauna that appear and begin to dominate the assemblages are shifts in associated palaeohabitats favoured by the taxa.

Fauna present represent a diminishing biogeographic link with East Africa, whilst witnessing incipient southern African endemism. **Taxa shared** with the upper Bed II, III and IV of the Olduvia sequence include: *Eurygnathohippus cornelianus*, *Hippopotamus gorgops*, *Kolpochoerus hesoloni*, *Syncerus antiquus* and *Antidorcas recki*.

Of these, the equid (*Eurygnathohippus cornelianus*) and suid (*Metridiochoerus compactus*) taxa became extinct in southern Africa prior to the Florisian LMA (Brink 1987), which is recorded in Gladysvale c. 780-560 ka (Lacruz et al. 2002).

Southern endemics include *Connochaetes gnou laticornutus*, a derived temporal form of *Damaliscus niro* and *Antidorcas bondi* (Brink and Lee-Thorp 1992; Thackeray and Brink 2004; Brink 2005).

Open, highveld-type grasslands becoming a lasting feature of southern African landscapes is marked by the appearance of the endemic black wildebeest (*Connochaetes gnou*) (Brink 2005).

ASSEMBLAGE ACCUMULATING AGENTS FOR EACH SITE MEMBERS

Although the majority of the faunal assemblages found from Plio-Pleistocene South African cave deposits were collected by multiple taphonomic agents (Brain 1981, 1993c; de Ruiter and Berger 2000; de Ruiter et al. 2009; Pickering 2001; Newman 1993), they can be considered representative of faunal communities, reliably indicative of their surrounding environment (Behrensmeyer et al. 1979; Reed 1997; de Ruiter et al. 2008: Kuhn et al. 2010; Steininger 2011). The carnivore collecting hypothesis cited here (Table A3.2) is based on predator-prey ratio, whereby a typical carnivore lair should have at least 20% carnivores (Cruz-Uribe 1991; Pickering 2002; Kuhn et al. 2010).

OTHER

Additional sites faunal assemblage lists are used for the meta-analyses (chapter 4), to place the main sites used in this research into context within southern Africa. The sites chosen were Southern African countries with modern endemic *Antidorcas marsupialis* associated with known palaeoanthropological sites of interest.

SOUTH AFRICA

Buffalo Cave

Located in the Makapan Valley in the Northern Transvaal [24°08 'S 29° 11 'E], a date of 1.07- 0.78 Ma was obtained via magnetobiostratigraphy (Herries et al. 2006). Kuykendall et al.'s (1995) initial reports suggest Buffalo Cave assemblages were deposited during the Pleistocene, during a palaeoenvironmental context of an open savanna landscape (Alcelaphines and other grazing bovids), with some wooded habitats and a local water source (Tragelaphines, Hippotragines and Reduncines), based on fauna present within the assemblages.

Wonderwerk Cave

Located in the dolomitic phreatic cavity in the Kuruman Hills in the Northern Cape Province [27°50′ 45″S. 23° 33′ 19″E], with deposits spanning 1.8 Ma from the Early Stone Age to the Late Stone Age. Strata 11 (Acheulean) and 12 (Oldowan), c. 1.8-1.1 Ma (Chazan et al. 2012; Matmon et al. 2012) faunal assemblages (Brink et al. 2015) are considered here. Based on biochronology, Wonderwerk Cave basal layers align with Swartkrans Member 1 and 2 (De Ruiter 2003; Watson 2004) and Sterkfontein Member 5 (Ogola 2009). The modern setting is an ecotone of hilly, broken topography of the Kuruman Hills and local plains environment to the east of the cave (Brink et al. 2015), similar is suggested for the palaeoenvironment of strata 11 and 12 of semi-arid plains to grassland savanna to the east of the cave based on bovid taxa present, as well as microfauna and phytolith records (Chazan et al. 2012; Brink et al. 2016). This palaeoenvironment is in contrast to the mesic conditions postulated for the Middle Pleistocene of central interior of South Africa (Brink 2005). The younger deposits of Wonderwerk Cave have recently revealed interesting niche partitioning evident among herbivore species (Ecker et al. 2018) which considered in relation to *Antidorcas* findings from this research, later in the thesis.

Malapa

Early Pleistocene cave deposits from the Cradle of Humankind [25.5339S, 27.4757E]. *A.sediba* hominins are associated with this site, dated to 1.97±0.002 Ma (Pickering et al. 2011). Taphonomic analysis of faunal assemblage suggests faunal assemblages were accumulated via a natural death trap (Val et al. 2015). The hominin and faunal remains in these deposits have a good state of preservation (Dirks et al. 2010). *Au. Sediba* deposits (Facies D) just post-date 1.977±0.003 Ma and a palaeoenvironmental landscape of extensive grasslands with some riparian woodlands is suggested (Holt et al. 2016).

Drimolen

Located in the Rhino Game Reserve within the Dolomitic cave of the Monte Cristo formation [25.9681S, 27.7564E] (Zipfel & Berger 2009). A diverse macromammalian faunal assemblage was found in Drimolen Main Quarry (Adams et al. 2016). The deposit is dated based on the stratigraphic location of a few specific taxa, to between 2.3 Ma (*Equus quagga*) and 1.6 Ma from (*D.* aff. *Piveteaui*) (Adams et al. 2016), or 2.0-1.5 Ma (Keyser et al. 2000; O'Regan and Menter 2009). Carnivores, specifically leopards (*Panthera pardus*) are implicated as the main assemblage- accumulating agents (O'Regan and Menter 2009). Faunal assemblages are curated at the ESI, University of the Witwatersrand.

BOTSWANA

Ngamiland sites of Gewihaba & Nqumtsa (Pickford 1990). Five Plio-Pleistocene fossiliferous sites in North-western Botswana were discovered by The Botswana Paleontology Expedition in 1988-9 (Pickford et al. 1994; Pickford 1990). Koanaka North has yielded Cercopithecoids (Williams et al. 2012) similar to those from Makapansgat (Pickford et al. 1994) Koanaka South yielded quartzite flakes, indicating hominin presence during the lower Pleistocene (Pickford et al. 1994). The sites are interpreted as fluctuating around a mean of arid and semi-arid palaeoenvironments based primarily on micromammals (Pickford et al. 1994).

Other southern African fossiliferous deposits were considered but sufficiently detailed faunal lists were not readily available to allow them to be added to the meta-analysis (chapter 4). These are briefly detailed below.

NAMIBIA

Berg Aukas (Grine et al. 1995), fossiliferous Karst cave breccias from Northern Namibia. Kaokoland, North West Namibia, with 6 breccias dated from Plio-Pleistocene to Holocene (Pickford et al. 1993). Palaeoenvironmental reconstructions for the Plio-Pleistocene at these sites fluctuate around a semi-arid mean with a broadly similar mean to that seen in the region today (Pickford et al. 2004).

ANGOLA

Fossil breccias of the Humpata Plateau, southern Angola date from late Plio- to early Pleistocene. For example, Cangalongue has been dated to 1.8-1.3 Ma and Malola is considered contemporary to Makapansgat (South Africa). Faunal analysis has been focused on the cercopithecids (Delson & Dean 1992; Jablonski 1994) and micromammals (Pickford et al. 1992). Similar environmental conditions to those experienced today are suggested, fluctuating between more humid and more arid than present (Pickford et al. 2004).

Table A3.2: South African fossil-bearing deposit faunal assemblage likely accumulating agents and relevant references. M=Member.

Site and Member	Assemblage accumulation interpretation	Reference
Sterkfontein M4	Carnivore-collecting	Brain 1981; Pickering et al. 2004
Sterkfontein M5 E	Fluvial action and natural death trap	Pickering 1999; Reynolds and Kibii 2011
Sterkfontein M5 W	Carnivore (likely hyaena) collecting and cave use (opening providing access)	Clarke 1994; Pickering 1999; Reynolds and Kibii 2011
Sterkfontein M5 StW 53 Infill	Carnivore-collecting	Pickering 1999
Sterkfontein L/63	Carnivore collecting, hyaena denning and porcupines	Reynolds et al. 2007
Swartkrans M1	Carnivore-collecting	Brain 1981; Pickering et al. 2012, 2016.
Swartkrans M2	Carnivore-collecting	Pickering et al. 2016
Swartkrans M3	Carnivore-collecting	Pickering et al. 2016
Kromdraai	Carnivore-collecting	Fourvel et al. 2018
Gondlin GD1	Fluvial action	Menter et al. 1999; Adams 2006; 2007
Gondolin GD2	Carnivore-collecting	Menter er al. 1999; Adams 2006, 2010; Grine et al. 2012
Malapa	Natural death trap	Val et al. 2015
Gladysvale	Carnivore-collecting	Berger 1993
Cooper's D	Carnivore-collecting	Steininger et al. 2008; De Ruiter et al. 2009; DeSilva et al. 2013
Drimolen Main Quarry	Carnivore-collecting	Gommery et al. 2002; O'Regan & Menter 2009; Moggi-Cecchi et al. 2010; Adams et al. 2016
Cave of Hearths	Carnivore-collecting and fluvial action	Klein 1988, 2000; Mason 1962, 1988; Herries & Latham 2009

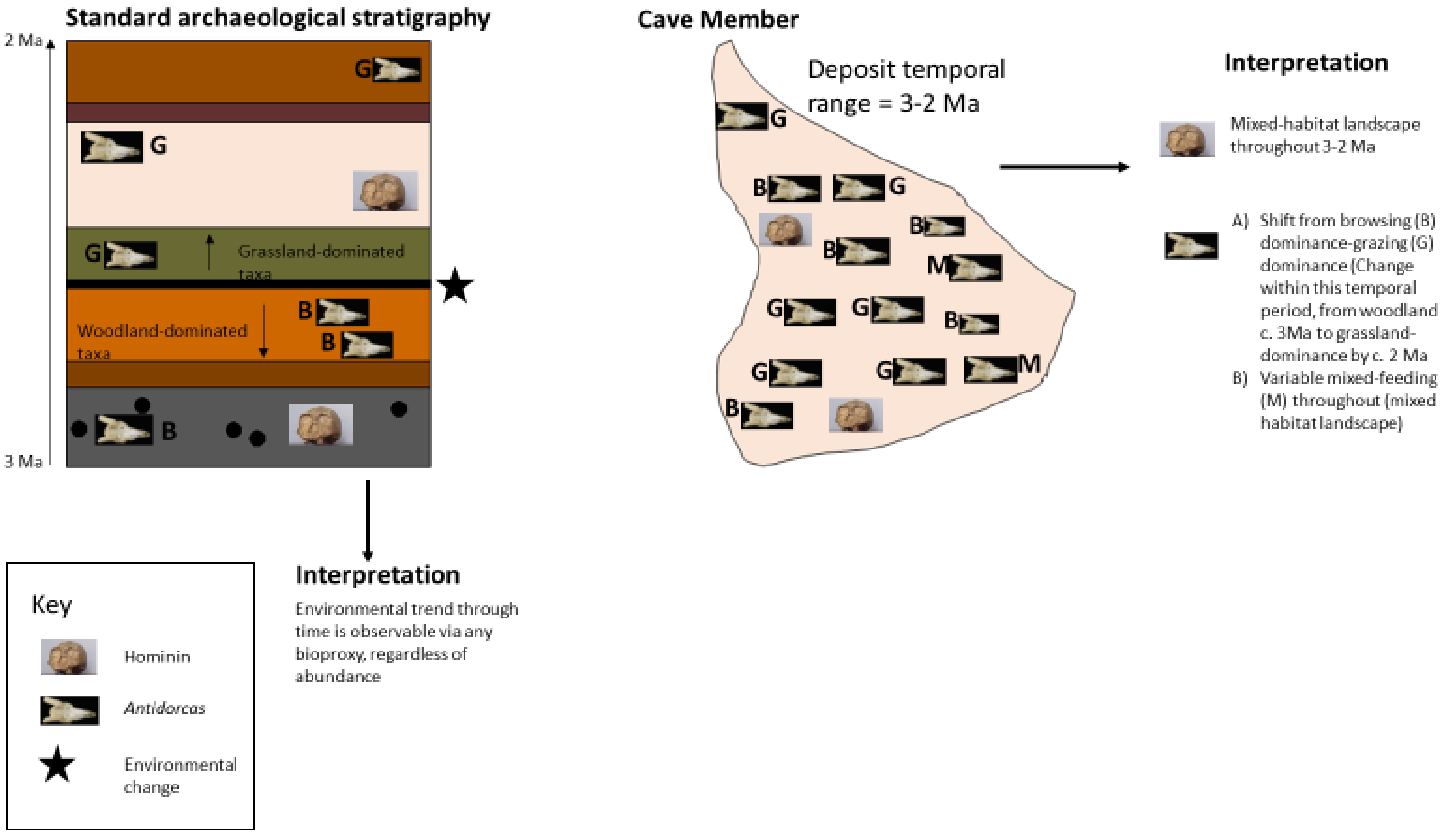


Figure A3.6: Simplified diagram of time-averaging in cave deposits and its implications for palaeoenvironmental interpretations and subsequent reasoning for using abundant, herbivorous antelopes from these contexts.

A3.2 PALAEOENVIRONMENTAL RECONSTRUCTIONS TO DATE OF SITE MEMBERS USED

Sterkfontein Palaeoenvironmental Reconstructions to date

Sterkfontein incorporates the Plio-Pleistocene transition, at 2.58 Ma (Cohen and Gibbard 2011). This transition is characterised by a series of shifts towards cooler, drier, more seasonal conditions (deMenocal 2004; Weigelt et al. 2008), with related effects on faunal morphologies and communities (Vrba 1974, 1975; Reynolds 2007, 2010). One of the critical changes is the apparent increase in the proportions of C_4 grasses within the vegetation present. The proposed increasing aridity in southern Africa after 2.1 Ma (Weigelt et al. 2008), would also have favoured the development of grasslands. Later indications of expansion of the C_4 (monocotyledonous) plants at approximately 1.7 Ma, have related to the onset of the Walker Circulation (Hopley et al. 2007).

Research to date supports palaeoenvironmental hypotheses for Sterkfontein reflecting the earlier assemblages being deposited during warmer climates, while later deposits reflect the cooling drying trends associated with the Pleistocene (e.g. Vrba 1973, 1974; Wood and Richmond 2000). This tallies with broader, regional-scale, reconstructions of climate change in Africa (e.g. deMenocal, 2004), which suggest step-wise drying trends resulting in “more varied and open habitats at 2.9-2.4 Ma and after 1.8 Ma” in eastern Africa (deMenocal 2004, p.3).

Early palaeoenvironmental reconstructions of Sterkfontein, based largely on faunal presence/absence were of closed, wooded-forested, wetter environments in Member 4 with a trend forwards through time towards more open, arid savannah by Member 5 and younger (e.g. Broom 1938; Cooke 1963; Robinson 1963; Vrba 1975, 1976, 1980, 1985; Brain et al. 1988; Watson 1993). Yet palaeoenvironmental studies have been continuously refined over time as more material is recovered and stratigraphic relationship of Members are reassessed, along with metholodological advancements and reanalysis of collections (Brophy 2011). Numerous palaeoenvironmental reconstructions have been postulated using various methods (including speleothems (e.g. Hopley 2004); bovid diets (including microwear; mesowear; isotopes) (e.g. Steininger 2011; Lee-Thorp et al. 2007) and carnivore guild assessment (e.g. O’Regan & Reynolds 2009). As a result of this shifted emphasis, the more recent palaeoenvironmental reconstructions tend towards habitat and environmental heterogeneity (e.g. Avery 2001; Reed 1997; de Ruiter et al. 2008; Brophy 2011).

Many recent studies indicate high levels of habitat variability in Member 4, but each study suggests a slightly different mix of these habitat types. Indeed, a significant grassland and open habitat component also existing during Member 4 has been identified, based on a variety of environmental proxies, ranging from fossil wood analysis (Bamford 1999); hominin diets (van der Merwe et al., 2003); through to micromammals (Avery 2001; Avery et al. 2010), primate postcranial morphology (Elton 2001) and isotopic analysis of bovid dental enamel (Luyt 2001; Luyt and Lee-Thorp 2003). These proxies all indicate that a significant grassland component was already present during Member 4 times and did not sample exclusively moister, more forested environments (e.g. Williams and Geissler 2014). While Member 5 deposits preserve numerous species more typically associated with grasslands, including the extinct gelada baboon (*Theropithecus oswaldi*) and ostrich bones and eggshell (*Struthio*), this does not necessarily prove that Member 5 represents exclusively dry, grassland environment.

Thus, the idea of habitat heterogeneity across the Sterkfontein landscape is supported, similar to contemporary East African sites (e.g. from Laetoli, Andrews and Bamford 2008). Studies have examined the role of the landscape in creating and sustaining such mosaic habitats (Bailey et al. 2011 Reynolds et al. 2011; Dirks and Berger 2013). Geomorphological evidence shows the presence of a fault close to Sterkfontein, which could have created and sustained heterogeneous habitats consistently at Sterkfontein (Bailey et al. 2011, Reynolds et al. 2011; Dirks and Berger 2013). Modern analogues of how tectonics affect diversity are the tectonically-controlled wetlands of the Nysvley (South Africa) and Okavango (Botswana) regions; in both cases, a close proximity to faults in the presence of surface water creates high habitat and species diversity (Ramberg et al. 2006; Havenga et al. 2007). Whilst no active faulting to the extent seen in East Africa is found, the subtle landscape dynamics resulting from geomorphological activity around these faults would undoubtedly support variable habitats (Dirks and Berger 2013). Continually supported micro-habitats can buffer the impact of the local/regional/global climatic conditions on the faunal communities they support. Yet, the key to temporal differentiations in South African contexts may lie in the variability of these landscapes through time, i.e. via the influence of global climate, such as enhanced seasonality and glacial episodes (e.g. Potts 1988).

The Member 5 **Stw53 paleoenvironments**, of open, drier, grassland conditions are suggested by the presence of the gelada, *Theropithecus oswaldi*, and an equid in the StW 53 infill (Kuman and Clarke 2000). This marks a shift from comparatively closed, wetter conditions dominating the landscape in Member 4 towards drier, more grassland conditions in Member 5.

Faunal composition from the **Member 5 East** (Oldowan) infill, including equids (*Equus* sp.), springhare (*Pedetes capensis*), ostrich (*Struthio* sp.) and lion (*Panthera leo*) as well as multiple species of Antelopine and Alcelaphine, have been interpreted as indicating a drier, more open environment (Pickering 1999). However, a taxon-free analysis of the bovids from this infill indicates that a significant amount of tree cover was available in the vicinity (Bishop et al., 1999).

Fauna from the **Member 5 West** (Early Acheulean) appear to indicate open landscapes, with open-wooded grassland or open savanna (Vrba 1975; McKee 1991; Reed 1997; Kuman and Clarke 2000). Certainly, isotope data appear to suggest Member 5 fauna being from a drier, grassland environment, compared with earlier Member 4 times (Luyt 2001; Luyt and Lee-Thorp 2003), and this would be in keeping with drier conditions after 1.7 Ma and the onset of the Walker Circulation, as has been proposed by Hopley et al. (2007).

A more open grassland at the time of the West Infill, with more browsing herbivores (increased C_3 vegetation) than during the earlier Oldowan infill has been suggested (Luyt 2001). This may well be the case, however, it is worth considering that these infills may reflect also geographic variation, with mosaic habitats being reflected rather than a vegetation (and potentially a climatic) shift over time.

Although outside the main temporal range of consideration here, some post-Member 6 L/63 Infill specimens are included for certain analysis (indicated for each method) as a *relatively* young comparative collection from the same locale. The deposit is dominated by extant fauna which are common in the area today. These younger deposits are dominated by small carnivore species, signifying either taphonomic processes influencing the deposit or that larger carnivores (such as lions, leopards and hyenas) moved out of the Sterkfontein area during the Upper Pleistocene (Reynolds, et al. 2007; Reynolds 2010).

Sterkfontein palaeoenvironmental changes appear to have occurred gradually, based on cercopithecoid postcranial evidence (Mokokwe 2016). Furthermore, the consistency of diet of fossil cercpithecoid taxa (as indicated via microwear studies by El Zaatari et al. 2005), indicates consistency in the availability and accessibility of food sources throughout this temporal period represented by the Sterkfontein formation, within the Sterkfontein valley area (Mokokwe 2016).

Whilst consistently harboring some degree of habitat heterogeneity throughout, the dominant palaeoenvironment signal within the Sterkfontein formation suggests a shift of closed, wetter, woodland-dominated habitats during Member 4 times, towards more open, arid grassland-dominated habitats from Member 5 onwards. Notwithstanding the potential confounding factors of mixture of sediments, along with time- and climate- averaging probabilities. As one of the main aims of this research, the palaeoenvironmental change and pace thereof is readdressed in the discussion chapter of this thesis in light of the *Antidorcas* data analysed.

SWARTKRANS Palaeoenvironmental Reconstructions to date

Mosaic habitat landscapes have been repeatedly inferred for the duration of the Swartkrans Members (1-3), consisting of open savanna with elements of woodland/riverine habitats and a trend towards a cooler, more arid environments (e.g. Vrba 1975; 1980, 1985; Brain 1995; McKee 1991; Watson 1993; Avery 2001; Reed 1997; Reed and Rector 2006; Lee- Thorp et al. 2007; de Ruiter et al. 2008).

Swartkrans Member 1 palaeoenvironment has been inferred as a largely open landscape, with woodland habitats on the banks of the Blaubank river (Vrba 1975; Watson 1993; Elton 2001; Lee-Thorp et al. 2007; Reed and Rector 2006; de Ruiter et al. 2008b), as well as supporting edaphic grasses (which may include those reliant on seasonal-flooding (Spencer 1997; Reed 1997; Avery 2001) although alternative interpretation of a more mesic, closed woodland palaeoenvironment have been suggested (e.g. Benefit and McCrossin 1990). Swartkrans Member 2 has yielded similar palaeoenvironmental reconstructions, albeit with a slight increase in grassland taxa presence and abundance (Vrba 1975; Reed 1997; Lee-Thorp et al. 2007). However, a greater abundance in C_3-feeding (Steininger 2011) and mixed-feeding (Lee-Thorp et al. 2007) has been shown for SKX M2, suggesting greater woodland (Peterson et al. 2018). Based on ecological diversity, Reed (1997) inferred an increase in fresh-grass grazing animals, supporting an open grassland dominated landscape for Swartkrans Member 3. The consensus is one of slowly increasing grasslands through time from Member 1 to 3, yet examples, such as Steininger (2011), show that a more heterogeneous environment was likely. The influence of the nearby Blaubank River supports more consistency (through time) in habitats the area can support (see chapters 2 and 4).

KROMDRAAI Palaeoenvironmental Reconstructions to date

Initially, when KB was inferred to be interim between Sterkfontein Member 4 (higher rainfall and more woodland) and Swartkrans Member 1 and Sterkfontein Member 5 (increased aridity and more grassland), which encouraged Vrba's (1975) AAC criterion and faunal turnover hypothesis c. 2.4-2.6 Ma. This is one of the theories that has underpinned a lot of evolutionary theory since. Yet, now 'KB' is seen to be time and therefore-climate-averaged (Braga et al. 2016). The unknown provenance of the majority of the KB fauna essentially now renders Vrba's AAC criterion (Vrba 1975) unusable in this setting (Braga et al. 2017), and new palaeoenvironmental reconstructions are required, that use the better stratified Kromdraai material to yield more informed palaeoecological Plio-Pleistocene conditions.

Kromdraai B Member 2 deposits are inferred to be originating from open landscapes, based on primate evidence (Fourvel et al. 2016).

Modern environment around the Cave of Heaths

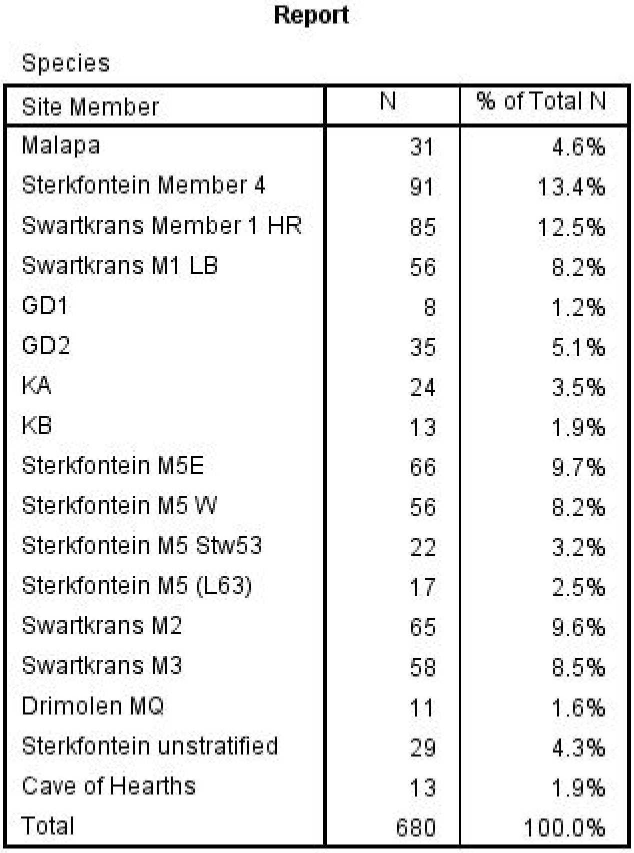
Limited extensive palaeoenvironmental reconstructions have been suggested for the Cave of Hearths. The location of the site, alongside its differing geology, topography, altitude and other related factors are likely to have created differing palaeoenvironments to the central Cradle of Humankind sites also. Today, the climate surrounding the COH site has a moisture gradient, which, combined with the impact of the elevation of the site, results in zonation of the local vegetation. Although typically experiencing warm, rainy seasons in the summer months of October to March and dry seasons from April to September, periods of extreme drought and extreme rainfall are known to occur. The precipitation is "sporadic and unpredictable in nature" (Macquire 2009, p. 40). The hottest months typically are in October, prior to the onset of the summer rainfall, June/July are the coldest months. Locally, the mountain crests are expectedly cooler than the valleys, although the valleys can be warmer during the daytime and resulting airflow maintains the COH in a "comfortable thermal belt" (Macquire 2009, p. 41). Aspect (angle and direction of the mountain slope) is responsible for differing vegetation on north (warmer) or south (cooler)-facing slopes. The COH opening is on a north-facing slope, so would be expected to facilitate the growth of vegetation associated with slightly warmer temperatures than nearby on the south-facing slope. Valley winds can sometimes create wildfires. Fewer fires results in bush, thicket and tree growth at the expense of expanding grasses, whilst more frequent fires encourage the spread of grasslands. Nutrient levels rise following fires, allowing fresh vegetation and associated fauna (McNabb et al. 2009). These factors contribute to the rich floral (and associated faunal) diversity associated with the region. Modern vegetation variation arises from differences in altitude, moisture availability, soil types, aspect, shade, temperature, wind exposure and a complex geology; currently supporting six vegetation types (Mucina and Rutherford 2006).

Table A3.3: Relevant date ranges and terminology used, to allow comparisons with the wider published literature.

Date	South African term	Epoch
3.4Ma-300,000ya	Early Stone Age (ESA)	Pliocene/Pleistocene
280,000-50,000ya	Middle Stone Age (MSA)	Pleistocene
50-39,000ya	Late Stone Age (LSA)	Holocene

A3.3 Faunal community meta-analysis taxa report and DFA

Table A3.4: Faunal community meta-analysis taxa report according to total number of species listed as being present at each site, for each member.



Report

Species

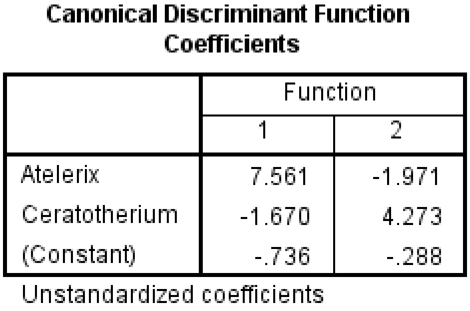
Site Member	N	% of Total N
Malapa	31	4.6%
Sterkfontein Member 4	91	13.4%
Swartkrans Member 1 HR	85	12.5%
Swartkrans M1 LB	56	8.2%
GD1	8	1.2%
GD2	35	5.1%
KA	24	3.5%
KB	13	1.9%
Sterkfontein M5E	66	9.7%
Sterkfontein M5 W	56	8.2%
Sterkfontein M5 Stw53	22	3.2%
Sterkfontein M5 (L63)	17	2.5%
Swartkrans M2	65	9.6%
Swartkrans M3	58	8.5%
Drimolen MQ	11	1.6%
Sterkfontein unstratified	29	4.3%
Cave of Hearths	13	1.9%
Total	680	100.0%

A discriminant function analysis (DFA) run on this presence/absence dataset of southern African (with probability groupings of South Africa, Botswana, Namibia and Angola) genera predicted all fossil sites to be Namibia, suggesting the faunal ranges are most similar to Namibia. However, the modern faunal lists from Botswana and Angola also aligned more closely with Namibia. This suggests that the model is not sufficiently reliable. Consequently, micromammal genera were removed from the analysis. Micromammals can falsely link sites together on the basis of archaeological method (i.e. sieving/ not-sieving, mesh size of sieve used).

A DFA run on the dataset without micromammals showed all fossil sites (including Gewihaba & Nqumtsa, the sites in Botswana) and modern South Africa were predicted to be South Africa (i.e. aligned most with modern South African fauna). Botswana and Namibia were predicted to be Namibia, Angola was correctly identified.

This attempted discriminant function analysis (Table A3.5) was over 91% accurate for modern sites categorising fossil sites with South Africa, but only 2 genera *Atelerix* (Hedgehog) and *Ceratotherium* (white rhinoceros) were taken forward in the analysis. This is reported as an unsuccessful DFA in chapter 5.

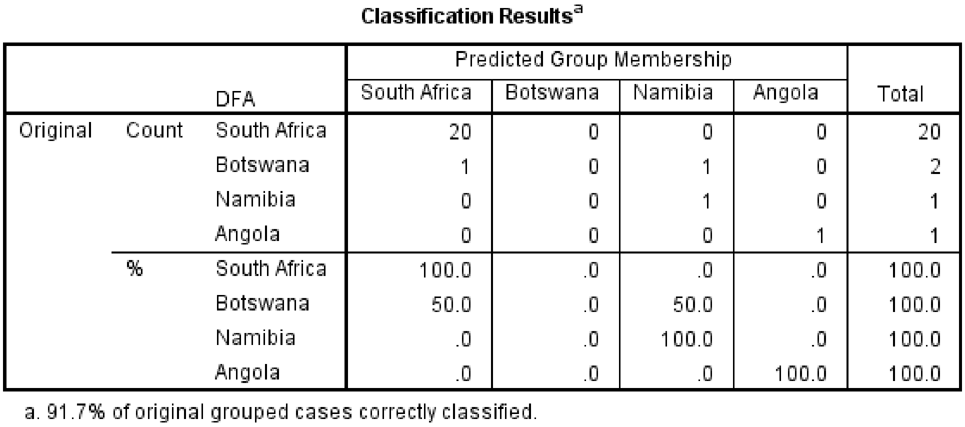
Table A3.5: Brief summary of discriminant function analysis carried out to test the alignment of each fossil site with modern faunal communities of southern Africa.



Canonical Discriminant Function Coefficients

	Function	
	1	2
Atelerix	7.561	-1.971
Ceratotherium	-1.670	4.273
(Constant)	-.736	-.288

Unstandardized coefficients



Classification Results[a]

		DFA	Predicted Group Membership				Total
			South Africa	Botswana	Namibia	Angola	
Original	Count	South Africa	20	0	0	0	20
		Botswana	1	0	1	0	2
		Namibia	0	0	1	0	1
		Angola	0	0	0	1	1
	%	South Africa	100.0	.0	.0	.0	100.0
		Botswana	50.0	.0	50.0	.0	100.0
		Namibia	.0	.0	100.0	.0	100.0
		Angola	.0	.0	.0	100.0	100.0

a. 91.7% of original grouped cases correctly classified.

Appendix A4. HORNCORES of the *Antidorcas* species.

The most definitive way to differentially identify *Antidorcas* species is via their horncore morphology. Unfortunately, their remains are often fragmentary and subject to informed interpretation to taxonomically assign them. A small subset of fossil *Antidorcas* horncore measurements (Reynolds *pers. comm*.) were included here to indicate the size range and variation prevalent within the fossil genus, these measurements are provided in Appendix A3.

Horncores have been shown to be one of the best indicators for differential species identification for *Antidorcas* species as well as differentiating between sexes (Vrba 1973, 1974; Cooke 1996). Cranial evidence can provide information that is somewhat troublesome to infer from the dentition alone. However, horncores are not indicative of diet and thus cannot be used for the main purposes of this research. Ideally, a combination of horncores alongside dental remains would be used to speculate on the population demographics and clear FAD/LAD (first / Last appearance datums) for *Antidorcas* species alongside climatic variations. Unfortunately, due to the fragmentary nature of many of the assemblages (e.g. often exposed via dynamite explosion or removed from breccia blocks) horncores are not often found articulated with their dentition, rendering sample sizes extremely small, where present at all. There is the potential that this is an avenue for future investigation.

- Males and females possess horns, which are typically lyrate in form but differ inter-specifically (for fossil species). Horncores appear almost parallel at the base and diverge backwards and outwards but return inwards towards the tips. Females have more gracile horncores.

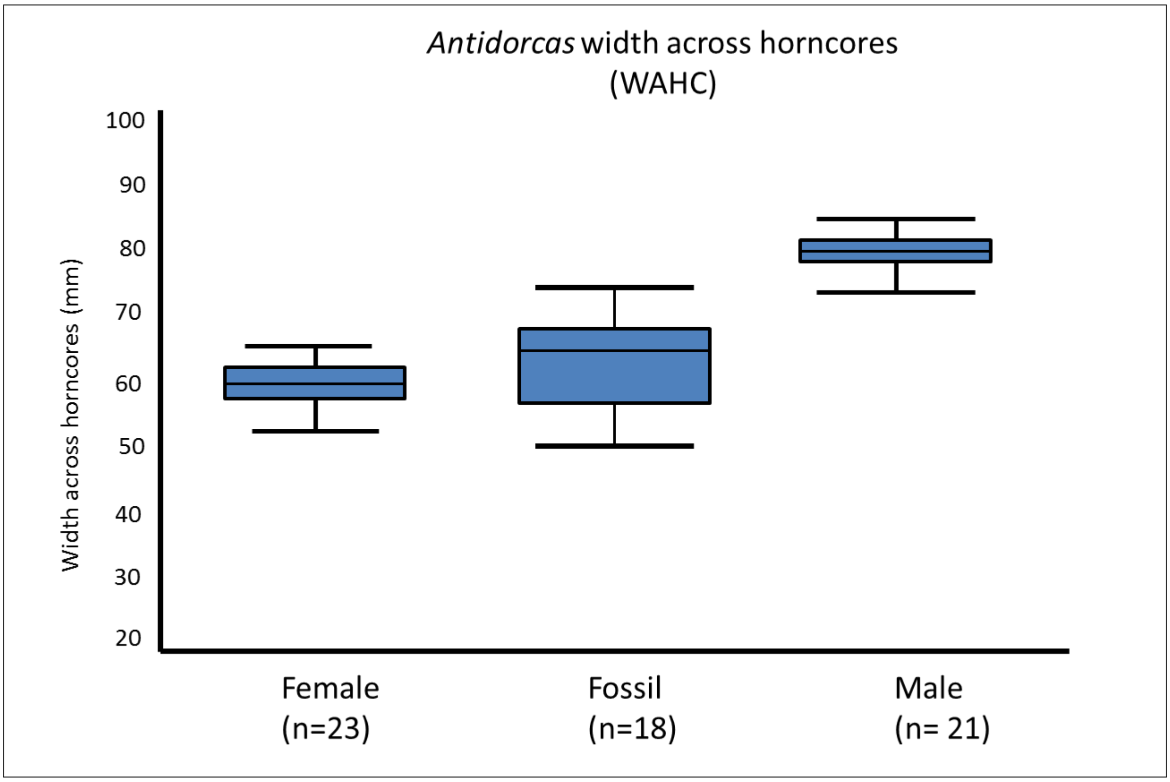
Horncore measurements were considered as a means to investigate taxonomic identification discrepancies in the *Antidorcas* lineage, namely, the taxonomic status of '*Antidorcas australis' or 'Antidorcas australis/ marsupialis'*. Vrba (1974) highlights the significance of horncore differences between fossil *A. marsupialis* and *A. australis.* The original species description of *A. australis* (Hendey & Hendey 1968) emphasizes the difference in horncore shape, with *A. australis* having somewhat straighter horns than the lyrate form typical of *A. marsupialis* (Cooke and Wells, 1951). Therefore, horncore measurements of fossil *Antidorcas* from relevant deposits used throughout this research were considered here. However, being unable to relate horncores to dentition and more importantly, the fragmentary nature of the majority of the horncores rendered this a task beyond the scope of this research. Considerable specification (training and expertise) into the morphology of numerous bovid (and similar) horncores would be required to attempt this type of research successfully.

Modern *A. marsupialis* horncore measurements were taken on 10 specimens from Ditsong Museum of Natural History, Pretoria. Measurements of fossil horncores were taken where present for cf. *Antidorcas*. These measurements were supplemented by data from S.C. Reynolds (pers. Comm.) from Natural History Museum, London, Ditsong Museum of Natural History, Archaeology department, University of the Witwatersrand and the National Museums, Kenya Palaeontology department.

The following measurements were taken of modern *Antidorcas marsupialis* horncores:

Where both left and right horncores were present, left-sided measurements were recorded (for APHD and MLHD). See horncore measurements diagram, 'Modern *Antidorcas*' chapter.

Figure A4.1: Modern male Antidorcas marsupialis skull TM 13232 (left), showing horncore measurements taken. Scale bar represents 1cm. Measurement A: WAHC (width across horncores), B: WBHC (width between horncores), C: APHD (Anterior-posterior horncore diameter), D: MLHD (mediolateral horncore diameter) and female frontlet (right) AZ 2437. Both curated at the Ditsong Museum of Natural History, Pretoria.



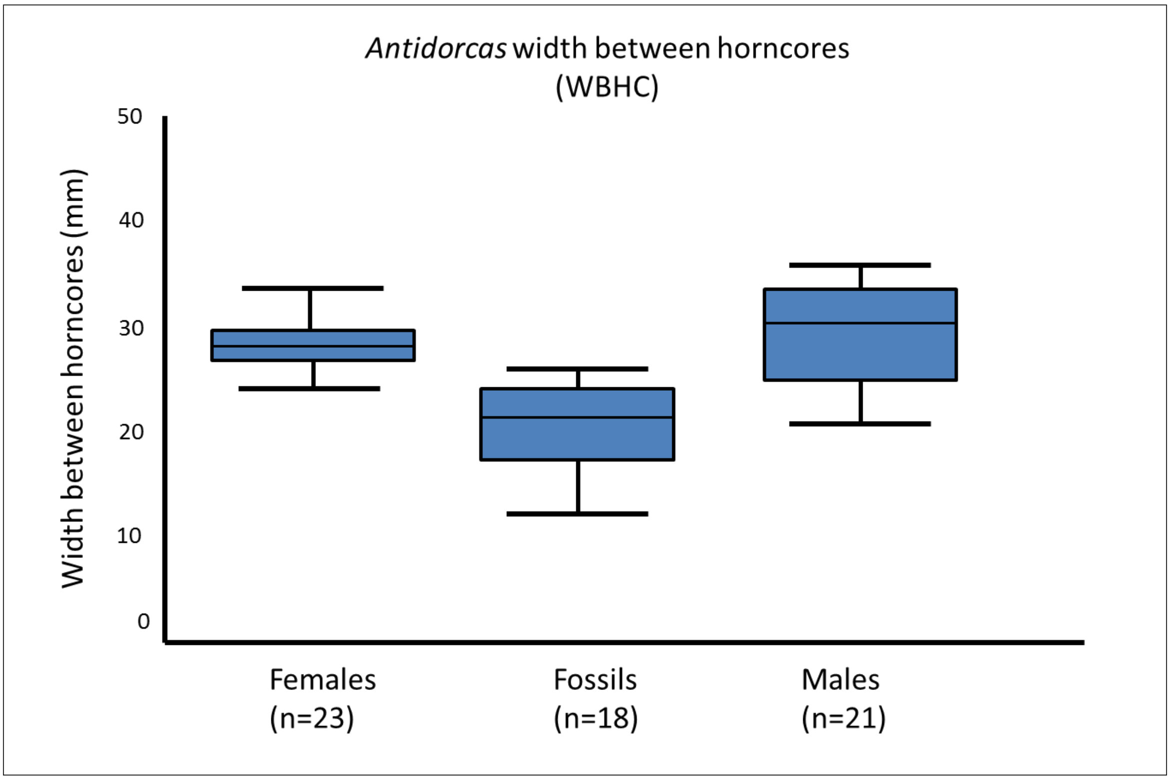


Figure A4.2: Box and whisker diagram showing the mean and standard deviation of modern Antidorcas marsupialis and fossil Antidorcas width across (top) and between (bottom) horncore measurements in mm, according to sex (fossil horncores are unsexed). This graph is based on measurements by Dr Sally Reynolds.

A4.2 HORNCORE MEASUREMENTS TAKEN AS PART OF THIS RESEARCH:

Minimal fossil horncores were measured due to taxonomic uncertainties. This is not investigated further here but is an avenue for future research.

Table A4.1: Mean horncore measurement values. Measurements Key: WBHC (width between horncores), WAHC (width across horncores), APHD (Anteroposterior horncore diameter), MLHD (mediolateral horncore diameter). Data collected by Sally Reynolds (Reynolds 2007).

Species	**n**	**Country**	**Sex**	**Mean WBHC**	**Mean WAHC**	**Mean APHD**	**Mean MLHD**
Antidorcas marsupialis	5	South Africa	male	16.21	57.82	32.73	26.99
	1	South Africa	female	21.08	59.39	21.1	19.2
	3	South Africa	Unknown	No data	No data	24.78	19.23
	9	South Africa	Total	18.65	58.61	28.79	23.54
Antidorcas recki	44	All	Unknown	7.15	23.94	29.47	65.51
	2	South Africa	Unknown	No data	No data	27.68	20.77
	42	East Africa	Unknown	7.50	25.08	29.55	67.64
Antidorcas bondi	2	South Africa	Unknown	No data	No data	29.92	25.84
Antidorcas sp.	5	South Africa	Unknown	21.12	62.88	29.92	21.34

Table A4.2: Horncore measurements from fossil specimens, measured by L.Sewell for this research.

			Horncore measurements			
Specimen number	**Provenance**	**Species**	**APHD**	**MLHD**	**WBHC**	**WAHC**
SK 7026	Swatrkrans M2	*cf Antidorcas sp.*	30.55	24.3	x	x
SK 17156	Swatrkrans M2	*cf Antidorcas sp.*	20.2	19.6	x	x
SK 7278	Swatrkrans M2	*cf Antidorcas sp.*	17.6	15	x	x
SK 10635	Swatrkrans M2	*cf Antidorcas sp.*	13.7	10.9	x	x
SK 3071	Swatrkrans M2	*cf Antidorcas sp.*	29.1	22.3	x	x
SK 3011	Swatrkrans M2	*cf Antidorcas sp.*	29.5	22.5	x	x
SK 1428	Swatrkrans M2	*cf Antidorcas sp.*	17.7	14.3	x	x
SK 7436	Swatrkrans M2	*cf Antidorcas sp.*	23.6	17.4	x	x
SK 7281	Swatrkrans M2	*cf Antidorcas sp.*	19.3	16.2	x	x
SK 9524	Swatrkrans M2	*cf Antidorcas sp.*	16.4	13.9	x	x
no #	Swatrkrans M2	*cf Antidorcas sp.*	14.7	13.5	x	x
SK 10597	Swatrkrans M2	*cf Antidorcas sp.*	17.4	14	x	x
SK 14216	Swatrkrans M2	*cf Antidorcas sp.*	14.9	13.3	x	x
KA 1567	Kromdraai A	*cf Antidorcas recki*	17.9	14.9	x	x
SE 801	Sterkfontein M5	*cf Antidorcas cf. recki*	32.2	24.6	x	x
SE 2774	Sterkfontein M5	*cf Antidorcas cf. recki*	18.6	15.8	x	x
STS 2351 (a)	Sterkfontein M4?	Antilopini indet.	15	13.5	x	x
SKX 28809	Swartkrans M3	*Antidorcas sp.*	17.4	14.4	x	x
SKX 35293 (& 4)	Swartkrans M3	*Antidorcas sp.*	11.4	9.1	x	x

			Horncore measurements			
Specimen number	**Provenance**	**Species**	**APHD**	**MLHD**	**WBHC**	**WAHC**
SKX 201130	Swartkrans M3	*Antidorcas sp.*	x	14.1	x	x
SKX 31124 (&3)	Swartkrans M3	*Antidorcas sp.*	13.7	11.8	x	x
SKX 22933	Swartkrans M3	*Antidorcas sp.*	13.6	10.9	x	x
SKX 20140	Swartkrans M3	*Antidorcas sp.*	16	13	x	x
SKX 29655	Swartkrans M3	*Antidorcas sp.*	17.8	15	x	x
SKX 19766 (&5)	Swartkrans M3	*Antidorcas sp.*	16.3	14.7	x	x
SKX 36312	Swartkrans M3	*Antidorcas sp.*	18.6	14.5	x	x
SKX 3092	Swartkrans M2	*cf Antidorcas sp.*	20.3	19.4	x	x
SKX 222	Swartkrans M2	*cf Antidorcas sp.*	18	17.6	x	x
SKX 1069(/8)	Swartkrans M2	*cf Antidorcas sp.*	11.7	x	x	x
SKX 7748	Swartkrans M1	*Antidorcas cf. marsupialis*	19.5	17.1	x	x
SKX 13610	Swartkrans M1	*Antidorcas cf. marsupialis*	17.1	16.4	x	x
SKX 6822	Swartkrans M1	*Antidorcas cf. marsupialis*	24.4	x	x	x
SKX 5683	Swartkrans M1	*Antidorcas cf. marsupialis*	16.4	14.9	x	x
KW 8443	Kromdraai	Size II bovid	19.7	16.6	x	x
KW 8918	Kromdraai	Size II bovid	21.1	20	x	x
KW 9369	Kromdraai	Size II bovid	20.3	14.2	x	x
KW 9326	Kromdraai	Size II bovid	18.1	16.3	x	x
27'3"-28'3"	Sterkfontein M4 O45	Size II bovid	39.5	26.5	x	x
SF-1356	Sterkfontein M5 (Q55)	*cf Antidorcas cf. marsupialis*	32.5	3	x	x
COH 1668	Cave of Hearths	*Antidorcas marsupialis*	34	28.6	9.9	77.3

Table A4.3: Summary of horncore data (SCR) showing range and means for each measurement taken. 'x' indicates unknown sex.

Species	**n**	**Country**	**Sex**	**Mean WBHC**	**Range WBHC**	**Mean WAHC**	**RANGE WAHC**	**Mean APHD**	**Range APHD**	**Mean MLHD**	**Range MLHD**
A.narsupialis	5	South Africa	m	16.21	12.79 to 25.36	57.82	63 to 77.12	32.73	29.51 to 35.77	26.99	24.38 to 30.54
	1	South Africa	f	21.08	21.08	59.39	59.39	21.1	21.1	19.2	19.2
	3	South Africa	x	No data	No data	No data	No data	24.78	17.83 to 29.37	19.23	14.49 to 22.11
	9	South Africa	Total	18.65	12.79 to 25.36	58.61	59.39 to 77.12	28.79	17.83 to 35.77	23.54	14.49 to 30.54
A.recki	44	All	x	7.15	10 to 24.12	23.94	31.34 to 73.12	29.47	17.73 to 37.81	65.51	14.45 to 29.06
	2	South Africa	x	No data	No data	No data	No data	27.68	23.42 to 31.93	20.77	17.5 to 24.04

Species	**n**	**Country**	**Sex**	**Mean WBHC**	**Range WBHC**	**Mean WAHC**	**RANGE WAHC**	**Mean APHD**	**Range APHD**	**Mean MLHD**	**Range MLHD**
	42	East Africa	x	7.50	10 to 24.12	25.08	31.34 to 73.12	29.55	17.73 to 37.81	67.64	14.45 to 29.06
A.bondi	2	South Africa	x	No data	No data	No data	No data	29.92	29.8 to 30.04	25.84	25.18 to 26.5
Antidorcas sp.	5	South Africa	x	21.12	21.12	62.88	62.88	29.92	19.36 to 35.51	21.34	16.37 to 24.68

Horncore Summary

One of the main discriminating features characterising each *Antidorcas* species is their horncore morphology. Both male and female springbok have horns, with female horns being more gracile.

A small sample of horncore measurements of male and female springbok were taken (Table A4.4 and Table A4.1). These measurements are as follows (Figure A4.1). Measurement A: WAHC (width across horncores), B: WBHC (width between horncores), C: APHD (Anterior-posterior horncore diameter), D: MLHD (mediolateral horncore diameter).

Table A4.4: Mean horncore values for modern A. marsupialis specimens. (+) denotes where measurements have been taken by Sally Reynolds. All other calculations based on measurements taken by L. Sewell (TM, total n=10).

Sex	**N**	**Mean WAHC (A)**	**Mean WBHC (B)**	**Mean APHD (C)**	**Mean MLHD (D)**
Male	6	74.77mm	9.78mm	38.4mm	31.1mm
Male (+)	5	x	x	37.1mm	31.5mm
Female	4	54.3mm	18.48mm	15.5mm	13.2mm
Female (+)	9	x	x	16.3mm	14.4mm

APPENDICES A5 *ANTIDORCAS*: additional background information

A5.1 DEFINING A SPECIES

Defining a group of individuals as a species can be controversial, with differing concepts proposed as to the most appropriate way to assign taxonomic identities (e.g. Aldhebiani 2018). Some of the key species concepts are briefly summarised below.

Biological species concept

The traditional, biological, definition of a species states that species can be identified by the ability to produce fertile offspring (Mayr 1950). A species is defined as an interbreeding group of genetically related individuals that is reproductively isolated from other groups and inhabits a particular niche (Mayr 1963, 1982). Isolation can arise from behavioural, geographic or physical means (Mayr 1963). However, seemingly viable populations may in fact not reproduce as expected for various reasons, such as hybridization. Thus, the species recognition concept emerged. This postulates that the individuals have to recognise others that they have the ability to reproduce with (Patterson 1985).

Genetic species concept

Species have a unique genetic signature. Thereby allowing biologists and archaeologists (with sufficiently young samples that preserve DNA signatures are preserved) to easily differentiate between species based on a group that share a common ancestor. A population experiencing vicariance will be subject to genetic drift. Genetic drift leads to reproductive isolation, thus inducing speciation (Via 2001; Turelli et al. 2001). Assessing species from this concept is rarely a possibility with fossilised samples.

Ecological species concept

A group of related populations (a lineage/ related set of lineages), occupying a unique adaptive zone. The members of the population compete more with their own kind than with members of other species. (Colinvaux 1986).Species distinctions may be visible from the fossil record via dietary (and by extension) habitat inferences.

Morphological species concept

The smallest natural populations that are constantly morphologicallydistinctive and distinguishable by average means are viewed as independent taxa / species (Cronquist 1978).

Whilst the biological and genetic species concepts may be the most robust method of defining a species, these options are not available in the fossil record. Thus, we rely on the morphology and morphological adaptations visible in the fossilised skeletal remains (with some support from dietary / habitat indicators). Continuations or changes in the size and shape of fossilised skeletal elements are viewed as indicative of species and speciation events. As a result, some speciation events may go unnoticed or be considerably post-dated from the fossil evidence. The skeleton and, in this case, the dentition of an animal may take a considerable length of time to display morphological change associated with speciation. Morphological changes rarely occur in significant quantities within an assemblage without considerable cause (Reynolds 2005). For example, postcranial body size changes are noted by Reynolds (2007) as occurring more in East Africa where local environmental factors appear to have been more extreme than in southern Africa. Without these extreme influencing factors (selection and adaptation), morphological changes appear to be less pronounced. However, postcranial changes can be more plastic than dentition.

Bone is relatively plastic and can acclimatise to a given environment at a population level (e.g. Lister 1966; Rosvold et al. 2014) without necessitating speciation. Dentition, however, is far less plastic. Thus, we can infer from any consistent directional and prolonged dental morphological changes, that this is more likely to represent speciation.

There can be considerable intraspecific variation, which may be due to geographical or temporal differences (Gentry 1992) or assemblages may appear to be unchanged over a long time period and be deemed as a continuous species (Vrba 1992). Species may have a wide habitat tolerance, either capable of withstanding climatic fluctuations with very little impact to the species, or be too specialised within a particular habitat that minimal niche alterations cause major impact. Unless obviously geographic (with a physical barrier, such as a mountain or river), isolating mechanisms are largely unobservable in the fossil record.

Sufficiently large sample sizes over a long time period would be required to notice subtle changes in the fossil record. Thereby allowing researchers to investigate where a derived trait gradually becomes more common (Gentry and Gentry 1978; Reynolds 2005).

Additional, complementary methods, such as isotopic and microwear analysis can now allow a window into behavioural and dietary changes that may provide insights around these speciation events, prior to any preserved major morphological changes. Identifying behavioural changes prior to morphological representation in the fossil record has been considered by others (Lister 2013). Using complementary methodologies enable anticipation of the likelihood of speciation, to a greater extent, than when based on morphology alone (as intraspecific variation in morphology can be high).

Sympatric and allopatric speciation

Allopatric speciation requires vicariance, generally through physical/geographic isolation of populations. Prolonged separation with populations exposed to differing environmental stimuli leads to speciation (Turelli et al. 2001; Jansson 2003). Islands display allopatric speciation, whereby populations become geographically isolated with restricted gene flow from mainland populations. Adaptations to island life occur and gradually, speciation occurs via selection. An example can be seen with the immigrant medium ground finch that arrived on Daphne Major (Galapagos). Although a similar population was established on the island, the slight morphological and cultural (bird song) differences produced reproductive barriers (Grant and Grant 2009). Geographically isolated from their original population and reproductively isolated from the island's population, speciation begins to occur (Grant and Grant 2009).

Sympatric speciation is viewed as rare (Turelli et al. 2001), although instances have been accepted (Via 2001). Unlike allopatric speciation, sympatric speciation does not require geographic isolation of populations but rather, occurs within a continuous population (Via 2001). For example, cichlid fish that are geographically constrained within a crater lake (Cameroon) display phenotypic divergence and reproductive isolation, leading to speciation. This occurs between sub-populations in a non-geographically isolated population within the lake (Schliewen et al. 1994). Or, as may be anticipated for the *Antidorcas* lineage, speciation by habitat specialization, (as a barrier to gene flow) without the physical barrier may have taken place (Rice 1987).

In the fossil record, it seems logical that geographically isolated, allopatric speciation events, are more readily recognisable (Reynolds 2005) than sympatric speciation. For South African assemblages, the majority of which comes from cave deposits, it would be easier to identify separate assemblages (populations) as differing than it would be to identify speciation events within one assemblage representing one geographic area but that are prone to time-averaging.

The many bovid species dental morphology in African Plio-Pleistocene assemblages share similarities, making even closely-related species challenging to distinguish from others without a well-trained eye. Whilst assemblages from the same geographic location may be easily compared (being stored in the same institution) than geographically isolation populations (stored at separate institutions), identifying speciation events within an assemblage with many morphologically similar teeth may be less easily decalred than deciding East African morphs are different to South African morphs for example.

Speciation events within the *Antidorcas* lineage will continue to be addressed in subsequent chapters. In order to understand the material being used and accurately interpret the findings from the fossil record, the *Antidorcas* lineage and the concept of *A. australis* as a species must be addressed first. From the evidence presented in this chapter, an informed decision is made on how to deal with the specimens that Vrba (1973) suggested may be *A. australis*.

Taxonomic ID of species

Since Darwin (1859), researchers have attempted to differentially acknowledge distinct species and this prevails in the field, with little agreement on how to define a fossil species. For example, within palaeoanthropology, Thackeray (2001, 2007, 2016) promotes using multiple landmark- based measurements as a method of defining a species/looking for conspecifics. Yet such methods are rarely adopted, choosing to distinguish species (hominins) based on a focus on their more general differences/ similarities. This has led to much discontinuity within the literature. Considering the dietary and habitat niches of hominins has gained popularity in recent years (e.g. Wood and Strait 2004; de Ruiter et al. 2008), focusing on behavioural interpretations of the fossil populations, in order to infer niche separation and likely species distinctions.

A5.2 *Antidorcas* ecology: additional detail

EXTANT *A. MARSUPIAILIS* POSTCRANIAL MORPHOLOGY

Figure 3.1: Male springbok observed grazing at the Rhino and Lion Nature Reserve within the Cradle of Humankind World Heritage Site, Gauteng Province, South Africa.

Springbok appear slender, with the hindquarters appearing higher than the forequarters and a relatively long neck (Skinner and Louw 1996). Pelage is typically cinnamon brown with a distinct darker band along the side from the foreleg to the hip. Underneath this band, the ventral and flank area is white. Dorsal long white hairs are usually hidden unless pronking. Black (chocolate-brown) and white variants exist, typically in farmed areas but can occur naturally (Skinner and Louw 1996; Kingdon 1997). Ears are typical of desert ungulates being narrow and pointed (Skinner and Louw 1996; Cain et al. 2004). The hooves are black and sharply pointed (Skinner and Smithers 1990; Cain et al. 2004). Both sexes possess horns, which are black and ringed with hooked tips that curve inwards at the tips (Estes 1991).

FOSSIL INTANGIBLE TRAITS AND BEHAVIOURS

Activity patterns Springbok have often been the subject of ecological observation (e.g. Bigalke 1972; Bednekoff and Ritter 1994; Nagy and Knight 1994; Burger et al. 2000; Mitchell et al. 1997), although few recent observational studies have been conducted. Observational studies suggest that the presence of large trees for shade and thermoregulatory purposes were of importance to the springbok daily activity patterns (Stapelberg et al. 2008). It is interesting to note that although springbok may not be feeding on these trees (and therefore, they would not show up from the *Antidorcas* dietary data), they were potentially an important resource within the *Antidorcas* habitat.

Vigilance Nutritional intake is affected by vigilance requirements (in regard to predation). Individuals in a herd of springbok will rotate around the herd, with those on the outskirts of the herd feeding less than those in the centre due to increased vigilance. Vigilance also increases when approaching trees and is lower in open grassland (Bednekoff and Ritter 1994).

Figure A5.1: Pronking springbok. Pronking is an unusual movement practiced by springbok, usually restricted to juveniles during play, or else by juveniles or adults when alarmed. Adults exhibit this behaviour when alarmed but not if under high alarm (such as when being pursued by a predator) (Estes 1991). Photograph by Barrie Wilkins IN: Skinner and Louw (1996 p. 30).

Herd demographics

Herd demographic appears to fluctuate seasonally, according to the rutting and lambing seasons as well as the seasonal climate. Larger, mixed herds (all ages and sexes represented) will form in the summer, rainy season where fresh grass is in abundance. In the dry season, where preferred vegetation is available in more patchy areas, populations are more widely dispersed in smaller herds (Bigalke 1972). Herd composition (and therefore the diet, due to access to territories and resources) changes throughout the year, with bachelor herds of males and female herds with young and a few dominant males typical of most of the year. Males will hold territories during the rut, which the females roam through (Bigalke 1970; Estes 1991), restricting the resources available to males during this time. Unlike other African bovids, springbok gather together in large herds in the wet season and disperse into smaller herds during the dry season (East 1999). Larger herds will form in the summer months, when resources are in greater abundance. Herd structure is very variable (Bigalke 1972; David 1978) and perhaps contributes to *Antidorcas*' ability to adapt to changing environments and climates. *A. marsupialis* are capable of forgoing their seasonal migrations where permanent grazing dictates (David 1978).

Sexual dimorphism

Females will form harem herds with one male, nursery herds with young, or seasonal mixed herds. Males often form bachelor herds or be solitary (David 1978; Nagy and Knight 1994). The rut occurs at any time of year lasting between 5-21 days. Females oestrus cycles synchronise to coincide with the rut, resulting in a birth peak 6 months later.

Males are larger (25-48kg) than females (20-44kg) typically (Gagnon and Chew 2000). The dimorphism seen in the springbok horns is a result of their rutting behaviour, with the development of hollow, backwards-swept horns that are considerably more robust than the gracile horns of the female (Skinner and Louw 1996) for *Antidorcas marsupialis marsupialis* but less sexual dimorphism in the horn thickness is observed for the subspecies of *A. m. hofmeyri* and *A. m. angolensis* (Groves 1981; Cain et al. 2004).

BIOLOGICAL FACTORS and COMMUNITY INTERACTIONS

Impala (*Aepyceros melampus*)

It would be fair to assume that impala would be more abundant at times of more water availability (interglacials) and springbok to be more abundant when water is scarcer (glacials). There are many alternative scenarios that would see the impala and springbok outcompete one another, such as increased seasonality, differing species-symbiotic relationships, thermoregulatory needs (as impala require shade to a greater extent than springbok and are not adapted to dry heat (Kingdon 1997). Perhaps the mixed mosaic hypothesis for the Cradle of Humankind would see the fluctuations of both impala and springbok depending upon the relative percentages of preferred habitats. Occasionally, there may be sufficient resources to support both springbok and impala, at other times, one must outcompete the other. Impala prefer ecotone habitats, shifting their diet according to herd demographics (solitary males observed to consume fewer dicots (van Rooyen and Skinner 1989)), and seasonal environmental conditions (Meissner et al. 1996; Wronski 2002; Dunham 2009; Kingdon et al. 2013). Impala can survive on moisture in succulents when water is scarce; however, their preference is to be by a water source.

Appendices

*Table A5.1: Key traits of Antidorcas marsupialis and assumed major competitor, Aepyceros melampus. *Will drink water when available but not water-dependent. **Though can survive on moisture content of succulents when water is scarce. ***Males (M) first, then females(F) for average height and weight (Estes 1991). References: Bigalke 1972, kingdon 1997, Estes 1991, Castelló 2016.*

Species	***Antidorcas marsupialis***	***Aepyceros melampus***
Preferred diet	Mixed	Mixed
Water requirements	None*	Essential **
Habitat preference	Arid adapted (short grasses) dry grasslands, bushland and shrubland	Ecotone- open well-wooded areas to medium density riverine forest.
Reproductive behaviour	Usually mate during dry season. Flexible.	3week rutting influenced by lunar cycle, 2 birthing peaks.
Sexual maturity	F-1 year, M-2years	F-1year, M-1.5years
Gestation period	165-180days	194-200days
Weaning period	3months	4-6months
***Average height	73cm-69cm	75-92cm-70-85cm
***Average weight	30.6kg-26.7kg	60kg-45kg
Sexual dimophism	Little, females have smaller horns	Males have horns
Feeding times	Early in the morning and late in afternoon	Active' 24hours
Predators	Caracal, cheetah, leopard, lion, spotted hyena, brown hyaena, African wild dog, black-backed jackal, python, humans	lion, leopard, cape hunting dog, spotted hyaena, crocodile, python, humans
Home range size	variable	2-6km^2
Preferred herd size	5-100, larger temporary herds in summer	M-~30, F-<200.
Migratory?	Yes	No
Gregarious?	Yes	Yes
Territorial?	Yes	Seasonally
Life expectancy	7-10 years	12-15 years

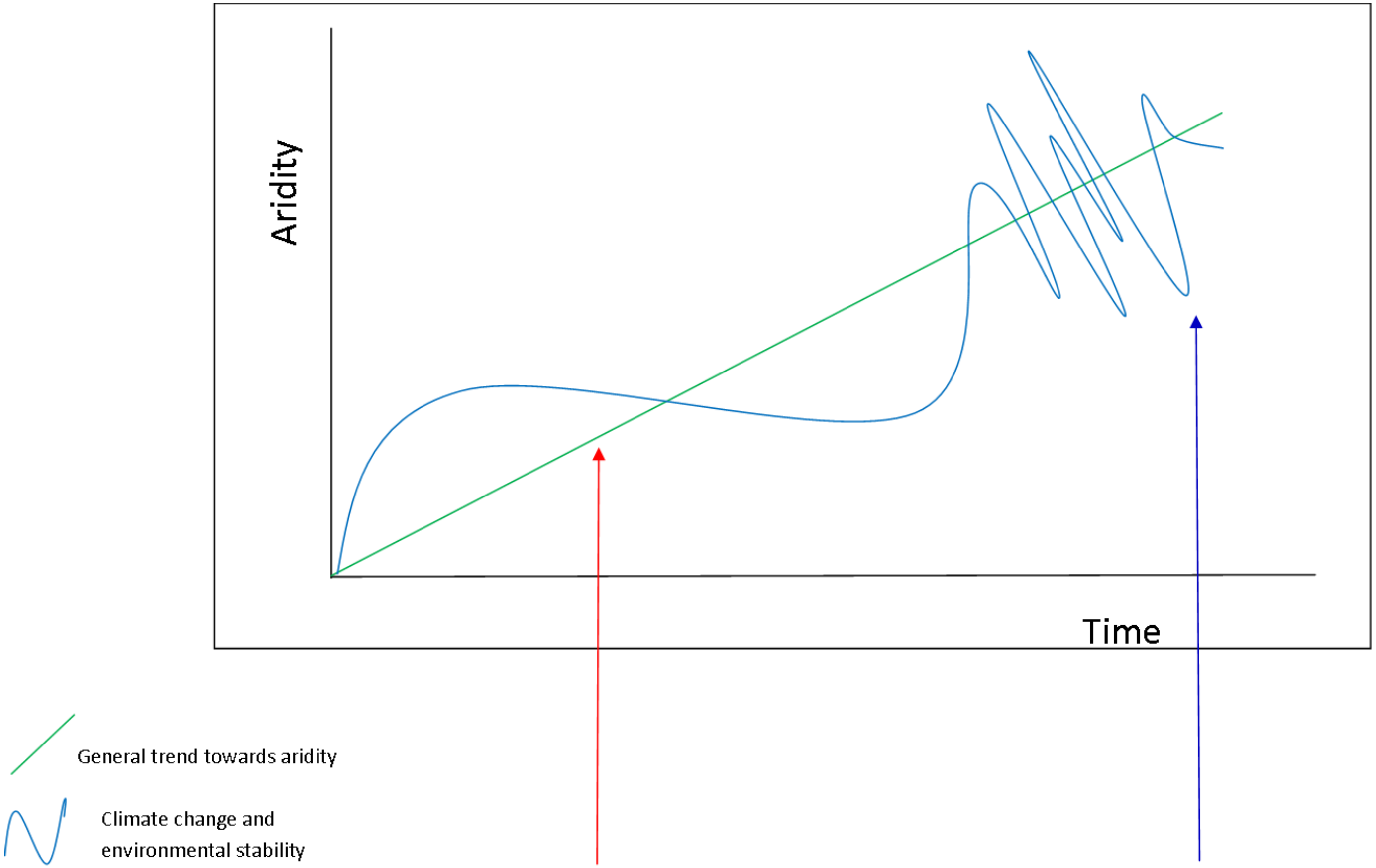
SYMBIOTIC SPECIES

Merino Sheep (*Ovis aries*)

Much of the modern springbok population inhabits enclosed farmland and are effectively forms of livestock (Kingdon 1997). This type of practice has been encouraged by studies highlighting their symbiosis with Merino sheep, where the two species opposing dietary practices (Liversidge 1972; Davies et al. 1986) can be beneficial, for example, in veld reclamation schemes (Davies et al. 2010). In addition to dietary differences, their activity patterns are also opposing. Springbok spend more time foraging but also more time resting (during optimal plant growth conditions). Interestingly, major springbok mortality was noted when resting behaviour was restricted (Davis and Skinner 1986).

Gemsbok (*Oryx gazella*)

Niche partitioning of these two species, often occupying the same geographic ranges of the Namibian desert, has been documented by Lehmann (2015). This study found that the gemsbok was more flexible in its dietary habits, varying between grass and succulent plants (60%) and shrubs and trees (30%) during dry periods but switched to primarily feed on fresh grass during rainy periods. Contrastingly, springbok maintained a browse-dominated diet throughout. During times of environmental stress, gemsbok and springbok adopted differing dietary tactics to one another, enabling their co-existence and survival during harsh and fluctuating environmental conditions (Lehmann 2015). Whilst springbok herds harbour migratory tendencies, moving across the landscape (as much as possible) in search of preferential habitat types; gemsbok adopt more solitary, sedentary tactics, utilising a range of habitat within a restricted home range.



Would expect an increase in arid-adaptation-species specialising and appearance of arid-adapted species.

May expect fewer specialists, or those that adapt in differing ways. For example, the springbok is biologically and physiologically arid-adapted whilst also being prone to migrations and is a mixed feeder, able to adapt its dietary needs as well as adapting reproductive behaviour to environmental conditions.

Figure A5.2: Hypothesised possible scenario of increased aridity alongside increased variability (potentially an increase in seasonality whilst maintaining the prevailing aridity trend) that may have led to adaptable specialists, such as Antidorcas marsupialis. These highlight likely climatic conditions we might expect Antidorcas marsupialis to evolve in, with increased aridity but also periods of instability, encouraging opportunistic mixed-feeding, whilst steadily becoming highly arid-adapted.

It would seem logical for a chronospecies of *A. marsupialis* to have evolved in the turbulent landscapes of East Africa and migrate, already arid-adapted, but also highly adaptable to changing environments with traits such as mixed feeding, minimal water requirements and a propensity to migrate. One method for understanding the evolution of *Antidorcas* is by examining the extant springbok adaptations. The inferences we can make regarding what caused these traits to appear has implications for the genus as a whole. Additionally, it allows inferences to be made relating to the climate in which these traits were selected for and ultimately, evolved.

A5.3 *ANTIDORCAS RECKI* EXTIRPATION IN EAST AFRICA

Antidorcas is recorded from the late Pliocene at Chad (Geraads et al. 2001); from the late Pliocene to the Pleistocene in eastern Africa, up to c. 2.5 Ma, or younger in the Afar (de Heinzelin et al. 1999, Gilbert and Asfaw 2008); the early Pleistocene in the Turkana Basin (Gentry 1976, 2010); and the middle Pleistocene in northern Tanzania (Gentry and Gentry 1978; Gentry 2010). *Antidorcas recki* was present in East African hominin deposits such as the following contemporaneous sites:

Laetoli Tanzania (4.36-<2.057 Ma Deino 2011); Olduvai Gorge, Tanzania (1.85-0.6 Ma Kimura 2002); The Omo-Turkana Basin: Formations of Koobi Fora (3.36-0.7 Ma Reed 1997), Nachukui (7.44-0.7 Ma Brown and Feibel 1991) and Shungura (3.6-1.0 Ma (Feibel and Brown 1993; Reed 1997); and the Hadar formation, Ethiopia 3.5-2.2 Ma (e.g. Campisano and Feibel 2007).

Turner and Wood (1993) identified a wave of mammalian dispersal that is likely to have included the migration of *Antidorcas recki* during a cool phase c.2.7-2Ma, following an initial wave c.3 Ma southwards (Lee-Thorp et al. 2009). Although previously the most abundant antelope in fossilized assemblages in East Africa (Kingdon 1997), around 1.8 Ma, they disappear from the East African fossil record and fail to reappear. The species now filling the niche is the Thomson's gazelle, which bares a striking resemblance in appearance to *Antidorcas marsupialis*. From observations of modern Kalahari springbok (*A. marsupialis*), springbok behaviour can be significantly affected by environmental change. Changes in climatic conditions or vegetation structure can negatively affect springbok behaviour (Stapelberg et al. 2008). It is probable that climatic conditions or other environmental causes were responsible for the extirpation of East African *Antidorcas* (*recki*).

There is some suggestion of hydrological factors, resulting in decreased aridity levels in *A. recki*'s old East African habitats (Johnson et al. 2016) making these habitats now inhospitable. It is possible that this eventually led to the disappearance of *Antidorcas* in East Africa. As would be expected in plant succession, the habitat generalist, *Antidorcas marsupialis,* was perhaps simply outcompeted by those more specifically adapted to that environment. Specialists who could thrive in the conditions they are specifically adapted for at the expense of the less specialised springbok. In contrast, in southern Africa, *Antidorcas marsupialis* has fewer similar competitors and occupies a broader ecological niche. It is the only gazelle occupying the range it does in southern Africa, where the same range size is partitioned amongst gazelle species in East and North Africa (Estes 1991).

The possibility exists that *Antidorcas* was symbiotic with others, either through grazing/dietary succession or through group safety from predators. If so, when any one of the species in this co-dependent relationship is affected for whatever reason, the other species in the relationship are consequently impacted. An association exists today between the modern springbok, blue wildebeest, red hartebeest and plains zebra (Estes 1991).

Research has shown that rising temperatures can alter biotic interactions within a community, with previously co-occuring species becoming competitive (Blois et al. 2013; Milazzo et al. 2013) and new predator-prey relationships may begin to emerge (Rockwell et al. 2011; Blois et al. 2013).

There is the potential that *Antidorcas recki* migrated out of East Africa due to increased competition (such as with the impala) during low resource opportunity periods and was unable to make it back. This could be due to many factors, such as sustained competition (or direct competition from a more specialised species occupying the vacant niche the springbok migrated from) and low resource levels; a physical barrier such as lake levels, tectonic activity or specific parasites; or pull factors to the southern African landscapes (such as abundant resources, reduced predation or reduced competition), leaving little need to return to East Africa.

POTENTIAL BIOTIC CAUSES OF *ANTIDORCAS* EAST AFRICAN EXTIRPATION

Competition and Niche partitioning

Competition avoidance through niche separation was found in the Kalahari between the extant blue wildebeest (*Connochaetes taurinus*) and the springbok (*Antidorcas marsupialis*). It is possible that resources were not sufficient to support two taxa with overlapping niche requirements, such as *Aepyceros* (impala) and *Antidorcas.* Niche separation would only be possible within positive environmental conditions, supporting sufficient resources for both taxa to co-inhabit.

Thomson's gazelle (*Gazella thomsonii*)

The antelope occupying the parallel niche to Springbok in East Africa, appears to be the Thomson's Gazelle, *Eudorcas thomsonii*, (look strikingly similar-especially in pelage). It is believed that the Thomson's gazelle occupied an empty niche (Estes 1991) rather than out-competing the ancestral springbok (*Antidorcas recki*).

Impala (*Aepyceros melampus*)

Extant springbok and impala rarely co-habit the same area. Where they do, in southern Africa, this is largely confined to game reserves. Modern humans have had a major impact on the habitat range and distribution of many species. As previously referred to, springbok ranges have been severely reduced by fencing, hunting and (largely human responsible) illness.

Both are generalists, able to adjust their diet according to prevailing vegetation and competition levels and reduce their water intake requirements, to those found only in succulents, when necessary (e.g. Estes 1991). However, they are often found in the same paleo-archaeological context. Whether this is this due to time- and habitat- averaging of the deposits or whether they previously did cohabit an area harmoniously is unknown. Indications of niche separation could assist in answering this question.

Co-dependent taxa

As suggested, it is possible that *Antidorcas* had a co-dependent relationship with others in the community, either through grazing/dietary succession, through group safety from predators or even being vulnerable to the same pathogens. If so, when any one of the species in this relationship is affected for whatever reason, the other species in the relationship are consequently impacted. As discussed in chapter 6, extant *Antidorcas marsupialis* associate with other species sharing their ecospace. It is possible that the extinct forms also had some form of dependency on other species. Thus, the potential fauna living contemporaneously alongside the *Antidorcas* species should be considered to place the species into context (interspecific competition, predation and so on) as well as to understand the dynamic of the ecosystem of which *Antidorcas* and hominins were a part.

ABIOTIC Environmental causes

Recently, Ecker et al's (2018) study featuring *Kobus leche*, showed that the environment around Wonderwerk Cave in the Northern Cape Province, was unlike any paralleled today but sustained species favouring much wetter conditions. The possibility remains that landscapes and habitat-scale palaeoenvironments and faunal palaeocommunities are unlike any occurring presently, making it challenging to comprehend the causes of East African *A. recki*'s demise. However, from 'known' climatic changes, inferences can be attempted. As previously discussed (see chapter 2 'Palaeoenvironments'). The onset and enhancement of the Walker circulation perhaps led to El Niños bringing intermittently wetter periods, for a prolonged period, to East Africa and warmer, drier conditions in southern Africa (e.g. Lyons et al. 2015; Johnson et al. 2016). It is possible that *A. recki* migrated away from East Africa during El Niño following the onset of the Walker circulation ca. 1.7 Ma (de Menocal 1995; 2011).

Environmental conditions could have become unfavourable to *A. recki*, causing the populations that remained to disperse out of East African areas. Either a physical barrier or a temporary environmental barrier to East Africa could have segregated populations in southern Africa, and when they returned, the niche was filled more successfully by a competitor. Alternatively, *A. recki* did not attempt to return as they acclimatised and eventually, adapted to the southern African environment and were unable to return to the niche they was no longer adapted to. The extant *A. marsupialis*, is highly arid-adapted (Estes 1991), this adaptation is likely to have occurred in southern Africa, in either the genus or after *A. recki* gave rise to *A. marsupialis*. Although *A. recki* is associated with woodland habitats and favouring a browse-dominated diet, there is the potential that East Africa became too wet for *A. recki*.

A mixture of biotic and abiotic: Parasites?

Associated with changing climates is an increase in moisture levels, which could have been responsible for the extirpation of *Antidorcas* in East Africa. Certain parasites are known to be associated with wetter habitats, perhaps an increase in parasitism as a side-effect of this palaeoenvironmental modification led to the demise of the east African *Antidorcas*?

Ecosystem environmental conditions are responsible for the development and survival of parasites in any given habitat. For example, modern springbok in southern Africa do not inhabit woodland, which is believed to be due to the presence of heartwater, a prevalent, tick-borne disease, zoonotic across the majority of bovid species in Africa. Unlike many of the other bovids, springbok show no resistance to the disease (Neitz 1944). The long dry seasons are less favourable for parasite development, inhibiting host-parasite transmission (Turner & Getz 2010). Increasing aridity (cooling and drying) hypothesised for southern Africa could therefore have been a more suitable habitat for *A. recki*.

A5.4 FURTHER CONSIDERATIONS affecting the interpretation of the fossils

There are many factors to consider when dealing with the fossil record, which is inherently incomplete by nature for a plethora of reasons, as identified in chapters 3 and 4 and throughout the main bodyof the thesis. A brief discussion of additional issues is given here.

Nature of deposition: How the *Antidorcas* specimens came to be in each assemblage is an important factor for consideration prior to accurately inferring palaeoenvironmental cues. Are we picking up *Antidorcas* only from certain times, such as only glacial periods within the peaks and troughs or is their evolutionary trajectory reflected in and obtainable from the fossil record? Are the springbok assemblages accumulating over a long timeframe or from one off events, such as migrations? Establishing this will assist us in acknowledging and understanding the palaeoenvironmental signals we are picking up.

Uniformitarianism: Modern ecological comparisons (uniformitarianism) are often used for bovid studies (Gagnon and Chew 2000) citing many of the same key resources (e.g. Walker 1975 Estes 1991 Kingdon 1997). Although the extant species can be a good starting point from which to guide interpretations, the possibility of deviation from the morphological and behavioural traits of the modern species should be anticipated (Potts 1996 P.145-6), especially when considering inter-lineage species of the same genus. For instance, Vrba's (1980) AAC (see chapter 2) assumed *A. recki* possessed the same dietary and habitat preferences as the extant *A. marsupialis*, which subsequently was proven to be at odds with the reality of the predominantly browsing fossil species (e.g. Lee-Thorp et al. 2007). Indeed, the wide geographic range of the *Antidorcas* genus throughout its history renders Pliocene phylogeographic inferences based on its modern geographic range are likely erroneous (Bibi 2013, 2014). Yet modern studies can also be of benefit. Intangible variations within the *Antidorcas* lineage that allowed one species to survive over another may be more readily inferred if equipped with knowledge of modern comparisons.

Appendix A6 Dental morphological measurements: Other tooth types

The primarily molar used for this research was the permanent second molar, particularly M^2. All other molar measurements are summarised here.

Table A6.1: Antidorcas measurements of all molars (other than M^2). All measurements given in millimetres (mm) to 2 decimal places. Number of specimens (N), mnean and standard error of the mean (SEM) are given. MDL=mesiodistal length, BLW=bucco-lingual width, CH=crown height, OH=occlusal height, TH=total height (of isolated molars). Differing sample sizes (N) are due to taphonomy/damage or molar isolation / being in the jaw, to the tooth preventing certain measurements.

Species	Tooth	MDLN	**Mean MDL**	SEM MDL	N BLW	**Mean BLW**	SEM BLW	N CH	**Mean CH**	SEM CH	N OH	**Mean OH**	SEM OH	OHN	**Mean TH**	SEM OH
A.recki	UM1	5	**13.62**	0.86	5	**9.54**	0.87	5	**8.48**	1.03	5	**3.50**	1.56	21	**13.89**	1.11
	UM3	8	**14.38**	2.78	8	**10.1**	1.45	1	**9.9**	x	8	**1.39**	0.65	8	**20.55**	2.55
	lm1	8	**11.48**	0.57	8	**6.83**	0.34	8	**7.30**	0.63	8	**2.00**	0.43	15	**11.42**	1.40
	lm2	22	**13.34**	0.32	22	**6.52**	0.13	22	**8.93**	0.38	22	**2.04**	0.56	25	**32.51**	2.22
	lm3	9	**19.14**	0.45	9	**7.17**	0.28	9	**9.36**	0.49	9	**1.72**	0.12	14	**20.21**	1.92
A.bondi	UM1	4	**14.05**	0.45	4	**10.13**	1.45	1	**8.80**	x	5	**1.66**	1.40	4	**32.08**	2.91
	UM3	6	**14.37**	0.56	6	**9.05**	0.51	6	**12.83**	0.61	6	**2.42**	0.47	12	**37.11**	1.08

Species	Tooth	MDL N	**Mean MDL**	SEM MDL	N BLW	**Mean BLW**	SEM BLW	N CH	**Mean CH**	SEM CH	N OH	**Mean OH**	SEM OH	OH N	**Mean TH**	SEM OH
	lm1	6	**11.12**	0.55	6	**6.12**	0.27	6	**7.18**	0.88	6	**1.53**	0.31	3	**22.23**	6.07
	lm2	31	**13.34**	0.32	31	**6.52**	0.13	31	**8.93**	0.38	31	**2.04**	0.56	28	**32.51**	2.22
	lm3	16	**20.04**	0.42	16	**6.88**	0.17	16	**9.96**	0.49	16	**1.63**	0.24	22	**31.18**	1.71
A.marsupailis fossil	UM1	20	**14.10**	0.27	20	**10.12**	0.39	20	**11.35**	0.68	20	**3.17**	0.25	27	**23.04**	1.22
	UM3	9	**16.10**	0.86	9	**9.40**	0.44	9	**13.52**	1.39	9	**3.18**	0.26	20	**24.08**	1.12
	lm1	10	**13.17**	0.53	10	**7.10**	0.22	10	**11.52**	1.17	10	**2.13**	0.28	15	**21.89**	1.38
	lm2	11	**13.97**	0.32	11	**8.21**	0.40	11	**9.85**	0.51	11	**2.73**	0.50	21	**22.17**	1.51
	lm3	8	**19.79**	0.95	8	**7.64**	0.34	8	**11.70**	1.70	8	**2.85**	0.31	10	**28.55**	0.93
A.marsupailis modern	UM1	37	**13.66**	0.21	37	**11.20**	0.11	37	**9.96**	0.51	37	**2.44**	0.31	x	**x**	x
	UM3	7	**17.04**	0.60	7	**9.83**	0.31	7	**11.81**	0.67	7	**3.60**	0.52	x	**x**	x
	lm1	19	**12.68**	0.23	19	**8.01**	0.37	19	**9.84**	0.41	19	**1.92**	0.15	x	**x**	x
	lm2	24	**14.99**	0.21	24	**8.19**	0.31	24	**11.13**	0.42	24	**2.41**	0.19	x	**x**	x
	lm3	4	**22.65**	1.52	4	**7.57**	0.44	4	**11.25**	1.48	4	**4.43**	0.78	x	**x**	x

Suggestions for further dental metrics work

- Further investigations into the *Antidorcas* lineage and species differences via morphological comparisons and analyses. This could be achieved by a thorough study of horncores by specialist able to identify the horncore and assign them taxonomically. Unfortunately, these cannot be related to the dental specimens, so was not pursued here. Additionally, a bayesian analysis of *Antidorcas* lineage would be beneficial. To assess the relatedness of *A. australis*, alongside rate of change, a Bayesian model could be implemented. A similar approach was implemented to analyse these questions for *Homo naledi* (Dembo et al. 2016).

- A more in-depth study, considering many more dental measurements, at multiple landmarks on the molars, could assist in identifying sexual dimorphism and/or herd demographics for each *Antidorcas* species. Whilst it can only be hinted at here by comparisons with modern specimens, the high probability of time-averaging of deposits, and therefore mixing of herds, makes this almost impossible to show for certain within this dataset. With the addition of further measurements, grouping could become more apparent, which may reflect males/females or different intraspecific populations within the assemblage. Unfortunately, for now, this is beyond the scope of the current research project.

- Hypsodonty index was not used as a primary measurement here. Although hypsodonty index as a primary variable (Janis 1988; Damuth and Janis 2011) has been less popular of late, Adams (2012) recently use hypsodonty to determine species identification for *Antidorcas recki*, *bondi* and *marsupialis* from Haasgat cave system. Vrba (1973) postulated that hypsodonty index [Z = (100 x tooth crown height) / occlusal length x breadth] decreases as skull length increases, and therefore, is probably allometrically related to body size. Thus, if we have the hypsodonty index of teeth we could hypothetically infer the body size of the animal. This is perhaps a better use of the hypsodonty index than as a direct correlate with feeding type.

Appendix A7: Mesowear

ORIGINAL EXPERIMENT RESEARCH QUESTIONS:

A) Photographs-are they a viable alternative/back-up for international researchers with limited funds for ‘field study’?
B) How do non-preferential molars (i.e. not M2) relate to M2. Can results across the molar row be combined to increase sample sizes?
C) How should molars with differential mesowear be classified? Is scoring the sharpest cusp the most accurate method?
D) How reliable are mesowear variables for assessing palaeodiets of mixed feeding species?

A7.1 EXPERIMENTS CONDUCTED TO TEST THE MESOWEAR METHOD:

1. Experiment on British fauna, conducted in the zooarchaeology laboratory, Bournemouth University.

A selection of zooarchaeological dental specimens from Bournemouth University were numbered and set out for assessment. The mesowear experiment document was given to volunteer participants (primarily Faculty of Science and Technology PhD and Masters students from Bournemouth University) to complete. Specimens were complete mandibles and maxillae of British sheep, goat, deer and cattle (detailed information given in

Appendix A5). Where possible, all molars were scored for each variable, where time constraints existed for participants, priority was given to second molars (as the principle tooth type used by researchers for mesowear analysis). Due to time constraints, only the first part of this experiment has been implemented as a part of this research. Task 2 is recommended as a future research avenue to evaluate the Mesowear III method (Solounias et al. 2014).

The aim of this experiment is primarily to assess consistency in participant mesowear variables scores to evaluate the method's subjectivity. Testing if there is differential mesowear patterning apparent for left/right-sided specimens or for maxillae versus mandibles on the same individual was originally an aim for this experiment but due to time constraints, this remains an avenue for future research. Specimens of known origin (and by extension, typical dietary behaviour) were selected for this study.

2. Mesowear scores assigned by participants with a range of experience from *Antidorcas* dentition photographs. A series of photographs of fossil *Antidorcas* were given to participants, with 3 scoring categories (Appendices A5). **Relief 1**- High and low occlusal relief; **Relief 2**- High, Medium and Low. An additional category is added to allow participants to score teeth as a 'medium' relief if the distinction is not as clear between high and low occlusal relief. Particularly among mixed feeders, the distinction between relief categories is often confused and highly subjective. As the specimens used in this sample are likely to consist of majority mixed feeders, a medium relief category was introduced for the PhD research. As this is a new category introduction, the use of this 'medium' relief category was given here for its use to be evaluated; **Cusp shape**- Sharp, rounded and blunt cusp shape. The tooth in the photograph to be scored was indicated by a red line.

Averages of all participants' results were analysed, alongside the variability (subjectivity) of scores assigned. These were compared to my mesowear assessments (in an ideal scenario, multiple scores/ the same participants would be used in field and for photographs).

3. Photographs of all bovids from sites used for this research were taken by Lucile Crété (September 2018) at the Ditsong Museum of Natural History, Pretoria and the University of the Witwatersrand, Johannesberg. Mesowear values (high/low relief, cusp shape (sharp, rounded, blunt) and mesowear scores) were assigned to each specimen by Lauren Sewell and Lucile Crété. It is envisaged that these photographs will be utilised further in future research to assess the practicalities of assigning mesowear values from photographs. Occlusal views, buccal and lingual views of each tooth were taken. Mesowear values were assigned to the buccal side of maxillary molars and the lingual side of mandibular molars in accordance with standard mesowear practice (Fortelius and Solounias 2000). Experiment 3 photographs have been taken (by L. Crété) and scored by the author but have not formed a central part of this *Antidorcas* study and are not considered further in this thesis.

A7.1 PARTICIPANT MESOWEAR STUDIES:

The worksheets given to participants to complete the mesowear experiments designed by the author are provided here.

A7.1.1 Mesowear Experiment 1:

Only task 1 was completed by participants for this study. The following is the exact information sheet given to participants.

Abstract

Mesowear has been traditionally used to infer lifetime dietary signals from the check-teeth of ungulates (Fortelius & Solounias 2000). This is based on an attrition-abrasion continuum, whereby grasses and abrasive diets obliterate facets, resulting in lower relief and rounded or blunt cusps of molar occlusal surfaces. The opposite is true for browsing diets, which are viewed as less abrasive; attrition (tooth-tooth contact) is therefore the dominant cause of wear, resulting in higher relief and sharper cusps of molar occlusal surfaces. Furthermore, with multiple comparative populations of a species, mesowear can be used as an environmental proxy to infer climatic signals (principally humidity), with abrasion-dominated mesowear signals being associated with drier climates (e.g. Kaiser & Schulz 2006). Typically, only maxillary teeth are used, due to mandibular teeth having been shown (Franz-Odendaal & Kaiser 2003) to over-emphasize the grazing element of the diet by being more subject to abrasive wear. Mesowear analysis is conducted by assigning the sharpest cusp of a tooth (usually upper permanent second molar) with a relief score of high/low and a cusp shape of either blunt, rounded or sharp cusps. Here, we propose conducting a mesowear experiment using all check teeth, scoring both cusps a) separately and b) together (average mesowear of cusps). The aim is to thoroughly test each aspect of the mesowear method that is typically used in modern and palaeo- dietary and environmental research. Mesowear appears highly subjective, thereby necessitating the inquiry into the robusticity of the method. Obtaining mesowear scores for the same teeth from many researchers will primarily allow analysis of the impact of subjectivity on the merit of this method; guiding data collection and analysis and lending support (or otherwise) to research conducted on fossil samples.

A collection of sheep, deer and cattle dentition is used for this experiment. All specimens used should be in the same state of wear. Juvenile, very young (M3 not in wear) and very old (M1 facets completely worn) will be excluded for the majority. One young (M3 unerupted/not in wear) and one old (M1 facets heavily worn) specimen can be used for calibration. Fossil results are often based on isolated teeth. Consequently, the exact wear stage of the individual cannot be ascertained but is estimated based on the isolated tooth available. A combination of males and females will be used. All available information on the teeth used will be recorded (zoo/wild shot/domesticated specimens, age, sex and country of origin).

To Participants

All scores will remain anonymous.

Please provide details of previous experience (e.g. zooarchaeology/palaeoenvironmental proxy specialist/ 1 module in human and animal bones years ago/no prior experience…).

You may leave your name off this if you wish.

Additionally, for acknowledgement in any resulting journals/thesis, please provide details below.

NAME:

EMAIL ADDRESS:

DEPARTMENT:

LEVEL OF STUDY (e.g. undergraduate year 2, taught masters, PhD):

PREVIOUS EXPERIENCE: ☐ **NONE** ☐ **SOME** ☐ **A LOT**

Please detail below if above ‘none’

MESOWEAR EXPERIMENT

Task 1:

Looking at the flatter edge of the molar tooth (buccal on maxillary teeth, lingual on mandibular teeth), give scores to each of the molars- fill in the table provided.

A score is given for occlusal relief (score 1) and cusp shape (score 2).

Scores are given for occlusal relief as low (flat) (score of 1) or high (pointy) (score of 2) AND cusp shape; blunt (score of 1), rounded (score of 2) or sharp cusp (score of 3) apices (tips), as shown in the image below.

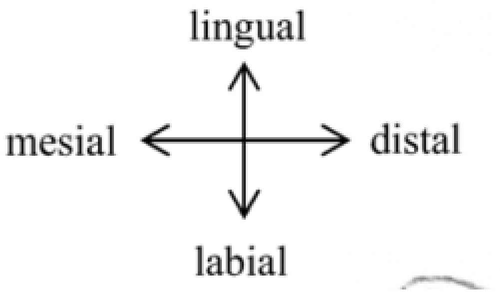
Give a score for each cusp (mesial and distal) **and** a score for both cusps together.

A) For **Upper molars**, use the buccal side view

1) 1st molar- scores for: 1.1 mesial cusp, 1.2 distal cusp, 1.3 both cusps.
2) 2nd molar- scores for: 2.1. mesial cusp, 2.2. distal cusp, 2.3 both cusps.
3) 3rd molar- scores for: 3.1. mesial cusp, 3.2 distal cusp, 3.3. both cusps.

B) For **lower molars**, use the lingual side view

1) 1st molar- scores for: 1.1 mesial cusp, 1.2 distal cusp, 1.3 both cusps.
2) 2nd molar- scores for: 2.1. mesial cusp, 2.2. distal cusp, 2.3 both cusps.
3) 3rd molar- scores for: 3.1. mesial cusp, 3.2 distal cusp, 3.3. both cusps.



To complete the table: Fill in scores 1 and 2 for Task 1 and scores for Task 2. Leave score 3 and totals columns (shaded grey) blank. (I.e. Fill in only the columns with a ★ please).

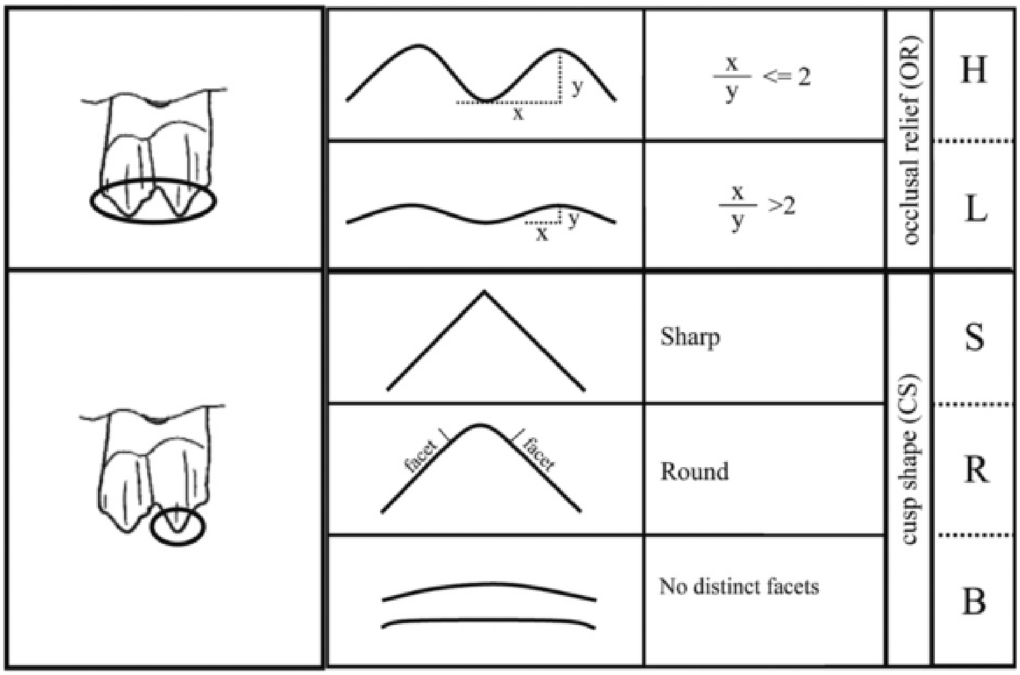


Figure 1. Task 1 scoring system 1 (Blondel et al. 2010)

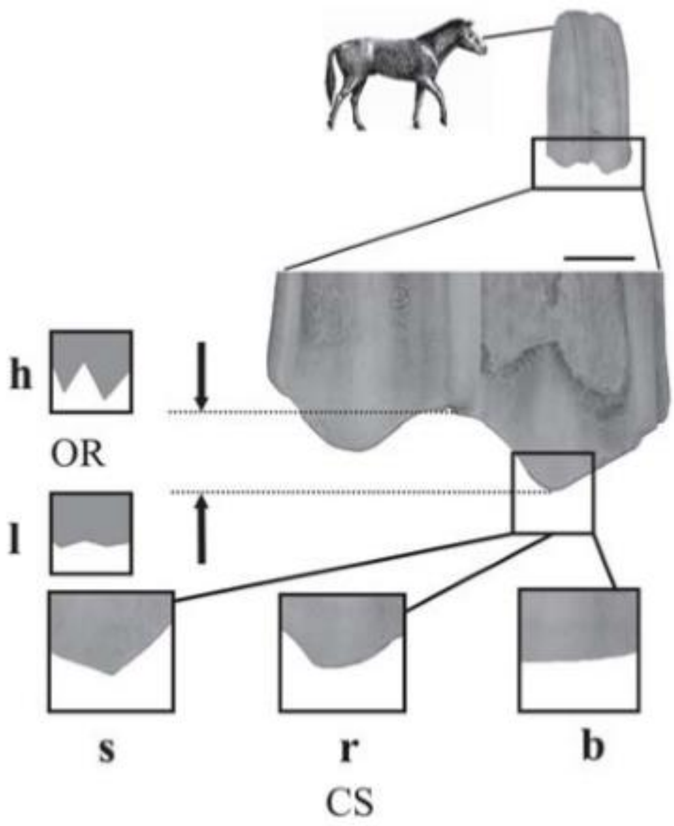


Figure 2: Mesowear scoring example for individual cusps (Kaiser & Schulz 2006).

Task 2:

Give a score to the same teeth as before, this time using the second enamel band (*enamel band 2 in the Fig. 3 below). Scores are given from 1-4 (Figure 4).

Score 1 is given to enamel bands with sharp ‘j points’, with smooth enamel either side. Score 2 is given to enamel bands with sharp ‘j points’ with scratches/pits on the enamel band either side. Score 3 is given where the ‘j point’ is more rounded, with scratches/ pits on the enamel band either side. Score 4 is given where the ‘j point’ is barely distinguishable, the enamel either side should have a complex surface but may have less obvious scratches/pits.

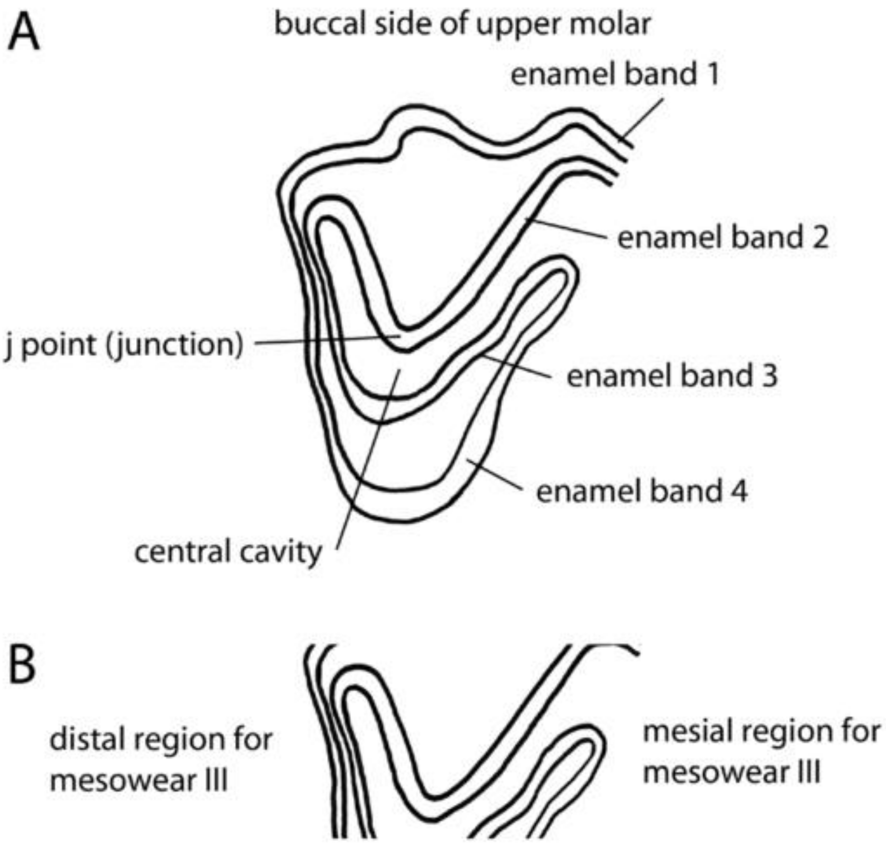


Figure 3. Task 2 enamel band mesowear scores (Mesowear III method) (Solounias et al. 2014).

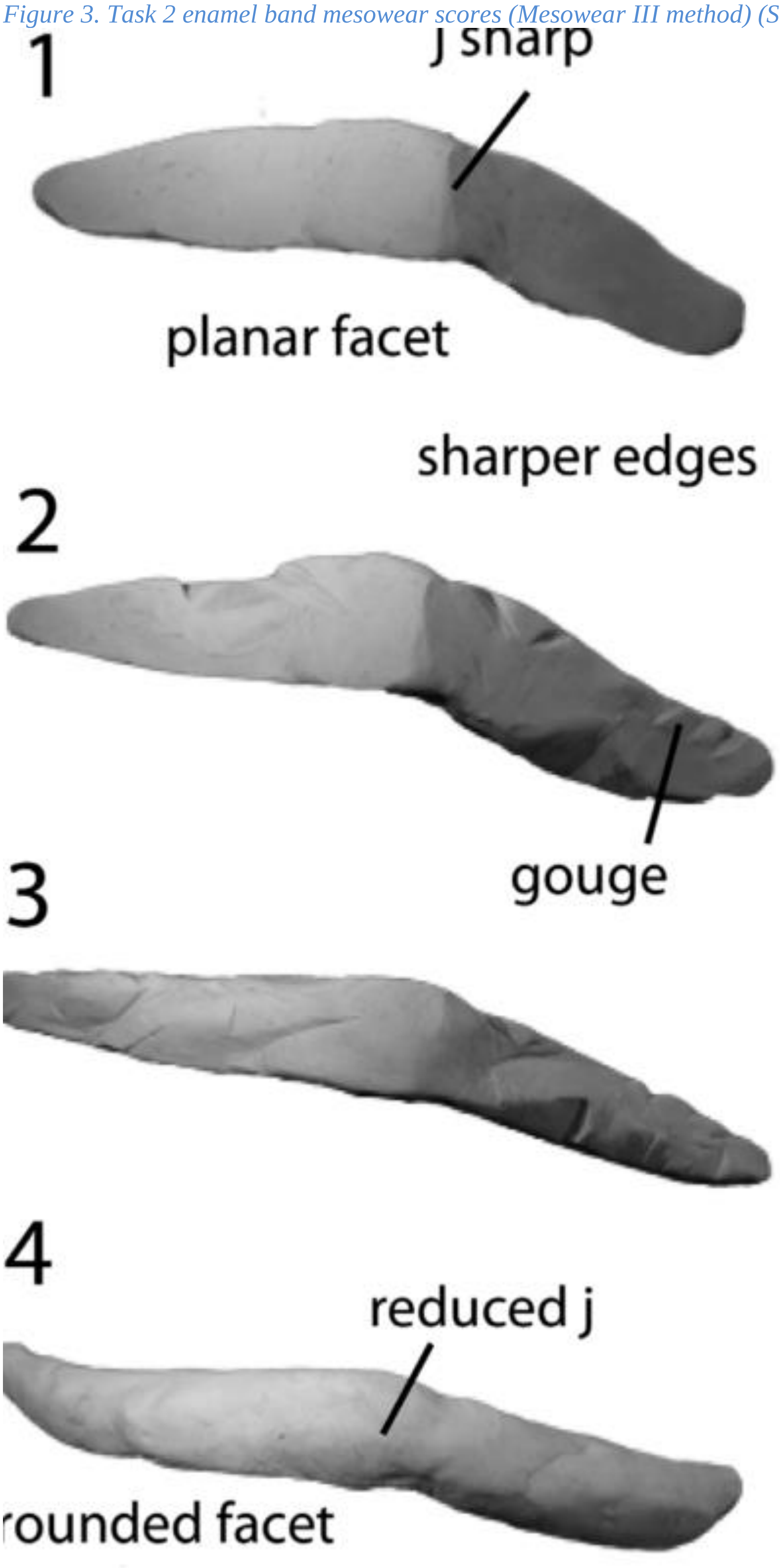


Figure 4. Task 2 scoring system (Solounias et al. 2014).

Number ★	**Tooth ★ position**	**Task 1**									**Task 2**	**Totals**		
		Score 1 ★			**Score 2 ★**			**Score 3**			**Score ★** **(Numerical Values 1-4)**	**Total Score**		
		Relief (h/l)			**Cusp shape (S, R, B)**			**Mesowear Score (score 1-6)**				**(Mesowear score + task 2 score)**		
		.1	.2	.3	.1	.2	.3	.1	.2	.3		.1	.2	.3
	M^1 (upper)													
	M^2													
	M^3													
	M_1 (lower)													
	M_2													
	M_3													
	M^1													
	M^2													
	M^3													
	M_1													
	M_2													
	M_3													
	M^1													
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	M_3													
	M^1													
	M^2													
	M^3													
	M_1													
	M_2													
	M_3													

A7.1.2 Mesowear experiment 2:

Below is the exact information sheet given to participants, up to Table A7.1, which shows the results of this experiment (as given in chapter 8 'Mesowear'). In addition, figures 2 & 3 (as experiment 1) were included in the participant handout.

Dear participant,
Thank-you for agreeing to take part in this pilot study. This study experiment will form part of the analysis for a PhD project entitled: "Using a multi-method analysis of springbok (Antidorcas) teeth to understand 2 million years of vegetation history in southern Africa". This PhD research is funded by the Institute for the Studies of Landscape and Human Evolution, Bournemouth University.
INSTRUCTIONS:

- Tick the most relevant box following the diagram provided as a guide.
- Complete relief 1 AND relief 2 (1 and 2 are the scoring the same thing, with just the additional option of 'medium' relief) as well as cusp shape.
- Once complete, please email to: lsewell@bournemouth.ac.uk by 30th January 2018.
- Any questions, please do not hesitate to contact me to ask via the email address above.
- Please also feel free to email any other feedback to the above email address.

ABSRACT

Mesowear has been traditionally used to infer lifetime dietary signals from the check-teeth of ungulates (Fortelius & Solounias 2000). This is based on an attrition-abrasion continuum, whereby grasses and abrasive diets obliterate facets, resulting in lower relief and rounded or blunt cusps of molar occlusal surfaces. The opposite is true for browsing diets, which are viewed as less abrasive; attrition (tooth-tooth contact) is therefore the dominant cause of wear, resulting in higher relief and sharper cusps of molar occlusal surfaces. Furthermore, with multiple comparative populations of a species, mesowear can be used as an environmental proxy to infer climatic signals (principally humidity), with abrasion-dominated mesowear signals being associated with drier climates (e.g. Kaiser & Schulz 2006). Typically, only maxillary teeth are used, due to mandibular teeth having been shown (Franz-Odendaal & Kaiser 2003) to over-emphasize the grazing element of the diet by being more subject to abrasive wear. Mesowear analysis is conducted by assigning the sharpest cusp of a tooth (usually upper permanent second molar) with a relief score of high/low and a cusp shape of either blunt, rounded or sharp cusps. Here, we propose conducting a mesowear experiment using all check teeth, scoring both cusps a) separately and b) together (average mesowear of cusps). The aim is to thoroughly test each aspect of the mesowear method that is typically used in modern and palaeo- dietary and environmental research. Mesowear appears highly subjective, thereby necessitating the inquiry into the robusticity of the method. Obtaining mesowear scores for the same teeth from many researchers will primarily allow analysis of the impact of subjectivity on the merit of this method; guiding data collection and analysis and lending support (or otherwise) to research conducted on fossil samples.

MESOWEAR (the macroscopic wear of teeth) is used to determine the abrasiveness of an animal's diet.

This data will be used to test the robustness of this method for interpreting palaeodiets (past diets) from African bovid teeth.

Score each M2 (indicated* for each photograph) for relief and cusp shape, following the scoring system (figure 1) to the right.
*

Figure 1: Mesowear scoring system (adapted from Fortelius and Solounias 2000).

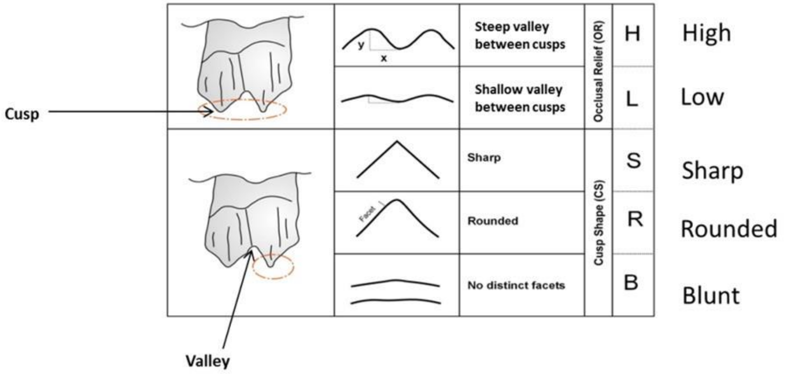


Image 1:
KA 2610

Relief 1
☒ High ☒ Low

Relief 2
☒ High ☒ Medium ☒ Low

Cusp shape
☒ Sharp ☒ Rounded ☒ Blunt

Image 2:
SK 2115

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

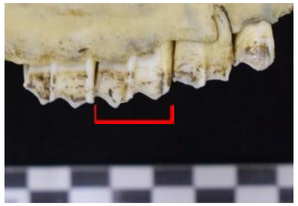
Cusp shape
☐ Sharp ☐ Rounded ☐ Blunt

Image 3:
SK 2366

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

Cusp shape
☐ Sharp ☐ Rounded ☐ Blunt



☐ ☐
High Low

☐ ☐ ☐
High Medium Low

☐ ☐ ☐
Sharp Rounded Blunt

5

Relief 1
☐ ☐
High Low

Relief 2
☐ ☐ ☐
High Medium Low

Cusp shape
☐ ☐ ☐
Sharp Rounded Blunt

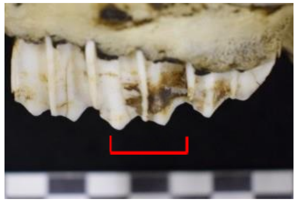
6

Relief 1
☐ ☐
High Low

Relief 2
☐ ☐ ☐
High Medium Low

Cusp shape
☐ ☐ ☐
Sharp Rounded Blunt

7

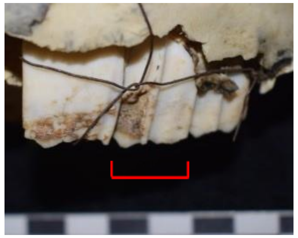


Relief 1
☐ ☐
High Low

Relief 2
☐ ☐ ☐
High Medium Low

Cusp shape
☐ ☐ ☐
Sharp Rounded Blunt

8

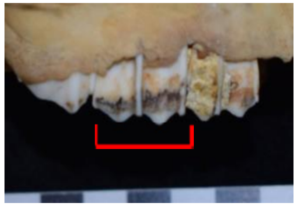


Relief 1
☐ ☐
High Low

Relief 2
☐ ☐ ☐
High Medium Low

Cusp shape
☐ ☐ ☐
Sharp Rounded Blunt

		☐ High ☐ Low	☐ High ☐ Medium ☐ Low	☐ Sharp ☐ Rounded ☐ Blunt
10		Relief 1 ☐ High ☐ Low	Relief 2 ☐ High ☐ Medium ☐ Low	Cusp shape ☐ Sharp ☐ Rounded ☐ Blunt
11		Relief 1 ☐ High ☐ Low	Relief 2 ☐ High ☐ Medium ☐ Low	Cusp shape ☐ Sharp ☐ Rounded ☐ Blunt
12		Relief 1 ☐ High ☐ Low	Relief 2 ☐ High ☐ Medium ☐ Low	Cusp shape ☐ Sharp ☐ Rounded ☐ Blunt
13		Relief 1 ☐ High ☐ Low	Relief 2 ☐ High ☐ Medium ☐ Low	Cusp shape ☐ Sharp ☐ Rounded ☐ Blunt



☐ ☐
High Low

☐ ☐ ☐
High Medium Low

☐ ☐ ☐
Sharp Rounded Blunt

Relief 2

Cusp shape

15

Relief 1

☐ ☐
High Low

☐ ☐ ☐
High Medium Low

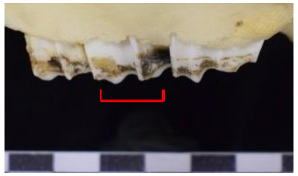
☐ ☐ ☐
Sharp Rounded Blunt

16

Relief 1

Relief 2

Cusp shape



☐ ☐
High Low

☐ ☐ ☐
High Medium Low

☐ ☐ ☐
Sharp Rounded Blunt

Cusp shape

Relief 2

17

Relief 1

☐ ☐
High Low

☐ ☐ ☐
High Medium Low

☐ ☐ ☐
Sharp Rounded Blunt

Relief 1

Relief 2

Cusp shape

☐ ☐
High Low

☐ ☐ ☐
High Medium Low

☐ ☐ ☐
Sharp Rounded Blunt

18

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

Cusp Shape
☐ Sharp ☐ Rounded ☐ Blunt

19

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

Cusp shape
☐ Sharp ☐ Rounded ☐ Blunt

20

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

Cusp shape
☐ Sharp ☐ Rounded ☐ Blunt

Relief 1
☐ High ☐ Low

Relief 2
☐ High ☐ Medium ☐ Low

Cusp shape
☐ Sharp ☐ Rounded ☐ Blunt

21

Relief 1

☐ High ☐ Low

Relief 2

☐ High ☐ Medium ☐ Low

Cusp shape

☐ Sharp ☐ Rounded ☐ Blunt

22

Relief 1

☐ High ☐ Low

Relief 2

☐ High ☐ Medium ☐ Low

Cusp shape

☐ Sharp ☐ Rounded ☐ Blunt

All scores will remain anonymous.

Please provide details of previous experience (e.g. zooarchaeology/palaeoenvironmental proxy specialist/ 1 module in human and animal bones years ago/no prior experience…).
You may leave your name off this if you wish.

Additionally, for acknowledgement in any resulting journals/thesis, please provide details below.

Name: ____
Email Address: ____
Department: (if applicable) Level of Study: __________________________________
(undergraduate/taught postgraduate/postgraduate researcher-masters/PhD)
Previous experience: ____
(Please detail below if above 'none') ____

A7.1.3 EXPERIMENT ANALYSIS

Results are summarized and assessed consistently with other mesowear studies, in this research and other, published sources (e.g. Fortelius and Solounias 2000; Kaiser and Schulz 2006) with relative percentages of relief and cusp shape categories summarized and mesowear scores analysed, with the intention of establishing dietary (and by inferences, palaeoenvironmental) indicators for the given sample.

Table 8.1: Experiment, experiment 1 results. Percentages for each individual specimen of mesowear relief, cusp shape and dominant mesowear score given. If equal percentages are given for relief, 'medium' category is assigned.

Number	**Relief %**			**Cusp shape %**			**Dominant Mesowear Score**
	Low	**Medium**	**High**	**Blunt**	**Rounded**	**Sharp**	
1	44.4	11.1	44.4	0	11.1	88.9	MS
2	66.7	0	33.3	14.3	85.7	0	LR
3	12.5	0	87.5	0	12.5	87.5	HS
4	88.9	0	11.1	77.8	11.1	11.1	LB
5	0	0	100	0	50	50	HR-S
6	12.5	0	87.5	0	12.5	87.5	HS
7	16.7	0	83.3	0	50	50	HR-S
8	0	0	100	0	14.3	85.7	HS
9	100	0	0	100	0	0	LB
10	33.3	22.2	44.4	0	22.2	77.8	HS
11	0	0	100	0	11.1	88.9	HS
12	0	0	100	0	12.5	87.5	HS
13	0	0	100	0	11.1	88.9	HS
14	57.1	0	42.9	14.3	42.9	42.9	HR-S
15	12.5	0	87.5	0	25	75	HS
16	28.6	0	71.4	0	14.3	85.7	HS
17	25	25	50	0	87.5	12.5	HR
18	14.3	0	85.7	0	14.3	85.7	HS
19	25	0	75	0	12.5	87.5	HS
20	25	0	75	0	25	75	HS
21	14.3	0	85.7	0	14.3	85.7	HS
22	55.6	11.1	33.3	0	100	0	LR
23	0	0	100	0	88.9	11.1	HR
24	12.5	12.5	75	0	62.5	37.5	HR
25	0	0	100	0	25	75	HS
26	0	0	100	0	57.1	42.9	HR
27	0	0	100	143	71.4	14.3	HR
28	0	0	100	0	0	100	HS
29	100	0	0	50	50	0	LB-R
30	0	0	100	0	42.9	57.1	HS
31	100	0	0	85.7	14.3	0	LB
32	0	14.3	85.7	0	71.4	28.6	HR
33	42.9	0	57.1	0	85.7	14.3	HR
34	0	42.9	57.1	0	100	0	HR
35	50	0	50		50	50	MR-S
36	50	0	50	0	50	50	MR-S

Table 8.2: Mesowear experiment 1 analysis. The merit of the method is analysed by the accuracy of the predicted dietary category (column 2) from participant mesowear scores, compared to the known dietary category of the species/ population/individual (column 1). Accuracy: 'Accurate' is given if the prevailing mesowear score matches the typical (expected) dietary category for the species; 'fairly accurate' is given if the

prevailing mesowear score includes the typical dietary category (i.e. if the species is typically a browser or a grazer and the mesowear score is reflective of a mixed -feeder); 'inaccurate' is assigned if the opposite dietary category is assigned (i.e. a typically browsing species yields a mesowear score meant to be reflective of grazing).

Dietary category	**Predicted diet**	**Accuracy**
1. Browser	Mixed	Fairly accurate
2. Mixed browser	Grazer	Inaccurate
3. Mixed browser	Browser	Fairly accurate
4. Grazer	Grazer	Accurate
5. Grazer	Mixed	Fairly accurate
6. Grazer	Browser	Inaccurate
7. Grazer	Mixed	Fairly accurate
8. Grazer	Browser	Inaccurate
9. Grazer	Grazer	Accurate
10. Browser	Browser	Accurate
11. Grazer	Browser	Inaccurate
12. Browser	Browser	Accurate
13. Browser	Browser	Accurate
14. Grazer	Mixed	Fairly accurate
15. Grazer	Browser	Inaccurate
16. Grazer	Browser	Inaccurate
17. Grazer	Mixed	Fairly accurate
18. Grazer	Browser	Inaccurate
19. Grazer	Browser	Inaccurate
20. Grazer	Browser	Inaccurate
21. Grazer	Browser	Inaccurate
22. Grazer	Grazer	Accurate
23. Grazer	Mixed	Fairy accurate
24. Grazer	Mixed	Fairy accurate
25. Grazer	Browser	Inaccurate
26. Grazer	Mixed	Fairly accurate
27. Grazer	Mixed	Fairly accurate
28. Grazer	Browser	Inaccurate
29. Grazer	Grazer	Accurate
30. Grazer	Browser	Inaccurate
31. Grazer	Grazer	Accurate
32. Grazer	Mixed	Fairly accurate
33. Grazer	Mixed	Fairly accurate
34. Grazer	Mixed	Fairly accurate
35. Grazer	Mixed	Fairly accurate
36. Grazer	Mixed	Fairly accurate

A total of 8 diets were accurately predicted (22%), 15 fairly accurately predicted (42%) and 13 inaccurately predicted (36%). The 'known' diets are given based on modern observation of similar species/populations, rather than a food-trial or similar (e.g. Ramdarshan et al. 2016, 2017) for each individual. Individual and population level variation notwithstanding, deviation from the typical diet of the species is deemed inaccurate.

Table A7. 1: Mesowear Experiment 2 results. See chapter 8 'Mesowear' and chapter 4 'Materials and Methods' for further information on the experiment. Dominant mesowear variables are indicated for each category in bold text. Full table with images scored by participants supplied in Appendices A7. The dominant score (given by the highest number of participants) is indicated by bold text. 'H' =high relief, 'L'=low relief, 'M'=medium relief (between high and low relief), 'S'=sharp cusps, 'R'=rounded cusps, 'B'=blunt cusps. 'N'=number of participants.

Image Number	N	Relief 1 Total		Relief 1 %		N	Relief 2 Total			Relief 2 %			N	Cusp shape Total			Cusp shape %		
		H	L	H	L		H	M	L	H	M	L		S	R	B	S	R	B
1	35	27	8	**77**	23	35	12	20	3	34	**57**	9	34	9	24	1	26	**71**	3
2	33	24	9	**73**	27	33	13	14	6	39	**42**	18	33	11	17	5	33	**52**	15
3	34	27	7	**79**	21	34	19	12	3	**56**	35	9	34	20	12	2	**59**	35	6
4	34	32	2	**94**	6	34	20	13	1	**59**	38	3	33	21	12	0	**64**	36	0
5	35	8	27	23	**77**	35	0	19	16	0	**54**	46	34	3	26	5	9	**76**	15
6	35	0	35	0	**100**	35	0	1	34	0	3	**97**	34	0	2	32	0	6	**94**
7	35	33	2	**94**	6	35	21	13	1	**60**	37	3	34	15	17	2	44	**50**	6
8	35	0	35	0	**100**	35	0	0	35	0	0	**100**	35	0	2	33	0	6	**94**
9	35	15	20	43	**57**	35	6	23	6	17	**66**	17	35	2	25	8	6	**71**	23
10	34	8	26	24	**76**	34	0	20	14	0	**59**	41	35	6	21	8	17	**60**	23
11	35	32	3	**91**	9	35	18	15	2	**51**	43	6	35	23	11	1	**66**	31	3
12	35	0	35	0	**100**	35	0	2	33	0	6	**94**	35	0	6	29	0	17	**83**
13	35	18	17	**51**	49	35	5	22	8	14	**63**	23	35	12	21	2	34	**60**	6
14	35	29	6	**83**	17	35	18	14	3	**51**	40	9	35	12	23	0	34	**66**	0
15	35	0	35	0	**100**	35	0	0	35	0	0	**100**	34	0	0	34	0	0	**100**
16	35	5	30	14	**86**	35	1	20	14	3	**57**	40	35	2	25	8	6	**71**	23
17a	34	28	6	**82**	18	34	19	12	3	**56**	35	9	34	21	13	0	**62**	38	0
17b	34	30	4	**88**	12	34	25	8	1	**74**	24	3	34	27	7	0	**79**	21	0
18	34	5	29	15	**85**	34	1	5	28	3	15	**82**	34	1	13	20	3	38	**59**
19	34	13	21	38	**62**	34	1	24	9	3	**71**	26	34	7	26	1	21	**76**	3
20a	34	0	34	0	**100**	34	0	2	32	0	6	**94**	34	1	10	23	3	29	**68**
20b	33	0	33	0	**100**	33	0	5	28	0	15	**85**	33	0	0	33	0	0	**100**
21	34	29	5	**85**	45	33	14	15	4	42	**45**	12	33	22	11	0	**67**	33	0
22	34	31	3	**91**	9	33	17	13	2	**52**	39	6	34	10	24	0	29	**71**	0

A7.1.4 EXPERIMENT CONCLUSIONS:

Based on participant feedback and analysis of experiment data.

1. Mesowear variables assessed visually from photographs show to be highly subjective and dependent on multiple factors, such as light intensity, angle of photograph and the type of teeth (i.e. a group of dental photographs together will be assessed as a discrete group, assigning high/low and sharp/rounded/blunt based on only those within the dataset / those seen together at the same time, rather than being based on the scale of dentition of all African bovids).

2. A medium relief category is often used where available, suggesting the need for more categories, particularly when considering mixed feeding antelopes. This enables the level of variation in dental use wear to really be examined.

3. More categories may be required where teeth display varying mesowear patterns on one tooth or across the toothrow. Traditionally, the sharpest cusp is scored but this could potentially limit the dietary and environmental information achievable from such a method.

4. Mesowear was only accurately reflective of typical species diets 22% of the time, and fairly accurate 42% of the time and inaccurate 36% of the time. Mesowear scoring therefore appears relatively inaccurate. Accuracy of dietary assessment based on experiment 1. There is considerable inter-observer error in assigning mesowear variable scores.

A7.2 New Mesowear scoring system results

It became quickly apparent that a continuous scale (1-49) for mesowear variables (high, medium, low relief and blunt, rounded, sharp cusps) created too much variation between individuals. The extent of this variation was too high for the purposes of this study as feeding categories for the species as a whole became lost. Therefore, the explanation and complete results were removed from the main body of text but included here to highlight the potential for new mesowear scoring systems and potentially more continuous categories, particularly for modern mixed-feeding bovids.

Introducing this new method, a mesowear score for an individual can be calculated (mean) to make the method more representative of individual animals, as teeth can be subject to damage to a variety of reason which would impact on the mesowear score given to the individual tooth. This can only be done for tooth *in situ* in the jaw. Individual teeth will only have one mesowear score.

Examples of new mesowear scoring system:

Left maxilla NHM.1942.4.11.1 *Antidorcas marsupialis marsupialis.*

Mesowear scores: LM^1: M-HR-S, LM^2: M-HR, LM^3: M-HS (33+32+35)/3=33

Right maxilla NHM NHM.1942.4.11.1 *Antidorcas marsupialis marsupialis.*

Mesowear scores: RM^1: M-HR-S, RM^2: M-HR, RM^3: M-HS (33+32+35)/3=33

Mesowear score for individual **33**

Figure A7. 1: Examples of a suggested mesowear score for an individual animal, incorporating all molars in the toothrow.

Right maxilla NHM.1972.4538 *Antidorcas marsupialis*

Mesowear score: RM^1: HS, RM^2: HS, RM^3: HR-S

(48+46+48)/3=47

Left maxilla NHM.1972.4538 *Antidorcas marsupialis*

Mesowear score: LM^1: HS-R, LM^2: HR, LM^3:HR-S

(49+49+48)/3=49 (48.7)

Mesowear score for individual specimen: **48**

Figure A7.2: Examples of new mesowear scoring scale, for an individual animal, incorporating all molars in the toothrow. based on modern Antidorcas marsupialis maxillae.

A7.2.1 New Mesowear scoring system results

Table A7.2: New Mesowear Scores given in this research to Antidorcas lower dentition. SK=Sterkfontein, SKX=Swartkrans, K=Kromdraai, GL=Gladysvale, PL=Plovers Lake with associated Member given afterwards (e.g. SKX M1 HR = Swartkrans Member 1 hanging remnant). Mesowear scoring system is explained in Chapter 8 'Mesowear'. L, M, H=low, medium or high relief; B, R, S=blunt, rounded or sharp cusps.

	SK M4	**SK M5**	**SK M5E**	**SK M5W**	**SKX M1**	**SKX M1 LB**	**SKX M1 HR**	**SKX M2**	**SKX M3**	**KA**	**KB**	**KE/D**	**KW**	**GL**	**SK LC**	**PL**	**CoH**	**SK NC**	**SK PM6**	**SK un.**	**Modern**
Total N	9	29	6	11	4	6	3	32	29	19	1	2	5	2	1	13	3	1	1	2	69
LB	0	4	2	3	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	3
% LB	0	14	33	27	0	0	0	0	0	0	0	0	20	0	0	8	0	0	100	0	4
LB-R	0	0	0	0	1	0	0	1	3	1	0	0	2	0	1	1	1	0	0	0	1
%LB-R	0	0	0	0	25	0	0	3	10	5	0	0	40	0	100	8	33	0	0	0	1
LR-B	0	7	0	2	0	0	1	6	4	2	1	0	2	0	0	0	0	0	0	0	6
%LR-B	0	24	0	18	0	0	33	19	14	11	100	0	40	0	0	0	0	0	0	0	9
LR	1	3	1	2	1	4	0	0	1	0	0	0	0	0	0	2	1	1	0	0	1
%LR	11	10	17	18	25	67	0	0	3	0	0	0	0	0	0	15	33	100	0	0	1
LR-S	1	1	1	1	0	0	0	3	4	2	0	0	0	1	0	0	0	0	0	0	2
%LR-S	11	3	17	9	0	0	0	9	14	11	0	0	0	50	0	0	0	0	0	0	3
LS-R	1	5	1	1	0	0	0	4	2	4	0	1	0	1	0	4	1	0	0	0	5
%LS-R	11	17	17	9	0	0	0	13	7	21	0	50	0	50	0	31	33	0	0	0	7
LS	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0
%LS	11	3	0	0	0	0	0	3	0	0	0	50	0	0	0	0	0	0	0	50	0
L-MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
%L-MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
L-MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%L-MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

L-MR-B	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
%L-MR-B	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1
L-MR	0	2	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	1
%L-MR	0	7	0	0	0	0	33	0	3	5	0	0	0	0	0	8	0	0	0	0	1
L-MR-S	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	7
%L-MR-S	0	0	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	10
L-MS-R	0	2	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	1
%L-MS-R	0	7	0	0	0	0	33	0	3	0	0	0	0	0	0	8	0	0	0	50	1
L-MS	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1
%L-MS	11	0	0	0	0	0	0	3	0	5	0	0	0	0	0	0	0	0	0	0	1
M-LB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%L-MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-LB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
%M-LB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
M-LR-B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-LR-B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-LR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
%M-LR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
M-LR-S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-LR-S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-LS-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

R																					
%M-LS-R	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
M-LS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-LS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MB	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
%MB	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
%MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
MR-B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
%MR-B	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MR	0	0	0	1	0	0	0	4	3	2	0	0	0	0	0	0	0	0	0	0	2
%MR	0	0	0	9	0	0	0	13	10	11	0	0	0	0	0	0	0	0	0	0	3
MR-S	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	1	0	0	0	0	6
%MR-S	0	0	0	0	0	0	0	9	3	0	0	0	0	0	0	8	0	0	0	0	9
MS-R	0	1	0	0	0	2	0	1	0	3	0	0	0	0	0	0	0	0	0	0	1
%MS-R	0	3	0	0	0	33	0	3	0	16	0	0	0	0	0	0	0	0	0	0	1
MS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
%MS	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
M-HB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-HB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-HB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-HB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-HR-B	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
%M-HR-B	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1

M-HR	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4
%M-HR	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6
M-HR-S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-HR-S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-HS-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-HS-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-HS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%M-HS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%H-MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%H-MB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-MR-B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%H-MR-B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-MR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
%H-MR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
H-MR-S	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
%H-MR-S	0	0	17	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
H-MS-R	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%H-MS-R	11	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-MS	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	0	0	0	2

%H-MS	0	0	0	0	0	0	0	0	3	5	0	0	0	0	0	15	0	0	0	0	3
HB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%HB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%HB-R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HR-B	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1
%HR-B	0	3	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	1
HR	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	3
%HR	0	7	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	4
HR-S	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
%HR-S	0	0	0	0	25	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
HS-R	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
%HS-R	11	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
HS	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5
%HS	11	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	7

New Mesowear Categories Results

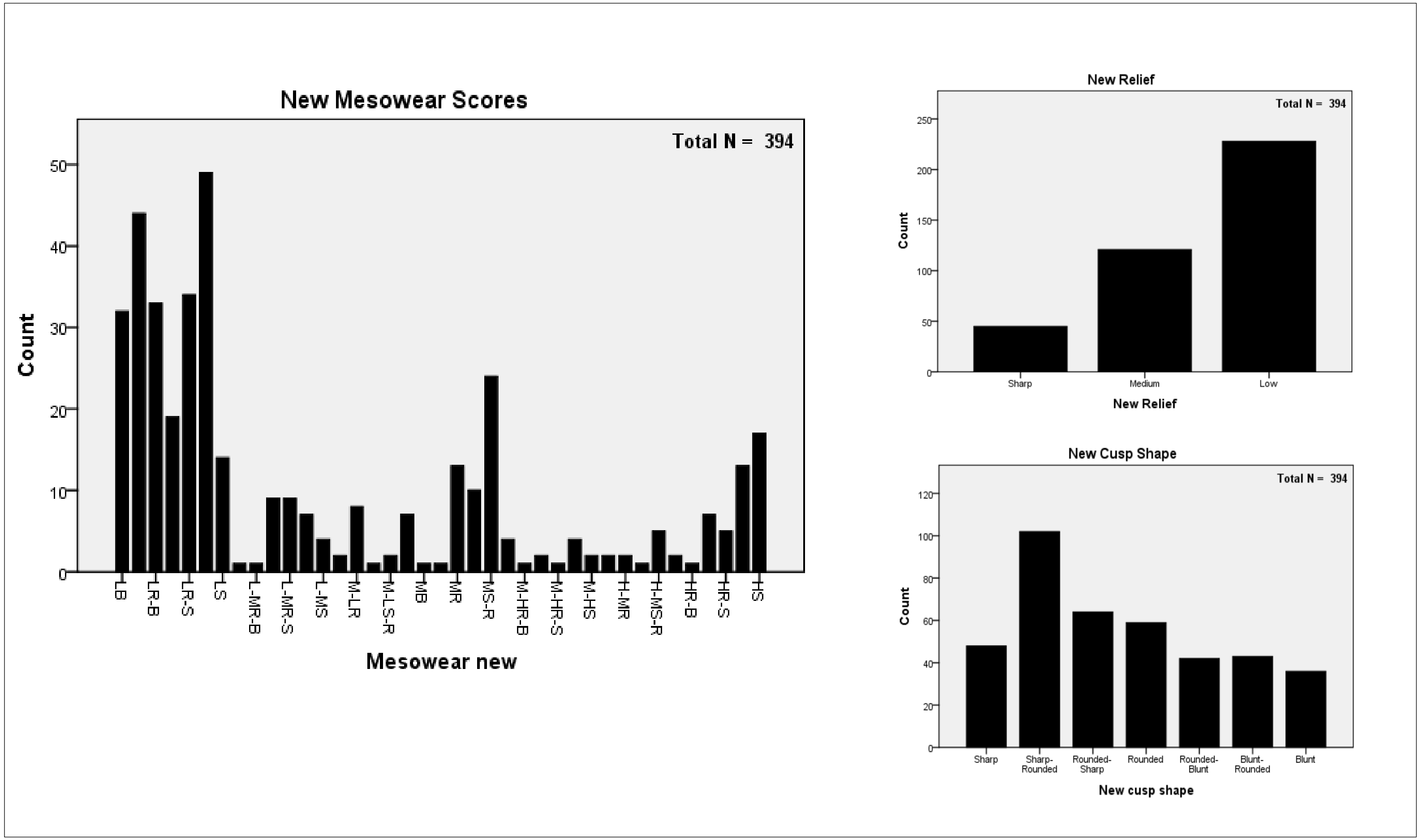


Figure A7.3: Antidorcas (all species) mesowear scores using the new scale mesowear scores for all temporal periods (2.8-0.8 Ma). The most common mesowear scores for Antidorcas favour lower relief and rounded cusps. Sharp to rounded cusps are the most prevalent, suggestive of an abrasive yet mixed-feeding-browsing diet.

A7.3 Mesowear Discriminant Function Analysis Results

Table A7.3: Discriminant function analysis for mesowear variables through time. Mesowear cannot be accurately used to predict group membership, with the DFA resulting in only 44.4% accuracy. SK=Sterkfontein, M=Member, SKX=Swartkrans, K=Kromdraai, PL=Plovers Lake, CoH=Cave of Hearths, u=unstratified, M=Modern. Rf=relief, CS=cusp shape, NM=new mesowear score, N=new, M III=Mesowear III, (c)=(constant). A. Eigenvalues, B. Wilks' Lambda, C.Classification function coefficients, D. Standardised canonical discriminant function coefficients.

A) Summary of canonical discriminant functions: Eigenvalues

Function	**Eigenvalue**	**% of Variance**	**Cumulative %**	**Canonical correlation**
1	1.541	59.8	59.8	.779
2	.646	25.1	84.8	.627
3	.222	8.6	93.4	.426
4	.082	3.2	96.6	.276
5	.051	2.0	98.6	.221
6	.036	1.4	100.0	.186

B) Wilks' Lambda

Test of Function(s)	**Wilks' Lambda**	**Chi-Square**	**df**	**Significance**
1 through 6	.166	111.324	66	.000
2 through 6	.422	53.509	50	.341
3 through 6	.695	22.601	36	.960
4 through 6	.849	10.184	24	.994
5 through 6	.918	5.278	14	.982
6	.965	2.183	6	.902

C) Classification function coefficients: Fishers' linear discriminant functions

	Provenance											
	SKM4	SKM5	SKM5W	SKXM1	SKXM2	SKXM3	KA	KW	PL	CoH	SKu	M
Rf	48.921	45.999	50.152	48.165	50.961	48.772	48.332	49.188	49.160	46.445	50.811	50.816
CS	27.678	28.130	27.455	32.896	30.140	29.559	31.411	32.351	29.277	28.071	30.989	32.360
NM	4.485	4.392	4.674	4.447	4.657	4.709	4.376	4.514	4.488	4.385	4.738	4.600
NRf	68.529	63.952	68.225	69.277	67.602	68.378	67.792	66.447	65.889	64.164	69.403	68.057
NCS	19.324	18.497	21.046	20.689	21.165	20.423	20.651	21.713	19.879	19.134	23.241	22.263
M III	-4.440	-.174	-2.713	-5.185	-3.484	-2.350	-6.481	-4.764	-2.485	-1.796	-4.041	-6.619
(c)	-215.416	-210.305	-231.089	-230.163	-232.791	-231.644	-218.011	-227.814	-219.995	-206.776	-248.527	-233.142

D) Standardised canonical discriminant function coefficients

	Function					
	1	**2**	**3**	**4**	**5**	**6**
Relief	.334	.526	-.281	-.042	.692	1.259
Cusp shape	.817	.064	.389	-.772	1.198	-.861
New mesowear	.119	1.915	.432	1.775	1.628	.876
New relief	.518	.370	-.033	1.944	1.424	-.127
New cusp shape	1.245	1.154	-.227	-.457	1.031	-.860
Mesowear III	-1.538	290	.130	-.152	.027	.073

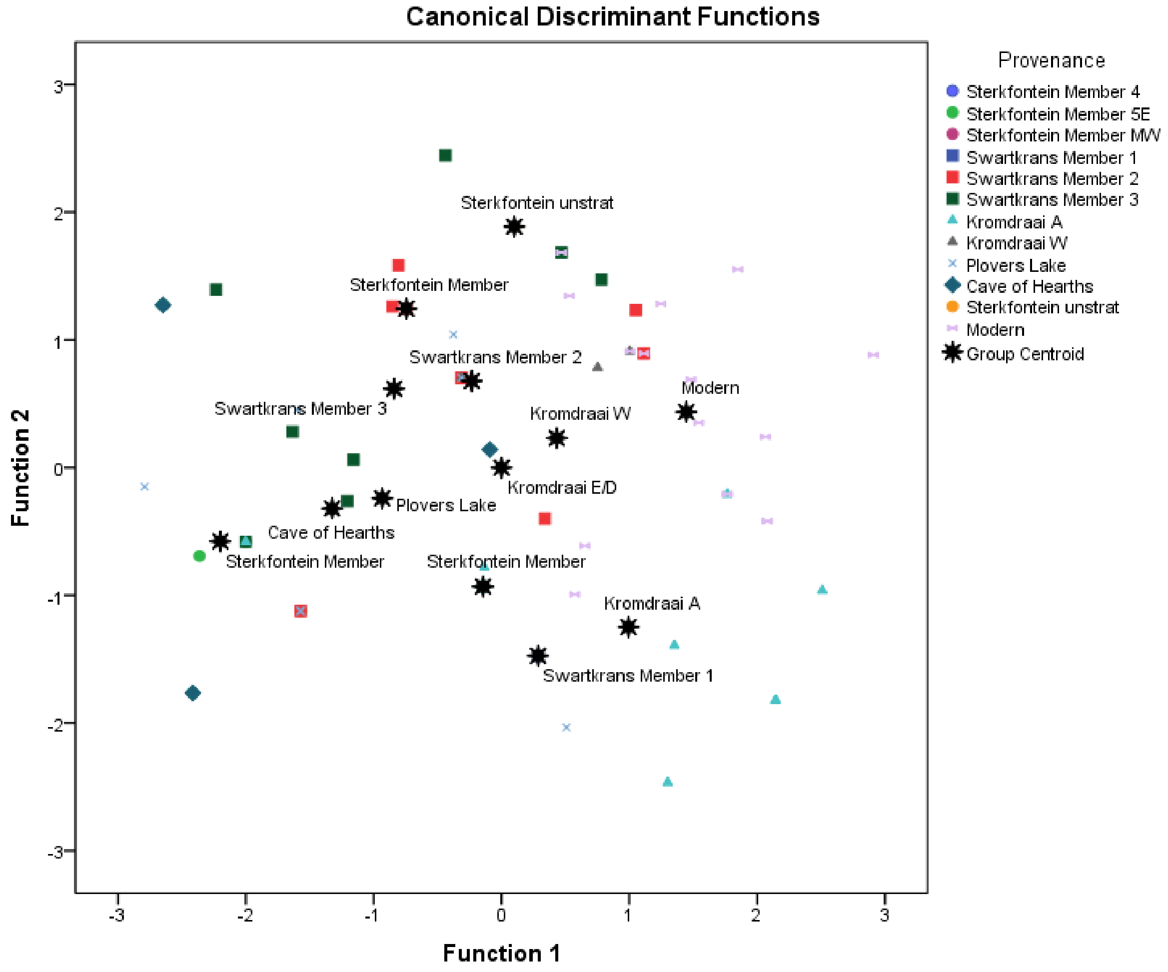


Figure A7. 4: Figure 10.4 Figure 8.3: Discriminant Function Analysis distribution of mesowear variables according to provenance.

Appendix A8: Stable Isotope Analysis

This appendix presents the stable isotope pre-treatment weights data sheet and the raw data used for the main stable isotope analysis, alongside the references they were taken from.

A8.1 Pre-treatment

Table A8.1:Stable isotope pre-treatment data sheet, showing pre-treatment process and weights.

Sample Number	Weight of empty vial (mg)	Weight with sample (mg)	Sample Weight (mg)	End Weight (mg)
SKX 10697	1034.0	1042.0	8.0	4.9
SKX 36545	1034.0	1043.0	9.0	6.8
SKX 34249x A	1032.0	1036.0	4.0	3.4
SKX 4842	1050.0	1062.0	12.0	8.0
SKX 35326	1032.0	1038.0	6.0	5.9
SKX 33839	1032.0	1039.0	7.0	4.9
SKX 34249x B	1034.0	1042.0	4.0	5.6
SKX 2899	1038.0	1047.0	9.0	6.6
SKX 10703	1035.0	1044.0	9.0	5.0
SKX 11602 f	1031.6	1036.9	5.3	10.9
SKX 11602 a	(error) 0.1	1037.3	error	5.9
SKX 11602 b	1037.5	1041.0	3.5	5.2
SKX 11602 c	1032.8	1037.3	4.5	5.8

SKX 11602 d	1037.1	1040.4	3.3	4.6
SKX 11602 e	1034.9	1039.3	4.4	5.2
SKX 28008 a	1036.0	1042.0	6.0	5.2
SKX 28008 b	1031.0	1036.0	5.0	6.0
SKX 28008 c	1034.0	1040.0	6.0	6.8
SKX 28008 d	1041.0	1048.0	7.0	5.9
SKX 28008 e	1034.0	1039.0	5.0	3.9
SKX 34249 a	1033.0	1038.0	5.0	3.8
SKX 34249 b	1031.0	1036.0	5.0	4.4
SKX 34249 c	1043.0	1048.0	5.0	5.4
SKX 34249 d	1035.0	1042.0	7.0	5.5
SKX 34249 e	1039.0	1044.0	5.0	6.3
SKX 34249 f	1036.0	1041.0	5.0	4.7
Standard	x	x	7.5	10.8

A8.2 Stable isotope published data used

Table A8.2: Stable isotope data (carbon δ3C) and Oxygen (δ18O) used in this research, from published sources and the references they were taken from. 'M'=Member.

Number	***Species***	**Values δ^{13}C ‰**	**Values δ^{18}O (PDB)‰**	**δ^{18}O SNOW‰**	**Site provenance**	**Reference**	**Other information**
STS 1125	*A. bondi*	-1.26	0.3	31.169258	Sterkfontein M4	Luyt 2001	Mean Luyt 2001 value
STS 1125	*A. bondi*	-1.30	x	x	Sterkfontein M4	van der Merwe et al. 2003	
STS 1435	*A.cf.recki*	-13.70	-4.3	26.427302	Sterkfontein M4	Luyt 2001	
STS 1435	*A.cf.recki*	-13.70	x	x	Sterkfontein M4	van der Merwe et al. 2003	P.590
STS 2369	*A.recki*	-10.46	-0.1	30.756914	Sterkfontein M4	Luyt 2001	Mean value
STS 1944	*A.recki*	-13.97	-7.6	23.025464	Sterkfontein M4	Luyt 2001	Mean Luyt 2001 value
STS 1944	*A.recki*	-14.00	x	x	Sterkfontein M4	van der Merwe et al. 2003	
STS 1325A	*A.recki*	-13.21	-4.9	25.808786	Sterkfontein M4	Luyt 2001	Mean value
STS 1325A	*A.recki*	-13.30			Sterkfontein M4	van der Merwe et al. 2003	
STS 1596	*A.recki*	-4.50	-4.0	26.73656	Sterkfontein M4	Luyt 2001	Mean Value
STS 2379	*A.recki*	-10.50	x	x	Sterkfontein M4	van der Merwe et al. 2003	
STS 1980	*Damaliscus*	-6.83	-2.3	28.489022	Sterkfontein M4	Luyt 2001	
STS2027	*Damaliscus*	-6.96	x	x	Sterkfontein M4	Luyt 2001	Mean value
SF 327	*Damaliscus sp.*	-0.65	x	x	Sterkfontein M4	Luyt 2001	Mean value
SF 328	*Damaliscus sp.*	1.42	-2.1	28.695194	Sterkfontein M4	Luyt 2001	
SF 329	*Damaliscus sp.*	1.42	-1.8	29.004452	Sterkfontein M4	Luyt 2001	
SF 332	*Damaliscus sp.*	3.10	-1.0	29.82914	Sterkfontein M4	Luyt 2001	
STS 1319	*Damaliscus Or Parmularis*	-2.20	x	x	Sterkfontein M4	Luyt 2001	Mean value
STS 2046	*Damaliscus Or Parmularis*	-5.44	x	x	Sterkfontein M4	Luyt 2001	Mean value
STS	*Damaliscus*	-0.30	x	x	Sterkfontein M4	Luyt 2001	

Number	***Species***	**Values $\delta^{13}C$ ‰**	**Values $\delta^{18}O$ (PDB)‰**	**$\delta^{18}O$ SNOW‰**	**Site provenance**	**Reference**	**Other information**
2586AVE	*Or Parmularis*						
STS 2059B	*Makapania broomi*	-7.75	x	x	Sterkfontein M4	Luyt 2001	Mean value
STS 1925	*Makapania broomi*	-8.60	-1.6	29.210624	Sterkfontein M4	Luyt 2001	
STS 952	*Makapania broomi*	-10.84	-2.1	28.695194	Sterkfontein M4	Luyt 2001	
STS 2565	*Makapania broomi*	-3.17	-3.5	27.25199	Sterkfontein M4	Luyt 2001	
STS 1721	*Makapania broomi*	-6.76	x	x	Sterkfontein M4	Luyt 2001	Mean value
Sts 12573	*Tragelaphus strepsiceros*	-10.00	x	x	Sterkfontein M4	Luyt 2001	
Sts 46	*Tragelaphus strepsiceros*	-9.00	x	x	Sterkfontein M4	Luyt 2001	
Sts 2121	*Tragelaphus strepsiceros*	-8.20	x	x	Sterkfontein M4	Luyt 2001	
Sts 1300	*Tragelaphus strepsiceros*	-8.10	x	x	Sterkfontein M4	Luyt 2001	
S94-6124	*Antelopini cf. antidorcas*	-9.56	-0.7	30.138398	Sterkfontein M5	Luyt 2001	Mean value
S94-7314	*A.cf.antidorcas*	0.74	4.0	34.98344	Sterkfontein M5	Luyt 2001	Mean value
S94-7958	*A.cf.antidorcas*	-7.37	-0.7	30.138398	Sterkfontein M5	Luyt 2001	Mean value
SE 1258	*A.cf.recki*	-10.79	-4.4	26.324216	Sterkfontein M5	Luyt 2001	Mean value
SE 1855.1	*A.recki*	-12.68	-1.7	29.107538	Sterkfontein M5	Luyt 2001	
SE 1334	*Damaliscus*	-0.38	x	x	Sterkfontein M5	Luyt 2001	Mean value
SE 1233.1	*Damaliscus*	-2.38	x	x	Sterkfontein M5	Luyt 2001	Mean value
SE1770	*Damaliscus*	0.60	x	x	Sterkfontein M5	Luyt 2001	Mean value
SE 1614.1	*Damaliscus cf. sp2.*	0.62	-4.2	26.530388	Sterkfontein M5	Luyt 2001	
SE 1185	*Damaliscus dorcas*	-4.90	-10.3	20.242142	Sterkfontein M5	Luyt 2001	
BP/3/16974	*A.cf.antidorcas*	-9.23	-2.8	27.973592	Sterkfontein M5 East	Luyt 2001	
S94 3459	*Sml Alcelaphini cf. damaliscus*	-3.97	-1.9	28.901366	Sterkfontein M5 East	Luyt 2001	
BP/3/19870	*Sml Alcelaphini cf. damaliscus*	0.51	x	x	Sterkfontein M5 East	Luyt 2001	Mean value
BP/3/17143	*Sml Alcelaphini cf. damaliscus*	-1.80	-3.6	27.148904	Sterkfontein M5 East	Luyt 2001	
S94	*Sml*	-2.97	x	x	Sterkfontein M5 East	Luyt 2001	Mean

Number	***Species***	**Values $\delta^{13}C$ ‰**	**Values $\delta^{18}O$ (PDB)‰**	**$\delta^{18}O$ SNOW‰**	**Site provenance**	**Reference**	**Other information**
2839AVE	*Alcelaphini cf. damaliscus*						value
S94-2837AVE	*Sml Alcelaphini cf. damaliscus*	-5.10	x	x	Sterkfontein M5 East	Luyt 2001	Mean value
S94 9669	*Sml Alcelaphini cf. damaliscus*	0.17	x	x	Sterkfontein M5 West	Luyt 2001	Mean value
S94 7927	*Sml Alcelaphini cf. damaliscus*	-2.54	x	x	Sterkfontein M5 West	Luyt 2001	Mean
S94 7251	*Sml Alcelaphini cf. damaliscus*	-2.08	-5.5	25.19027	Sterkfontein M5 West	Luyt 2001	
S94 1787	*Damaliscus*	-0.38	x	x	Sterkfontein M5 West	Luyt 2001	
S94 390	*Damaliscus*	-2.38	x	x	Sterkfontein M5 West	Luyt 2001	
S94 349	*Damaliscus*	0.60	x	x	Sterkfontein M5 West	Luyt 2001	
S94 1750	*Damaliscus*	0.62	x	x	Sterkfontein M5 West	Luyt 2001	
SE 1233.1	*Antidorcas cf. recki*	-10.79	x	x	Sterkfontein M5 West	Luyt 2001	
SE 1770	*A. recki*	-12.68	x	x	Sterkfontein M5 West	Luyt 2001	
SKX 12067	*A. bondi*	-2.30	x	x	Swartkrans	Lee-Thorp et al. 2000	
SK 2574	*A. bondi*	-4.50	x	x	Swartkrans	Lee-Thorp et al. 2000	
SK 6023	*A. bondi*	-4.30	x	x	Swartkrans	Lee-Thorp et al. 2000	
SKX 5907	*A. bondi*	-2.90	x	x	Swartkrans	Lee-Thorp et al. 2000	
SKX 9385	*A. bondi*	-3.30	x	x	Swartkrans	Lee-Thorp et al. 2000	
SKX 5962	*A. bondi*	-4.20	x	x	Swartkrans	Lee-Thorp et al. 2000	
SK 3841	*A. bondi*	-1.70	x	x	Swartkrans	Lee-Thorp et al. 2000	
SK 5922	*A. bondi*	-2.40	x	x	Swartkrans	Lee-Thorp et al. 2000	
SKX 12273	*A. bondi*	-3.80	x	x	Swartkrans	Lee-Thorp et al. 2000	
SK 2304	*Tragelaphus strepsiceros*	-10.90	x	x	Swartkrans M1 HR	Lee-Thorp et al. 1989	
SK 2576	*Tragelaphus strepsiceros*	-10.80	x	x	Swartkrans M1 HR	Lee-Thorp et al. 1989	
SK 2681	*Tragelaphus strepsiceros*	-10.90	x	x	Swartkrans M1 HR	Lee-Thorp et al. 1989	
SK 3023	*Tragelaphus strepsiceros*	-10.70	x	x	Swartkrans M1 HR	Lee-Thorp et al. 1989	

Number	***Species***	**Values δ^{13}C ‰**	**Values δ^{18}O (PDB)‰**	**δ^{18}O SNOW‰**	**Site provenance**	**Reference**	**Other information**
SK 2541	*Tragelaphus strepsiceros*	-12.40	x	x	Swartkrans M1 HR	Lee-Thorp et al. 1994	
SK 14112	*Tragelaphus strepsiceros*	10.60	x	x	Swartkrans M1 HR	Lee-Thorp et al. 2007	
SK 2095	*Tragelaphus strepsiceros*	-8.20	x	x	Swartkrans M1 HR	Lee-Thorp et al. 2007	
SK 2281	*Tragelaphus strepsiceros*	-9.40	x	x	Swartkrans M1 HR	Lee-Thorp et al. 2007	
SK 3110	*Tragelaphus strepsiceros*	-9.90	x	x	Swartkrans M1 HR	Lee-Thorp et al. 2007	
SK 3000	*Tragelaphus strepsiceros*	-10.10	x	x	Swartkrans M1 HR	Steininger 2012	
SKX 811	*Antidorcas recki*	-12.9	x	x	Swartkrans M2	Lee-Thorp et al. 1994	
SKX 1896	*Antidorcas sp.*	-10.6	x	x	Swartkrans M2	Lee-Thorp et al. 2007	
SKX 2736	*Antidorcas sp.*	-11.5	x	x	Swartkrans M2	Lee-Thorp et al. 2007	
SK5882	*Antidorcas sp.*	1.761	-0.756	30.0806698	Swartkrans M2	Sewell et al. 2019	
SK5882	*Antidorcas sp.*	1.558	-1.516	29.2972162	Swartkrans M2	Sewell et al. 2019	
SK5990	*Antidorcas sp.*	-4.817	1.562	32.4702033	Swartkrans M2	Sewell et al. 2019	
SK10555	*Antidorcas sp.*	-1.103	0.102	30.9651477	Swartkrans M2	Sewell et al. 2019	
SK10555	*Antidorcas sp.*	-1.634	0.201	31.0672029	Swartkrans M2	Sewell et al. 2019	
SK4064	*Antidorcas sp.*	-0.575	0.586	31.464084	Swartkrans M2	Sewell et al. 2019	
SK6118	*Antidorcas sp.*	1.089	0.609	31.4877937	Swartkrans M2	Sewell et al. 2019	
SK2264	*Antidorcas sp.*	-3.78	-0.857	29.976553	Swartkrans M2	Sewell et al. 2019	
SK4083	*Antidorcas sp.*	-0.438	1.791	32.7062703	Swartkrans M2	Sewell et al. 2019	
SK4083	*Antidorcas sp.*	-0.39	1.511	32.4176295	Swartkrans M2	Sewell et al. 2019	
SK4080	*Antidorcas sp.*	-1.677	0.141	31.0053513	Swartkrans M2	Sewell et al. 2019	
SK2292	*Antidorcas sp.*	-5.925	-1.281	29.5394683	Swartkrans M2	Sewell et al. 2019	
SK4633	*Antidorcas sp.*	-0.611	-1.102	29.7239923	Swartkrans M2	Sewell et al. 2019	
SK11899	*Antidorcas sp.*	2.144	-0.814	30.02088	Swartkrans M2	Sewell et al. 2019	
SK6106	*Antidorcas sp.*	-0.218	0.337	31.2073998	Swartkrans M2	Sewell et al. 2019	
SK11073	*Antidorcas sp.*	-12.739	-1.273	29.5477152	Swartkrans M2	Sewell et al. 2019	
SK14070	*Antidorcas sp.*	-12.86	-1.918	28.8828105	Swartkrans M2	Sewell et al. 2019	
SK4054	*Antidorcas sp.*	-11.55	0.163	31.0280302	Swartkrans M2	Sewell et al. 2019	

Number	***Species***	**Values δ^{13}C ‰**	**Values δ^{18}O (PDB)‰**	**δ^{18}O SNOW‰**	**Site provenance**	**Reference**	**Other information**
		5					
SK 5958	*Antidorcas sp.*	-9.082	-0.792	30.0435589	Swartkrans M2	Sewell et al. 2019	
SK 4081	*Antidorcas sp.*	-10.321	0.371	31.2424491	Swartkrans M2	Sewell et al. 2019	
SK 2953	*Antidorcas sp.*	-14.98	-2.076	28.7199346	Swartkrans M2	Sewell et al. 2019	
SK 3014	*Antidorcas sp.*	-1.107	-0.76	30.0765464	Swartkrans M2	Sewell et al. 2019	
SK 2366	*Antidorcas sp.*	-5.174	-2.163	28.6302498	Swartkrans M2	Sewell et al. 2019	
SK 14123	*Antidorcas sp.*	-12.692	0.753	31.6362376	Swartkrans M2	Sewell et al. 2019	
SK 3055	*Antidorcas sp.*	-10.964	2.15	33.076349	Swartkrans M2	Sewell et al. 2019	
4417	*Antidorcas australis*	-8.90	-1.4	29.416796	~250Ka	Hare and Sealy 2013	Site: Hoedjiespunt
4792	*Antidorcas australis*	-11.10	-2.0	28.79828	~250Ka	Hare and Sealy 2013	
4186	*Antidorcas australis*	-10.60	0.1	30.963086	~250Ka	Hare and Sealy 2013	
4214	*Antidorcas australis*	-8.50	2.5	33.43715	~250Ka	Hare and Sealy 2013	
3705	*Antidorcas australis*	-9.10	2.0	32.92172	~250Ka	Hare and Sealy 2013	
4367	*Damaliscus pygargus pygargus*	-9.30	-2.0	28.79828	~250Ka	Hare and Sealy 2013	
4776	*Damaliscus pygargus pygargus*	-13.10	0.9	31.787774	~250Ka	Hare and Sealy 2013	
4191	*Damaliscus pygargus pygargus*	-11.10	3.3	34.261838	~250Ka	Hare and Sealy 2013	
3597	*Damaliscus pygargus pygargus*	-10.40	2.3	33.230978	~250Ka	Hare and Sealy 2013	
no number	*A.marsupialis*	-9.8	0.810902	31.7	Wonderwerk Stratum 2b	Ecker et al. 2018	Mean value (n=3)
no number	*A.marsupialis*	-6.8	2.168986	33.1	Wonderwerk Stratum 3a	Ecker et al. 2018	Mean value (n=6)
no number	*A.marsupialis*	-9.8	1.780962	32.7	Wonderwerk Stratum 3b	Ecker et al. 2018	Mean value (n=2)
no number	*A.marsupialis*	-5.1	0.907908	31.8	Wonderwerk Stratum 4a	Ecker et al. 2018	Mean value (n=2)
no number	*A.marsupialis*	-7.0	0.13186	31.0	Wonderwerk Stratum 4aLH	Ecker et al. 2018	Mean value

Number	***Species***	**Values $\delta^{13}C$ ‰**	**Values $\delta^{18}O$ (PDB)‰**	**$\delta^{18}O$ SNOW‰**	**Site provenance**	**Reference**	**Other information**
							(n=2)
no number	*A.marsupialis*	-7.7	4.0121	35.0	Wonderwerk Stratum 4b	Ecker et al. 2018	Mean value (n=1)
no number	*A.bondi*	-2.5	0.519884	31.4	Wonderwerk Stratum 4c	Ecker et al. 2018	Mean value (n=1)
SKX10697	A.marsupialis/australis	-7.19	-4.48	26.24	Swartkrans M1	This research, pilot study	Bulk
SKX4842	A.marsupialis/australis	-7.01	0.62	31.5	Swartkrans M1	This research, pilot study	Bulk
SKX10703	A.marsupialis/australis	-4.66	12.72	43.97	Swartkrans M1	This research, pilot study	Bulk
SKX11602A	A.marsupialis/australis	-7.45	-1.2	29.63	Swartkrans M1	This research, pilot study	Serial (nearest root)
SKX11602B	A.marsupialis/australis	-9.19	0.46	31.34	Swartkrans M1	This research, pilot study	Serial
SKX11602C	A.marsupialis/australis	-9.43	-0.09	30.77	Swartkrans M1	This research, pilot study	Serial
SKX11602D	A.marsupialis/australis	-9.73	0.34	31.21	Swartkrans M1	This research, pilot study	Serial
SKX11602E	A.marsupialis/australis	-9.66	-1.1	29.73	Swartkrans M1	This research, pilot study	Serial
SKX11602F	A.marsupialis/australis	-9.85	0.14	31.01	Swartkrans M1	This research, pilot study	Serial (nearest cusp)
SKX36545	A.marsupialis/australis	-8.11	-1.69	29.13	Swartkrans M3	This research, pilot study	Bulk
SKX34249X	A.marsupialis/australis	-4.1	4.98	36	Swartkrans M3	This research, pilot study	Bulk
SKX34249X (REP)	A.marsupialis/australis	-6.24	3.46	34.43	Swartkrans M3	This research, pilot study	Bulk
SKX33839	A.marsupialis/australis	-9.08	-0.03	30.83	Swartkrans M3	This research, pilot study	Bulk
SKX28999	A.marsupialis/australis	-5.2	3.49	34.46	Swartkrans M3	This research, pilot study	Bulk
SKX28008B	A.marsupialis/australis	-9.27	3.63	34.6	Swartkrans M3	This research, pilot study	Serial
SKX28008C	A.marsupialis/australis	-8.92	6.83	37.91	Swartkrans M3	This research, pilot study	Serial
SKX35326	Antidorcas sp.	-10.82	0.41	31.29	Swartkrans M3	This research, pilot study	Bulk
SKX34249A	Antidorcas sp.	-8.26	0.48	31.36	Swartkrans M3	This research, pilot study	Serial
SKX34249B	Antidorcas sp.	-7.63	0.52	31.4	Swartkrans M3	This research, pilot study	Serial
SKX34249C	Antidorcas sp.	-7.56	1.4	32.3	Swartkrans M3	This research, pilot study	Serial
SKX34249D	Antidorcas sp.	-8.44	3.25	34.21	Swartkrans M3	This research, pilot study	Serial
SKX34249E	Antidorcas sp.	-7.62	7.01	38.09	Swartkrans M3	This research, pilot study	Serial

Number	***Species***	**Values δ^{13}C ‰**	**Values δ^{18}O (PDB)‰**	**δ^{18}O SNOW‰**	**Site provenance**	**Reference**	**Other information**
SKX34249F	Antidorcas sp.	-7.63	8.28	39.4	Swartkrans M3	This research, pilot study	Serial
88300	*Antidorcas recki*	3	-2.196284	28.6	Anabo Koma (ca. 1.6 Ma), Djibouti	Bocherens et al. 1996	
no number	*Damaliscus pygargus*	0.5	x	x	Modern - South Africa	Sponheimer et al. 2003	Mean value
no number	*Tragelaphus strepsiceros*	-13.0	x	x	Modern - South Africa	Sponheimer et al. 2003	Mean value
no number	*Tragelaphus strepsiceros*	-13.4	-0.78	30.0559292	Modern-Maswa, Tanzania	van der Merwe et al. 2013	Mean value
UCT 7062	*Tragelaphus strepsiceros*	-14.1	2	32.92172	Modern-Maswa, Tanzania	van der Merwe et al. 2013	
UCT 7063	*Tragelaphus strepsiceros*	-16.6	-3.5	27.25199	Modern-Maswa, Tanzania	van der Merwe et al. 2013	
UCT 1709	*Tragelaphus strepsiceros*	-10.3	2.1	33.024806	Albany thicket, Addo National Park, South Africa	Luyt & Sealy 2018	
UCT 1711	*Tragelaphus strepsiceros*	-11.2	1.8	32.715548	Albany thicket, Addo National Park, South Africa	Luyt & Sealy 2018	
UCT 1710	*Tragelaphus strepsiceros*	-10.9	1.5	32.40629	Albany thicket, Addo National Park, South Africa	Luyt & Sealy 2018	
no number	*Aepyceros melampus*	-5.8	x	x	Modern - South Africa	Sponheimer et al. 2003	Mean value
no number	*Aepyceros melampus*	-3.3	3.52707	34.5	Modern - South Africa	Sponheimer & Lee-Thorp 2001	Mean value
no number	*Aepyceros melampus*	-1.04	1.5	32.40629	Modern- Tanzania	van der Meerwe et al. 2013	Mean value
UCT 9992	*Aepyceros melampus*	-2.6	0.5	31.37543	Modern-Serengeti, Tanzania	van der Meerwe et al. 2013	Mean value
UCT 9999	*Aepyceros melampus*	-2.3	3	33.95258	Modern-Serengeti, Tanzania	van der Meerwe et al. 2013	Mean value
UCT 7074	*Aepyceros melampus*	1.8	1	31.89086	Modern-Maswa, Tanzania	van der Meerwe et al. 2013	Mean value
no number	*A. marsupialis*	-18.10	x	x	Modern - South Africa	Vogel 1978	Mean value
no number	*A. marsupialis*	-10.10	x	x	Modern - South Africa	Sponheimer et al. 2003	Mean value
UCT 8080	*A. marsupialis*	-10.90	4.5	35.49887	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value
UCT 8082	*A. marsupialis*	-10.9	3.5	34.46801	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value
UCT 8085	*A. marsupialis*	-12.2	5.1	36.117386	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value
UCT 8086	*A. marsupialis*	-13.5	4.1	35.086526	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value

Number	***Species***	**Values $\delta^{13}C$ ‰**	**Values $\delta^{18}O$ (PDB)‰**	**$\delta^{18}O$ SNOW‰**	**Site provenance**	**Reference**	**Other information**
UCT 8087	*A. marsupialis*	-11.7	5	36.0143	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value
UCT 8090	*A. marsupialis*	-11.1	3.4	34.364924	Modern, Nama Karoo, South Africa	Luyt & Sealy 2018	Mean value
UCT 8104	*A. marsupialis*	-13.3	5.3	36.323558	Succulent Karoo, Anysberg, South Africa	Luyt & Sealy 2018	Mean value

APPENDIX A9 MULTI-METHOD CORRELATIONS

Correlations that were suggested by this data are included here. These graphs are not included in the main body of the thesis because small sample sizes render these correlations unprovable and would require substantial further analysis with an increased sample size/ dataset to definitively prove these correlations, and go on to make palaeoenvironmental/ dietary inferences as a result. The trend shown is the focus of the figures given, rather than the specific values (which are provided for each method in the main thesis), larger figures available on request.

Stable Isotopes and Enamel Thickness

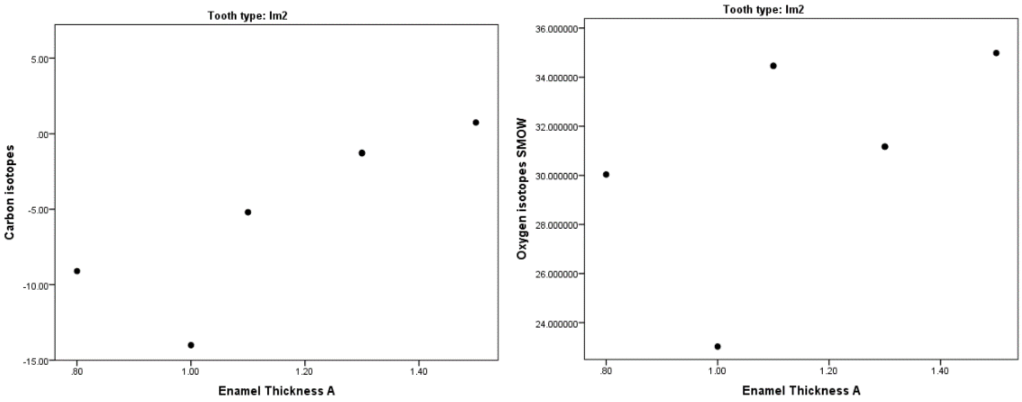


Figure 11.1: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the buccal enamel facet of the lower second molar (location 'A').

For enamel thickness B, the interior enamel (paracone/metacone), the trend appeared to prevail across more of the toothrow, albeit with very small sample sizes. Sample sizes this small preclude any reliable conclusions from this data alone but can assist in highlighting suggestive trends for avenues for future exploration.

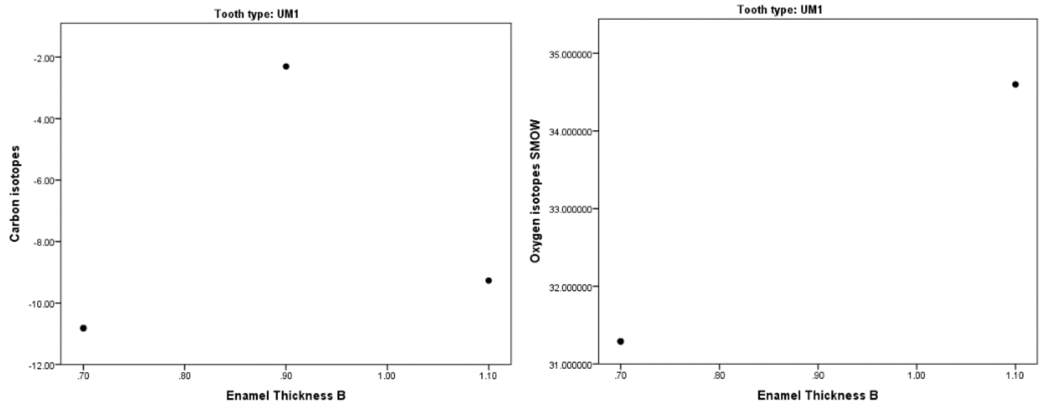


Figure 11.2: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the interior (infundibulum) enamel facet of the upper first molar (location 'B').

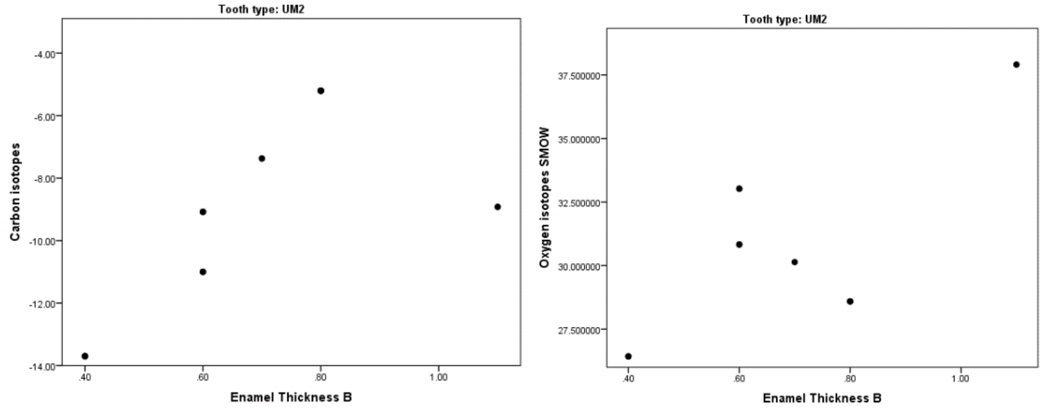


Figure 11.3: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the interior (infundibulum) enamel facet of the upper second molar (location 'B').

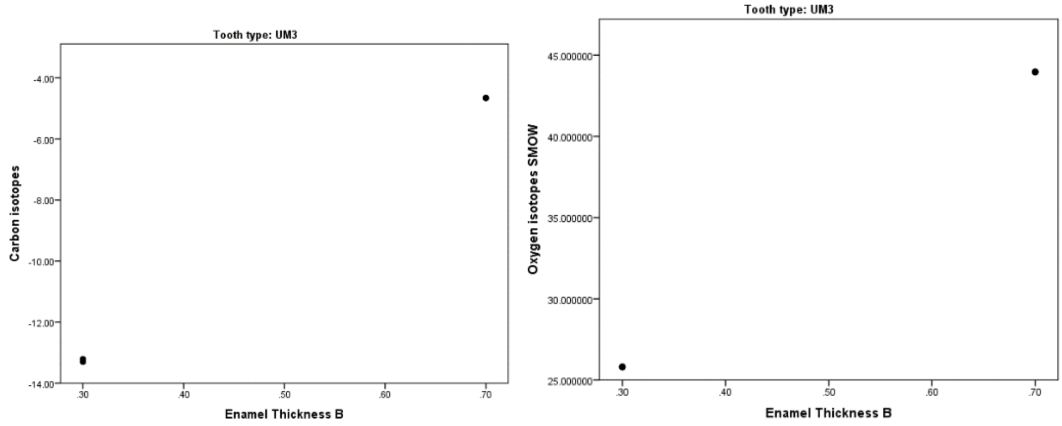


Figure 11.4: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the interior (infundibulum) enamel facet of the upper third molar (location 'B').

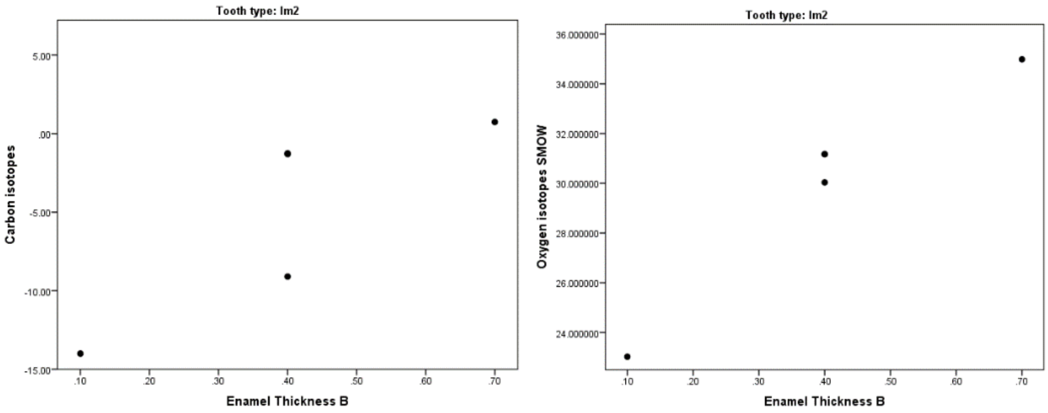


Figure 11.5: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the interior (infundibulum) enamel facet of the lower second molar (location 'B').

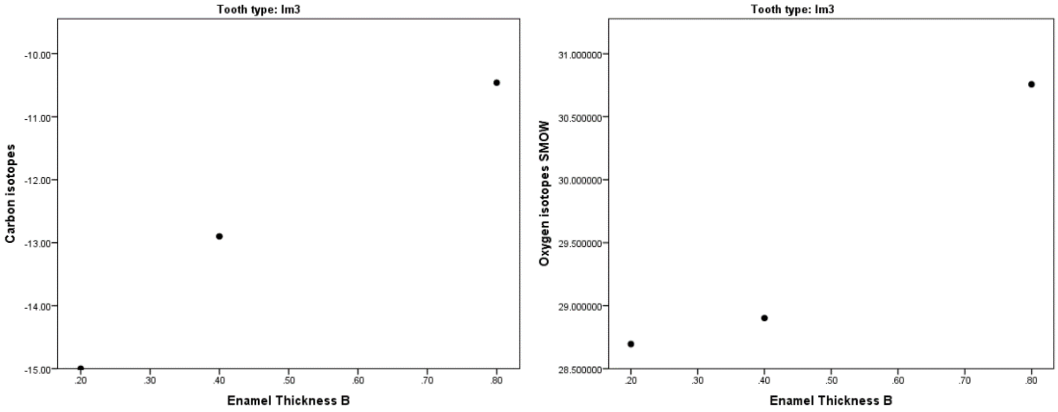


Figure 11.6: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the interior (infundibulum) enamel facet of the lower third molar (location 'B').

A weak trend exists for enamel thickness C (buccal wall for maxillary molars; lingual wall for mandibular molars). Lm$_1$ has consistent enamel thickness of 05.mm (n=7) in this location (so no correlation is observed with either carbon or oxygen isotopes). The trend is strongest for third molars.

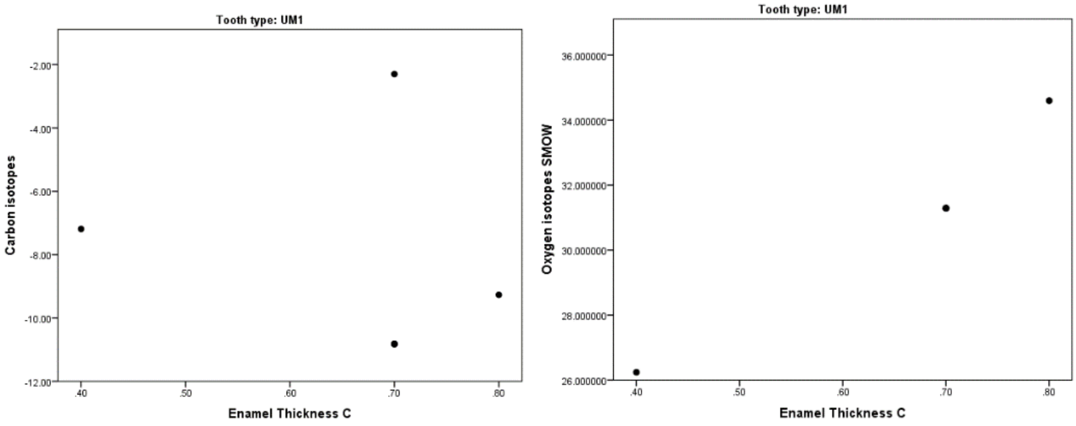


Figure 11.7: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the buccal enamel facet of the upper first molar (location 'C').

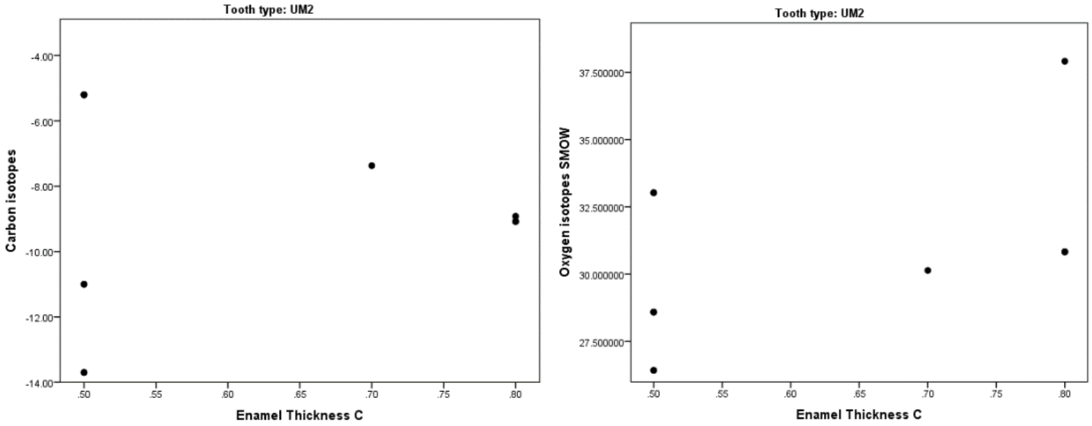


Figure 11.8: Scatter plot showing individual Antidorcas specimens carbon $\delta^{13}C$ (‰) (left) and oxygen $\delta^{18}O$ (‰) (right) against enamel thickness on the buccal enamel facet of the upper second molar (location 'C').

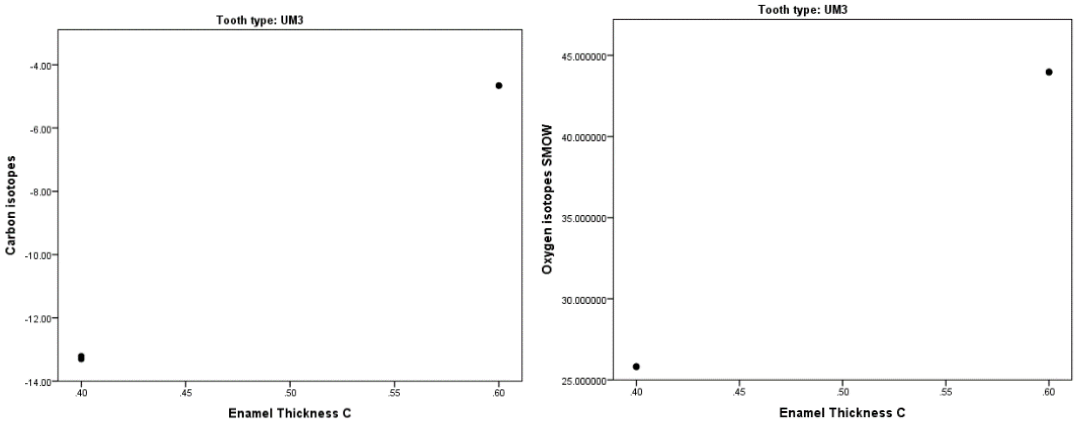


Figure 11.9: Scatter plot showing individual Antidorcas specimens carbon δ13C (‰) (left) and oxygen δ18O (‰) (right) against enamel thickness on the buccal enamel facet of the upper third molar (location 'C').

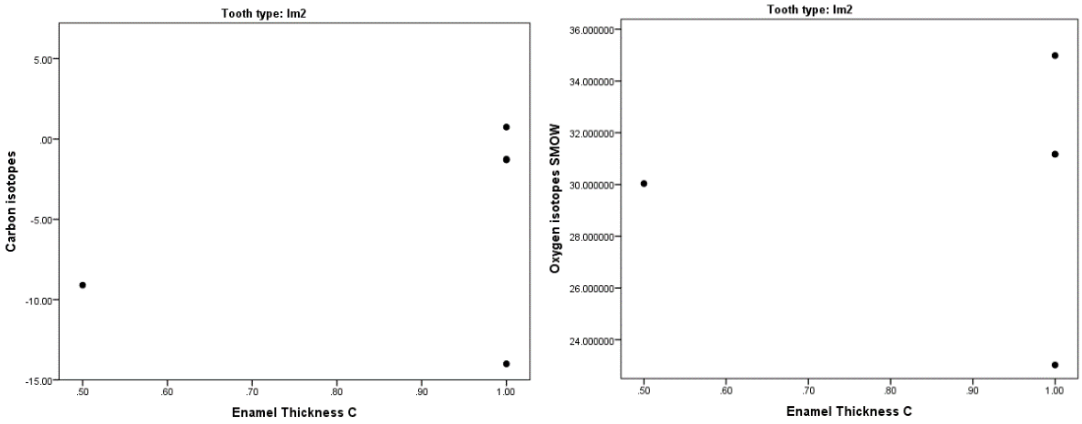


Figure 11.10: Scatter plot showing individual Antidorcas specimens carbon δ13C (‰) (left) and oxygen δ18O (‰) (right) against enamel thickness on the lingual enamel facet of the lower second molar (location 'C').

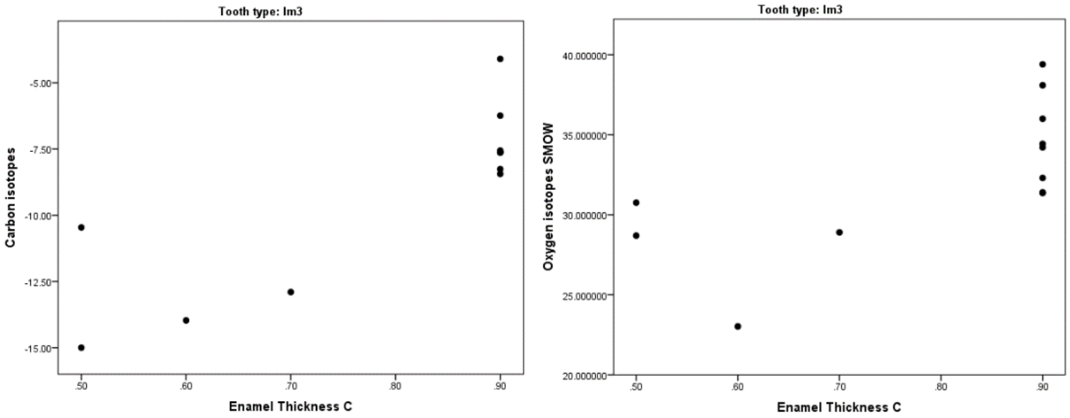


Figure 11.11: Scatter plot showing individual Antidorcas specimens carbon δ13C (‰) (left) and oxygen δ18O (‰) (right) against enamel thickness on the lingual enamel facet of the lower third molar (location 'C').

A weak negative correlation was observed for enamel thickness on the mesostyle (location D) against carbon isotopes, present only in maxillary molars. The opposite was seen for oxygen isotopes, other than for the third molar, in which a negative correlation was also seen.

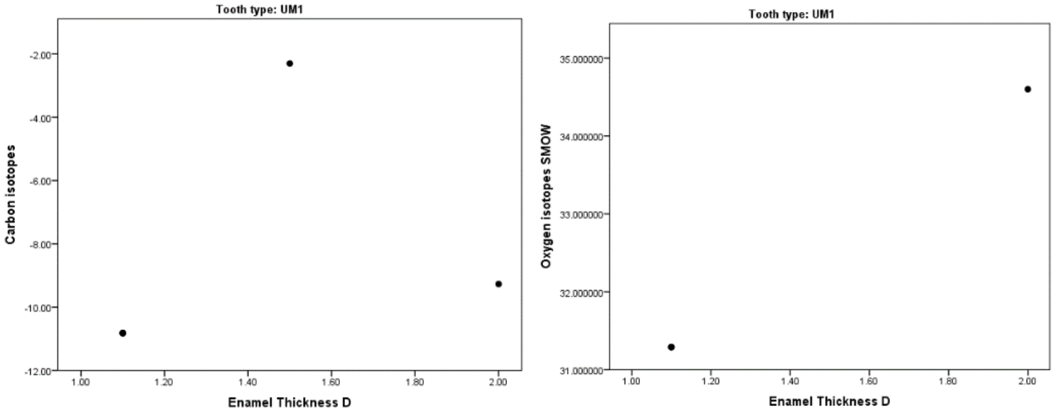


Figure 11.12: Scatter plot showing individual Antidorcas specimens carbon δ^{13}C (‰) (left) and oxygen δ^{18}O (‰) (right) against enamel thickness on the mesostyle of the upper first molar (location 'D').

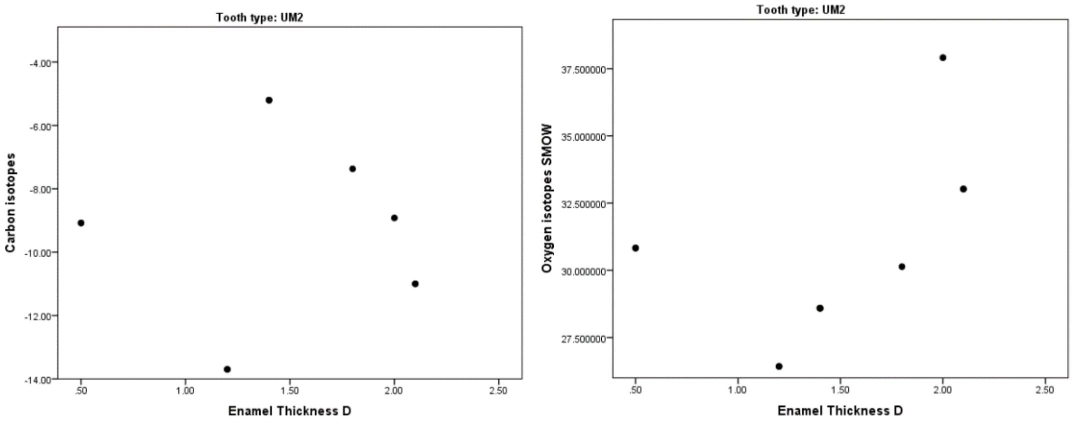


Figure 11.13: Scatter plot showing individual Antidorcas specimens carbon δ^{13}C (‰) (left) and oxygen δ^{18}O (‰) (right) against enamel thickness on the mesostyle of the upper second molar (location 'D').

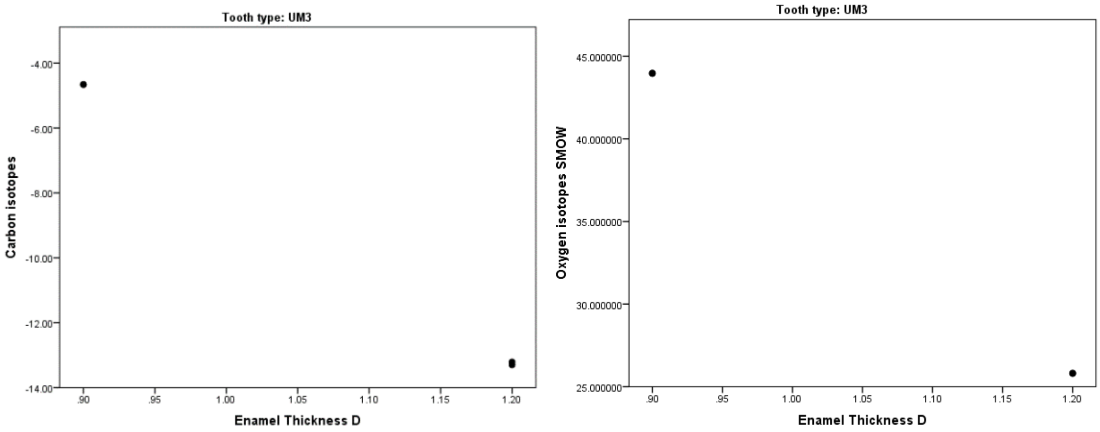


Figure 11.14: Scatter plot showing individual Antidorcas specimens carbon δ^{13}C (‰) (left) and oxygen δ^{18}O (‰) (right) against enamel thickness on the mesostyle of the upper third molar (location 'D').

DMTA and Enamel Thickness

Dietary abrasion may be implied by the correlation of these methods, however, the sample sizes here are too small to state this definitively.

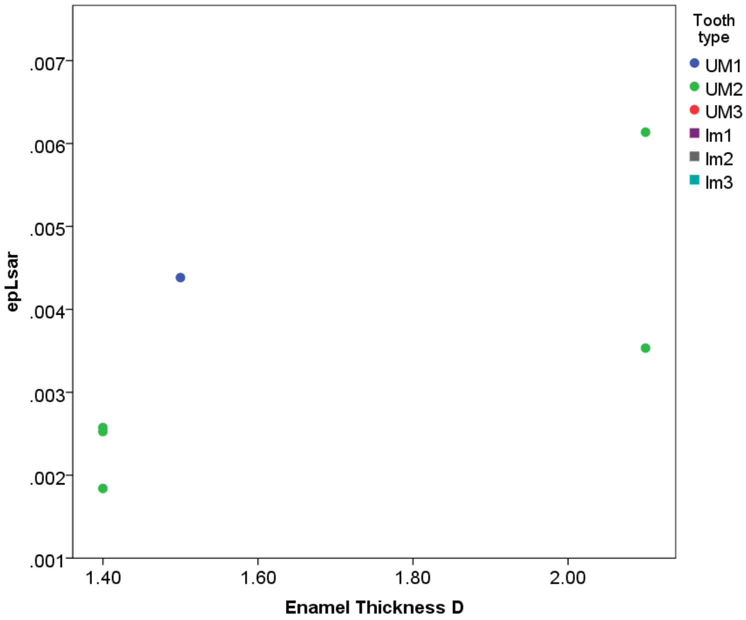


Figure 11.15: Scatterplot of Antidorcas mesostyle enamel thickness (enamel thickness D, in mm) correlated against dental microwear complexity (epLsar, in µm)

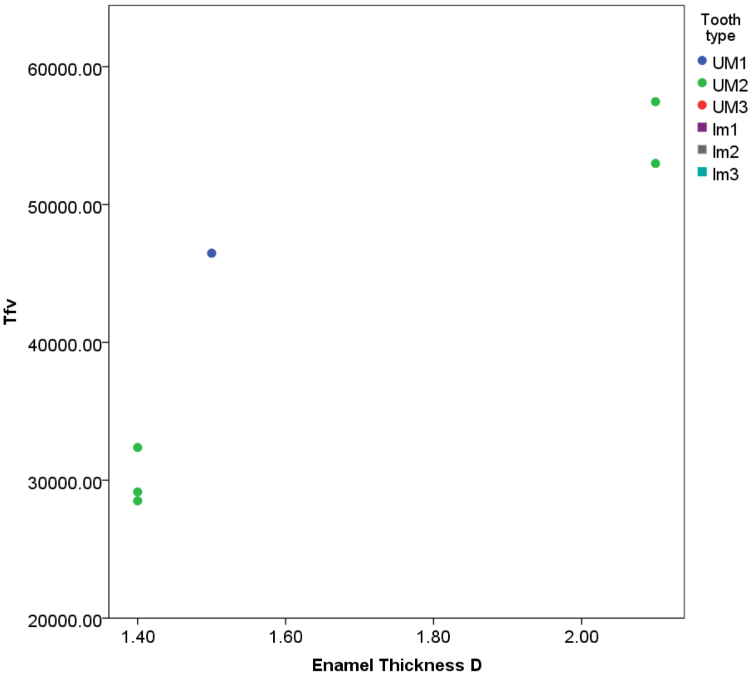


Figure 11.16: Scatterplot of Antidorcas mesostyle enamel thickness (enamel thickness D, in mm) correlated against dental microwear textural fill volume (epLsar, in µm)

Appendix A10: Dataset used in this research

A10.1 Modern Antidorcas marsupialis

Specimen number	Sex	Tooth measured	Provenance	Genus	species
TM 16538/ AZ 692	female	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16538/ AZ 692	female	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16538/ AZ 692	female	LLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16538/ AZ 692	female	RLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16538/ AZ 692	female	LLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 16538/ AZ 692	female	RLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 11479	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 11479	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16173	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 16173	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	RUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	LUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	LLM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	RLM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	LLM3	Ditsong	*Antidorcas*	*marsupialis*
AZ 2437	female	RLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	LLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	RLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	LLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 13232	male	RLM3	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	LLM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	RLM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	LLM3	Ditsong	*Antidorcas*	*marsupialis*
AZ 3140	male	RLM3	Ditsong	*Antidorcas*	*marsupialis*
SM 514 (T.5.14)	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
SM 514 (T.5.14)	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13233	male	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13233	male	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13233	male	LLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13233	male	LLM3	Ditsong	*Antidorcas*	*marsupialis*
AZ 22438	female	RUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 22438	female	LUM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 22438	female	LLM2	Ditsong	*Antidorcas*	*marsupialis*
AZ 22438	female	RLM2	Ditsong	*Antidorcas*	*marsupialis*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
AZ 22438	female	LLM3	Ditsong	*Antidorcas*	*marsupialis*
AZ 22438	female	RLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	RUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	LUM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	LLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	RLM2	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	LLM3	Ditsong	*Antidorcas*	*marsupialis*
TM 13231	female	RLM3	Ditsong	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	L lower M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	L lower M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	L upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	L upper M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	R upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2012.34.1	Male	R upper M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	L upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	L upper M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	R upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	R upper M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	L lower M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	L lower M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	R lower M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.1939.1.2	x	R lower M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	L lower M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	L lower M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	R upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	R upper M3	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	L upper M2	NMS	*Antidorcas*	*marsupialis*
NMS.Z.2002.212.2	Female	L upper M3	NMS	*Antidorcas*	*marsupialis*
31.2.1.31	x	L lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.31	x	L lower M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.31	x	R lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.31	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
19.7.15.334	x	L lower M1	NHM	*Antidorcas*	*marsupialis*
19.7.15.334	x	L lower M2	NHM	*Antidorcas*	*marsupialis*
19.7.15.334	x	R lower M1	NHM	*Antidorcas*	*marsupialis*
19.7.15.334	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
2.12.1.42	x	L lower M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.42	x	L lower M2	NHM	*Antidorcas*	*marsupialis*
2.12.1.42	x	R lower M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.42	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.33	Female	L upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.33	Female	L upper M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.33	Female	R upper M1	NHM	*Antidorcas*	*marsupialis*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
31.2.1.33	Female	R upper M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	L upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	L upper M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	L lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	L lower M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	R lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.35	Female	R lower M2	NHM	*Antidorcas*	*marsupialis*
64.445	x	R upper M1	NHM	*Antidorcas*	*marsupialis angolensis*
64.445	x	R upper M2	NHM	*Antidorcas*	*marsupialis angolensis*
64.445	x	R upper M3	NHM	*Antidorcas*	*marsupialis angolensis*
31.2.1.34	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	L lower M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	L lower M2	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	R lower M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
4.1.11.42	x	L lower M1	NHM	*Antidorcas*	*marsupialis marsupialis*
4.1.11.42	x	L lower M2	NHM	*Antidorcas*	*marsupialis marsupialis*
4.1.11.42	x	R lower M1	NHM	*Antidorcas*	*marsupialis marsupialis*
4.1.11.42	x	R lower M2	NHM	*Antidorcas*	*marsupialis marsupialis*
27.2.11.88	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
27.2.11.88	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
27.2.11.88	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
27.2.11.88	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
1972.4538	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
1972.4538	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
1972.4538	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
1972.4538	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
28.9.11.454	x	L upper M1	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.454	x	L upper M2	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.454	x	R upper M1	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.454	x	R upper M2	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.453	x	L upper M1	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.453	x	L upper M2	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.453	x	R upper M1	NHM	*Antidorcas*	*angolensis hofmeyri*
28.9.11.453	x	R upper M2	NHM	*Antidorcas*	*angolensis hofmeyri*
31.2.1.34	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.34	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.34	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.34	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
42.4.11.1	x	L upper M1	NHM	*Antidorcas*	*marsupialis marsupialis*
42.4.11.1	x	L upper M2	NHM	*Antidorcas*	*marsupialis marsupialis*
42.4.11.1	x	R upper M1	NHM	*Antidorcas*	*marsupialis marsupialis*
42.4.11.1	x	R upper M2	NHM	*Antidorcas*	*marsupialis marsupialis*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
31.2.1.32	Male	L upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.32	Male	L upper M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.32	Male	R upper M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.32	Male	R upper M2	NHM	*Antidorcas*	*marsupialis*
20.4.27.35	Female	L upper M1	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.35	Female	L upper M2	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.35	Female	R upper M1	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.35	Female	R upper M2	NHM	*Antidorcas*	*marsupialis angolensis*
26.12.7.324	Female	L lower M1	NHM	*Antidorcas*	*angolensis hofmeyri*
26.12.7.324	Female	L lower M2	NHM	*Antidorcas*	*angolensis hofmeyri*
26.12.7.324	Female	R lower M1	NHM	*Antidorcas*	*angolensis hofmeyri*
26.12.7.324	Female	R lower M2	NHM	*Antidorcas*	*angolensis hofmeyri*
20.4.27.32	Male	L upper M1	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.32	Male	L upper M2	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.32	Male	R upper M1	NHM	*Antidorcas*	*marsupialis angolensis*
20.4.27.32	Male	R upper M2	NHM	*Antidorcas*	*marsupialis angolensis*
2.12.1.35	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
2.12.1.35	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
27.2.11.82	Male	L upper M1	NHM	*Antidorcas*	*marsupialis*
27.2.11.82	Male	L upper M2	NHM	*Antidorcas*	*marsupialis*
27.2.11.82	Male	R upper M1	NHM	*Antidorcas*	*marsupialis*
27.2.11.82	Male	R upper M2	NHM	*Antidorcas*	*marsupialis*
25.1.2.254	Male	L upper M1	NHM	*Antidorcas*	*angolensis hofmeri*
25.1.2.254	Male	L upper M2	NHM	*Antidorcas*	*angolensis hofmeri*
25.1.2.254	Male	R upper M2	NHM	*Antidorcas*	*angolensis hofmeri*
72.4539	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
73.4539	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
74.4539	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
75.4539	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
28.9.11.450	x	L upper M1	NHM	*Antidorcas*	*angolensis hofmeri*
28.9.11.450	x	L upper M2	NHM	*Antidorcas*	*angolensis hofmeri*
28.9.11.450	x	R upper M1	NHM	*Antidorcas*	*angolensis hofmeri*
28.9.11.450	x	R upper M2	NHM	*Antidorcas*	*angolensis hofmeri*
70.231	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
70.231	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
70.231	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
70.231	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
26.12.7.324	Female	L upper M1	NHM	*Antidorcas*	*angolensis hofmeri*
26.12.7.324	Female	L upper M2	NHM	*Antidorcas*	*angolensis hofmeri*
26.12.7.324	Female	R upper M1	NHM	*Antidorcas*	*angolensis hofmeri*
26.12.7.324	Female	R upper M2	NHM	*Antidorcas*	*angolensis hofmeri*

Specimen number	Sex	Tooth measured	Provenance	Genus	species
96.11.28.8	x	L upper M1	NHM	*Antidorcas*	*marsupialis*
96.11.28.8	x	L upper M2	NHM	*Antidorcas*	*marsupialis*
96.11.28.8	x	R upper M1	NHM	*Antidorcas*	*marsupialis*
96.11.28.8	x	R upper M2	NHM	*Antidorcas*	*marsupialis*
28.9.11.450	x	L lower M1	NHM	*Antidorcas*	*angolensis hofmeri*
28.9.11.450	x	L lower M2	NHM	*Antidorcas*	*angolensis hofmeri*
31.2.1.30	x	L lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.30	x	L lower M2	NHM	*Antidorcas*	*marsupialis*
31.2.1.30	x	R lower M1	NHM	*Antidorcas*	*marsupialis*
31.2.1.30	x	R lower M2	NHM	*Antidorcas*	*marsupialis*
19.7.15.335	x	L lower M1	NHM	*Antidorcas*	*marsupialis marsupialis*
19.7.15.335	x	L lower M2	NHM	*Antidorcas*	*marsupialis marsupialis*
19.7.15.335	x	R lower M1	NHM	*Antidorcas*	*marsupialis marsupialis*
19.7.15.335	x	R lower M2	NHM	*Antidorcas*	*marsupialis marsupialis*

A10.1.2 Supplementary modern species

Specimen number	Sex	Tooth measured	Provenance	Genus	species
AZ 12611	female	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 12611	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 12611	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 12611	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 12611	x	RLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 12611	x	LLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	RLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2188	x	LLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	RLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1592	x	LLM3	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1287	x	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1287	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1287	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1287	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1151	x	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1151	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1151	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 1151	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3818	Female	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
TM 3818	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3818	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3297	Female	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3297	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3297	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3297	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 1030	Female	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 1030	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 1030	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 1030	x	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3293	x	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3293	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3293	x	RLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 3293	Male	LLM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 13094	Female	RUM2	Ditsong	*Tragelaphus*	*strepsiceros*
TM 13094	x	LUM2	Ditsong	*Tragelaphus*	*strepsiceros*
AZ 2141	x	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2141	x	LUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2094	Male	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2094	x	LUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2820	x	LLM2	Ditsong	*Damaliscus*	*pygargus*
AZ 1735	x	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 1735	Female	RLM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2092	x	LUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 2092	x	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 1613	x	RUM2	Ditsong	*Damaliscus*	*dorcas phillipsi*
AZ 1613	x	LUM2	Ditsong	*Damaliscus*	*dorcas phillipsi*
AZ 3084	x	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 3084	x	LUM2	Ditsong	*Damaliscus*	*pygargus*
TM 12599	Male	RUM2	Ditsong	*Damaliscus*	*dorcas albifrons*
TM 12599	x	LUM2	Ditsong	*Damaliscus*	*dorcas albifrons*
TM 12599	x	LLM2	Ditsong	*Damaliscus*	*dorcas albifrons*
AZ 3074	Female	RUM2	Ditsong	*Damaliscus*	*pygargus*
AZ 3074	x	LUM2	Ditsong	*Damaliscus*	*pygargus*
NMS.Z.1990.28.7	x	R lower M2	NMS	*Damaliscus*	*dorcas*
NMS.Z.1990.28.7	x	R lower M3	NMS	*Damaliscus*	*dorcas*
NMS.Z.1990.28.7	x	R upper M2	NMS	*Damaliscus*	*dorcas*
NMS.Z.1990.28.7	x	R upper M3	NMS	*Damaliscus*	*dorcas*
NMS.Z.1990.28.7	x	L upper M2	NMS	*Damaliscus*	*dorcas*
NMS.Z.1990.28.7	x	L upper M3	NMS	*Damaliscus*	*dorcas*
58.3.17.3	x	L upper M2	NHM	*Damaliscus*	*pygargus*
58.3.17.3	x	R upper M2	NHM	*Damaliscus*	*pygargus*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
74.461	x	L upper M1	NHM	*Damaliscus*	*dorcas*
74.461	x	L upper M2	NHM	*Damaliscus*	*dorcas*
74.461	x	R upper M1	NHM	*Damaliscus*	*dorcas*
74.461	x	R upper M2	NHM	*Damaliscus*	*dorcas*
74.461	x	L lower M2?	NHM	*Damaliscus*	*dorcas*
74.461	x	R lower M2?	NHM	*Damaliscus*	*dorcas*
7.1.39.25	x	L lower M1	NHM	*Damaliscus*	*pygragus*
7.1.39.25	x	L lower M2	NHM	*Damaliscus*	*pygragus*
8.12.8.1	x	L lower M1	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	L lower M2	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	R lower M1	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	R lower M2	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	L upper M1	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	L upper M2	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	R upper M1	NHM	*Damaliscus*	*albifrons*
8.12.8.1	x	R upper M2	NHM	*Damaliscus*	*albifrons*
16f	x	L lower M1	NHM	*Damaliscus*	*pygargus*
16f	x	R lower M1	NHM	*Damaliscus*	*pygargus*
16f	x	L upper M2	NHM	*Damaliscus*	*pygargus*
16f	x	R lower M2	NHM	*Damaliscus*	*pygargus*
70.345	x	L lower M1	NHM	*Damaliscus*	*dorcas*
70.345	x	L lower M2	NHM	*Damaliscus*	*dorcas*
70.345	x	L lower M3	NHM	*Damaliscus*	*dorcas*
70.345	x	R lower M1	NHM	*Damaliscus*	*dorcas*
70.345	x	R lower M2	NHM	*Damaliscus*	*dorcas*
70.345	x	R lower M3	NHM	*Damaliscus*	*dorcas*
70.345	x	L upper M1	NHM	*Damaliscus*	*dorcas*
70.345	x	L upper M2	NHM	*Damaliscus*	*dorcas*
70.345	x	R upper M1	NHM	*Damaliscus*	*dorcas*
70.345	x	R upper M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	L lower M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R lower M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	L upper M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R upper M1	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R upper M2	NHM	*Damaliscus*	*dorcas*
39.7.25.2	x	L upper M1	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R upper M2	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	L upper M1	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	L upper M2	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	R upper M1	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	R upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R lower M1	NHM	*Damaliscus*	*pygargus*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
39.7.25.1	x	R lower M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	L upper M1	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	L upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R upper M1	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R upper M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L lower M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L lower M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R lower M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R lower M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L upper M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L upper M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R upper M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L lower M3	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R lower M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R lower M3	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	L upper M1	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	L upper M2	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	R upper M1	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	R upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L lower M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L lower M2	NHM	*Damaliscus*	*pygargus*
70.345	x	R lower M2	NHM	*Damaliscus*	*dorcas*
70.345	x	R lower M3	NHM	*Damaliscus*	*dorcas*
70.345	x	L upper M1	NHM	*Damaliscus*	*dorcas*
70.345	x	L upper M2	NHM	*Damaliscus*	*dorcas*
70.345	x	R upper M1	NHM	*Damaliscus*	*dorcas*
70.345	x	R upper M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	L lower M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R lower M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	L upper M2	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R upper M1	NHM	*Damaliscus*	*dorcas*
1857.12.21.7	x	R upper M2	NHM	*Damaliscus*	*dorcas*
39.7.25.2	x	L upper M1	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R upper M2	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	L upper M1	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	L upper M2	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	R upper M1	NHM	*Damaliscus*	*pygargus*
19.7.15.95	x	R upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R lower M1	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R lower M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	L upper M1	NHM	*Damaliscus*	*pygargus*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
39.7.25.1	x	L upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R upper M1	NHM	*Damaliscus*	*pygargus*
39.7.25.1	x	R upper M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L lower M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L lower M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R lower M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R lower M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L upper M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	L upper M2	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R upper M1	NHM	*Damaliscus*	*pygargus*
58.3.17.4	x	R upper M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	L lower M3	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R lower M2	NHM	*Damaliscus*	*pygargus*
39.7.25.2	x	R lower M3	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	L upper M1	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	L upper M2	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	R upper M1	NHM	*Damaliscus*	*pygargus*
51.10.23.13	x	R upper M2	NHM	*Damaliscus*	*pygargus*
75.1164	x	L lower M1	NHM	Damaliscus	*korrigum*
75.1164	x	L lower M2	NHM	Damaliscus	*korrigum*
75.1164	x	R lower M1	NHM	Damaliscus	*korrigum*
75.1164	x	R lower M2	NHM	Damaliscus	*korrigum*
75.1164	x	L upper M1	NHM	Damaliscus	*korrigum*
75.1164	x	L upper M2	NHM	Damaliscus	*korrigum*
75.1164	x	R upper M1	NHM	Damaliscus	*korrigum*
75.1164	x	R upper M2	NHM	Damaliscus	*korrigum*
31.2.1.11	x	L lower M1	NHM	Damaliscus	*lunatus*
31.2.1.11	x	L lower M2	NHM	Damaliscus	*lunatus*
31.2.1.11	x	R lower M1	NHM	Damaliscus	*lunatus*
31.2.1.11	x	R lower M2	NHM	Damaliscus	*lunatus*
75.1160	x	L lower M2	NHM	Damaliscus	*korrigum*
75.1160	x	L lower M3	NHM	Damaliscus	*korrigum*
75.1160	x	R lower M2	NHM	Damaliscus	*korrigum*
75.1160	x	R lower M3	NHM	Damaliscus	*korrigum*
75.1160	x	L upper M2	NHM	Damaliscus	*korrigum*
75.1160	x	L upper M3	NHM	Damaliscus	*korrigum*
75.1160	x	R upper M2	NHM	Damaliscus	*korrigum*
75.1160	x	R upper M3	NHM	Damaliscus	*korrigum*
26.11.18.17	x	L lower M1	NHM	Damaliscus	*korrigum*
26.11.18.17	x	L lower M2	NHM	Damaliscus	*korrigum*
26.11.18.17	x	R lower M1	NHM	Damaliscus	*korrigum*
26.11.18.17	x	R lower M2	NHM	Damaliscus	*korrigum*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
35.9.1.846	x	R lower M1	NHM	Damaliscus	*lunatus*
35.9.1.846	x	R lower M2	NHM	Damaliscus	*lunatus*
12.7.2.6	x	L lower M1	NHM	Damaliscus	*hunteri*
12.7.2.6	x	L lower M2	NHM	Damaliscus	*hunteri*
12.7.2.6	x	R lower M1	NHM	Damaliscus	*hunteri*
12.7.2.6	x	R lower M2	NHM	Damaliscus	*hunteri*
34.11.1.10	x	L upper M1	NHM	Damaliscus	*lunatus*
34.11.1.10	x	L upper M2	NHM	Damaliscus	*lunatus*
34.11.1.10	x	R upper M1	NHM	Damaliscus	*lunatus*
34.11.1.10	x	R upper M2	NHM	Damaliscus	*lunatus*
75.1164	x	L lower M1	NHM	Damaliscus	*korrigum*
75.1164	x	L lower M2	NHM	Damaliscus	*korrigum*
75.1164	x	R lower M1	NHM	Damaliscus	*korrigum*
75.1164	x	R lower M2	NHM	Damaliscus	*korrigum*
75.1164	x	L upper M1	NHM	Damaliscus	*korrigum*
75.1164	x	L upper M2	NHM	Damaliscus	*korrigum*
75.1164	x	R upper M1	NHM	Damaliscus	*korrigum*
75.1164	x	R upper M2	NHM	Damaliscus	*korrigum*
31.2.1.11	x	L lower M1	NHM	Damaliscus	*lunatus*
31.2.1.11	x	L lower M2	NHM	Damaliscus	*lunatus*
31.2.1.11	x	R lower M1	NHM	Damaliscus	*lunatus*
31.2.1.11	x	R lower M2	NHM	Damaliscus	*lunatus*
75.1160	x	L lower M2	NHM	Damaliscus	*korrigum*
75.1160	x	L lower M3	NHM	Damaliscus	*korrigum*
75.1160	x	R lower M2	NHM	Damaliscus	*korrigum*
75.1160	x	R lower M3	NHM	Damaliscus	*korrigum*
75.1160	x	L upper M2	NHM	Damaliscus	*korrigum*
75.1160	x	L upper M3	NHM	Damaliscus	*korrigum*
75.1160	x	R upper M2	NHM	Damaliscus	*korrigum*
75.1160	x	R upper M3	NHM	Damaliscus	*korrigum*
26.11.18.17	x	L lower M1	NHM	Damaliscus	*korrigum*
26.11.18.17	x	L lower M2	NHM	Damaliscus	*korrigum*
26.11.18.17	x	R lower M1	NHM	Damaliscus	*korrigum*
26.11.18.17	x	R lower M2	NHM	Damaliscus	*korrigum*
35.9.1.846	x	R lower M1	NHM	Damaliscus	*lunatus*
35.9.1.846	x	R lower M2	NHM	Damaliscus	*lunatus*
12.7.2.6	x	L lower M1	NHM	Damaliscus	*hunteri*
12.7.2.6	x	L lower M2	NHM	Damaliscus	*hunteri*
12.7.2.6	x	R lower M1	NHM	Damaliscus	*hunteri*
12.7.2.6	x	R lower M2	NHM	Damaliscus	*hunteri*
34.11.1.10	x	L upper M1	NHM	Damaliscus	*lunatus*
34.11.1.10	x	L upper M2	NHM	Damaliscus	*lunatus*
34.11.1.10	x	R upper M1	NHM	Damaliscus	*lunatus*

Specimen number	**Sex**	**Tooth measured**	**Provenance**	**Genus**	**species**
34.11.1.10	x	R upper M2	NHM	Damaliscus	*lunatus*

A10.2 Fossil specimens

Specimen number	**Provenance**	***Genus and Species***
SF 4393	Sterkfontein U45, M4	*A. recki*
SF 4393 (2)	Sterkfontein U45, M4	*A. recki*
STS 1996	Sterkfontein M4	*A. recki*
STS 1996	Sterkfontein M4?	*A. recki*
STS 2076	Sterkfontein M4	*A. recki*
STS 2076	Sterkfontein M4?	*A. recki*
STS 1435	Sterkfontein M4?	*A. recki*
STS 1944	Sterkfontein M4?	*A. recki*
STS 1944 (2)	Sterkfontein M4?	*A. recki*
STS 1560	Sterkfontein M4?	*A. recki*
STS 2369	Sterkfontein M4?	*A. recki*
STS 1325 (A)	Sterkfontein M4?	*A. recki*
STS 1125	Sterkfontein M4?	*A. bondi*
STS 2581	Sterkfontein M4?	*D. pygargus*
STS 2582	Sterkfontein M4?	*D. pygargus*
STS 2582 (2)	Sterkfontein M4?	*D. pygargus*
no #	Sterkfontein R45, M4	*D. pygargus*
STS 2582	Sterkfontein M4	*Damaliscus sp.*
SF 3960	Sterkfontein T47, M4	*Damaliscus sp.*
SF 4245	Sterkfontein T51, M4	*D. pygargus*
SF 4195	Sterkfontein T50, M4	*D. pygargus*
STS 2565	Sterkfontein (M.broomi box)	*Makapania broomi*
SF 3670	Sterkfontein M4	*Bovid (cf. T. strepsiceros)*
STS 812	Sterkfontein type site	Size II bovid
SF 3386	Sterkfontein T47, M4	*T. strepsiceros*
SF 3398	Sterkfontein T47, M4	*T. strepsiceros*
SF 3305	Sterkfontein T47, M4	*T. strepsiceros*
16'5"-17'5" no #	Sterkfontein M46, M4	*Bovid*
x	Sterkfontein M42, M4	*Bovid*
18'9"-19'11"	Sterkfontein N45, M4	*cf. Tragelaphus strepsiceros*
23'10"-24'10" no #	Sterkfontein O46, M4	*Bovid size III premolar*
20'8"-21'10" no #	Sterkfontein O46, M4	*size III bovid*
20'8"-21'10" no #	Sterkfontein O46, M4	*large cf. Tragelaphus cf. strepsiceros (1/2)*
21'4"-22'9" no #	Sterkfontein O42, M4	*size IV bovid*
SF 3718	Sterkfontein T60, M4/5 mix	*A.cf. recki*
SF 4096	Sterkfontein T60, M4/5 mix	*Antidorcas sp.*
SF 3889	Sterkfontein T59, M4/5 mix	*Damaliscus sp.*
SF 3712	Sterkfontein T60, M4/5 mix	*D. pygargus*
SF 4095	Sterkfontein T60, M4/5 mix	*D. pygargus*

Specimen number	**Provenance**	***Genus and Species***
SF 3715	Sterkfontein T60, M4/5 mix	*Alcelaphine sp.*
S94- 3164	Sterkfontein Q50, M4/5 mix	*Tragelaphus sp.*
SF 3722	Sterkfontein T60, M4/5 mix	Size II Bovid
SF 3717	Sterkfontein T61, M4/5 mix	Size II Bovid
SF 3716	Sterkfontein T62, M4/5 mix	Size II Bovid *(Connochaetes sp.)*
SF 4094	Sterkfontein T63, M4/5 mix	Size II Bovid
SF 3710	Sterkfontein T64, M4/5 mix	Size II Bovid
SF 4084	Sterkfontein T62, M4/5 mix	Size II Bovid
SF 3883	Sterkfontein T62, M4/5 mix	Size II Bovid
SF 4028	Sterkfontein T59, M4/5 mix	Size II Bovid
SF 3893	Sterkfontein T59, M4/5 mix	Size II Bovid
S94-234	Sterkfontein V58, StW 53 Infill	*Damaliscus sp.*
S94-6430	Sterkfontein V60, StW 53 Infill	*T. strepsiceros*
S94-1488	Sterkfontein V58, StW 53 Infill	*Size V Bovid*
S94-9462	Sterkfontein V58, StW 53 Infill	*juvenile bovid tooth cf. Damaliscus*
S94-9462	Sterkfontein V58, StW 53 Infill	*juvenile bovid tooth cf. Damaliscus*
S94-6193	Sterkfontein R55, M5E	*A. recki*
BP/3/17182	Sterkfontein Q55, M5E	*A. recki*
SF 1914	Sterkfontein R56, M5E	*A. recki*
SF 2254	Sterkfontein S55, M5E	*A. recki*
SF 1429	Sterkfontein Q56, M5E	*A. recki*
SF 2480	Sterkfontein S54, M5E	*A. recki*
SF 2287	Sterkfontein S56, M5E	*A. bondi*
BP/3/17490	Sterkfontein M5E	*A. bondi*
SF 1528	Sterkfontein Q54, M5E	*A. bondi*
SF 1799	Sterkfontein R56, M5E	*A. bondi*
SF 1700	Sterkfontein R56, M5E	*A. bondi*
SF 1792	Sterkfontein R56, M5E	*A. bondi*
SF 1795	Sterkfontein R56, M5E	*A. bondi*
S94-3376	Sterkfontein R55, M5E	*cf A. cf bondi*
SF 2393	Sterkfontein S55, M5E	*A. marsupialis*
SF 1991	Sterkfontein R56, M5E	*A. marsupialis*
S94-6124	Sterkfontein M5E	*Antidorcas sp.*
BP/3/16974	Sterkfontein M5E	*Antidorcas sp.*
S94-2837	Sterkfontein M5E	*Damaliscus sp.*
S04-3459	Sterkfontein M5E	*Damaliscus sp.*
S94-2839	Sterkfontein M5E	*Damaliscus sp.*
BP/3/17143	Sterkfontein M5E	*Damaliscus sp.*
BP/3/19870	Sterkfontein M5E	*Damaliscus sp.*
SF 1204	Sterkfontein P53, M5E	*Damaliscus sp.*
SF 1794	Sterkfontein R56, M5E	*D. pygargus*

Specimen number	**Provenance**	***Genus and Species***
S94- 6077	Sterkfontein R55, M5E	*D. pygargus*
S94- 15221	Sterkfontein R55, M5E	*D. pygargus*
BP/3/17366	Sterkfontein Q54, M5E	*D. pygargus*
S94- 3118	Sterkfontein Q56, M5E	*D. pygargus*
BP/3/17654	Sterkfontein Q53, M5E	*D. pygargus*
SF 2865	Sterkfontein S53, M5E	*D. pygargus*
SF 2714	Sterkfontein S53, M5E	*D. pygargus*
SF 1293	Sterkfontein M5E	*Damaliscus cf. dorcas*
SF 4165	Sterkfontein T55, M5E	*D.lunatus*
S94-2840	Sterkfontein Q55, M5E	*cf. Damaliscus*
S94-2840	Sterkfontein Q55, M5E	*cf. Damaliscus juvenile*
S94-2838	Sterkfontein Q55, M5E	*cf. Damaliscus*
S94-2838	Sterkfontein Q55, M5E	*cf. Damaliscus*
S94-3706	Sterkfontein R56, M5E	*cf. Damaliscus*
S94-3714	Sterkfontein R56, M5E	*cf. Damaliscus.*
BP/3/16947	Sterkfontein M5E	*Tragelaphini cf. Taurotragus*
BP/3/16956	Sterkfontein M5E	*Tragelaphini cf. Taurotragus*
SF 4234	Sterkfontein T55, M5E	*T. strepsiceros*
BP/3/17418	Sterkfontein Q53, M5E	Size II Bovid
S94-3373	Sterkfontein R55, M5E	Size II Bovid
S94-3374	Sterkfontein R55, M5E	Size II Bovid
S94-3665	Sterkfontein R55, M5E	Size II Bovid
S94-3371	Sterkfontein R55, M5E	Size II Bovid
SF 894	Sterkfontein N64, M5W	*A. recki*
SF 979	Sterkfontein N64, M5W	*A. recki*
SF 830	Sterkfontein N62, M5W	*A. recki*
SF 825	Sterkfontein N62, M5W	*A. recki*
SF 930	Sterkfontein N62, M5W	*A. recki*
SF 944	Sterkfontein N62, M5W	*A. recki*
SF 944	Sterkfontein N62, M5W	*A. recki*
SF 949	Sterkfontein N62, M5W	*A. recki*
SF 942	Sterkfontein N62, M5W	*A. recki*
SF 647	Sterkfontein M64, M5W	*A. recki*
SF 645	Sterkfontein M64, M5W	*A. recki*
SF 681	Sterkfontein M64, M5W	*A. recki*
SF 679	Sterkfontein M64, M5W	*A. recki*
SF 648	Sterkfontein M64, M5W	*A. recki*
S94-7314	Sterkfontein M5W	*A. bondi*
S94-7958	Sterkfontein M5W	*A. bondi*
S94-14707	Sterkfontein M5W	*A. bondi*
SF 933	Sterkfontein N64, M5W	*A. bondi*
SF 892	Sterkfontein N64, M5W	*A. bondi*

Specimen number	**Provenance**	***Genus and Species***
SF 890	Sterkfontein N64, M5W	*A. bondi*
SF 890 (2)	Sterkfontein N64, M5W	*A. bondi*
SF 890 (3)	Sterkfontein N64, M5W	*A. bondi*
SF 893	Sterkfontein N64, M5W	*A. bondi*
SF 915	Sterkfontein N62, M5W	*A. bondi*
SF 826	Sterkfontein N62, M5W	*A. bondi*
SF 992	Sterkfontein O63, M5W	*A. bondi*
SF 992 (2)	Sterkfontein O63, M5W	*A. bondi*
SF 993	Sterkfontein O63, M5W	*A. bondi*
SF 989	Sterkfontein O63, M5W	*A. bondi*
SF 989 (2)	Sterkfontein O63, M5W	*A. bondi*
SF 761	Sterkfontein M64, M5W	*A. bondi*
SF 617	Sterkfontein M64, M5W	*A. bondi*
SF 617 (2)	Sterkfontein M64, M5W	*A. bondi*
SF 677	Sterkfontein M64, M5W	*A. bondi*
SF 677 (2)	Sterkfontein M64, M5W	*A. bondi*
SF 680	Sterkfontein M64, M5W	*A. bondi*
SF 643	Sterkfontein M64, M5W	*A. bondi*
SF 640	Sterkfontein M64, M5W	*A. bondi*
SF 990	Sterkfontein O63, M5W	*A. marsupialis*
SF 921	Sterkfontein N62, M5W	*A. marsupialis*
SF 4079	Sterkfontein T64, M5W	*Antidorcas sp.*
SF 1502	Sterkfontein Q61, M5W	*Antelopini*
S94-7938	Sterkfontein M5W	*Antelopini*
S94-7965	Sterkfontein M5W	*Antelopini*
S94-8283	Sterkfontein M5W	*Antelopini*
SF 891	Sterkfontein N64, M5W	*D. pygargus*
SF 891 (2)	Sterkfontein N64, M5W	*D. pygargus*
SF 997	Sterkfontein O63, M5W	*D. pygargus*
SF 1393	Sterkfontein Q59, M5W	*D. pygargus*
SF 2022	Sterkfontein S63, M5W	*D. pygargus*
SF 676	Sterkfontein M64, M5W	*D. pygargus*
SF 619	Sterkfontein M64, M5W	*D. pygargus*
SF 619 (2)	Sterkfontein M64, M5W	*D. pygargus*
SF 919	Sterkfontein N62, M5W	*D. pygargus*
SF 649	Sterkfontein M64, M5W	*D. pygargus*
S94-8355	Sterkfontein M5W	*Damaliscus sp.*
S94-7251	Sterkfontein M5W	*Damaliscus sp.*
S94-7927	Sterkfontein M5W	*Damaliscus sp.*
S94-9669	Sterkfontein M5W	*Damaliscus sp.*
SF 817	Sterkfontein N64, M5W	*Damaliscus sp.*
SF 937	Sterkfontein N62, M5W	*Damaliscus sp.*
SF 916	Sterkfontein N62, M5W	*R.campestris*

Specimen number	**Provenance**	***Genus and Species***
SF 920	Sterkfontein N62, M5W	*Oryx gazella*
SF 641	Sterkfontein M64, M5W	*Redunca sp.*
S94-2344	Sterkfontein M5W	Size II Bovid
S94-7966	Sterkfontein M5W	Size II Bovid
S94-7120	Sterkfontein M5W	Size II Bovid
L63 BP/3/17224	Sterkfontein M5W	Size II Bovid
S94-14684	Sterkfontein M5W	Size II Bovid
S94-3808	Sterkfontein M5W	Size II Bovid
R/55 33'4''3414	Sterkfontein M5W	Size II Bovid
SF 3907	Sterkfontein M5W	Size II Bovid
SF 4039	Sterkfontein M5W	Size II Bovid
SF 4070	Sterkfontein M5W	Size II Bovid
SE 771	Sterkfontein M5	*A. recki*
S94-7976	Sterkfontein M5	Bovid size III
S94-7945	Sterkfontein M5	Size III bovid
S94-7945	Sterkfontein M5	*juvenile large hypsodont molar*
S94-7949	Sterkfontein M5	Size III bovid
S94-7949	Sterkfontein M5	*juvenile large hypsodont molar*
S94 2643	Sterkfontein Q58, PM6/M5E	*Size II Bovid*
SF 592	Sterkfontein M63, PM6, M5W	*A. bondi*
SF 592 (2)	Sterkfontein M63, PM6, M5W	*A. bondi*
SF 548	Sterkfontein M63, PM6, M5W	*A. marsupialis*
no #	Name Chamber	*A. bondi*
no #	Name Chamber	*Damaliscus sp.*
no #	Name Chamber	*x*
S94- 14668	Sterkfontein L/63	*A. bondi*
S94- 14672	Sterkfontein L/63	*Antidorcas sp.*
no #	Lincoln Cave	*A. bondi*
no #	Lincoln Cave	*D. pygargus*
BP/3/33268	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33045	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33928	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/34189	Sterkfontein PM6 Infill	*A. marsupialis*
S94-6871	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33856	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/34188	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33046	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33776	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33048	Sterkfontein PM6 Infill	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
BP/3/33044	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/34493	Sterkfontein PM6 Infill	*A. marsupialis*
BP/3/33228	Sterkfontein PM6 Infill	*Damaliscus dorcas*
BP/3/32399	Sterkfontein PM6 Infill	*Damaliscus dorcas*
BP/3/33152	Sterkfontein PM6 Infill	*Damaliscus dorcas*
BP/3/34500	Sterkfontein PM6 Infill	*Damaliscus dorcas*
BP/3/34639	Sterkfontein PM6 Infill	*Damaliscus dorcas*
BP/3/34386	Sterkfontein PM6 Infill	*Damaliscus dorcas*
S94-8045	Sterkfontein PM6 Infill	*Size II Bovid*
S94-8044	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/33779	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/34370	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/34627	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/32339	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/34205	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/34371	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/33778	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/34562	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/33919	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/32751	Sterkfontein PM6 Infill	*Size II Bovid*
BP/3/32706	Sterkfontein PM6 Infill	*Size II Bovid*
S94-6704	Sterkfontein PM6 Infill	*Size II Bovid*
SF 4944	Sterkfontein Block T	*Size II bovid*
SF 4948	Sterkfontein Block T	*Size II bovid*
SF 3786	Sterkfontein T63	*Size II Bovid*
SF 4004	Sterkfontein T62	*Impala?*
SF 4004	Sterkfontein T62	*D. pygargus*
SF 3868	Sterkfontein T61	*Impala?*
SF 3868	Sterkfontein T61	*D.lunatus*
SF 3870	Sterkfontein T61	*Size II Bovid*
SF 3870	Sterkfontein T61	*D.lunatus*
SF 4187	Sterkfontein T57	*D.lunatus*
SF-1071	Sterkfontein	*A. recki*
SF-2287	Sterkfontein	*cf. A. bondi*
SF-2028	Sterkfontein	*cf. Antidorcas*
SF-2480	Sterkfontein	*cf. Antidorcas*
SF-1061	Sterkfontein	*cf. Antidorcas*
SF-993	Sterkfontein	*cf. Antidorcas*
SF-989	Sterkfontein	*cf. Antidorcas*
SF-990	Sterkfontein	*cf. Antidorcas*
SF-992	Sterkfontein	*cf. Antidorcas*
SF-548	Sterkfontein	*cf. Antidorcas*

Specimen number	**Provenance**	***Genus and Species***
SF-592	Sterkfontein	*cf. Antidorcas (or impala)*
SF-681	Sterkfontein	*cf. Antidorcas cf. recki*
SF-679	Sterkfontein	*cf. Antidorcas cf. recki (/ cf. Pelea capreolus)*
SF-645	Sterkfontein	*Antidorcas cf. recki*
SF-647	Sterkfontein	*A. cf. recki*
SF-648	Sterkfontein	*cf. Antidorcas cf. recki*
SF-640	Sterkfontein	*cf. Antidorcas bondi*
SF-643	Sterkfontein	*cf. Antidorcas sp.*
SF-677	Sterkfontein	*cf. Antidorcas (or Pelea)*
SF-677	Sterkfontein	*cf. Antidorcas*
SF-680	Sterkfontein	*A. cf. bondi*
SF-761	Sterkfontein	*cf. Antidorcas bondi*
SF-3813	Sterkfontein	*cf. Antidorcas. Young*
SF-4039	Sterkfontein	*cf. Antidorcas*
8'2"-9'2" no #	Sterkfontein	*cf. Antidorcas bondi*
S94-7951	Sterkfontein	*cf. Antidorcas*
SF-821	Sterkfontein	*juvenile cf. Antidorcas bondi*
SF-819	Sterkfontein	*juvenile cf. Antidorcas bondi*
SF-2708	Sterkfontein	*size II bovid*
SF-2733	Sterkfontein	*cf. Taurotragus oryx*
SF-2771	Sterkfontein	*juvenile*
SF-2865	Sterkfontein	*cf. Damaliscus dorcas*
SF-2866	Sterkfontein	*cf. Damaliscus dorcas*
SF-2714	Sterkfontein	*cf. Damaliscus dorcas*
SF-2703	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-2700	Sterkfontein	Size V Bovid
SF-2254	Sterkfontein	Size II Bovid
SF-2166	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-2159	Sterkfontein	*cf. Damaliscus*
SF-2022	Sterkfontein	*Damaliscus cf. dorcas*
SF-2464	Sterkfontein	*cf. Damaliscus*
SF-2026	Sterkfontein	*cf. Damaliscus*
SF-2029	Sterkfontein	*cf. Damaliscus*
SF-2451	Sterkfontein	Size II Bovid
SF-2252	Sterkfontein	*cf. Damaliscus*
SF-2250	Sterkfontein	*cf. Damaliscus*
SF-2366	Sterkfontein	Size II Bovid
SF-3928	Sterkfontein	*cf. Oryx gazella*
SF-3928	Sterkfontein	*cf. Oryx gazella*
SF-1072	Sterkfontein	*juvenile cf. A. bondi mandible*
SF-1087	Sterkfontein	*cf. Oreotragus*
SF-1036	Sterkfontein	*cf. Gazella*
SF-997	Sterkfontein	*cf. Damaliscus*

Specimen number	**Provenance**	***Genus and Species***
SF-593	Sterkfontein	*cf. Damaliscus*
SF-642	Sterkfontein	*juvenile*
SF-618	Sterkfontein	*cf. Damaliscus*
SF-619	Sterkfontein	*cf. Damaliscus cf. dorcas*
SF-676	Sterkfontein	*cf. Damaliscus*
SF-641	Sterkfontein	*Redunca darti*
9'2"-10'2" no #	Sterkfontein	*cf. Damaliscus (medium-sized alcelaphine)*
SF-3305	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-3337	Sterkfontein	*cf. Damaliscus*
SF-3337	Sterkfontein	*cf. Damaliscus/Parmularius/Pelea capreolus*
SF-3258	Sterkfontein	*juvenile (1/2 molar)*
SF-3550	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-3550	Sterkfontein	*juvenile. Cf. Tragelaphus strepsiceros*
SF-3113	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-3087	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-4165	Sterkfontein	*cf. Damaliscus*
SF-3760	Sterkfontein	*cf. Damaliscus*
SF-3924	Sterkfontein	*cf. Damaliscus cf. dorcas*
SF-3885	Sterkfontein	*Alcelaphine*
SF-3907	Sterkfontein	*cf. Damaliscus/Redunca*
S94-2974	Sterkfontein	*juvenile bovid*
S94-2836	Sterkfontein	*Giraffid type molar (1/2)*
12'10"-13'8" no #	Sterkfontein	*cf. Tragelaphus strepsiceros*
18'0"-19'9" no #	Sterkfontein	*cf. Tragelaphus strepsiceros*
16' 5"-17'5" no #	Sterkfontein	*cf. Tragelaphus strepsiceros*
S94-7336	Sterkfontein	*size II bovid*
21'9"-22'9" no #	Sterkfontein	*large cf. Tragelaphus cf. strepsiceros*
SF-3637	Sterkfontein	*larger than Tragelaphus strepsiceros*
SF-3257	Sterkfontein	*cf. Damaliscus cf. dorcas*
SF-3413, 3411	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-1283	Sterkfontein	*cf. Malapania broomi*
SF-3103	Sterkfontein	*size V/IV bovid*
SF-3237	Sterkfontein	*cf. Tragelaphus strepsiceros*
SF-859	Sterkfontein	*cf. Damaliscus cf. dorcas*
SF-809	Sterkfontein	*cf. Oreotragus (cf. major?)*
SF-4094	Sterkfontein	*cf. Damaliscus cf. lunatus*
SF-3737	Sterkfontein	*cf. Makapania broomi*
SF-3737	Sterkfontein	*cf. Makapania broomi*
SF-1473&4	Sterkfontein	*cf. Damaliscus/Parmularius*
SF-1364	Sterkfontein	*cf. Taurotragus oryx*
SF-1518	Sterkfontein	*cf. Boselaphini sp.*
SF 198	Sterkfontein D16	*A. bondi*

Specimen number	**Provenance**	***Genus and Species***
SF 199	Sterkfontein D16	*A. bondi*
SF 197	Sterkfontein D16	*A. bondi*
SF 195	Sterkfontein D16	*A. bondi*
SF 211	Sterkfontein D16	*A. bondi*
SF 206	Sterkfontein D16	*A. bondi*
SF 207	Sterkfontein D16	*A. bondi*
SF 192	Sterkfontein D16	*A. bondi*
SF 209	Sterkfontein D16	*A. bondi*
SF 208	Sterkfontein D16	*A. bondi*
SF 202	Sterkfontein D16	*A. bondi*
SF 204	Sterkfontein D16	*A. bondi*
SF 210	Sterkfontein D16	*A. bondi*
SF 216	Sterkfontein D16	*A. bondi*
SF 201	Sterkfontein D16	*A. bondi*
SF 200	Sterkfontein D16	*A. bondi*
SF 196	Sterkfontein D16	*A. bondi*
SF 205	Sterkfontein D16	*A. bondi*
SF 194	Sterkfontein D16	*A. marsupialis*
SF 193	Sterkfontein D16	*A. marsupialis*
SF 191	Sterkfontein D16	*A. marsupialis*
SF 141*	Sterkfontein D8	*Antidorcas sp.*
SF 141	Sterkfontein D8	*A. bondi*
SF 142	Sterkfontein D8	*A. bondi*
SF 140	Sterkfontein D8	*A. bondi*
SF 105	Sterkfontein H2	*A. bondi*
SF 84	Sterkfontein D1	*A. bondi*
SF 106	Sterkfontein D2	*A. bondi*
SF 143	Sterkfontein D2	*A. bondi*
SF 85	Sterkfontein D1	*A. marsupialis*
SF 86	Sterkfontein D1	*A. marsupialis*
SKX 13351	Swartkrans M1	*A. bondi*
SKX 13351	Swartkrans M1 LB	*A. recki*
SKXX 11602	Swartkrans M1 LB	*A. bondi*
SKX 12068	Swartkrns M1 (LB)	*A. marsupialis*
SKX 12068	Swartkrans M1	*A. recki*
SKX 14147	Swartkrns M1 (LB)	*Antidorcas sp.*
SKX 14147	Swartkrans M1 LB	*A. recki*
SKX 14250	Swartkrns M1 (LB)	*Antidorcas sp.*
SKX 14250	Swartkrans M1	*A. marsupialis*
SKX 4191	Swartkrns M1	*A. marsupialis*
SKX 4191	Swartkrans M1 LB	*A. marsupialis*
SKX 7066	Swartkrns M1	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
SKX 7066	Swartkrans M1 LB	*A. marsupialis*
SKX 4842	Swartkrns M1	*A. marsupialis*
SKX 4842	Swartkrans M1 LB	*A. recki*
SKX 12067	Swartkrns M1 (LB)	*A. marsupialis*
SKX 12067	Swartkrans M1 LB	*A. marsupialis*
SKX 10703	Swartkrns M1	*Antidorcas sp.*
SKX 10703	Swartkrans M1 LB	*A. marsupialis*
SKX 4249	Swartkrans M1 LB	*D. pygargus*
SK 2545	Swartkrans M1	*A. recki*
SKX 6432	Swartkrans M1	*A. bondi*
SKX 13353	Swartkrans M1	*A. bondi*
SKX 6331	Swartkrans M1	*A. marsupialis*
SKX 8455a	Swartkrans M1	*A. marsupialis*
SK 3012	Swartkrans M1	*A. marsupialis*
SK 3012 (2)	Swartkrans M1	*A. marsupialis*
SK 3012	Swartkrans M1	*A. marsupialis*
SK 3012 (2)	Swartkrans M1	*A. marsupialis*
SKX 13511	Swartkrns M1	*A. marsupialis*
SKX 13511	Swartkrns M1	*A. recki*
SKX 10697	Swartkrns M1	*A. marsupialis*
SKX 10697	Swartkrans M1	*A. recki*
SKX 14573	Swartkrns M1	*A. marsupialis*
SKX 11602	Swartkrns M1	*A. marsupialis*
SKX 8293	Swartkrns M1	*A. marsupialis*
SKX 5821	Swartkrns M1	*A. marsupialis*
SKX 4829	Swartkrans M1	*Damaliscus sp.*
SKX 4829	Swartkrans M1	*D. pygargus*
SK 1239a	Swartkrans M1	*Damaliscus sp.*
SKX 12839a	Swartkrans M1	*D. pygargus*
SKX 5833	Swartkrans M1	*D. pygargus*
SKX 6194	Swartkrns M1	*SizeII bovid*
SK 3095 (2)	Swartkrans M1 HR	*A. bondi*
SK 2310	Swartkrans M1 HR	*A. bondi*
SK 3095	Swartkrans M1 HR	*Antidorcas sp.*
SK 3000	Swartkrans M1 HR	*T. strepsiceros*
SK 3000 (2)	Swartkrans M1 HR	*T. strepsiceros*
SK 50 0049	Swartkrans M2	*A. marsupialis*
SK 50 0049	Swartkrans M2	*A. marsupialis*
SK 50 0049	Swartkrans M2	*A. marsupialis*
SK 3122	Swartkrans M2	*Antidorcas* sp.
SK 2506	Swartkrans M2	*Antidorcas* sp.
SK 11514	Swartkrans M2	*Antidorcas* sp.

Specimen number	**Provenance**	***Genus and Species***
SK 6084	Swartkrans M2	*Antidorcas bondi*
SK 10724	Swartkrans M2	*A. cf. recki*
SK 14047	Swartkrans M2	*A. cf. recki*
SK 14047	Swartkrans M2	*A. cf. recki*
SK 7426	Swartkrans M2	*A. recki? Not bondi*
SK 2414	Swartkrans M2	*A. marsupialis*
SK 11683	Swartkrans M2	*Antidorcas* sp.
SK 12671	Swartkrans M2	*Antidorcas* sp.
SK 12671	Swartkrans M2	*Antidorcas* sp.
SK 2417	Swartkrans M2	*Antidorcas* sp.
SK 2417	Swartkrans M2	*Antidorcas* sp.
SK 2465	Swartkrans M2	*Antidorcas* sp.
SK 2465	Swartkrans M2	*Antidorcas* sp.
SK 3112	Swartkrans M2	*Antidorcas* sp.
SK 3112	Swartkrans M2	*Antidorcas* sp.
SK 2439	Swartkrans M2	*A. bondi*
SK 2439	Swartkrans M2	*A. bondi*
SK 3931	Swartkrans M2	*Antidorcas* sp.
SK 3931	Swartkrans M2	*Antidorcas* sp.
SK 7703	Swartkrans M2	*Antidorcas* sp.
SK 7703	Swartkrans M2	*Antidorcas* sp.
SK 2067	Swartkrans M2	*Antidorcas* sp.
SK 2067	Swartkrans M2	*Antidorcas* sp.
SK 5731	Swartkrans M2	*A. bondi*
SK 5731	Swartkrans M2	*A. bondi*
SK 2051	Swartkrans M2	*Antidorcas* sp.
SK 2051	Swartkrans M2	*Antidorcas* sp.
SK 2984	Swartkrans M2	*Antidorcas* sp.
SK 2984	Swartkrans M2	*Antidorcas* sp.
SK 2984	Swartkrans M2	*Antidorcas cf. recki/marsupialis*
SK 2393	Swartkrans M2	*Antidorcas* sp.
SK 2393	Swartkrans M2	*Antidorcas* sp.
SK 5992	Swartkrans M2	*Antidorcas* sp.
SK 5992	Swartkrans M2	*Antidorcas* sp.
SK 11557	Swartkrans M2	*Antidorcas* sp.
SK 11557	Swartkrans M2	*Antidorcas* sp.
SK 10520	Swartkrans M2	*A. bondi*
SK 10520	Swartkrans M2	*Antidorcas* sp.
SK 10670	Swartkrans M2	*Antidorcas* sp.
SK 10670	Swartkrans M2	*A. bondi*
SK 3048	Swartkrans M2	*Antidorcas* sp.
SK 3048	Swartkrans M2	*Antidorcas* sp.
SK 5902	Swartkrans M2	*Antidorcas* sp.

Specimen number	**Provenance**	***Genus and Species***
SK 5902	Swartkrans M2	*Antidorcas* sp.
SK 5914	Swartkrans M2	*A. cf. recki*
SK 5914	Swartkrans M2	*A. cf. recki*
SK 4059	Swartkrans M2	*Antidorcas* sp.
SK 4059	Swartkrans M2	*Antidorcas* sp.
SK 11122	Swartkrans M2	*A. bondi*
SK 11122	Swartkrans M2	*A. bondi*
SK 11122	Swartkrans M2	*Antidorcas cf. bondi*
SK 5910	Swartkrans M2	*Antidorcas* sp.
SK 5910	Swartkrans M2	*Antidorcas* sp.
SK 3941	Swartkrans M2	*Antidorcas* sp.
SK 3941	Swartkrans M2	*Antidorcas* sp.
SK 2531	Swartkrans M2	*Antidorcas* sp.
SK 2531	Swartkrans M2	*Antidorcas* sp.
SK 2293	Swartkrans M2	*A. bondi*
SK 2293	Swartkrans M2	*A. bondi*
SK 2387	Swartkrans M2	*A. bondi*
SK 2387	Swartkrans M2	*A. bondi*
SK 3838	Swartkrans M2	*A. bondi*
SK 3838	Swartkrans M2	*A. bondi*
SK 2530	Swartkrans M2	*Antidorcas* sp.
SK 2530	Swartkrans M2	*Antidorcas* sp.
SK 7694	Swartkrans M2	*Antidorcas* sp.
SK 7694	Swartkrans M2	*Antidorcas* sp.
SK 4039	Swartkrans M2	*A. cf. bondi*
SK 4039	Swartkrans M2	*A. cf. bondi*
SK 11946	Swartkrans M2	*A. cf. bondi*
SK 11946	Swartkrans M2	*A. cf. bondi*
SK 10356	Swartkrans M2	*Antidorcas* sp.
SK 4626	Swartkrans M2	*Antidorcas* sp.
SK 4626	Swartkrans M2	*Antidorcas* sp.
SK 1509	Swartkrans M2	*Antidorcas* sp.
SK 1509	Swartkrans M2	*Antidorcas* sp.
SK 2699	Swartkrans M2	*A. bondi*
SK 14071	Swartkrans M2	*A. bondi*
SK 2389	Swartkrans M2	*Antidorcas* sp.
SK 10499	Swartkrans M2	*A. bondi*
SK 7648	Swartkrans M2	*A. cf. bondi*
SK 11463	Swartkrans M2	*A. bondi*
SK 7996	Swartkrans M2	*A. cf. bondi*
SK 3707	Swartkrans M2	*cf. Antidorcas*
SK 2226	Swartkrans M2	*Antidorcas* sp.
SK 11384	Swartkrans M2	*A. bondi*

Specimen number	**Provenance**	***Genus and Species***
SK 11384	Swartkrans M2	*A. bondi*
SK 2616	Swartkrans M2	*A. bondi*
SK 11958	Swartkrans M2	*A. bondi*
SK 2522	Swartkrans M2	*Antidorcas* sp.
SK 5209	Swartkrans M2	*A. bondi*
SK 6007	Swartkrans M2	*A. bondi*
SK 5288	Swartkrans M2	*A. bondi*
SK 6009	Swartkrans M2	*A. bondi*
SK 4227	Swartkrans M2	*A. bondi*
SK 5387	Swartkrans M2	*A. bondi*
SK 5188	Swartkrans M2	*A. bondi*
SK 2382	Swartkrans M2	*A. bondi*
SK 5885	Swartkrans M2	*A. bondi*
SK 7919	Swartkrans M2	*Antidorcas* sp.
SK 3149	Swartkrans M2	*Antidorcas* sp.
SK 4092	Swartkrans M2	*A. marsupialis*
SK 2436	Swartkrans M2	*A. marsupialis*
SK x8	Swartkrans M2	*Antidorcas* sp.
SK 11699	Swartkrans M2	*Antidorcas* sp.
SK 10359	Swartkrans M2	*A. marsupialis*
SK 6011	Swartkrans M2	*Antidorcas* sp.
SK 4072	Swartkrans M2	*Antidorcas* sp.
SK ? 4009	Swartkrans M2	*(small)*
SK 2301	Swartkrans M2	*A. marsupialis*
SK 10681	Swartkrans M2	*A. marsupialis*
SK 4050	Swartkrans M2	*A. cf. bondi*
SK 6058	Swartkrans M2	*A. marsupialis*
SK 94090	Swartkrans M2	*Antidorcas* sp.
SK 5884	Swartkrans M2	*Antidorcas* sp.
SK 5913	Swartkrans M2	*Antidorcas* sp.
SK 4038	Swartkrans M2	*Antidorcas* sp.
SK 2470	Swartkrans M2	*Antidorcas* sp.
SK 6995	Swartkrans M2	*cf. Antidorcas sp.*
SK 2115	Swartkrans M2	*Antidorcas sp.*
SK 2664	Swartkrans M2	*Antidorcas sp.*
SK 3116	Swartkrans M2	*A. recki*
SK 3116 (2)	Swartkrans M2	*A. recki*
SK 1979	Swartkrans M2	*A. marsupialis*
SK 1979	Swartkrans M2	*A. marsupialis*
SK 24645	Swartkrans M2	*A. bondi*
SK 24645	Swartkrans M2	*A. bondi*
SK 24645	Swartkrans M2	*Antidorcas* sp.
SK 2404	Swartkrans M2	*A. bondi*

Specimen number	**Provenance**	***Genus and Species***
SK 2404	Swartkrans M2	*Antidorcas* sp.
SK 11482	Swartkrans M2	*A. bondi*
SK 11482	Swartkrans M2	*A. marsupialis*
SK 6905	Swartkrans M2	*A. recki*
SK 14205	Swartkrans M2	*A. recki*
SK 14205	Swartkrans M2	*cf. Antidorcas sp.*
SK 11287	Swartkrans M2	*A. marsupialis*
SK 11287	Swartkrans M2	*A. marsupialis*
SK 11287	Swartkrans M2	*A. recki*
SK 1930	Swartkrans M2	*A. recki*
SK 1930 (2)	Swartkrans M2	*A. recki*
SK 1930	Swartkrans M2	*A. cf. recki*
SK 1930	Swartkrans M2	*A. cf. recki*
SK 1930	Swartkrans M2	*A. recki*
SK 3152 (?-2)	Swartkrans M2 (SK6)	*A. bondi*
SK 10577	Swartkrans M2 (SK6)	*A. bondi*
SK 7435	Swartkrans M2 (SK6)	*A. bondi*
SK 5929	Swartkrans M2 (SK6)	*A. bondi*
SK 4061	Swartkrans M2 (SK6)	*A. bondi*
SK 5984	Swartkrans M2 (SK6)	*A. bondi*
SK 12669	Swartkrans M2 (SK6)	*A. bondi*
SK 5905	Swartkrans M2 (SK6)	*A. bondi*
SK 11801	Swartkrans M2 (SK6)	*A. bondi*
SK 14072	Swartkrans M2 (SK6)	*A. bondi*
SK 5890	Swartkrans M2 (SK6)	*A. bondi*
SK 3248	Swartkrans M2 (SK6)	*A. bondi*
SK 5354	Swartkrans M2 (SK6)	*A. bondi*
SK 4063	Swartkrans M2 (SK6)	*Antidorcas sp.*
SK 4071	Swartkrans M2 (SK6)	*A. bondi*
SK 10489	Swartkrans M2 (SK6)	*A. bondi*
SK 12677	Swartkrans M2 (SK6)	*A. bondi*
SK 11272	Swartkrans M2 (SK6)	*A. bondi*
SK 2277	Swartkrans M2 (SK6)	*A. bondi*
SK 6117	Swartkrans M2 (SK6)	*A. bondi*
SK 12472	Swartkrans M2 (SK6)	*A. bondi*
SK 5944	Swartkrans M2 (SK6)	*A. bondi*
SK 10278	Swartkrans M2 (SK6)	*A. bondi*
SK 59(?)04	Swartkrans M2 (SK6)	*A. bondi*
SK 6080	Swartkrans M2 (SK6)	*A. bondi*
SK 6109	Swartkrans M2 (SK6)	*A. bondi*
SK 4032	Swartkrans M2 (SK6)	*A. bondi*
SK 5976	Swatrkrans M2	*Antidorcas sp.*
SK 5976	Swartkrans M2	*Antidorcas* sp.

Specimen number	**Provenance**	***Genus and Species***
SK 5976	Swartkrans M2	*Antidorcas* sp.
SK 14066	Swatrkrans M2	*Antidorcas sp.*
SK 14066	Swartkrans M2	*Antidorcas sp.*
SK 1035?	Swatrkrans M2	*Antidorcas sp.*
SK 1035?	Swartkrans M2	*Antidorcas* sp.
SK 5975	Swatrkrans M2	*Antidorcas sp.*
SK 5975	Swartkrans M2	*Antidorcas* sp.
SK 5975	Swartkrans M2	*Antidorcas* sp.
SK 4240	Swatrkrans M2	*Antidorcas sp.*
SK 4240	Swartkrans M2	*Antidorcas* sp.
SK 4240	Swartkrans M2	*Antidorcas* sp.
SK 12056	Swatrkrans M2	*Antidorcas sp.*
SK 12056	Swartkrans M2	*A. recki*
SK 3055	Swatrkrans M2	*A. marsupialis*
SK 3055	Swartkrans M2	*A. marsupialis*
SK 3147	Swatrkrans M2	*Antidorcas sp.*
SK 3147	Swartkrans M2	*Antidorcas* sp.
SK 5938	Swatrkrans M2	*Antidorcas sp.*
SK 5938	Swartkrans M2	*Antidorcas sp.*
SK 5995	Swatrkrans M2	*Antidorcas sp.*
SK 5995	Swartkrans M2	*Antidorcas* sp.
SK 5995	Swartkrans M2	*Antidorcas* sp.
SK 5007	Swatrkrans M2	*Antidorcas* sp.
SK 5007	Swartkrans M2	*A. marsupialis*
SK 11506	Swatrkrans M2	*Antidorcas* sp.
SK 11506	Swartkrans M2	*Antidorcas* sp.
SK 11506	Swartkrans M2	*Antidorcas* sp.
SK 12596	Swatrkrans M2	*Antidorcas* sp.
SK 12596	Swartkrans M2	*Antidorcas* sp.
SK 12596	Swartkrans M2	*Antidorcas* sp.
SK 4025	Swatrkrans M2	*Antidorcas* sp.
SK 4025	Swartkrans M2	*Antidorcas* sp.
SK 4025	Swartkrans M2	*Antidorcas* sp.
SK 2366	Swatrkrans M2	*Antidorcas* sp.
SK 2366	Swartkrans M2	*A. bondi*
SK 2366	Swartkrans M2	*A. bondi*
SK 11036	Swatrkrans M2	*Antidorcas sp.*
SK 11036	Swatrkrans M2	*A. bondi*
SK 41626	Swatrkrans M2	*Antidorcas sp.*
SK 41626	Swartkrans M2	*Antidorcas cf. bondi*
SK 14070	Swatrkrans M2	*A. marsupialis*
SK 14070	Swartkrans M2	*Antidorcas sp.*
SK 4080	Swatrkrans M2	*A. bondi?*

Specimen number	**Provenance**	***Genus and Species***
SK 5882	Swatrkrans M2	*A. bondi*
SK 5882	Swartkrans M2	*A. bondi*
SK 2292	Swatrkrans M2	*A. bondi*
SK 4083	Swatrkrans M2	*A. bondi*
SK 5958	Swatrkrans M2	*A. marsupialis*
SK 5958	Swartkrans M2	*A. bondi*
SK 2953	Swatrkrans M2	*A. marsupialis*
SK 2953	Swartkrans M2	*Antidorcas sp.*
SK 5990	Swatrkrans M2	*Antidorcas sp.*
SK 5990	Swartkrans M2	*A. marsupialis*
SK 6106	Swatrkrans M2	*Antidorcas* sp.
SK 6106	Swartkrans M2	*Antidorcas* sp.
SK 6106	Swartkrans M2	*Antidorcas* sp.
SK 1055(5)5	Swatrkrans M2	*A. marsupialis*
SK 10555	Swartkrans M2	*Antidorcas* sp.
SK 10555	Swartkrans M2	*Antidorcas* sp.
SK 10555	Swartkrans M2	*Antidorcas cf. bondi*
SK 4633	Swatrkrans M2	*Antidorcas* sp.
SK 4633	Swartkrans M2	*Antidorcas* sp.
SK 4633	Swartkrans M2	*Antidorcas* sp.
SK 4633	Swartkrans M2	*A. recki*
SK 11899	Swatrkrans M2	*Antidorcas* sp.
SK 11899	Swartkrans M2	*Antidorcas* sp.
SK 11899	Swartkrans M2	*Antidorcas* sp.
SK 11899	Swartkrans M2	*Antidorcas cf. bondi*
SK 6118	Swatrkrans M2	*Antidorcas* sp.
SK 6118	Swartkrans M2	*Antidorcas* sp.
SK 6118	Swartkrans M2	*Antidorcas* sp.
SK 11073	Swatrkrans M2	*A. marsupialis*
SK 11073	Swartkrans M2	*Antidorcas* sp.
SK 11073	Swartkrans M2	*Antidorcas* sp.
SK 11073	Swartkrans M2	*A. recki*
SK 4064	Swatrkrans M2	*A. bondi*
SK 3123	Swartkrans M2	*D. pygargus*
SK 10867	Swartkrans M2	*D. pygargus*
SK 3397	Swartkrans M2	*D. pygargus*
SK 6037	Swartkrans M2	*D. pygargus*
SK 11777	Swartkrans M2	*D. pygargus*
SK 11889	Swartkrans M2	*D. pygargus*
SK 14220	Swartkrans M2	*D. pygargus*
SK 2707	Swartkrans M2	*D. pygargus*
SK 2296	Swartkrans M2	*D. pygargus*
SK 1941	Swartkrans M2	*T. strepsiceros*

Specimen number	**Provenance**	***Genus and Species***
SK 1941	Swartkrans M2	*cf. Tragelaphus cf. strepsiceros*
SK 114171	Swartkrans M2	*T. strepsiceros*
SK 114171	Swartkrans M2	*cf. Tragelaphus cf. strepsiceros*
SK 2271	Swartkrans M2	*T. strepsiceros*
SK 6860	Swartkrans M2	*T. strepsiceros*
SK 3086	Swartkrans M2	*T. strepsiceros*
SK 3098	Swartkrans M2	*T. strepsiceros*
SK 1308	Swartkrans M2	*T. strepsiceros*
SK 5053	Swartkrans M2	*T. strepsiceros*
SK 24644	Swartkrans M2	*T. strepsiceros*
SK 2108	Swartkrans M2	*Raphicerus cf. campestris*
SK 2024	Swartkrans M2	*Raphicerus cf. campestris*
SK 5930	Swartkrans M2	*Raphicerus cf. campestris*
SK 14060	Swartkrans M2	*Raphicerus cf. campestris*
SK 2179	Swartkrans M2	*Raphicerus cf. campestris*
SK 4168	Swartkrans M2	*Oreotragus oreotragus*
SK 4168	Swartkrans M2	*Oreotragus oreotragus*
SK 5893	Swartkrans M2	*Oreotragus oreotragus*
no #	Swartkrans M2	*Oreotragus oreotragus*
no #	Swartkrans M2	*Oreotragus oreotragus*
no #	Swartkrans M2	*Oreotragus oreotragus*
SKX 19645	SKX M3	*Antidorcas sp.*
SKX 19645	Swartkrans M3	*A. recki*
SKX 29541	SKX M3	*A. recki*
SKX 29541	Swartkrans M3	*A. recki*
SKX 27211	Swartkrans M3	*A. recki*
SKX 28491	Swartkrans M3	*A. recki*
SKX 29771	Swartkrans M3	*A. recki*
SKX 22746	Swartkrans M3	*A. recki*
SKX 35265	Swartkrans M3	*A. recki*
SKX 30875	Swartkrans M3	*A. recki*
SKX 35038	Swartkrans M3	*A. recki*
SKX 27717	Swartkrans M3	*A. recki*
SKX 21834	Swartkrans M3	*A. recki*
SKX 46244	Swartkrans M3	*A. recki*
SKX 32887	Swartkrans M3	*A. recki*
SKX 22254	Swartkrans M3	*A. recki*
SKX 39103	Swartkrans M3	*A. recki*
SKX 39209	Swartkrans M3	*A. recki*
SKX 32642	Swartkrans M3	*A. bondi*
SKX 52703	Swartkrans M3	*A. bondi*
SKX 34249	Swartkrans M3	*Antidorcas sp.*

Specimen number	**Provenance**	***Genus and Species***
SKX 34249	Swartkrans M3	*A. bondi*
SKX 2287	Swartkrans M3	*A. marsupialis*
SKX 36544	Swartkrans M3	*A. marsupialis*
SKX 2899	Swartkrans M3	*A. marsupialis*
SKX 19646	Swartkrans M3	*A. marsupialis*
SKX 368036	Swartkrans M3	*A. marsupialis*
SKX 29148	Swartkrans M3	*A. marsupialis*
SKX 39821	Swartkrans M3	*A. marsupialis*
SKX 30304	Swartkrans M3	*A. marsupialis*
SKX 29420	Swartkrans M3	*A. marsupialis*
SKX 28381	Swartkrans M3	*A. marsupialis*
SKX 201101	Swartkrans M3	*A. marsupialis*
SKX 25562	Swartkrans M3	*A. marsupialis*
SKX 39611	Swartkrans M3	*A. marsupialis*
SKX 36183	Swartkrans M3	*A. marsupialis*
SKX 38594	Swartkrans M3	*A. marsupialis*
SKX 39908	Swartkrans M3	*A. marsupialis*
SKX 39719	Swartkrans M3	*A. marsupialis*
SKX 39719	Swartkrans M3	*A. marsupialis*
SKX 38394	Swartkrans M3	*A. marsupialis*
SKX 2562	Swartkrans M3	*A. marsupialis*
SKX 25040	Swartkrans M3	*A. marsupialis*
SKX 25040	Swartkrans M3	*A. recki*
SKX 26844	Swartkrans M3	*A. marsupialis*
SKX 26844	Swartkrans M3	*A. recki*
SKX 35320	Swartkrans M3	*A. marsupialis*
SKX 35320	Swartkrans M3	*A. marsupialis*
SKX 30334	Swartkrans M3	*A. marsupialis*
SKX 30334	Swartkrans M3	*A. marsupialis*
SKX 28x	Swartkrans M3	*A. marsupialis*
SKX 368036 (36803b)	Swartkrans M3	*A. marsupialis*
SKX 35327	Swartkrans M3	*A. marsupialis*
SKX 35327	Swartkrans M3	*A. marsupialis*
SKX 36545/36544	Swartkrans M3	*A. marsupialis*
SKX 20143	Swartkrans M3	*A. marsupialis*
SKX 20143	Swartkrans M3	*A. marsupialis*
SKX 33839	Swartkrans M3	*A. marsupialis*
SKX 33839	Swartkrans M3	*A. marsupialis*
SKX 46727	Swartkrans M3	*Antidorcas sp.*
SKX 46727	Swartkrans M3	*A. marsupialis*
SKX 29147	Swartkrans M3	*A. marsupialis*
SKX 35384	Swartkrans M3	*A. marsupialis*
SKX 35384	Swartkrans M3	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
SKX 35388	Swartkrans M3	*A. marsupialis*
SKX 35388	Swartkrans M3	*A. marsupialis*
SKX 27876	Swartkrans M3	*A. marsupialis*
SKX 27876	Swartkrans M3	*A. marsupialis*
SKX 35066	Swartkrans M3	*A. marsupialis*
SKX 35066	Swartkrans M3	*A. marsupialis*
SKX 37716	Swartkrans M3	*A. marsupialis*
SKX 37716	Swartkrans M3	*A. marsupialis*
SKX 27338	Swartkrans M3	*A. marsupialis*
SKX 27338	Swartkrans M3	*A. bondi*
SKX 30332	Swartkrans M3	*A. marsupialis*
SKX 30332	Swartkrans M3	*A. marsupialis*
SKX 22287	Swartkrans M3	*A. marsupialis*
SKX 37102	Swartkrans M3	*A. marsupialis*
SKX 37102	Swartkrans M3	*A. marsupialis*
SKX 32176	Swartkrans M3	*A. marsupialis*
SKX 32176	Swartkrans M3	*A. recki*
SKX ?2?101	Swartkrans M3	*A. marsupialis*
SKX 30806	Swartkrans M3	*A. marsupialis*
SKX 30806	Swartkrans M3	*A. marsupialis*
SKX 32624	Swartkrans M3	*A. marsupialis*
SKX 37809	Swartkrans M3	*A. marsupialis*
SKX 37809	Swartkrans M3	*A. recki*
SKX 37198	Swartkrans M3	*A. marsupialis*
SKX 37198	Swartkrans M3	*A. marsupialis*
SKX 30878	Swartkrans M3	*A. marsupialis*
SKX 30878	Swartkrans M3	*A. marsupialis*
SKX 36347	Swartkrans M3	*A. marsupialis*
SKX 36347	Swartkrans M3	*A. recki*
SKX 37821	Swartkrans M3	*A. marsupialis*
SKX 29418	Swartkrans M3	*A. marsupialis*
SKX 29278	Swartkrans M3	*A. marsupialis*
SKX 29278	Swartkrans M3	*A. recki*
SKX 37508	Swartkrans M3	*A. marsupialis*
SKX 37508	Swartkrans M3	*Antidorcas sp.*
SKX 28008	Swartkrans M3	*A. marsupialis*
SKX 28008	Swartkrans M3	*A. marsupialis*
SKX 35326	Swartkrans M3	*A. marsupialis*
SKX 35326	Swartkrans M3	*A. recki*
SKX 35326	Swartkrans M3	*Antidorcas sp.*
SKX 21826.21835.21834	Swartkrans M3	*A. marsupialis*
SKX 28393	Swartkrans M3	*A. marsupialis*
SKX 28393	Swartkrans M3	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
SK 37597	Swartkrans M3	*Antidorcas sp.*
SK 25367	Swartkrans M3	*Antidorcas sp.*
SK 37641	Swartkrans M3	*Antidorcas sp.*
SKX 29963	Swartkrans M3	*cf. O. major*
SKX 32704	Swartkrans M3	*cf. O. major*
SKX 34250	Swartkrans M3	*cf. O. major*
SKX 27668	Swartkrans M3	*Damaliscus sp.*
SKX 28492	Swartkrans M3	*Damaliscus sp.*
SKX 32005	Swartkrans M3	*Damaliscus sp.*
SKX 38858	Swartkrans M3	*Damaliscus sp.*
SKX 37041	Swartkrans M3	*Damaliscus sp.*
SKX 30135	Swartkrans M3	*Damaliscus dorcas*
SKX 28274	Swartkrans M3	*Damaliscus sp.*
SKX 27623	Swartkrans M3	*Damaliscus sp.*
SKX 40083	Swartkrans M3	*Damaliscus sp.*
SKX 38374	Swartkrans M3	*Damaliscus sp.*
SKX 38336	Swartkrans M3	*Damaliscus sp.*
SKX 39107	Swartkrans M3	*Damaliscus dorcas*
M7238	Makapansgat	*T. strepsiceros*
M 6272	Makapan	*Makapania broomi*
KA 1046	Kromdraai A	*A. recki*
KA 901	Kromdraai A	*A. recki*
KA 901	Kromdraai	*A. recki*
KA 1213a	Kromdraai A	*A. recki*
KA 1213a	Kromdraai	*A. recki*
KA 1310	Kromdraai A	*A. recki*
KA 1310 (2)	Kromdraai A	*A. recki*
KA 1639	Kromdraai A	*A. recki*
KA 1162	Kromdraai A	*A. recki*
KA 2610	Kromdraai A	*A. recki*
KA 1002	Kromdraai A	*A. recki*
KA 1002	Kromdraai A	*A. recki*
KA 864	Kromdraai A	*A. recki*
KA 881a	Kromdraai A	*A. recki*
KA 881b	Kromdraai A	*A. recki*
KA 964b	Kromdraai A	*A. recki*
KA 964 (2)	Kromdraai A	*A. recki*
KA 964c	Kromdraai A	*A. recki*
KA 964c (2)	Kromdraai A	*A. recki*
KA 506	Kromdraai A	*A. recki*

Specimen number	**Provenance**	***Genus and Species***
KA 1517b	Kromdraai A	*A. recki*
KA 1111	Kromdraai A	*A. recki*
KA 765	Kromdraai A	*A. recki*
KA 925	Kromdraai A	*A. recki*
KA 1867	Kromdraai A	*A. recki*
KA 1205	Kromdraai A	*A. recki*
KA 2474	Kromdraai A	*A. recki*
KA 1157	Kromdraai A	*A. bondi*
KA 2172	Kromdraai A	*A. bondi*
KA x	Kromdraai A	*A. bondi*
KA 2465	Kromdraai A	*A. bondi*
KA 2472	Kromdraai A	*A. bondi*
KA 1676	Kromdraai A	*A. bondi*
KA 648	Kromdraai A	*A. bondi*
KA 537	Kromdraai A	*A. bondi*
KA 1826	Kromdraai A	*A. bondi*
KA 1517a	Kromdraai A	*A. bondi*
KA 2464	Kromdraai A	*A. bondi*
KA 1163	Kromdraai A	*A. bondi*
KA 751	Kromdraai A	*D. pygargus*
KA 751	Kromdraai A	*Damaliscus cf. dorcas*
KA 2430	Kromdraai A	*D. pygargus*
KA 2430 (2)	Kromdraai A	*D. pygargus*
KA 2068a	Kromdraai A	*D. pygargus*
KA 1687a	Kromdraai A	*D. pygargus*
KA 1739	Kromdraai A	*D. pygargus*
KA 2432	Kromdraai A	*D. pygargus*
KA 1127	Kromdraai A	*D. pygargus*
KA 1484	Kromdraai A	*D. pygargus*
KA 661	Kromdraai A	*D. pygargus*
KA 960	Kromdraai A	*D. pygargus*
KA 929	Kromdraai A	*D. pygargus*
KA 1915	Kromdraai	*Damaliscus sp.*
KA 1820	Kromdraai	*Damaliscus sp.*
KA 1244a	Kromdraai	*Damaliscus sp.*
KA 1010	Kromdraai	*Damaliscus sp.*
KA 914	Kromdraai	*Damaliscus sp.*
KA 1668	Kromdraai	*Damaliscus sp.*
KA 542	Kromdraai	*Damaliscus sp.*
KA 935	Kromdraai	*Damaliscus sp.*
KA 1004	Kromdraai	*Damaliscus sp.*
KA 2350	Kromdraai	*Damaliscus sp.*
KA 576	Kromdraai	*Damaliscus sp.*

Specimen number	**Provenance**	***Genus and Species***
KB 6284	Kromdraai B	*A. marsupialis*
KB 6517	Kromdraai B	*D. pygargus*
KB 6511	Kromdraai B	*Damaliscus sp.*
KB 6511 (2)	Kromdraai B	*Damaliscus sp.*
KB 6514	Kromdraai	*cf. Connochaetes sp.*
KB 6512	Kromdraai	*cf. Connochaetes taurinus*
KD 4	Kromdraai	*Bovid*
KD 1407	Kromdraai	*Bovid*
KD 13	Kromdraai	*Bovid*
KD 271	Kromdraai	*Bovid*
KD 1404	Kromdraai	*Bovid*
KD 267	Kromdraai	*Bovid*
KD 22	Kromdraai	*Bovid*
KD 1543	Kromdraai	*Bovid*
KD 1543	Kromdraai	*Bovid*
KD 1318	Kromdraai	*Bovid*
KD 1370	Kromdraai	*Bovid*
KD 1252	Kromdraai	*Bovid*
KD 41	Kromdraai	*Bovid*
KD 1384	Kromdraai	*Bovid*
KD 103	Kromdraai	*Bovid*
KD 2092	Kromdraai	*Bovid*
KD 1327	Kromdraai	*Bovid*
KD 1353	Kromdraai	*Bovid*
KD 116	Kromdraai	*Bovid*
KD 3	Kromdraai	*Bovid*
KD 136	Kromdraai	*Bovid*
KD 81	Kromdraai	*Bovid*
KD 1432	Kromdraai	*Bovid*
KD 424	Kromdraai	*Bovid*
KD 161	Kromdraai	*Bovid*
KD 1239	Kromdraai	*Bovid*
KD 99	Kromdraai	*Bovid*
KD 67	Kromdraai	*Bovid*
KD 1544	Kromdraai	*Bovid*
KD 1295	Kromdraai	*Bovid*
KE 7196	Kromdraai E	*A. recki*
KE 7257	Kromdraai E	*A. recki*
KE 6939	Kromdraai E	*A. recki*
KW 5874	Kromdraai W	*A. recki*
KW 6747	Kromdraai W	*A. recki*
KW 8050	Kromdraai W	*A. recki*

Specimen number	**Provenance**	***Genus and Species***
KW 9136	Kromdraai W	*A. recki*
KW 9106	Kromdraai W	*A. recki*
KW 8532	Kromdraai W	*A. recki*
KW 8512	Kromdraai W	*A. recki*
KW 8512 (2)	Kromdraai W	*A. recki*
KW 8337	Kromdraai W	*A. recki*
KW 8337 (2)	Kromdraai W	*A. recki*
KW 8769	Kromdraai W	*A. marsupialis*
KW 8769 (2)	Kromdraai W	*A. marsupialis*
KW 8769 (3)	Kromdraai W	*A. marsupialis*
KW 8769 (4)	Kromdraai W	*A. marsupialis*
KW 7458	Kromdraai W	*A. marsupialis*
KW 8424	Kromdraai W	*A. marsupialis*
KW 8219	Kromdraai	*cf. Oryx gazella*
GV 8250	Gladysvale	*A. recki*
GV 8250 (2)	Gladysvale	*A. recki*
GV 5338	Gladysvale	*P.capreolus*
GV 8298	Gladysvale	*D. pygargus*
GV 8237a	Gladysvale	*Damaliscus sp.*
GV 8237b	Gladysvale	*D. pygargus*
GV 7109	Gladysvale	*Damaliscus sp.*
GV 5322	Gladysvale	*D. pygargus*
GV 6249	Gladysvale	*D. pygargus*
GV 7537a	Gladysvale	*D. pygargus*
GV 5323	Gladysvale	*cf. Damaliscus dorcas*
GV 8248	Gladysvale	*cf. Damaliscus cf. lunatus*
GV 8406	Gladysvale	*T. strepsiceros*
GV 6988	Gladysvale	*T. strepsiceros*
GV 5311	Gladysvale	*cf. Parmularius urbae*
GV 5114	Gladysvale	*Alcelaphine (Parmularius/Boselaphus)*
GV 5401	Gladysvale	*small alcelahpine*
COH 1848	Cave of Hearths	*Antidorcas sp.*
COH 1589	Cave of Hearths	*Antidorcas sp.*
COH 1589	Cave of Hearths	*Antidorcas sp.*
COH 1131	Cave of Hearths	*Antidorcas sp.*
COH 2590	Cave of Hearths	*Antidorcas sp.*
COH 244	Cave of Hearths	*Antidorcas sp.*
COH 2436	Cave of Hearths	*Antidorcas sp.*
COH 1158	Cave of Hearths	*A. marsupialis*
COH 1731	Cave of Hearths	*A. marsupialis*
COH 1731	Cave of Hearths	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
COH 1772	Cave of Hearths	*A. marsupialis*
COH 1772	Cave of Hearths	*A. marsupialis*
COH 2458	Cave of Hearths	*A. marsupialis*
COH 1112	Cave of Hearths	*A. marsupialis*
COH 1112	Cave of Hearths	*A. marsupialis*
COH 1746	Cave of Hearths	*A. marsupialis*
COH 1746	Cave of Hearths	*A. marsupialis*
COH 1752	Cave of Hearths	*A. marsupialis*
COH 1155	Cave of Hearths	*A. marsupialis*
COH 2457	Cave of Hearths	*A. marsupialis*
COH 2457	Cave of Hearths	*A. bondi*
COH 1056	Cave of Hearths	*A. bondi*
COH 1842	Cave of Hearths	*A. bondi*
COH 1874	Cave of Hearths	*A. bondi*
COH 1644	Cave of Hearths	*A. bondi*
COH 1750	Cave of Hearths	*A. bondi*
COH 2381	Cave of Hearths	*A. bondi*
COH 2084	Cave of Hearths	*A. bondi*
COH 2175	Cave of Hearths	*A. bondi*
COH 2589	Cave of Hearths	*A. bondi*
?	Cave of Hearths	*A. bondi*
?	Cave of Hearths	*A. bondi*
COH 2445	Cave of Hearths	*A. bondi*
COH 2154	Cave of Hearths	*A. bondi*
COH 1807	Cave of Hearths	*A. bondi*
COH 2110	Cave of Hearths	*A. bondi*
COH 1413	Cave of Hearths	*A. bondi*
COH 8562	Cave of Hearths	*A. bondi*
COH 1780	Cave of Hearths	*A. bondi*
COH 1454	Cave of Hearths	*A. bondi*
COH 2184	Cave of Hearths	*A. bondi*
COH 2083	Cave of Hearths	*A. bondi*
COH 2071	Cave of Hearths	*A. bondi*
COH 2097	Cave of Hearths	*A. bondi*
COH 1543	Cave of Hearths	*A. bondi*
COH 1610	Cave of Hearths	*A. bondi*
COH 1783	Cave of Hearths	*A. bondi*
COH 1328	Cave of Hearths	*A. bondi*
COH 1060	Cave of Hearths	*A. bondi*
COH 1333	Cave of Hearths	*A. bondi*
COH 1542	Cave of Hearths	*A. bondi*
COH 1624	Cave of Hearths	*A. bondi*
COH 1107	Cave of Hearths	*A. bondi*

Specimen number	**Provenance**	***Genus and Species***
COH 1831	Cave of Hearths	*A. bondi*
COH 2058	Cave of Hearths	*A. bondi*
COH 1538	Cave of Hearths	*A. bondi*
COH 2152	Cave of Hearths	*A. bondi*
COH 2157	Cave of Hearths	*A. bondi*
COH 1816	Cave of Hearths	*A. bondi*
COH 1113	Cave of Hearths	*A. bondi*
COH 1849	Cave of Hearths	*A. bondi*
COH 1351	Cave of Hearths	*A. bondi*
COH 2245	Cave of Hearths	*A. bondi*
COH 2265	Cave of Hearths	*A. bondi*
COH 1546	Cave of Hearths	*A. bondi*
COH 2448	Cave of Hearths	*Antidorcas sp.*
COH 1066	Cave of Hearths	*T. strepsiceros*
COH 1920	Cave of Hearths	*T. strepsiceros*
COH 1740	Cave of Hearths	*Aepyceros sp.*
COH 1740 (2)	Cave of Hearths	*Aepyceros sp.*
PV 11190	Plovers Lake	*A. recki*
PV 16331	Plovers Lake	*A. recki*
PV 16832	Plovers Lake	*A. recki*
PV 17720	Plovers Lake	*A. recki*
PV 19268	Plovers Lake	*A. recki*
PV 19209	Plovers Lake	*A. bondi*
PV 19857	Plovers Lake	*A. bondi*
PV 5822	Plovers Lake	*A. bondi*
PV 10703	Plovers Lake	*A. bondi*
PV 21589	Plovers Lake	*A. bondi*
PV 1777	Plovers Lake	*A. bondi*
PV 17788	Plovers Lake	*A. bondi*
PV 17759	Plovers Lake	*A. bondi*
PV 10671	Plovers Lake	*A. bondi*
PV 10724	Plovers Lake	*A. bondi*
PV 10670	Plovers Lake	*A. bondi*
PV 4135	Plovers Lake	*A. bondi*
PV 17772	Plovers Lake	*A. bondi*
PV 6026	Plovers Lake	*A. bondi*
PV 14545	Plovers Lake	*A. bondi*
PV 17770	Plovers Lake	*A. bondi*
PV 17787	Plovers Lake	*A. marsupialis*
PV 17779	Plovers Lake	*A. marsupialis*
PV 10646	Plovers Lake	*A. marsupialis*
PV 21245	Plovers Lake	*A. marsupialis*

Specimen number	**Provenance**	***Genus and Species***
PV 10750	Plovers Lake	*A. marsupialis*
PV 16716	Plovers Lake	*A. marsupialis*
PV 17783	Plovers Lake	*A. marsupialis*
PV 762	Plovers Lake	*A. marsupialis*
PV 1169	Plovers Lake	*A. marsupialis*
PV 3331	Plovers Lake	*A. marsupialis*
PV 3331 (2)	Plovers Lake	*A. marsupialis*
GA 253	Gondolin	*A. marsupialis*
GA 242	Gondolin	*A. marsupialis*
GA 41	Gondolin	*Antidorcas sp.*
U.W.27-8185	Cooper's Cave	*A. recki*
U.W.27-8672	Cooper's Cave	*A. recki*
U.W.27-15672	Cooper's Cave	*A. recki*
U.W.27-8535	Cooper's Cave	*A. recki*
U.W.27-1222	Cooper's Cave	*A. recki*
U.W.27-1223	Cooper's Cave	*A. recki*
U.W.27-9987	Cooper's Cave	*A. recki*
U.W.27-6156	Cooper's Cave	*A. recki*
U.W.27-8694	Cooper's Cave	*A. recki*
U.W.27-6193	Cooper's Cave	*A. recki*
U.W.27-5417	Cooper's Cave	*A. recki*
U.W.27-212	Cooper's Cave	*A. recki*
U.W.27-8186	Cooper's Cave	*A. recki*
U.W.27-1225	Cooper's Cave	*A. recki*

A10.3 Fossil specimens sampled for DMTA

Year	**Genus**	**Species**	**Specimen Number**
2016	*Antidorcas*	*recki*	SKX 14147
2016	*Antidorcas*	*recki*	SKX 14147
2018	*Antidorcas*	*marsupialis*	SK 3012
2018	*Antidorcas*	*marsupialis*	SKX 7066
2018	*Antidorcas*	*marsupialis*	SKX 12067
2018	*Antidorcas*	*marsupialis*	SKX 12068
2018	*Antidorcas*	*marsupialis*	SKX 13511
2018	*Antidorcas*	*marsupialis*	SKX 14250
2016	*Damaliscus*	*pygargus*	SK 12839a
2016	*Damaliscus*	*pygargus*	SK 12839a
2016	*Antidorcas*	*bondi*	SK 2360
2018	*Antidorcas*	*bondi*	SK 2360
2016	*Antidorcas*	*bondi*	SK 315(2)
2016	*Antidorcas*	*bondi*	SK 315(2)

Year	**Genus**	**Species**	**Specimen Number**
2016	*Antidorcas*	*bondi*	SK 4064
2016	*Antidorcas*	*bondi*	SK 4080
2018	*Antidorcas*	*bondi*	SK 4083
2016	*Antidorcas*	*bondi*	SK 4083
2016	*Antidorcas*	*bondi*	SK 5905
2016	*Antidorcas*	*bondi*	SK 5354
2016	*Antidorcas*	*bondi*	SK 5354
2016	*Antidorcas*	*bondi*	SK 5354
2016	*Antidorcas*	*bondi*	SK 5929
2016	*Antidorcas*	*bondi*	SK 5929
2016	*Antidorcas*	*bondi*	SK 5984
2016	*Antidorcas*	*bondi*	SK 5984
2016	*Antidorcas*	*bondi*	SK 6080
2016	*Antidorcas*	*bondi*	SK 6080
2016	*Antidorcas*	*bondi*	SK 6080
2016	*Antidorcas*	*bondi*	SK 11272
2016	*Antidorcas*	*bondi*	SK 11272
2016	*Antidorcas*	*bondi*	SK 11272
2016	*Antidorcas*	*bondi*	SK 12677
2016	*Antidorcas*	*marsupialis*	SK 3055
2016	*Antidorcas*	*marsupialis*	SK 3055
2016	*Antidorcas*	*marsupialis*	SK 5958
2016	*Antidorcas*	*marsupialis*	SK 11073
2016	*Antidorcas*	*marsupialis*	SK 11073
2018	*Antidorcas*	*marsupialis*	SKX 500049
2016	*Antidorcas*	*sp.*	SK 2366
2016	*Antidorcas*	*sp.*	SK 2366
2016	*Antidorcas*	*sp.*	SK 2366
2018	*Antidorcas*	*sp.*	SK 2984
2016	*Antidorcas*	*sp.*	SK 3629
2018	*Antidorcas*	*sp.*	SK 4633
2016	*Antidorcas*	*sp.*	SK 4633
2016	*Antidorcas*	*sp.*	SK 4633
2016	*Antidorcas*	*sp.*	SK 5938
2016	*Antidorcas*	*sp.*	SK 5938
2016	*Antidorcas*	*sp.*	SK 5938
2018	*Antidorcas*	*sp.*	SK 5975
2016	*Antidorcas*	*sp.*	SK 5990
2016	*Antidorcas*	*sp.*	SK 3147
2016	*Antidorcas*	*sp.*	SK 3147
2016	*Antidorcas*	*sp.*	SK 6106
2016	*Antidorcas*	*sp.*	SK 6118

Year	**Genus**	**Species**	**Specimen Number**
2016	*Antidorcas*	*sp.*	SK 10555
2016	*Antidorcas*	*sp.*	SK 11899
2016	*Antidorcas*	*sp.*	SKX 13351
2016	*Antidorcas*	*recki*	SKX 29541
2016	*Antidorcas*	*recki*	SKX 29541
2018	*Antidorcas*	*bondi*	SKX 13351
2016	*Antidorcas*	*marsupialis*	SKX 25040
2016	*Antidorcas*	*marsupialis*	SKX 30334
2016	*Antidorcas*	*marsupialis*	SKX 30334
2016	*Antidorcas*	*marsupialis*	SK 35320
2016	*Antidorcas*	*marsupialis*	SK 35320
2016	*Antidorcas*	*marsupialis*	SKX 35327
2016	*Antidorcas*	*marsupialis*	SKX 368036
2018	*Antidorcas*	*marsupialis*	SKX 39908
2016	*Antidorcas*	*sp.*	SKX 19645
2018	*Damaliscus*	*cf. pygargus*	SKX 38336
2018	*Damaliscus*	*cf. pygargus*	SKX 38374
2018	*Damaliscus*	*cf. pygargus*	SKX 39107
2016	*Antidorcas*	*sp.*	COH 1589
2016	*Antidorcas*	*bondi*	COH 1780
2016	*Antidorcas*	*bondi*	COH 1780
2016	*Antidorcas*	*bondi*	COH 1807
2016	*Antidorcas*	*bondi*	COH 1807
2016	*Antidorcas*	*bondi*	COH 2110
2016	*Antidorcas*	*bondi*	COH 2154
2016	*Antidorcas*	*bondi*	COH 2154
2016	*Antidorcas*	*bondi*	COH 2445
2016	*Antidorcas*	*bondi*	COH 2457
2016	*Antidorcas*	*bondi*	COH 2457
2016	*Antidorcas*	*marsupialis*	COH 1112
2016	*Antidorcas*	*marsupialis*	COH 1112
2016	*Antidorcas*	*marsupialis*	COH 1112
2016	*Antidorcas*	*marsupialis*	COH 1731
2016	*Antidorcas*	*marsupialis*	COH 1746
2016	*Antidorcas*	*marsupialis*	COH 1772
2016	*Antidorcas*	*marsupialis*	COH 1772
2016	*Antidorcas*	*marsupialis*	COH 244x
2016	*Antidorcas*	*marsupialis*	COH 244x
2016	*Antidorcas*	*marsupialis*	COH 244x
2016	*Antidorcas*	*marsupialis*	COH 2458
2016	*Antidorcas*	*marsupialis*	COH 2590

Year	**Genus**	**Species**	**Specimen Number**
2016	*Antidorcas*	*marsupialis*	COH 2590
2018	*Antidorcas*	*marsupialis*	GA 253
2018	*Damaliscus*	*cf. pygargus*	GA 41
2018	*Damaliscus*	*cf. pygargus*	GA 41
2018	*Antidorcas*	*recki*	KA 881b
2018	*Antidorcas*	*recki*	KA 1162
2018	*Antidorcas*	*recki*	KA 1639
2018	*Antidorcas*	*bondi*	KA 537
2018	*Antidorcas*	*bondi*	KA 1157
2018	*Antidorcas*	*bondi*	KA 1676
2018	*Antidorcas*	*bondi*	KA 2472
2018	*Antidorcas*	*bondi*	KA 2472
2018	*Antidorcas*	*marsupialis*	KA 111
2018	*Antidorcas*	*marsupialis*	KA 925
2018	*Antidorcas*	*marsupialis*	KA 765
2018	*Antidorcas*	*marsupialis*	KB 6284
2018	*Damaliscus*	*cf. pygargus*	KB 6511
2018	*Antidorcas*	*recki*	KE 7257
2018	*Antidorcas*	*recki*	KW 6747
2018	*Antidorcas*	*recki*	KW 8337
2018	*Antidorcas*	*recki*	KW 8512
2018	*Antidorcas*	*recki*	KW 9106
2018	*Antidorcas*	*recki*	KW 9136
2018	*Antidorcas*	*recki*	KW 9136
2018	*Antidorcas*	*marsupialis*	KW 8424
2018	*Damaliscus*	*cf. pygargus*	KW 8199
2018	*Damaliscus*	*cf. pygargus*	KW 9293
2018	*Damaliscus*	*cf. pygargus*	KW 9293
2018	*Tragelaphus*	*cf.strepsiceros*	KW 6247a
2016	*Antidorcas*	*recki*	UW 27-212
2016	*Antidorcas*	*recki*	UW 27-212
2016	*Antidorcas*	*recki*	UW 27-6193
2016	*Antidorcas*	*recki*	STS 1996
2016	*Antidorcas*	*recki*	STS 1996
2016	*Antidorcas*	*recki*	STS 1996
2016	*Antidorcas*	*recki*	STS 1996.2
2016	*Antidorcas*	*recki*	STS 1996.2
2016	*Antidorcas*	*recki*	STS 2076
2016	*Antidorcas*	*recki*	STS 2076

Year	Genus	Species	Specimen Number
2016	*Antidorcas*	*recki*	STS 2076.2
2016	*Damaliscus*	*cf. pygargus*	STS 2582
2018	*Tragelaphus*	*cf.strepsiceros*	SF 3305
2016	*Makapania*	*broomi*	STS 2565
2016	*Makapania*	*broomi*	STS 2565
2016	Bovid	sp.	STS 812
2018	*Antidorcas*	*bondi*	SF 592
2018	*Antidorcas*	*sp.*	SF 768
2018	*Damaliscus*	*cf. pygargus*	SF 1393
2018	*Damaliscus*	*cf. pygargus*	SF 1498
2016	*Damaliscus*	*cf. pygargus*	SF 2712
2016	*Damaliscus*	*cf. pygargus*	SF 2712
2016	*Damaliscus*	*cf. pygargus*	SKDamaliscus
2016	*Damaliscus*	*cf. pygargus*	SKDamaliscus #
2016	Bovid	sp.	S94-3808
2016	Bovid	sp.	S94-3808
2016	Bovid	sp.	S 94.unknown
2018	*Antidorcas*	*bondi*	SF 617
2018	*Antidorcas*	*bondi*	SF 640
2018	*Antidorcas*	*bondi*	SF 677
2018	*Antidorcas*	*bondi*	SF 680
2018	*Antidorcas*	*bondi*	SF 890
2018	*Antidorcas*	sp.	SF 189
2018	*Damaliscus*	*cf. pygargus*	SF 817
2018	*Damaliscus*	*cf. pygargus*	SF 891
2016	Bovid	sp.	S 94.unknown
2016	*Makapania*	*broomi*	M 6272

A10.3.1 Modern specimens sampled for DMTA

Year	Genus	Species	Specimen Number
2016	*Antidorcas*	*marsupialis*	NMS .Z.2002.217.2.
2018	*Antidorcas*	*marsupialis*	TM 11479
2018	*Antidorcas*	*marsupialis*	TM 13231
2018	*Antidorcas*	*marsupialis*	AZ 2438
2018	*Antidorcas*	*marsupialis*	AZ 2437
2016	*Antidorcas*	*marsupialis*	NHM 26.12.7.324
2016	*Antidorcas*	*marsupialis*	NHM .25.1.2.254
2018	*Antidorcas*	*marsupialis*	TM 13231
2018	*Antidorcas*	*marsupialis*	TM 13233
2018	*Antidorcas*	*marsupialis*	TM 13231
2018	*Antidorcas*	*marsupialis*	TM 16173

Year	Genus	Species	Specimen Number
2016	*Antidorcas*	*marsupialis*	NHM .31.2.1.35
2016	*Antidorcas*	*marsupialis*	NHM .42.4.11.1
2018	*Antidorcas*	*marsupialis*	TM 13232
2016	*Antidorcas*	*marsupialis*	NHM .64.445
2016	*Antidorcas*	*marsupialis*	NHM .14.7.15.334
2018	*Antidorcas*	*marsupialis*	AZ 3140
2016	*Antidorcas*	*marsupialis*	NHM .14.7.15.334
2018	*Antidorcas*	*marsupialis*	AZ 1692
2016	*Antidorcas*	*marsupialis*	NHM .42.4.11.1
2016	*Antidorcas*	*marsupialis*	NHM 26.12.7.324
2016	*Antidorcas*	*marsupialis*	NMS .Z.2012.34.1
2016	*Antidorcas*	*marsupialis*	NHM .74.461
2016	*Antidorcas*	*marsupialis*	NHM .2.12.1.35
2016	*Antidorcas*	*marsupialis*	NHM .2.12.1.42
2016	*Antidorcas*	*marsupialis*	NHM .42.4.11.1
2016	*Antidorcas*	*marsupialis*	NHM .27.2.11.82
2016	*Antidorcas*	*marsupialis*	NMS .Z.2002.217.2
2016	*Antidorcas*	*marsupialis*	NHM .25.1.2.254
2016	*Antidorcas*	*marsupialis*	NHM .31.2.1.34
2016	*Antidorcas*	*marsupialis*	NHM .31.2.1.31
2016	*Antidorcas*	*marsupialis*	NHM 26.12.7.324
2016	*Antidorcas*	*marsupialis*	NHM 72.4539
2018	*Antidorcas*	*marsupialis*	AZ 2437
2018	*Antidorcas*	*marsupialis*	AZ 2438
2016	*Antidorcas*	*marsupialis*	NHM .2.12.1.42
2018	*Antidorcas*	*marsupialis*	AZ 692
2016	*Antidorcas*	*marsupialis*	NMS .Z.1939.1.2
2016	*Antidorcas*	*marsupialis*	NHM .20.4.27.32
2016	*Antidorcas*	*marsupialis*	NMS .Z.2002.217.2
2016	*Antidorcas*	*marsupialis*	NHM .28.9.11.453
2018	*Antidorcas*	*marsupialis*	TM 11479
2016	*Damaliscus*	*dorcas*	NHM .1857.12.21.7
2016	*Damaliscus*	*dorcas*	NHM .1857.12.21.7
2016	*Damaliscus*	*pygargus*	NHM .7.1.39.25
2016	*Damaliscus*	*pygargus*	NHM .12.7.2.6
2016	*Damaliscus*	*pygargus*	NHM .12.7.2.6
2016	*Damaliscus*	*dorcas*	NHM .70.345
2016	*Damaliscus*	*dorcas*	NHM .1857.12.21.7
2016	*Damaliscus*	*pygargus*	NHM .7.1.39.25
2016	*Damaliscus*	*dorcas*	NHM .70.345
2016	*Damaliscus*	*dorcas*	NHM .70.345
2016	*Damaliscus*	*dorcas*	NHM .1857.12.21.7

Year	**Genus**	**Species**	**Specimen Number**
2016	*Damaliscus*	*dorcas*	NMS .Z.1990.28.7
2016	*Damaliscus*	*dorcas*	NMS .Z.1990.28.7
2016	*Damaliscus*	*dorcas*	NHM .70.345
2016	*Damaliscus*	*korrigum*	NHM .26.11.18.17
2016	*Damaliscus*	*korrigum*	NHM .26.11.18.17
2016	*Damaliscus*	*albifrons*	NHM .8.12.8.1