The role of Testudines in Oakhurst Hunter-gatherer Societies: an analysis of chelonian remains from the Later Stone Age Oakhurst layers at Klipdrift Cave, Western Cape, South Africa

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Abstrakt

Forholdet mellom mennesker og skilpadder strekker seg langt tilbake i tid. Sammenliknet med pattedyr har disse reptilene fått relativt lite oppmerksomhet i arkeologisk forskning, dette til tross for at de tallmessig kan utgjøre en betraktelig del av faunaen fra et funnsted, og at de har potensiale for å dekke en rekke behov som mat og ulike bruksgjenstander. I kulturlagene i den sørafrikanske hulen Klipdrift Cave, datert til årtusenene rundt overgangen mellom pleistocen og holocen, som er en periode forbundet med store omveltninger som klimaendringer og utryddelse av megafauna, er det funnet en ansamling skilpaddebein som bærer vitne om dette forholdet. Gjennom en tafonomisk analyse av disse, og ved å sammenlikne resultatene med andre relevante funnsted, har jeg undersøkt hvilken rolle skilpadder har spilt i jeger- og sankersamfunn fra denne tidsperioden. Som en del av dette, har jeg brukt etnografiske kilder til å utvide idegrunnlaget for hvordan disse dyrene kan samles og brukes, og optimal foraging teori til å vurdere fordeler opp mot kostnader ved bruk av skilpadder som ressurs.

Den relative frekvensen av ulike skjelettelementer har sammen med identifikasjon av modifikasjoner på beina, inkludert spor etter brann, kuttmerker og en flere mulige slagmerker, vist at mennesker trolig er hovedagenten bak ansamlingen av skilpaddene fra Klipdrift Cave, og at disse mest sannsynlig har vært spist. Artssammensetningen tyder på at vegetasjonen gjennom preget av Fynbos vegetasjon, og at det muligens finnes arter i den arkeologiske samlingen som ikke finnes i området i dag. Samlingen bærer trolig preg av å ha vært utsatt for tafonomiske prosesser etter at de ble avsatt, hvilket sammen med variasjon i prøveomfanget mellom lagene har komplisert både analysen og tolkning av resultater i denne oppgaven. Andre funnsted fra samme periode har hatt varierende mengder skilpadder. Dette kan forklares av en kombinasjon av variasjon i tilstedeværelse av disse dyrene i landskapet, bevaring, og utgravningsteknikk. Men også hvilke aspekter ved funnstedene som har vert vektlagt og rapportert i litteraturen.

Preface and acknowledgements

I have been burdened with the trait of having a great variety of interests and passions that dies just as fast as they are sparked. There is a handful however, that have been burning with a steadfast flame throughout my entire life. Animals of all kinds and sizes and have since my childhood had a very special place in my heart. This, I am sure, has amused some, and displeased many (I would like to sincerely apologise to everybody I have ever forced into touching my pet tarantula). One of my earliest fixations, which is incidentally the one that sparked my passion for science, was with Charles Darwin and the tortoises of the Galápagos Islands. Although my obsession with this specific theme dowsed slightly over the years, my love for the natural world never did, and it eventually led me into the wonderful field of archaeology. When my supervisor Karen van Niekerk suggested that the tortoises from Klipdrift Cave should be the theme of my archaeology thesis, it felt like my life had made a come full circle.

I must have gone through every emotion humanly possible in the process of writing this thesis. It has been fascinating, exciting, difficult, and frustrating. To finally see it all come together fills me with joy, a bit of sadness, and relief (a lot of relief). There are so many people to whom I owe gratitude for their support, help, and inspiration throughout these years, which sadly cannot be expressed to the full extent here.

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Naturally, I would like to end this with thanking my beloved pets: my dog Falk, and yes, my tarantula too.

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1. Introduction

The ancient order Testudines had its origin about 220 million years ago (Stanford et al., 2020). This order has witnessed the reign and extinction of the dinosaurs, the appearance and evolution of primates, hominins, and finally the prehistory and history of our own species. It is currently comprising 360 living (and recently extinct) species; many of which are now facing extinction due to loss of habitat and global climate change (Rhodin et al., 2015; Stanford et al., 2020). The extant members are known as turtles or chelonians, and while some are adapted to a terrestrial life, others thrive in aquatic environments.

These lovable animals have long captivated us and are found in many different contexts spanning from old stories such as that of “The Tortoise and the Hare” in one of Aesop’s fables, to more recent popular culture such as the giant, wise tortoise Morla in the movie *The NeverEnding Story*. Alternatively, the father of evolutionary theory Charles Darwin and the Galápagos Islands might come to mind, or perhaps the art of indigenous communities in Australia. Regardless, our and our hominin ancestor’s interaction with chelonians spans back millions of years, with a plethora of archaeological sites worldwide testifying to this (e.g. Blasco, 2008; Braun et al., 2010; Thompson, 2010; White et al., 2010; Martin et al., 2013; Blasco et al., 2016; del Papa, 2016; Hawkins et al., 2016; Alfonso-Rojas et al., 2021). They have served an array of purposes including food (Braun et al., 2010; Blasco et al., 2016), containers (Thompson and Henshilwood, 2014b), and even musical instruments (Holzman, 2016; Gillreath-Brown and Peres, 2018).

The South African archaeological record is no exception. Middle Stone Age (MSA), and Later Stone Age (LSA) sites often contain an abundance of chelonian remains, especially members of the land-dwelling family *Testudinidae*, or tortoises (Schweitzer and Wilson, 1978; Klein and Cruz-Uribe, 1983, 2016). Despite this, Testudines traditionally do not receive the same attention as mammals. The topic of my thesis adds to this gap in our understanding of the relationship between humans and this taxonomic order during the Oakhurst period in South Africa, particularly in the context of Klipdrift Cave (KDC).

1.1 Research questions

In this study I aim to address the following research questions:

1) What is the main agent of accumulation of the Testudines specimens from the Oakhurst layers of Klipdrift Cave?
2) What Testudines were utilised during the Oakhurst layers, and how were they utilised and processed?
3) Do the Testudines remains from the Oakhurst period reflect the climatic changes at that time and do any changes coincide with shifts in the rest of the KDC material?
4) What was the role of Testudines in hunter gatherer societies during the Oakhurst period in the south-western Cape of South Africa?

2. Literature review

This chapter consists of five parts. The first section covers previous research done on Testudines in archaeology and ethnography. The second is a presentation of the time period in which the KDC Oakhurst sequence occurred, and contemporary sites from the south-western Cape. The third section includes descriptions of the De Hoop Nature reserve in which KDC is located, and of the site. The fourth is a review of Taphonomy and includes quantification units that were measured in this thesis, and descriptions of various taphonomic modifications that have been demonstrated on Testudines remains in previous research. The fifth and final section is a description of the ecology and the skeleton of Testudines.

The term "tortoise" is used in reference to all reptile species belonging to the family *Testudinidae*, which is one of 14 families that make up the order of Testudines or Chelonia, more commonly known as "turtles" (Stanford et al., 2020). Aquatic or marine turtles refers to members of the families *Cheloniidae* and *Dermochelyidae* (Bates et al., 2014). Terrapins are semiaquatic freshwater turtles, which in South Africa comprises the family *Pelomedusidae* (Bates et al., 2014).

2.1 Testudines in archaeology and ethnography

Human-Testudines interaction has a long history. This is evident in for example the archaeological material that was excavated at the 1.95-million-year-old location FwJj20 in

Kenya, where aquatic turtle remains containing traces of hominin modification were identified (Braun et al., 2010). Tortoises have been exploited at least as far back as 400 000 years ago (Blasco et al., 2016), and they are together with other members of this taxonomic order, still being utilised by various people (e.g. Balée, 1985; del Papa, 2016; Backwell and D'Errico, 2021). The aim of this section is to present archaeological research of these human-testudines interactions, followed by some ethnographic examples demonstrating use that would be both visible, and invisible archaeologically.

2.1.1 Archaeological research on Testudines

Despite Testudines being a feature of many archaeological sites worldwide, and often quite abundant at that, when compared to the extensive literature there is on taphonomy of mammalian remains they seem to have received relatively little attention. There are exceptions to this, including studies focusing or touching on themes such as taphonomy (see chapter 2.4 for further elaboration on this) and reconstruction of the processing sequence (Wadley, 1993; Sampson, 1998; Speth and Tchernov, 2002; Blasco, 2008; Thompson, 2010; Thompson and Henshilwood, 2014b; Blasco et al., 2016; Holt et al., 2019; Nabais and Zilhão, 2019), the role these animals played in the diet and what other purposes they may have served (Wadley, 1993; Speth and Tchernov, 2002; Thompson and Henshilwood, 2014b; Blasco et al., 2016; del Papa, 2016), what their presence can indicate about the palaeoenvironment (Klein and Cruz-Uribe, 2000; Thompson and Henshilwood, 2014b) and discussions regarding whether changes in mean tortoise size reflects pressure put on the populations by humans as a result of changes in demographics or changes in climate (Klein and Cruz-Uribe, 1983; Speth and Tchernov, 2002; Avery et al., 2004). Furthermore, the identification of archaeological specimens down to species level has also been touched upon as this is not always straight forward (Baker and Shaffer, 1999; Sampson, 2000, p.783; Speth and Tchernov, 2002, p.481). Finally, the South African rock art record also contains some depictions of Testudines (Helm et al., 2023).

Anthropogenic modification of Testudines bones related to butchery has been demonstrated both archaeologically and ethnographically to appear in the shape of cutmarks, scrape marks, human tooth marks, thermal alteration, impact flakes, and percussion pits, marks and notches, and drilled holes (Rybczynski et al., 1996; Speth and Tchernov, 2002; Blasco, 2008; Thompson, 2010; Thompson and Henshilwood, 2014b; Berthon et al., 2016; Blasco et al., 2016; del Papa, 2016; Nabais and Zilhão, 2019). Taphonomic modifications of assemblages that have been used to argue for utilisation beyond that of food includes the following: representation of shell elements relative to the rest of the skeleton together with historical sources to highlight the possibility of the shells being prestige items, and shields (Çakırlar et al., 2021, p.137), spatial distribution and completeness of shell elements compared to the arrangement and fragmentation of other fauna to argue they were used as containers (Speth and Tchernov, 2002). Lack of representation of elements other than from the shell has also been suggested to indicate tortoises being used as bowls or containers (Inskeep, 1987). Other recorded modifications includes polishing, grinding and/or ochre staining on carapace (Deacon, 1982; Inskeep, 1987; Sampson, 2000; Thompson and Henshilwood, 2014b). Inskeep (1987, p.169) mentions shell specimens that have been grinded and smoothed to the extent that the inner tabula is exposed. Furthermore, musical instruments made of Testudines shell have been demonstrated archaeologically though modifications such as drilled holes, and includes lyres (Holzman, 2016) and rattles (Gillreath-Brown and Peres, 2018). In addition to this, carapace specimens with paired, drilled holes have been interpreted as pendants (Deacon, 1982; Inskeep, 1987). Humans are not the only taphonomic agent to accumulate and modify Testudines. In terms of modern South African tortoises, several animals prey on them, which has been considered in archaeological research as well. According to Sampson (2000) raptor assemblages from kill sites and roosts have different breakage patterns and skeletal frequencies to those of human or other predator origin. By comparing raptor deposits to an archaeological assemblage, he argues that human made collections tend to contain higher frequencies of shell elements, front limbs and shoulder girdles, while axial and cranial elements appearing in lower frequencies. They are also often burnt and show heavy breakage, with a typical San-made assemblage containing 30-40% burnt bones (Sampson, 2000, p.785). Bushfires is another taphonomic agent shown to create tortoise assemblages (Avery et al., 2004; Stahlschmidt et al., 2023).

Tools are not necessarily required to butcher small animals (Landt, 2007). However, the bodies of Testudines are encompassed by a hard, protective shell, and they likely required a processing sequence that differed from those used on mammals to break into the shell. In their study of tortoise remains deposited by the neanderthals of Kebara Cave, Israel, Speth and Tchernov noted how the carapace appeared to be the most commonly burnt element, and furthermore how 53.7% of these were only burnt on the dorsal side (Speth and Tchernov, 2002, p.473). They suggest that this indicates that the first step in the process was to put the tortoises in the fire upside down to be cooked in the shell. Blasco (2008) comes to the same conclusion in her taphonomic analysis of the tortoises of Bolomor Cave in Spain. According to her, the tortoises were further fractured open to enable the visceral organs to be removed by cutting or scraping them out, as cutmarks and scrape marks were found on the interior of the carapace. Some limbs and girdles also contained cutmarks (Blasco, 2008, p.2844). Finally, some of the bones were then thrown on the fire. Similarly, tortoises from Blombos Cave in South Africa also shows signs of being cooked upside down in their shells and then fractured open, with 66.1% of the specimens displaying charring and 71/4343 specimens displaying percussion marks (Thompson and Henshilwood, 2014b, p.222-223). Additionally, they note that some of the bones showed signs of being chewed on, although they emphasise that identification of toothmarks can be ambiguous (Thompson and Henshilwood, 2014b, p.222). A similar processing sequence was also likely used among the neanderthals from Gruta da Oliveira and Gruta da Figueira Brava in Portugal (Nabais and Zilhão, 2019). They observed damage to the proximal epiphysis of the limbs which they suggest could indicate that they were twisted of after the tortoise had been cooked and opened.

Testudines have been considered in terms of what role they fill in various hunter-gatherer diets using optimal foraging theory and models (Thompson and Henshilwood, 2014b, 2014a; Nabais and Zilhão, 2019). I will come back to this in chapter 3. Tortoise remains from Quesem Cave in Israel were analysed by Blasco et al. (2016), with the aim of investigating how humans adapted to the landscape and how dietary gaps were filled by supplementing with smaller fauna, such as tortoises, as the larger fauna was not always available. (Nabais and Zilhão, 2019) Related to this is also how they were obtained, and if they were targeted, or collected opportunistically either through chance encounters or after bush fires (Avery et al., 2004).

Size differences between tortoises throughout sequences at sites have been used to argue for increased predation pressure because they are slow-growing and procreate slowly, which makes them unlikely to sustain intensive predation over longer periods (Klein and Cruz-Uribe, 1983; Avery et al., 2004; Klein and Cruz-Uribe, 2016; Nabais and Zilhão, 2019). Changes in size may also be related to environmental changes (Speth and Tchernov, 2002; Avery et al., 2004).

Baker and Shaffer (1999) stresses the importance of properly accounting for the methods by which archaeological specimens are assigned to species. In terms of tortoise species, they do not necessarily differ from each other in their skeleton, and criteria for distinguishing between some of them may include traits such as colour, sound, and size, which, apart from the latter, does not preserve archaeologically. Baker and Shaffer (1999) further emphasise that in the case of size, many species are overlapping. Geographical range also often plays a role in the identification process where many species may be excluded from consideration based on where they live rather than morphological traits. They argue that the criteria by which a specimen is identified needs to be explicitly defined to allow other researchers to evaluate the results of the analysis or use them as an identification guide within their own research. Sampson also touches on the subject when he points out that the two South African species *Homopus boulengeri* and *Homopus femoralis* are hard to differentiate osteologically, and rather refer them as *Homopus* sp. when identifying them in the archaeological material (Sampson, 2000, p.783). Speth and Tchernov (2002) also points out issues regarding taxonomic identification as size differences in tortoises throughout sequences in the archaeological record might very well be due to the species composition of the assemblage rather than predation pressure or environmental/climate changes.

Depictions of Testudines is rare occurrence in the South African rock art record. Helm et al. (2023) note that they could find two sites containing possible Testudines rock paintings, both in the Eastern Cape, while petroglyphs of possible chelonians were slightly more common. Rock art in South Africa had been made by a wide variety of people of different cultures and ethnicities, and has been associated with themes such as healing, rain making, trance, and hunting and “taming” of game (Deacon and Deacon, 1999, p.163-169; McGranaghan and Challis, 2016). Deacon and Deacon (1999, p.173) mentions tortoises as one of several animals that are linked to rain, but not necessarily to rain making.

2.1.2 Testudines in ethnography

The aim of this section is to show some ethnographic examples of utilisation, hunting/gathering techniques, and symbolic meanings of Testudines, to draw attention to aspects of human-chelonian interactions that does not necessarily preserve archaeologically, and some that do.

Four elders of the Ju/'hoansi people of the Nyae Nyae Conservancy in Namibia shared their knowledge on artefacts that had been collected from various Khoisan groups in the Kalahari Desert by the physician and anthropologist Louis Fourie in the early 20th century (Backwell and D’Errico, 2021).They mentioned a variety of ways tortoises are utilised. One way of using the shells is as bowls in which sun-dried, poisonous insect larvae are pulverised as a part of the preparation process of poison arrowheads (Backwell and D’Errico, 2021, p.176-179). They also mentioned the carapace can be used to mix ostrich egg in as a part of the cooking process (Backwell and D’Errico, 2021, p.114). Furthermore, tortoise shells are also used as perfume containers. Holes are drilled into the shell (**figure 2.1**), and the container is filled with a mixture consisting of a type of wood (*Peltophorum africanum*) and other ingredients (Backwell and D’Errico, 2021, p.70). This is mainly worn by girls and women who menstruate, or to mask smells, but this perfume can also be used to drive away evil if people get sick, or to facilitate peaceful sleep among people that come to visit the village (Backwell and D’Errico, 2021, p.70).

The indigenous Ka’apor people from Brazil have certain food taboos, which were recorded and described by Balée (1985). When women eat meat during menstruation, they exclusively eat the yellow footed tortoise, as eating any other animal would cause her to become ill. This is also the only meat consumed by a woman the first six months after childbirth, and by girls for eight months after they start menstruating. In this society, the father also eats this tortoise for the first 15 days of fatherhood. It is his responsibility to provide the tortoises, and no other hunter. The time spent to search for tortoises can be long, but when they are encountered the capturing and handling is not costly in time or energy. Other indigenous people such as some groups of the Tupinambá, who also lives in Brazil, prohibit consumption of tortoises, as eating them will cause hunters to become sluggish (Balée, 1985, p.505). Other ethnographic sources contains records of capturing methods that includes placing water in front of their burrows to lure them out, tapping on the floor of the burrow to make the tortoise emerge, and the use of hooks and sticks to drag the tortoise out (Blasco et al., 2016).

Gathering of Testudines can also be opportunistic, such as among Wichí groups in South America, and by rural populations in Mendoza, Argentina (del Papa, 2016). When encountered, they are collected and brough home and put in a pen. Alternatively, holes are drilled into their shell, and they are tied until enough are collected, and then eaten. Villagers in Republic of Congo, Gabon and Central African Republic also collect tortoises opportunistically when foraging for other resources (Blasco et al., 2016, p.178).

Other use of Testudines documented ethnographically includes consumption of tortoise and turtle eggs (Emory, 1975; del Papa, 2016), fishhooks made by scutes and bone from carapaces of aquatic turtles (Emory, 1975), medicinal, aesthetical and symbolic purposes (del Papa, 2016), and turtle and tortoise shell rattles used by various indigenous groups in North America in dance, ceremonies and rituals (Gillreath-Brown and Peres, 2018). In the latter example, holes are drilled into the shell, which is filled with various objects such as pebbles, seeds, or teeth. Testudines are also an important part of the cosmology of many indigenous groups (Gillreath-Brown and Peres, 2018).

Figure 2.1. Tortoise perfume containers. Photograph by Brent Stirton, taken from (Backwell and D’Errico, 2021, p.224).

2.2 The Pleistocene/Holocene transition, and Oakhurst in the Southern Cape

The Klipdrift Cave Testudines analysed in this thesis comes from layers dated to between 13 700 cal BP and 10 700 cal BP (Ryano et al., 2017). This sequence falls within the African

Later Stone Age (LSA), which, depending on the location, started between 45 000 cal BP and 24 000 cal BP (Ryano et al., 2017).

On a global scale, the time period the Oakhurst sequence occurs in is characterised by climatic changes, a rise in sea level (Abell and Plug, 2000; Hepp et al., 2019), and the extinction of megafauna (Barnosky et al., 2004; Grayson, 2007; Gill et al., 2009; Faith, 2014). The transition between the Pleistocene and Holocene epochs at ~ 11 500 cal BP (Walker et al., 2019, p.134; Gradstein et al., 2020, p.1232), marked the end of the Last Glacial Period with the Last Glacial Maximum (LGM), when global glaciation reached its largest extent, occurring between 26 500 and 19 000 cal BP (Clark et al., 2009; Palacios et al., 2020; Škrdla et al., 2021). This was followed by fluctuations between periods of warmer and wetter, and colder and drier conditions, although generally trending towards a warmer climate (Abell and Plug, 2000; Noronha-D'Mello et al., 2021). Between 12 800 and 11 500 cal a climatic event referred to as the Younger Dryas (YD) occurred, which was a brief cooling period (Abell and Plug, 2000; Haynes, 2008; Jochim, 2012; Mahaney, 2023).

The exact cause, impact, timing, intensity and geographical context of the YD is complex and debated (Abell and Plug, 2000; Surovell et al., 2009; Haynes et al., 2010; Palacios et al., 2020; Mahaney, 2023). In South Africa, evidence at sites such as Boomplaas Cave and Byneskranskop, suggest aridity increased during the LGM to the start of the Holocene, and the climate became more humid again following the Holocene (Faith et al., 2019).

In part due to these uncertainties, the impact of the YD on human cultural changes such as shifts in technology, subsistence strategies and settlement patterns during the Oakhurst period is debated (Klein, 1984; Meltzer and Bar-Yosef, 2016; Johnson, 2019, p.27).

The lithics manufactured in the southern Cape across the Pleistocene/Holocene transition belong to the Oakhurst techno-complex, also referred to as the Albany Industry, and were utilised between 14 000 and 8000 cal BP (Ryano et al., 2017). The Oakhurst period followed the Robberg period, however, the timing was asynchronous across the Cape (Ryano et al., 2017), and was superseded by the Wilton techno-complex (Lombard et al., 2022).

The Oakhurst industry is characterised by unstandardised and irregular flakes, few or no blades, and low frequencies of formal tools (Ryano et al., 2017). When formal tools do appear, it is often in the shape of scrapers, which tend to be larger in the early parts of the Oakhurst (Ryano et al., 2017). The tools are in general largely unstandardised and were likely discarded rather than maintained or repaired when broken, which could be tied to sources of subsistence being relatively predictable (Ryano et al., 2017, p.116). The lithics tend to be made from raw material which can be found locally, with quartzite being the most common, but hornfels is also often found (Ryano et al., 2017).

The abundance of shellfish remains and evidence for fishing at Oakhurst sites suggest these populations were more reliant on marine resources than during the predating period. This is likely due to sea level rise making these resources more readily available (Klein, 1972a; Ryano et al., 2017).

Although many African large mammals survived the megafaunal extinction during the late Pleistocene and throughout the Holocene, several species and genera disappeared, including the large buffalo *Syncerus antiquus* and the giant zebra *Equus capensis* (Faith, 2014). In South Africa, there is evidence from sites such as Nelson Bay Cave, Byneskranskop and Boomplaas Cave that grazers were replaced by browsers/mixed feeders as open grasslands dissapeared during this transitional period (Faith, 2014; Discamps et al., 2020).
In addition to KDC, there are eight other sites in the Southern Cape associated with this industry (**figure 2.2**), four coastal sites: Nelson Bay Cave, Matjes River Shelter, Byneskranskop 1, and Oakhurst Shelter, while the remaining Boomplaas Cave, Kangkara Cave, Wilton Large Rock Shelter, and Melkhoutboom Cave, are inland sites (Ryano et al, 2019, p.1). The dates from many of these are not precise, and Loftus et al. (2016) points out that to compare the timing of environmental and cultural changes across the region can only be done in a coarse framework.

Nelson Bay Cave is located on the Robberg Peninsula about 45-50 m from the coast and contains both LSA and MSA material (Klein, 1972a; Klein, 1972b; Inskeep, 1987). Inskeep first excavated the cave between 1964 and 1965, followed by Klein in 1970 and 1971. The Holocene layers consist of shell middens, and the underlaying Pleistocene layers lack marine shells (Loftus et al., 2016). ^{14}C dates reported by Fairhall et al. (1976), were later confirmed, refined or changed by Loftus et al. (2016), and the current dates for the Oakhurst layers are ca. 12,174–11,669 to about 9500 cal BP. Klein (1972b) initially concluded changes in the species composition of the mammals from grassland antelopes to an abundance of marine organisms could be due to environmental changes caused by rising sea levels around 12,000-11,000 BP. He argued for a link between faunal and cultural changes as they appeared to be synchronous, and that the extinction of megafauna in Southern Africa might have been more extensive than what had previously been assumed. The new dates reported by Loftus et al. (2016) however altered some of these previous interpretations of the site. In terms of tortoises, Inskeep (1987) mentions that they were likely absent or rare in the area surrounding the cave, and the ones he found came from younger layers than Oakhurst. When Klein

(1972a) later excavated the site, he did find tortoise carapace and limb fragments but these were not analysed. Klein (1998, p.516) later noted that tortoises have historically been abundant on the western and south-western coast, and less so on the south central coast, which he suspects might have been the case in the past as well, because they are rare at all south-central coastal sites, and more abundant at sites towards the west and north-west.

Matjes River Shelter is located near the mouth of the Matjes River, and contains one of the largest shell middens in Southern Africa (Sealy, 2006). It was according to Ericka et al. (2008) excavated by Dreyer in the 1920s, and again over the course of over 30 years by Hoffmann and Meiring from the 1950s. The methods by which the site was originally excavated has been described as “crude”, and a lot of contextual information is missing as well as material, as most of the food waste was disposed of (Sealy, 2006, p.573). From the sections remaining at the site there seems to be an abundance of shellfish and fish bones (Döckel, 1998; Sealy, 2006). There is no mention of Testudines from the site apart from terrapin shells in some younger Wilton layers (n ~140) (Ludwig, 2005).

Byneskranskop is located at Byneskranskop hill, about 7 km from the coastline (Loftus et al., 2016). It was excavated in 1974 and 1976, where a total of 19 LSA layers were identified, of which layer 13-17 belong to the Oakhurst period (Klein and Cruz-Uribe, 1983; Loftus et al., 2016). Layer 17 is dated to 14,320–13,860 cal BP, Layer 15 to 11,695-11,245 cal BP, while the end of the Oakhurst at this site is more unsure due to possible stratigraphic mixing (Loftus et al., 2016, p.377-378). Shellfish, fish and seal increase from layer 10 and up which has been attributed to the rise in sea level (Klein and Cruz-Uribe, 1983). There is also a change in terrestrial mammals, switching from grazers in level 10 and below, to “browsers and mixed feeders” from level 9 and up. The whole site contained what to my understanding is to be read as 1113 tortoise individuals (Schweitzer and Wilson, 1978, p.137), but they were especially highly concentrated in layer 14, hypothesized to be due to exploitation of a wildfire event where large numbers of tortoises were killed (Avery et al., 2004). Schweitzer and Wilson (1978) mention tortoise carapace, and three tortoise buttons from layers younger than Oakhurst. Klein and Cruz-Uribe (1983, p.27-28) measured a total of 647 humeri from the Oakhurst layers, and found tortoises from layer 10 and below to be larger than from layer 9 and up.

Boomplaas Cave is an inland site located near the Cango Valley about 80 km north of the coast, excavated by H.J. Deacon between 1974-1979 (Deacon, 1979; Deacon, 1982; Faith, 2013). The CL layer, dated to 13,668 – 14,186 cal BP (Faith, 2013), is noted to be a thick occupational layer with high densities of fauna and artefacts (Deacon, 1979, p.249). Layer

BLR, consisting of 7 stratigraphic units, is dated to between 9866-10,595 and 11,954-12,613 cal BP, and contains Oakhurst material with the transition to Holocene occurring between unit BLR5 and BLR6 (Deacon, 1979, p.251; Faith, 2011). This transition is according to Deacon marked by a change in the faunal record from a dominance of larger antelopes and equids to small/medium antelopes. Klein and Cruz-Uribe (2016) mentions that tortoises are rare at this site. Two tortoiseshell bowls have been found, but they are from younger and older layers than Oakhurst (Deacon, 1984). The combined number of identified specimens (NISP, see 2.4.1) of tortoises in the BLR layer is 1610 (Faith, 2011, p.134). Carapace and plastron dominate the tortoise collection, of which the differentially burnt specimens are more often burnt on the exterior (Faith, 2011, p.107). There is also a decrease in tortoise abundance throughout the Holocene, but this was not related to the change in frequencies between grazers and browsers (Faith, 2011, p.119).

Wilton Large Rock Shelter is located in the Eastern Cape, and lies 50 km away from the coast, and 440 m above sea level (Deacon, 1972). It was first excavated in 1921 by Hewitt, Stapleton and Kilroe, and later between 1966 and 1967 by Deacon (Deacon, 1972). In 1966/67, excavators defined 14 units spread out over four layers, in which an abundance of artefacts were found, including and over 40 000 bone fragments (Deacon, 1972). Layer 3I-3G is suggested to contain lithics representing a formative phase of Wilton, and the lithics from layer 4 is described to consist of large scrapers, often made of quartzite industry (Deacon, 1972). Uncalibrated dates for layer 4 puts it at 10 000 BP (Deacon, 1972). There is a shift in mollusc shell representation from marine shells to freshwater shells after unit 3E, which Deacon suggests points to a shift in territorial range (Deacon, 1972, p.35). Marine shell was rarely present in large quantities, and Deacon argues they were primarily used for bead-making rather than food. The faunal remains were highly fragmented, with 77.6% being unidentified (Deacon, 1972, p.35). She further states the most frequent animals includes small/medium antelopes, rock hyraxes, tortoises, snakes and crabs, and observed a consistent frequency of large animals appearing where the older layers were reached. The minimum number of individuals (MNI, see 2.4.1) of tortoises at the site in total was 41, of which 5 came from layer 4, while 3I and 3H contained 3 and 2 respectively (Deacon, 1972, p.35). Brain (1981) identified angulate and leopard tortoise in the collection, and notes that shell is abundant, while there are few limbs and no crania. He suggest that the head was chewed and swallowed (Brain, 1981, p.43).

To my knowledge, there is no mention of Testudines from Oakhurst Shelter. The preservation of bones at Kangkara Cave was poor, and only mammals are reported (Deacon, 1982). At Melkhoutboom Cave, tortoise carapace is mentioned (Hewitt, 1931), however it is unclear how abundant they are. Due to these uncertainties, these sites are not further described.

Figure 2.2. Contemporary Oakhurst sites. Wilton Large Rock shelter is not included here as it lies slightly more east than Melkhoutboom Cave. Map taken from (Ryano et al., 2019, p.2).

2.3 Klipdrift Cave in the context of De Hoop Nature Reserve and Klipdrift Complex: ecology, geology and archaeology

2.3.1 De Hoop Nature Reserve

KDC is located in the De Hoop Nature Reserve at the southern coast of South Africa (**figure 2.3**), and is a World Heritage Site protected and managed by CapeNature (CapeNature, 2016). The climate is Mediterranean with warm summers and temperate winters, February being the warmest month on average (24 °C) (CapeNature, 2016, p.25). The annual rainfall varies between 500 to 2000 mm and is mostly evenly distributed throughout the year although June to August receives slightly more rainfall than December to February (CapeNature, 2016, p.25; Mudavanhu et al., 2016, p.790).

The geology of the nature reserve is composed of three sedimentary groups containing quartzites, limestone and sandstone: the Table Mountain Group, Bokkeveld Group and Uitenhage Group (Henshilwood et al., 2014, p.286; Mudavanhu et al., 2016, p.790). The coast contains cliffs and caves eroded by the sea. Offshore, the Agulhas bank extends past the nature reserve, where masses of water of different temperatures and sources mixes. The major ocean currents, the Agulhas Current, South Atlantic Current and the Benguela Current, sustains a rich marine biodiversity of mixed warm- and cold-water species (Rau et al., 2002; CapeNature, 2016, p.33).

The vegetation in the reserve belongs to the Cape Floristic Region, one of the world's 6 floral kingdoms, and is dominated by low shrub heathlands called Fynbos (Henshilwood et al., 2014, p.286; CapeNature, 2016, p.34-35). Wildfire seasons play an important role in naturally managing the landscape (van Wilgen, 2013; Henshilwood et al., 2014, p.286; CapeNature, 2016). Both Khoekhoen pastoralists and San communities have also traditionally burned vegetation throughout history (Avery et al., 2004, p.148; CapeNature, 2016, p.39).

In addition to the great marine biodiversity, the geological and ecological features also supports a rich diversity of terrestrial fauna, with 68 mammal- and 277 bird species (Henshilwood et al., 2014; CapeNature, 2016, p.X).

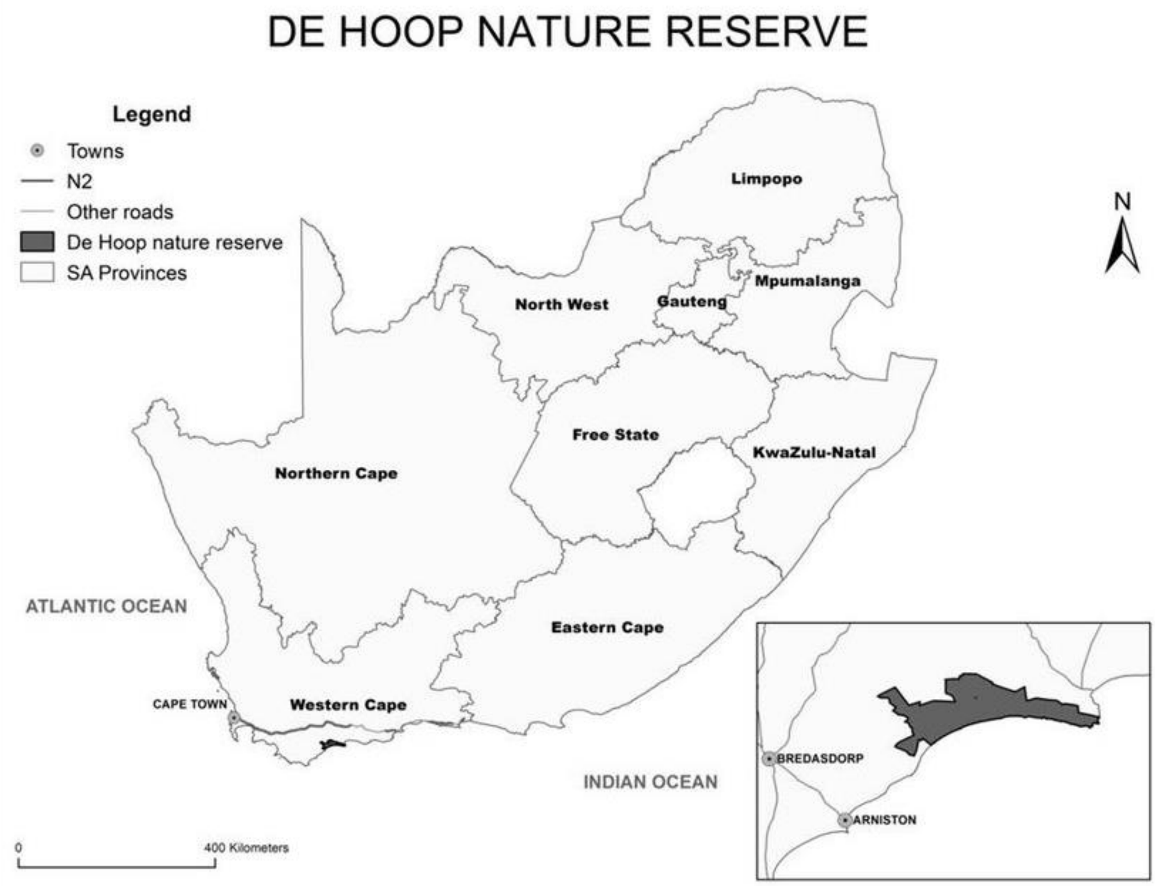


Figure 2.3. Location of De Hoop Nature Reserve. Map from (Mutavhatsindi, 2017, p.13).

2.3.2 Klipdrift Cave: context and previous research

More than 160 archaeological sites were mapped during surveys along the coastline of De Hoop from 1998 to 2009 (Henshilwood et al., 2014). Finds from the reserve includes Acheulean hand axes and various deposits visible from the surface. (Henshilwood et al., 2014). During these surveys, the Klipdrift Complex was discovered.

The Klipdrift Complex contains Klipdrift Shelter (KDS), Klipdrift Cave (KDC) and Klipdrift Cave Lower (KDCL) (**figure 2.4-2.5**). KDS and KDCL contains MSA deposits with OSL-dates between 51,700 ± 3,3 ka and 71,600 ± 5,1 ka (Henshilwood et al., 2014), and at least 70 ka respectively (Discamps et al., 2020). The KDC contains LSA deposits radiocarbon dated between 13,700 and 10,700 cal BP (Ryano et al., 2017).

KDC is situated on a quartzite cliff about 17 m above sea level, and the shoreline in the immediate area surrounding the cave is rocky, with a cobble beach just below the site, and few sandy beaches in the area (Ryano et al., 2017; Discamps et al., 2020). There are two freshwater sources nearby: the Klipdriftfonteinspruit stream and Noetsie Waterfall, about 200 m to the East of the complex, (Henshilwood et al., 2014, p.286).

The accessibility, preservation of fauna and visible LSA and MSA deposits on the surface were the main reasons for selecting this location for test excavations (Henshilwood et al., 2014). These were conducted over two seasons, 2010 and 2011, and at KDC, covering an area of 2.75 m^2 (Henshilwood et al., 2014; Ryano et al., 2017). Nine layers were identified, going from youngest to oldest: JY, JYA, JZ, JZA, JZB, KAB, KAC, KAD and KAE (**figure 2.6**), with some also containing hearths (JZh and KADh1).

There are few published studies on the archaeological material found in these layers. The preliminary report (Henshilwood et al., 2014), includes some information on the cave, but the main focus is on the MSA material from Klipdrift Shelter. The bulk of data from Klipdrift Cave comes from studies undertaken and subsequently published as part of (Ryano, 2014) doctoral thesis, and comprises an extensive description and discussion of the morphology and manufacturing techniques of the lithic material (Ryano et al., 2017), and an analysis of the shellfish remains have been published. The most recent publication on the site is an analysis of large mammals by Discamps et al. (2020).

In Ryano's (2014) unpublished doctoral dissertation he mentions there were 58 tortoise humeri that could be measured to investigate if there is a decrease in mean size over time. He found that the pattern displayed by these, and that some of the largest specimens occurred in the highest layers, does not indicate any intensive harvesting pressure leading to decrease in the mean size of tortoises over time.

The lithic collection consists of 13 512 pieces. Ryano et al. (2017) identifies subtle differences between the two lowermost layers KAD and KAE and the rest of the sequence in several aspects. These layers had larger sized and a higher abundance of scrapers and cores, smaller flakes, more bladelets and higher diversity of raw material. Quartzite is the most abundant raw material from the site, which is typical of the Oakhurst period, however silcrete, cryptocrystalline silica (CCS), hornfels and quartz is also present, but in lower quantities. The occurrence of quartz is higher in KAD and KAE, and JZ (Ryano et al., 2017, p.103). Flakes are the most abundant artefact class from the site (Ryano et al., 2017, p.103). The authors mention that layer JZA contains more flakes and less bladelets and cores that the rest of the sequence, and further point out that this composition is the complete opposite of KAD and KAE (Ryano et al., 2017, p.103). They found the shift from the Robberg industry to Oakhurst at KDC did not coincide with the environmental changes of the period (i.e. sea level rise and plant distribution), which they argue weakens any link between them, which is substantiated by the wide use of the Oakhurst technology in Southern Africa across multiple different environments (Ryano et al., 2017, p.116). They further compared their results to other contemporary sites in the Southern Cape, focusing on Matjes River Shelter and Nelson Bay Cave, and detected both similarities and differences between them. Examples of the former includes a dominance of quartzite, low frequencies of formal tools, of which scrapers were the most common tool (Ryano et al., 2017, p.111-113). Examples of differences includes the high frequencies of blades in KAD and KAE, and high amount of quartz (Ryano et al., 2017, p.111). They suggest the lithic material from the two lowest layers of KDC, and possibly layer GSL from Nelson Bay cave, might represent a transition between lithic industries, showing some last remnants of the Robberg techno-complex.

Ryano et al. (2019) detected an abrupt shift in the relative frequency of dominant shellfish species in the assemblage from *Dinoplax gigas* to *Turbo samaticus*, between layers JZB and JZA. They suggest this might be attributed to changes in habitat rather than sea temperatures as several of the species they record have substrates preferences, and the sea level rise could have caused a shift from sandy-rocky shores to more rocky ones. They measured the highest density of shellfish in layer KAD, while layer JZB contained the lowest density. From layer JZA and up, shellfish density increased again (Ryano et al., 2019, p.4). Measurements of the *T samaticus* operculae showed a size decrease from layer JZA and up.

Combined with the increase in densities, the authors suggest these data could point to more intensive shellfish collection.

The preservation of large mammals at KDC is excellent, and due to evidence of human butchering activities and low involvement from predators, they were determined to have been accumulated by humans (Discamps et al., 2020). The authors analysed samples of plotted bone, and from bone and coarse fraction bags. They note that they did not include the thousands of small fragments from the coarse fraction in their analysis. The species composition displayed a subtle shift in frequency between small and big herbivores between the layers KAD and KAE which contained higher proportions of larger mammals. Similarly to other studies at the site, the authors argue that these remains reflect a relatively stable environment with some subtle shifts throughout the Oakhurst period. The biggest change occurs between KAE and KAD, and the following layers. Furthermore, the authors point out that the dates for four out of five layers (KAE, KAD, KAB and JZB) are relatively close in time and overlap each other (**figure 2.6**), which they argue shows the changes between KAE and KAD, and the rest of the sequence were relatively abrupt. But as with the two previous papers on KDC, the authors too point out that these shifts are not temporally overlapping with the greater climatic changes of the period and concludes they are all rather results of the local environmental changes and social dynamics.

Figure 2.4. The Klipdrift Complex. Taken from (Henshilwood et al., 2014, p.286).

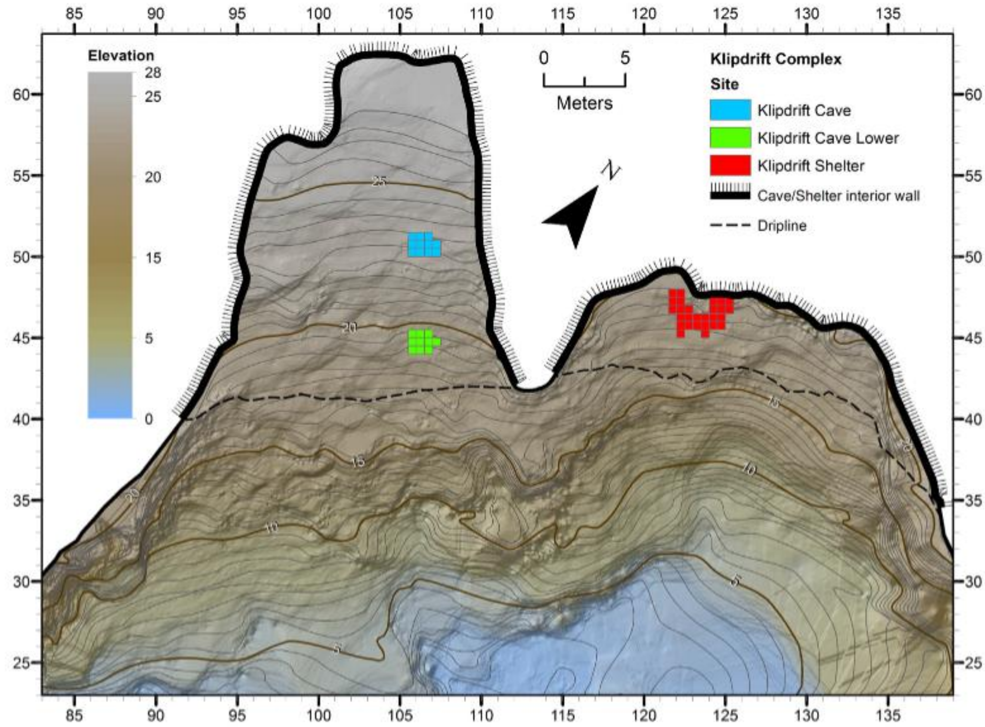


Figure 2.5. Overview of the Klipdrift Complex (from Henshilwood et al., 2014, p.287).

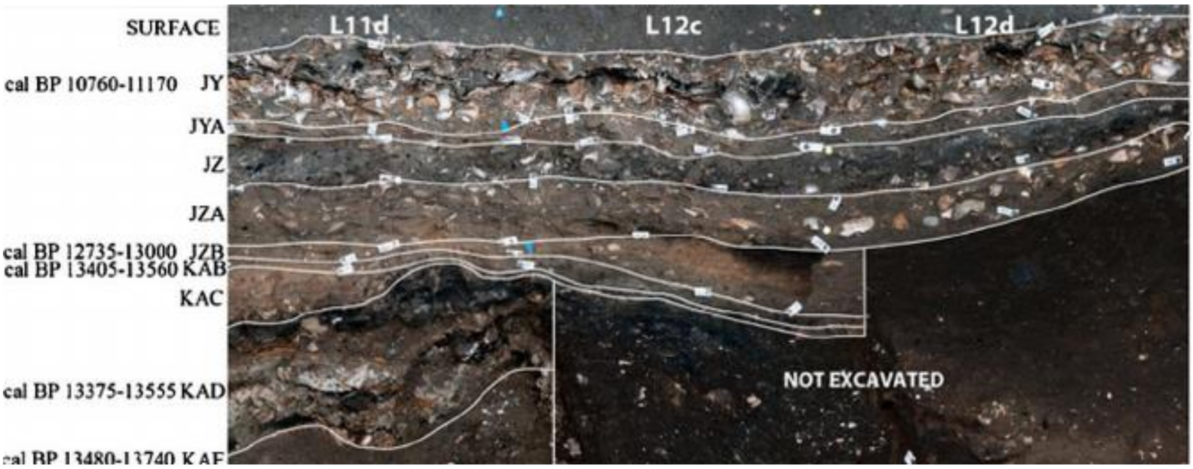


Figure 2.6. The layers of KDC and calibrated carbon isotope dates (from Ryano et al., 2017, p.97).

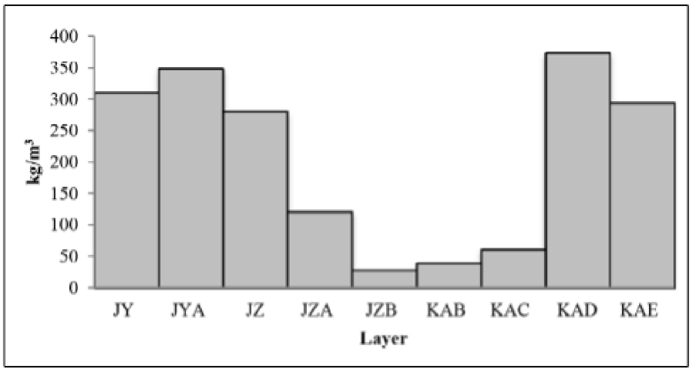
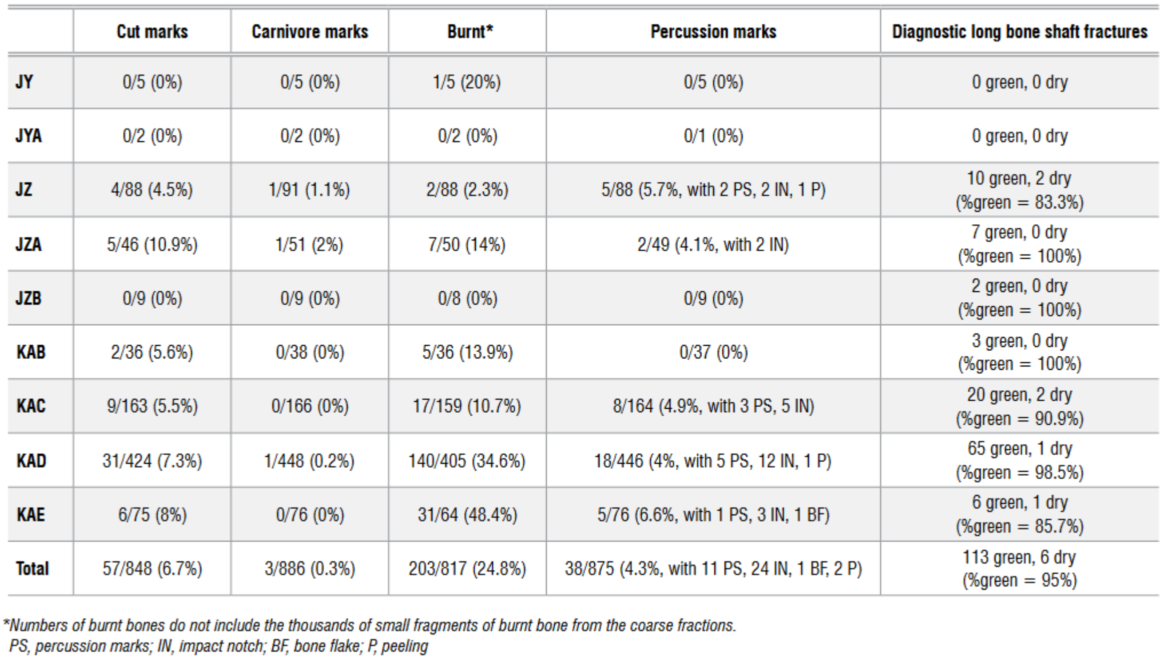


Figure 2.7. Shellfish densities throughout the Oakhurst sequence at KDC. Taken from (Ryano et al., 2019, p.4).



	Cut marks	Carnivore marks	Burnt*	Percussion marks	Diagnostic long bone shaft fractures
JY	0/5 (0%)	0/5 (0%)	1/5 (20%)	0/5 (0%)	0 green, 0 dry
JYA	0/2 (0%)	0/2 (0%)	0/2 (0%)	0/1 (0%)	0 green, 0 dry
JZ	4/88 (4.5%)	1/91 (1.1%)	2/88 (2.3%)	5/88 (5.7%, with 2 PS, 2 IN, 1 P)	10 green, 2 dry (%green = 83.3%)
JZA	5/46 (10.9%)	1/51 (2%)	7/50 (14%)	2/49 (4.1%, with 2 IN)	7 green, 0 dry (%green = 100%)
JZB	0/9 (0%)	0/9 (0%)	0/8 (0%)	0/9 (0%)	2 green, 0 dry (%green = 100%)
KAB	2/36 (5.6%)	0/38 (0%)	5/36 (13.9%)	0/37 (0%)	3 green, 0 dry (%green = 100%)
KAC	9/163 (5.5%)	0/166 (0%)	17/159 (10.7%)	8/164 (4.9%, with 3 PS, 5 IN)	20 green, 2 dry (%green = 90.9%)
KAD	31/424 (7.3%)	1/448 (0.2%)	140/405 (34.6%)	18/446 (4%, with 5 PS, 12 IN, 1 P)	65 green, 1 dry (%green = 98.5%)
KAE	6/75 (8%)	0/76 (0%)	31/64 (48.4%)	5/76 (6.6%, with 1 PS, 3 IN, 1 BF)	6 green, 1 dry (%green = 85.7%)
Total	57/848 (6.7%)	3/886 (0.3%)	203/817 (24.8%)	38/875 (4.3%, with 11 PS, 24 IN, 1 BF, 2 P)	113 green, 6 dry (%green = 95%)

**Numbers of burnt bones do not include the thousands of small fragments of burnt bone from the coarse fractions.*
PS, percussion marks; IN, impact notch; BF, bone flake; P, peeling

Figure 2.8. Taphonomic modifications of the large mammal bones as reported in (Discamps et al., 2020, p.5).

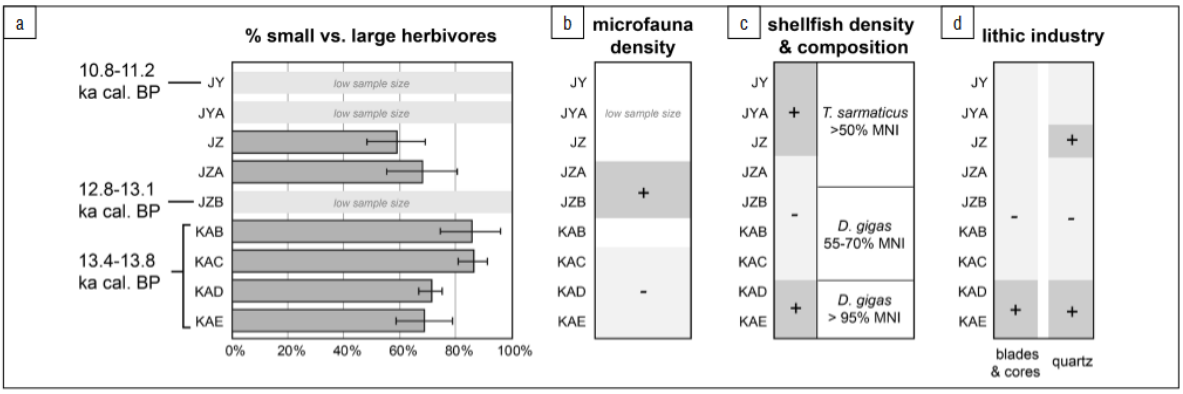


Figure 2.9. Variability in the Oakhurst sequence from KDC, a) large mammals, b) relative density of microfauna (hyrax and mammals smaller than hyrax), c) shellfish density, d) lithics (figure taken from Discamps et al., 2020, p.6).

2.4 Taphonomy

Several agents and processes may act on bones after they are deposited by altering their appearance and arrangement, the identification and description of which lays within the field of taphonomy (Lyman, 1994b). Zooarchaeologists utilise an array of units, terms, techniques and methods when investigating topics such as subsistence strategies and past environments (White, 1953; Lyman, 1994b; Lyman, 1994a; Marean et al., 2001; Lambacher et al., 2016). This includes quantification and identification of various taphonomic agents and modifications. This section contains descriptions of these topics, but before elaborating on these, there are some key terms that needs to be defined to avoid ambiguity.

“Specimen” is used here about a complete, or fragment of a bone or a tooth (Lyman, 1994b, p.100). The specimen can also be referred to as an “element” if it is complete, and as a “fragment of an element” if it is not (Reitz and Wing, 2007, p.9). “Skeletal element” is a more abstract concept, referring to the bones as such. Lyman (1994a, p.39) refers to it as a “natural anatomical unit of a skeleton”, and further exemplifies this by pointing out that a fragment of a femur is a *representation* of a skeletal element.

A “sample” consist of a combination of faunal specimens that are presumed to have had some relationship to each other prior to the excavation (Reitz and Wing, 2007, p.9). When combining all the samples that originates from the same site and time period, this is referred to as a “collection”, while an “assemblage” comprises the combination of multiple different collections from the same site (Reitz and Wing, 2007, p.9).

2.4.1 Quantification: NISP, NSP, MNE and MNI

The aim of quantification is to measure specified properties of a faunal assemblage, such as changes in taxonomic abundance between different occupational phases in a site, frequencies of modifications on bones to identify patterns that can be used to assess human behaviour, and/or to make inferences about past environmental conditions (Lyman, 1994a, p.48). An array of methods are used within zooarchaeology, and likewise a plethora of measuring units, sometimes with overlapping and ambiguous meanings (see Lyman, 1994a, for a discussion of this). The following section contains a description of the units: number of identified specimens (NISP), number of specimens (NSP), minimum number of individuals (MNI), and minimum number of elements (MNE). The specifics surrounding the *methods* by which these were calculated are more appropriately found in chapter 4.

NISP is an observational unit, or a unit of measurement, calculated from what can be directly observed without being derived from another data set, unlike analytical units where indirect observations are measured (Lyman, 1994a, p.37; Marean et al., 2001). It is a raw count of all the identified specimens within a defined limit such as a unit or a whole site, depending on the research question. Lyman (2008) underlines the necessity of explicitly defining terms like “identified” to avoid ambiguity, which he considers to be a greater issue within zooarchaeology in general (Lyman, 1994a; 1994b). In the case of “identified” it can mean to skeletal element, but it can also mean to taxon to at least family level, or both of these (Lyman, 2008, p.27). The related unit NSP includes both identified and unidentified specimens (Lyman, 1994a, p.45), but is also sometimes used in this thesis about specimens that were not identified lower than the order Testudines alone to differentiate between these and NISP. How I use this term in this thesis is made clear in each context.

Several issues with NISP have been identified and discussed (Lyman, 2008), especially with regards to what this unit is actually measuring. Variation in fragmentation is one problem, for example between different taxa, or assemblages that have a higher degree of it as it leads to higher NISP-values due to there being more pieces that are identifiable (Cannon, 2013, p.397). Another significant aspect of NISP is that it does not account for interdependence (Lyman, 1994a; Lyman, 2008). It does not distinguish between fragments and complete elements, and one must be aware of the possibility of counting two specimens that constitutes the same element. One option is to count such specimens as one if they clearly fit, however there is according to Reitz and Wing (2007, p.168) some disagreement as to whether this is to be done or not. They further emphasise that whatever decision is made by the analysist, it should be made clear. Furthermore, a collection of specimens may or may not be from the same individual. Factors like the mesh size when sieving, taphonomic processes, sample size, identification skills and tenacity of the person analysing the bones can also affect this units (Lyman, 1994a, p.51; 1994b; Reitz and Wing, 2007). These issues also apply to the other units mentioned here. However, Lyman (2008, p.30-36) states many of these can be solved analytically and differs between each specific case. NISP is also a widely used unit and allows comparisons between sites to be made.

The issue of specimen interdependence does not apply to MNI to the same degree as NISP (Lyman, 2008, p.78). MNI is an analytical unit, in which the number of individuals a set of specimens represent in minimum is inferred by the analysist through specified criteria, such as size, side, fraction preserved and sex (Lyman, 1994a). It is calculated from NISP, which means many of the concerns with NISP (e.g. fragmentation), also applies to this unit. The introduction of MNI from palaeontology to archaeology has according to Lyman (2008, p.39-41) often been attributed Theodor White (1953), who aimed to calculate the amount of meat each taxon contributed with to the diet. Lyman further mention that William Adams in an unpublished master's thesis in archaeology in 1949 also technically used this unit, but he seemes to have done so independently of any paleontological work. An important underlaying assumption for this unit is that animals are symmetrical, with the appendicular skeleton consisting of paired elements. White (1953) separates elements into left and right and uses the highest value as the foundation of his calculation of MNI. He emphasises that a subsequent consequence of this procedure is a degree of uncertainty with regards to whether the right and left pairs in reality match, meaning that there is a risk of undercounting the number of individuals.

MNE, which is also an analytical unit, is the basis of MNI calculations, and the earliest definition given of the term was by Henry Bunn in his Ph.D. dissertation from 1982, although it was used before this, (Lyman, 1994a; Lyman, 2008, p.214). It is typically used about the minimum numbers of a specified element that is represented in a collection, sample or assemblage, both by complete and uncomplete specimens(Lyman, 1994a, p.52). The highest MNE count yields the MNI (Thompson and Henshilwood, 2014b). It is also used to investigate the relative frequency of elements (Lyman, 1994a, p.53).

2.4.2 Bone modifications: anthropogenic and non-anthropogenic

Bone modifications when produced by humans can be related to butchering and carcass processing (Shipman and Rose, 1983; Bennett, 1999), or cultural behaviour like ritual acts and art (e.g. Williamson and Veilleux, 1956; Rosenthal, 1976) although these activities are not necessarily mutually exclusive. This section contains general descriptions of modifications that have also been previously identified on Testudines bones in archaeological contexts around the world. Anthropogenic modifications include burning, cut- and scrape-marks, percussion-marks, ochre residue and polishing and drilled holes. Some of which can also be created by non-human agents, together with toothmarks, beak/talon punctures and trampling.

It is not unusual for archaeological sites to contain burnt bones, which can be attributed to human cultural activities such as cooking, fuelling of hearths, disposal of rubbish or cremation (Nicholson, 1993; Bennett, 1999; Cain, 2005; Fernandez-Jalvo and Andrews, 2016, p.157), or natural causes like bushfires (Avery et al., 2004; Stahlschmidt et al., 2023). Alterations indicative of fire exposure includes discolouration, shrinkage, changes in crystalline structure and cracking (Bennett, 1999; Reitz and Wing, 2007, p.132; Fernandez-Jalvo and Andrews, 2016, p.157). However, the severity and appearance of these tend to be affected by multiple variables (e.g. temperature, humidity, duration, presence/non-presence of soft tissue, and the location of the bones within the fire (Reitz and Wing, 2007, p.132; Fernandez-Jalvo and Andrews, 2016, p.157), which has led to the reliability of using them to determine factors like the temperature of the fire being questioned. In addition to this, several taphonomic processes may mimic the effects described here, a few examples of which includes discolouration by soil, bacterial or root damage, black staining caused by manganese dioxide, or cracking due to alkaline/acidic conditions in the soil or weathering (Fernandez-Jalvo and Andrews, 2016). Bones can also be exposed to heat damage well beyond the time they were originally deposited, as heat from a hearth transfers downwards into underlaying sediments (Bennett, 1999), further complicating attempts to reconstruct processing sequences or determining the cause and agent behind the assemblage. When subjected to fire, bones go through a sequence of colour and morphological changes on the surface that differs very little between mammals and non-mammals (Nicholson, 1993). This sequence has been systemised on a scale going from 1-5 stages or grades of burning, with 0 symbolising unburnt bones (Fernandez-Jalvo and Andrews, 2016). Stages 1-5 are as follows: 1) largely unburnt with localised brown spots from the beginnings of burning damage; 2) a brownish colour but still intact and without cracks; 3) black colour and charring; 4) cracked on the surface, and a dark grey or blueish colour, with a reduction in size and shiny appearance; 5) calcined and extremely fragile, with a bright white colour. Calcined bones tend to be more fragmented than unburnt or moderately burnt bone and are likely to be the result of accidental exposure to fire rather than from cooking (Clark and Ligouis, 2010; Stahlschmidt et al., 2023). Such modifications may indicate cooking when for example appearing on the exterior of the Testudines shell (e.g. Speth and Tchernov, 2002).

Cutmarks are associated with removal of tissue and are the result of accidental contact between the stone tool and the bone during butchery (Cruz-Uribe and Klein, 1994; Fernandez-Jalvo and Andrews, 2016). A typical cutmark will appear as a long, linear incision on the bone, with a V-shaped cross section that is often asymmetrical (Fernandez-Jalvo and Andrews, 2016, p.25-26). When magnified, striations caused by irregularities in the tool can be observed within and/or outside the main cut, along with cone-shaped stress patterns referred to as Hertzian fracture cones (Fernandez-Jalvo and Andrews, 2016). In terms of depth, width, and length, this varies with factors such as the type of tool that is being used, and the raw material it is made of (Fernandez-Jalvo and Andrews, 2016). Other processes, such as trampling, discussed below, may produce modifications that mimics cutmarks. However, the location, abundance, depth and orientation of the mark may sometimes be used to differentiate between agents (Cruz-Uribe and Klein, 1994; Domínguez-Rodrigo et al., 2009; Fernandez-Jalvo and Andrews, 2016). Cutmarks tend to be located somewhat in relation to muscle attachment, often close to or on epiphyses, few in numbers, and oriented obliquely to the long axis on long bones (Fernandez-Jalvo and Andrews, 2016). On tortoises, such marks are often on limbs, girdles and the interior on the shell (e.g. Blasco, 2008).

Scrape marks are linear abrasions on the bone similar to cutmarks, but tend to be broader (Fernandez-Jalvo and Andrews, 2016, p.27). They are produced mechanically by a scraping action to remove muscle fibres or clean the bones. As with cutmarks, anthropogenic made scrape marks can also be identified by looking at the location on the bone, however the morphology may vary and they can be both V- or U-shaped (Fernandez-Jalvo and Andrews, 2016, p.27). These marks are often located on the interior of the Testudines shell (e.g. Blasco, 2008)

Percussion marks are the result of using a hammerstone to break the bone (Capaldo and Blumenschine, 1994; Fernandez-Jalvo and Andrews, 2016, p.108), or alternatively by bashing the bone against a hard surface (Blasco et al., 2016, p.176). Such modifications can be of various sizes and depths and can be circular percussion pits, or semicircular percussion notches if they occur on a fracture edge a bone (Blumenschine and Selvaggio, 1988; Capaldo and Blumenschine, 1994). In the case of the latter, there are often also negative scars corresponding with the notch as one or several fragments of bone flakes off (Capaldo and Blumenschine, 1994; Blasco, 2008). There are also often microstriations in or emanating from the pit/notch as the hammerstone can slip on impact (Blasco, 2008). Several other processes such as chewing by scavengers and trampling can mimic this effect, often making the determination of the agent behind it challenging, however the location and frequency can sometimes clarify this (Blumenschine and Selvaggio, 1988; Capaldo and Blumenschine, 1994; Fernandez-Jalvo and Andrews, 2016). Percussion marks on tortoise remains have previously been demonstrated, mostly on shell elements, and often on the peripherals where the carapace and plastron connect as this is a weak point (Thompson and Henshilwood, 2014b; Blasco et al., 2016; Nabais and Zilhão, 2019, p.234).

Ochre is a general term used about a group of iron-rich minerals, which in addition to being present in the archaeological record, is also found on various artefacts (including bone) as residue (Hodgskiss, 2010; Fernandez-Jalvo and Andrews, 2016; Culey et al., 2023). On Testudines, it has been found on the interior of the shell (Thompson and Henshilwood, 2014b).

A bone with polished surface appears shiny (Fernandez-Jalvo and Andrews, 2016, p.176). When done by humans, it can be unintentionally through use wear such as when tortoise carapace bowls are used for drinking, or when eating (Inskeep, 1987; Thompson and Henshilwood, 2014b). It can also happen intentionally, for example as a part of the process of making bone tools (Rosell et al., 2011). Processes such as trampling and burning, and digestion can also create polished surfaces (Reynard, 2014; Fernandez-Jalvo and Andrews, 2016, p.177). When polished by humans, this modification can be very localised (Fernandez-Jalvo and Andrews, 2016).

Some perforations found on bones have been argued to be drilled holes, and have for example been interpreted pendants and musical instruments (Inskeep, 1987; D'Errico and Villa, 1997). These can appear similar to tooth punctures by animals such as hyenas, and mushrooms and bacteria can also perforate bones (D'Errico and Villa, 1997). Inskeep (1987) does not describe how the drilled holes on the tortoises from Nelson Bay Cave were identified, apart from having been drilled from the interior of the shell. If traces of stone tool marks are associated with the holes, they can be argued to be drilled by humans (D'Errico and

Villa, 1997). D'Errico and Villa (1997) also found that bones with perforations produced by hyenas are often corroded by gastric acids.

Toothmarks can be created by humans, rodents, carnivores, and herbivores, which can sometimes be identified by their morphology, but they are notoriously hard to identify (Cáceres et al., 2007; Landt, 2007; Saladié et al., 2024). If made by incisors, human and carnivore toothmarks can be u-shaped in cross section, while canines, molars and premolars often produce pits and perforations (Fernandez-Jalvo and Andrews, 2016). Predatory or scavenger birds can create marks on bone with their beaks or talons. When made by the latter, they tend to be superficial punctures with flat bottoms (Fernandez-Jalvo and Andrews, 2016, p.33).

Trampling marks on bones are created when rocks rub against the bones, or alternatively mollusc shell as is often a feature of coastal sites (Olsen and Shipman, 1988; Blasco et al., 2008; Domínguez-Rodrigo et al., 2009; Reynard, 2014; Fernandez-Jalvo and Andrews, 2016, p.26-27). This may produce modifications like striations that resemble those left by humans, such as cutmarks or notches, and polished surfaces. Marks made by trampling may be differentiated from cutmarks in that they often are more shallow and not placed according to any tendons or muscle attachments (Olsen and Shipman, 1988; Fernandez-Jalvo and Andrews, 2016). Furthermore, notches produced by this process are often also associated with other trampling modifications (Blasco et al., 2008). Bone polished by trampling as opposed to humans tend to exhibit a different sheen, and does not normally smooth fractured edges (Reynard, 2014).

2.5 The order of Testudines: ecology and anatomy

To understand the role of the chelonians within the context of KDC, it is also necessary to understand certain aspects of their ecology and anatomy.

2.5.1 Relevant species and ecology

In the atlas by Bates et al. (2014), the region they cover comprises South Africa, Lesotho and Eswatini, within which there are five terrapin species (family *Pelomedusidae*), five aquatic turtle species (families *Cheloniidae* and *Dermochelyidae*) and finally 13 species from the terrestrial turtles or tortoise family (*Testudinidae*). The De Hoop Nature Reserve is currently inhabited by three tortoise species: the angulate tortoise (*Chersina angulata*, **figure 2.10**), the parrot beaked tortoise (*Homopus areolatus*, **figure 2.11**) and the leopard tortoise (*Stigmochelys pardalis*), the latter of which is native to South Africa, but alien to the De Hoop Nature Reserve, and was likely introduced by people over the past 50 to 80 years (Dr Ernst Baard, personal communication by e-mail, 25.01.2023). Therefore, a description of this species is excluded. According to the distribution map from the International Union for Conservation of Nature (IUCN), the South African helmeted terrapin (*Pelomedusa galeata*) also falls within the area (**figure 2.12**). It is not clear to me if there are any exemplars of this species currently living there, but according to Henshilwood et al. (2014), terrapin remains were found in the MSA layers of KDS, which is why it has been included.

Chersina angulata is the only member belonging to the genus *Chersina* (Van Den Berg and Baard, 1994). Their size rarely exceeds 300 mm, and they are classified as a small to medium sized tortoise (Van Den Berg and Baard, 1994; Hofmeyr, 2009). The average size and body mass for males is 187 mm and 916g, and 168 mm and 813g for females (Hofmeyr, 2009). This species is a generalist and may be found in several different habitats and climatic zones throughout the Cape Province and Namibia (Van Den Berg and Baard, 1994; Ramsay et al., 2002). There is no evidence of statistically significant regional variation in body size among these modern angulate tortoise populations, except for the larger size of the Dassen Island population, and the females in the in the Western Cape, which are smaller than the eastern and northern ones (Van Den Berg and Baard, 1994; Ramsay et al., 2002). Climate conditions that are unfavourable for tortoises growth could be an explanation for the latter (Van Den Berg and Baard, 1994). There is evidence of two genetically different lineages in South Africa that split about 3.8 million years ago and have had little mixing between them (apart from in the zone where the two lineages overlap) since the LGM (Spitzweg et al., 2020). These two lineages are likely to have been adapted to different climatic niches since LGM, with the southern lineage tolerating a broader range of biomes, and the western being confined to Fynbos and Succulent Karoo biomes (Spitzweg et al., 2020, p.423). The males are more active than females during summer and spring, but there are no differences in activity patterns during the winter (Ramsay et al., 2002). They use vegetation as shelter, but can also hide between rocks or under large boulders, and populations in sandy areas are known to also bury themselves when they are under vegetation cover (Bates et al., 2014, p.70).

Homopus areolatus is a small tortoise associated with fynbos and renosterveld vegetation, as well as Albany thicket in the east (Bates et al., 2014, p.72; Vamberger et al., 2018; Hofmeyr et al., 2020b, p.1257). The females are larger than males, with the largest reaching 104 mm (possibly up to 114 mm), and 96 mm respectively (Berry and Shine, 1980, p.186; Branch, 2007, p.17). The carapaces of members of this genus contains deep depressions (Branch, 2007).

Pelomedusa galeata is a large terrapin, which thrives in both fresh and stagnant waters such as marshes and seasonal water bodies (Vamberger et al., 2018, p.15; Price et al., 2021; Tolley et al., 2023). It is divided into two genetic lineages, which might constitute two different species, with the westernmost lineage confined to the winter rainfall region (Vamberger et al., 2018). The shell length of an adult individual is ~ 26 cm, with the largest individuals reaching 32.2 cm (Petzold et al., 2014, p.532).

Testudines are ectotherms, which means their regulation of body temperature is reliant on external sources, and several of their physiological processes such as growth, embryotic development and maturing are affected by their surroundings (e.g. temperature and moisture) (Angilletta et al., 2004; Vitt and Caldwell, 2014; Nagy et al., 2016; Waterson et al., 2016; Hofmeyr et al., 2020a; Currylow et al., 2021). Bushfires, which is an integral part of the ecosystem, carries the potential of altering tortoise populations. This process can affect tortoises by killing them directly (Avery et al., 2004; Stahlschmidt et al., 2023), and indirectly through damaging their habitats by destroying vegetation which provides food and cover that normally protects the tortoise from predators and helps them thermoregulate (Chergui et al., 2019). Such wildfires can kill thousands of tortoises, as is evident in the aftermath of a bushfire that occurred north of Cape Town in January 2000, which killed an estimated 90 000 to 280 000 tortoises (Avery et al., 2004, p.149). Several animals such as mongooses, jackals, foxes, badgers, hyenas, and predatory or scavenger birds like hawks, eagles, crows, and kelp gulls, prey on smaller tortoises (Sampson, 1998; Ramsay, 2002; Avery et al., 2004).

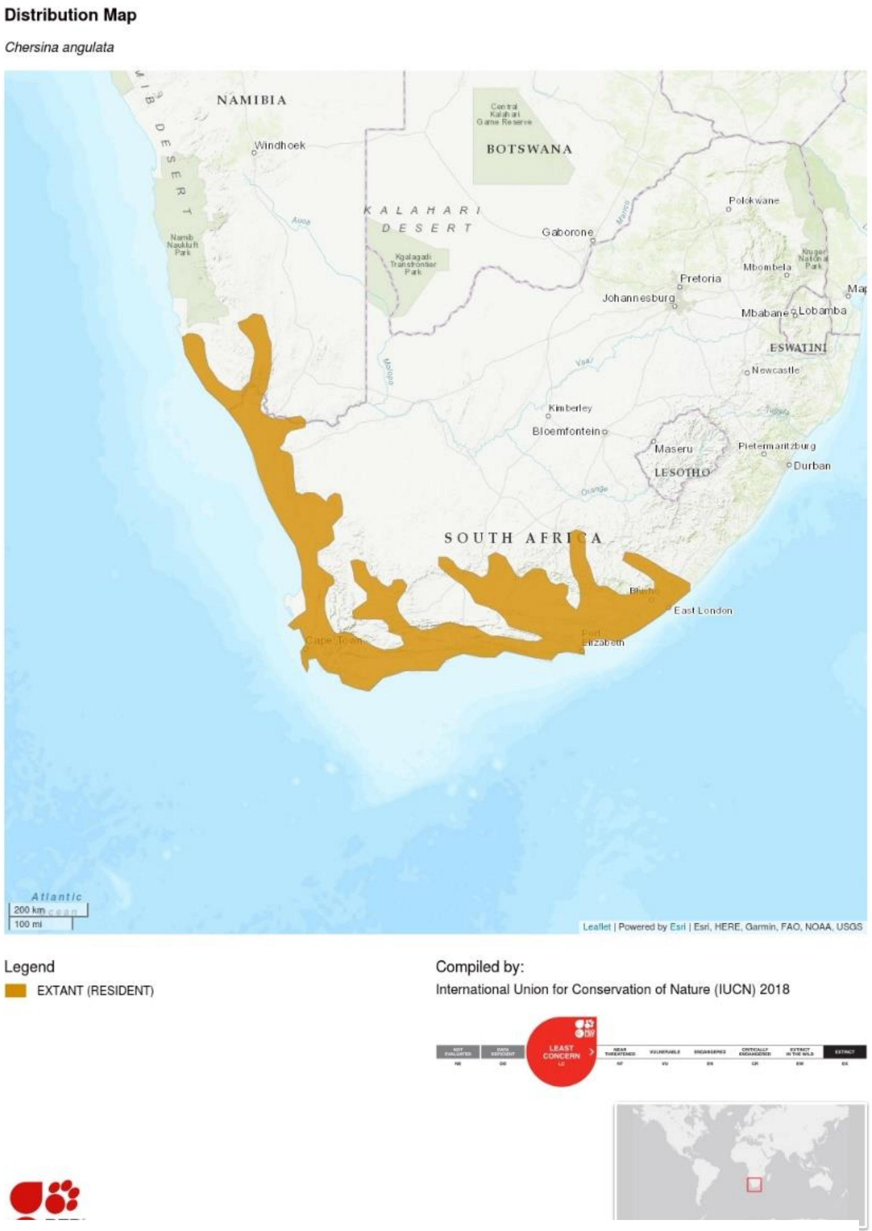
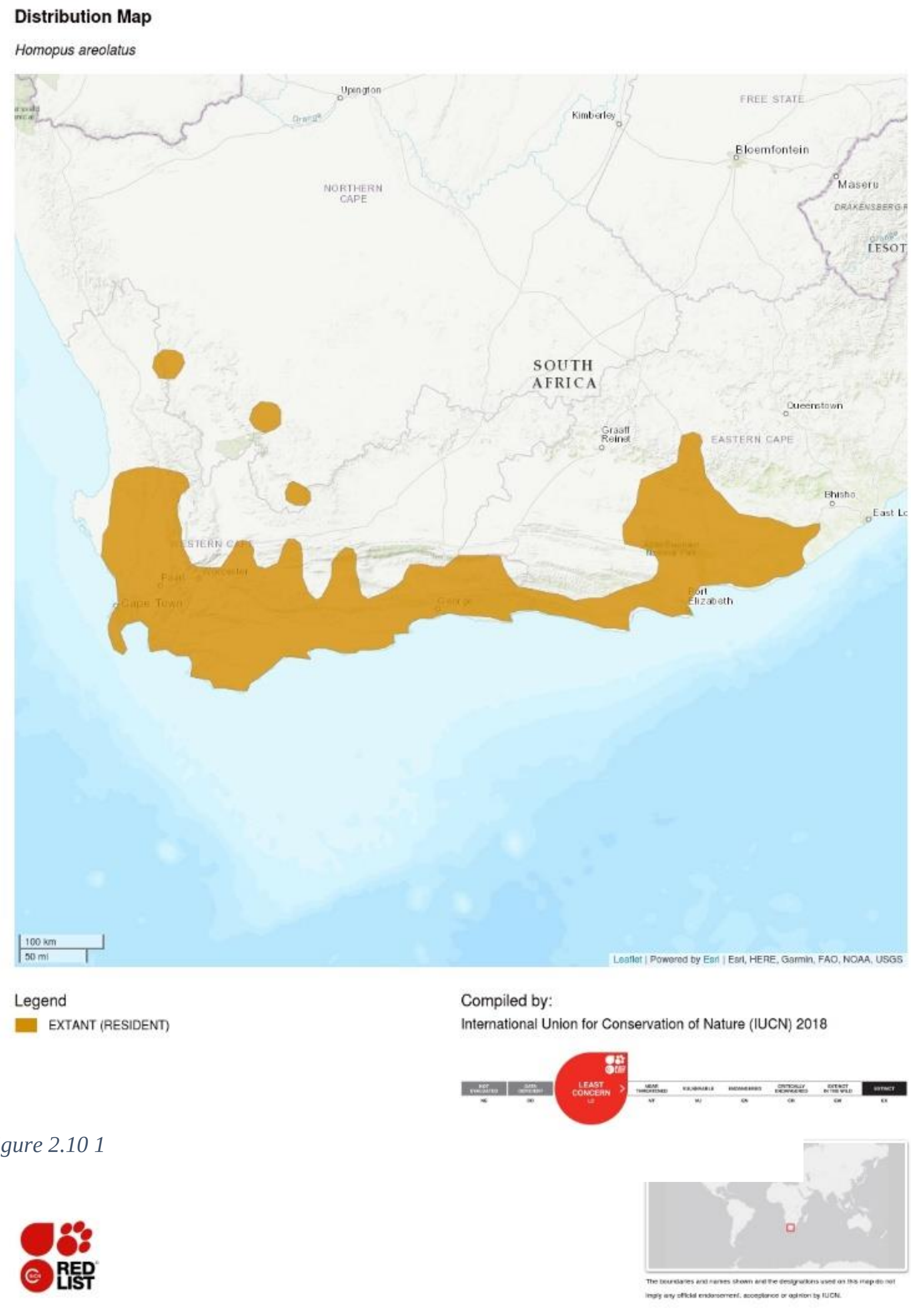


Figure 2. 10. Distribution of *Chersina angulata.* From (Hofmeyr and Keswick, 2018a)



Distribution Map

Homopus areolatus

Legend

▆ EXTANT (RESIDENT)

Compiled by:

International Union for Conservation of Nature (IUCN) 2018

The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

Figure 2.10 1

Figure 2.11. Distribution of *Homopus areolatus From (Hofmeyr and Keswick, 2018b).*

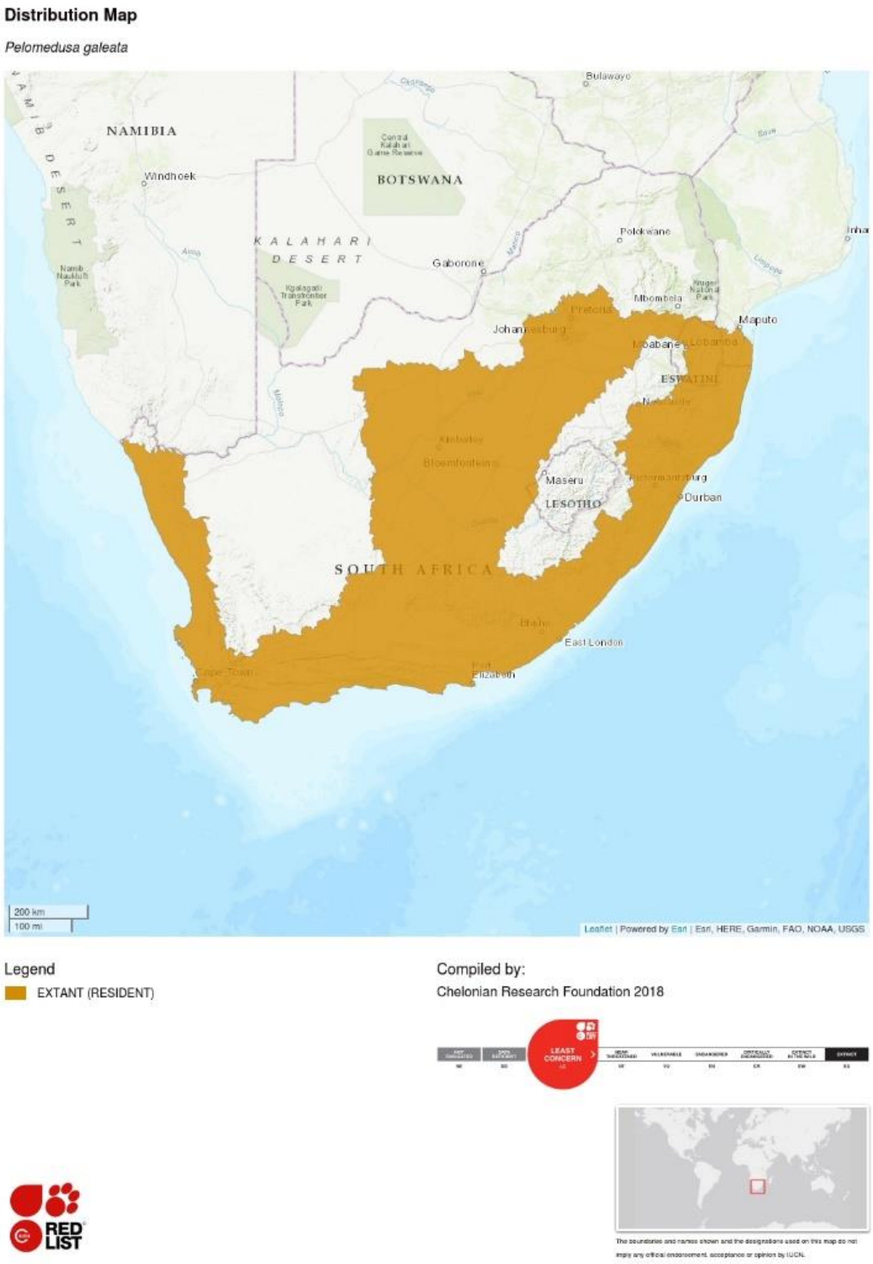


Figure 2.12. Distribution of Pelomedusa galeata. From (Hofmeyr, 2018).

2.5.2 The Testudines Skeleton

The aim of this section is to give a general description of the Testudines skeleton, but with the tortoise as the basis as they tend to be the most abundant in the South African archaeological record (Schweitzer and Wilson, 1978, p.e.g. ; Klein and Cruz-Uribe, 2000; Thompson and Henshilwood, 2014b; Klein and Cruz-Uribe, 2016).

The elements are generally easy to identify, especially the shell, which is an adaptation of the ribs that protects the tortoise from threats such as predators. It consists of the dorsal dome-shaped—albeit with various degrees of curvature— carapace, and the plastron covering the ventral part of the tortoise. Keratinised scutes cover the bone plates, but do not overlap with the fusion of the bones (Holt et al., 2019). Keratin is rarely preserved in the archaeological record (Mahan et al., 2023), but negative scars of the scutes are imprinted on the bones (**figure 2.13-2.14**). The tortoise carapace consists of a nuchal bone, several neurals, pleurals and peripherals, and the suprapygal and pygal bone (Holt et al., 2019). Several of the vertebrae are fused with the neurals. The plastron is made up of paired epiplastron, hyoplastron, hypoplastron and xiphiplastron, and one entoplastron (**figure 2.15**). On some tortoises, such as the angulate, the epiplastron on male is projecting (Thompson and Henshilwood, 2014b). The plastron on the males tends to be more concave than on the female (Thompson and Henshilwood, 2014b). While this is the normal configuration of the shell, anomalies are frequent within the whole Testudines order, and occurs without necessarily affecting the animal negatively (Cherepanov, 2016). Of the different ways anomalies may manifest, additional bones in the carapace are according to Cherepanov (2016) the most frequent, while the nuchal and plastron elements tends to be less variable in their morphology.

The pectoral (shoulder) girdle consists of the almost right-angled shaped scapula, and the coracoid, which is separated from the scapula (**figure 2.16**). Two processes are protruding from the glenoid socket on the scapula: the long scapular blade and the acromion (Nagashima et al., 2015). The pelvic girdle consists of three bones: an elongated ischium, pubis and ilium (**figure 2.17**).

The humerus has a characteristic s-shape with an accentuated curve at the proximal end of the shaft and a big humoral head (**figure 2.18**). The femur appears similar to the humerus but lacks the prominent curve (**figure 2.19**). The rest of the long bones (radius, ulna, tibia and fibula) also have a morphology which makes them readily identifiable (Codron et al., 2022, p.62).

Testudines do not have teeth, but their jaw bones are covered in a keratinized beak, which similarly to the scutes, rarely survive in the archaeological record (Reitz and Wing, 2007).

According to Lyman (1994b), axial elements, those close to the midline of the animal from the torso, includes cranium, mandible, vertebrae, ribs and sternum, while the appendicular skeleton includes limbs and girdles. This is complicated in Testudines as their ribs and sternum is modified and comprises the shell that encompass their bodies. When using the term axial in this thesis, the shell is excluded. This is how I understand Sampson's (2000) use of this term in his study, where it is necessary to differentiate between the shell and axial elements as a part of the discussion of skeletal element representation.

Figure 2.13. Dorsal view of a tent tortoise (*Psammobates tentorius*) carapace with and without scutes. The blue shaded area shows where a pleural bone lays under four keratinised scutes. From the comparative collection lend from the University of Cape Town.

Figure 2. 14. Interior of tortoise carapace.

Figure 2.15. *Chersina angulata* platron, interior. From the comparative collection provided by the IZIKO South African Museum.

Figure 2.16. *Chersina angulata*. Pectoral girdle. Left: Scapula, right: coracoid. From the comparative collection provided by the IZIKO South African Museum.

Figure 2.17. *Chersina angulata.* Left to right: pubis, ilium and ischium. From the comparative collection provided by the IZIKO South African Museum.

Figure 2.18. *Chersina angulata.* Humerus. From the comparative collection provided by the IZIKO South African Museum.

Figure 2.19. *Chersina angulata.* Femur. From the comparative collection provided by the IZIKO South African Museum.

3. Theoretical framework and concepts

Fields like archaeology, geology and palaeontology all seek to describe and explain phenomena that have already occurred and can no longer be directly observed. The concepts of uniformitarianism and actualism are central to all of these disciplines in the attempt to bridge the gap between these past phenomena and the observable traces they have left behind (Lyman, 1994b). These concepts have together with ecological and ethnographic studies been used within archaeology with the aim of understanding taphonomic histories of sites and the behaviour of past humans, for example in relation to subsistence strategies (e.g. Shipman et al., 1984; Binford et al., 1988; Reynard, 2014). These concepts and fields are central to the further works in this thesis. Although I emphasise that these are all large topics which I cannot do justice here, but they are briefly discussed in this chapter in two sub-sections.

Part one is a review of the concepts of uniformitarianism, and actualism which are especially important to the parts of this study concerned with how different agents and processes act on the osteological material. But these concepts have also been central to the development of the themes in part two of this chapter.

Part two is concerned with how uniformitarian principles and actualism historically have been used in ethnoarchaeology, and the use of human behavioural ecology within archaeology in terms of subsistence strategies through optimal foraging theory. This section is relevant to this thesis for several reasons. First and foremost, to determine the agent of accumulation ethnographic and actualist studies provide observations of how human and non-human agents accumulate and modify Testudines bones. Secondly, ethnographic sources provide ideas as to how Testudines can be acquired, for example through what techniques can be employed to catch them. Thirdly, chelonians are examined here not only in terms of subsistence, but also what other roles they can serve, which is inspired by ethnographic sources. Fourthly, as a part of examining the role of Testudines, they are also considered as a resource in relation to other fauna in terms of advantages and disadvantages. And finally, because the material analysed here comes from a period of climatic and environmental changes, and previous studies both from KDC and other contemporary sites are concerned with whether changes in material culture are related to these external factors, results of the analysis of the Testudines collection are also considered in light of this, which is a part of the larger debate over whether changes are initiated by external factors or social and cultural. The use of both behavioural ecology and ethnoarchaeology have been criticised (Trigger, 2006), which is also why it is especially important to show why I still include this, and how.

Before this, there are a couple of terms that should be elaborated on. First and foremost: “culture”. How to properly define culture, or if it is something that is indeed possible to define, is a classic topic continuously under discussion (e.g. Jahoda, 2012; Mironenko and Sorokin, 2018) that I will not delve into here. What is evident from these is that culture is a dynamic phenomenon that contains both internal and external components, and that it has something to do with the behaviours, ideas, values and norms of a social group (Jahoda, 2012; Mironenko and Sorokin, 2018). A third aspect that is relevant here is that culture can manifests itself materially, which is an assumption essential to archaeological research.

“Ritual” is similarly hard to define, and may be difficult to separate from secular behaviour, but it is for the sake of simplicity understood here as an action or behaviour that carries a symbolic meaning, and it creates, reaffirms and modifies religious beliefs and/or social structures (Fogelin, 2007).

3.1 The concepts of uniformitarianism and actualism

Uniformitarianism originated in the field of geology and although ideas and principles related to this had already been explored in the 15th century, it is mainly associated with the 19th century geologist Charles Lyell, who was inspired by the methodological reasoning within the field of physics, and the works of the naturalist James Hutton (Baker, 1998; Romano, 2015). This concept is often seen as opposed to catastrophism, in which it is postulated that the Earth’s configuration is largely the result of a series of catastrophic events (Baker, 1998; Romano, 2015). According to Lyman (1994b), the concept earlier consisted of two parts: the theory called substantive uniformitarianism, and the analytical procedure: methodological uniformitarianism. Following substantive uniformitarianism, all major landforms were created by the various geological processes that can be observed today acting gradually over long periods of time at a constant rate, and the configuration of the Earth is always changing, but it follows a cyclic pattern (Gould, 1965; Lyman, 1994b; Romano, 2015, p.174). Methodological uniformitarianism, contains the following principles: 1) natural laws are invariant throughout time and space, and 2) processes are invariant throughout time and space (Lyman, 1994b). According to these principles there are no natural laws or processes unique to the past. While substantive uniformitarianism has been falsified, methodological uniformitarianism is still held by many geologists(Lyman, 1994b).

Related to this, and often used synonymously, is the concept of actualism which, in addition to encompassing the principles from methodological uniformitarianism, permits variation in the intensity and energy of processes throughout time and space (Lyman, 1994b). Thereby also allowing explanations of catastrophic nature without adhering to catastrophism. In essence, causal links between modern processes and observed results are established, which are then used when inferring cause and agent of past phenomena.

Epistemology is one important aspect of both concepts that has been discussed. As Lyman (1994b) states, they are a priori assumptions, and it is impossible to demonstrate natural laws and processes are temporally invariant through direct observations. However, they have not been discarded because they work when predicting outcomes, and a better alternative has yet to be presented (Lyman, 1994b). These concepts are crucial to taphonomic research. They are especially important to the parts of this thesis concerned with how physical and chemical forces operate on and modify osteological material post-deposition. Although not always explicitly stated, these concepts are applied when actualist and experimental studies, for example of how water may transport bones, are transferred to interpretations of the archaeological material. But at archaeological sites, there is a third component to consider: the biotic one.

On one level, processes crated by biological entities are mechanical, such as mastication, and may leave physical traces of this force behind on bones that to a certain degree can be identifiable. However, behaviour is also a major part of this component, for example how a hyena holds the bone it chews on, where the marks are created, or which elements are targeted (Binford et al., 1988). Behaviour is subjected to evolutionary mechanisms such as natural selection (Campbell et al., 2018, p.1223-1224). It is by nature something that is dynamic and changing, meaning principles of invariance throughout time and space cannot be applied to it directly, neither human, nor animal. That does not mean we cannot make inferences of past behaviour, which actualistic and ecological studies are essential to (Reitz and Wing, 2007, p.144), but we cannot do so directly through uniformitarian principles. Despite this, modern ethnic groups have on several occasions been used as direct analogies to past societies within archaeological research, and it is especially within the processualism paradigm, which obtained inspiration from the natural sciences and anthropology that this became prevalent.

3.2 Ethnoarchaeology, and human behavioural ecology, and optimal foraging theory

With the popularisation of processualism within the archaeological sphere in the 1960s and 70s, societies largely came to be viewed as functional systems with an inherent “intention” of staying in balance with the surroundings, whereas culture was considered to be a means of adaptation by which this was achieved (Binford, 1962; Olsen, 1997, p.133-138; Trigger, 2006, p.393-395). This meant that changes in material culture, which was a reflection of the living culture, had been stimulated- and could be explained by external factors such as changes in climate and demographics, rather than internal forces such as creativity, or by migration as had often been argued in the first half of the 20th century (Binford, 1962; Olsen, 1997, p.133-138; Trigger, 2006, p.393-395). This view of culture is in part connected to the influence that behavioural ecology had on the theoretical frameworks of the time. This is the field within biology concerned with how animal behaviour is affected by environment and ecology, which found its way into archaeology through ethnography and ethnoarchaeology (Bird and O'Connell, 2006). When applied specifically to humans, it is referred to as human behavioural ecology (Nagaoka, 2019).

Ethnoarchaeology, defined by Lyons and Casey as “ a methodology that is used to study the relationship between contemporary people and the material from an archaeological perspective” (Lyons and Casey, 2016, p.609), became essential in the processualists’ pursuit of generalisations and universal laws of human behaviour that could be inferred from material and applied to the mute archaeological record. Lyman (1994b) states that the ethnographic analogies is the most common application of the actualistic method within archaeology. Such analogies were strong if the ethnographic and archaeological source lived in similar environment and technological level, and even stronger if the modern group were descendants of the archaeological one (Lyman, 1994b, p.54).

The accuracy and ethics surrounding this approach has been debated over many years, (Lyons and Casey, 2016, p.611). Some of the criticism is centred around how humans does not necessarily act out of what from an ecological/economical point of view would be the most “optimal” and “rational”, which Lyons and Casey (2016) argue that the archaeological record contains multiple examples of. This is also relevant for part of this sub-section concerned with optimal foraging theory in which just such assumptions about “optimal” decisions are in focus. Furthermore, modern indigenous communities have not remained stagnant over thousands of years. In the South African context, San groups have frequently been used as analogies (Binford, 1980; Pargeter et al., 2016) and as pointed out by Backwell and D’Errico (2021), the various living San communities are not living fossils, they are not culturally the same as the hunter gatherers of the stone age, and the symbolic meaning that the archaeological artefacts once carried is lost. Considering this one might argue that ethnoarchaeology should be discarded, for if the meaning behind an artefact is forever lost, and direct analogies cannot be applied, how can it still be relevant?

However, there are several arguments in favour of ethnoarchaeology. Lyons and Casey (2016) points out that ethnoarchaeology it is not a stagnant field, and analogies are not applied as described above anymore. They further argue that ethnographic sources may encourage and inspire us to think more creatively about people’s relationship, interactions, and perspectives on the material, and that it provides a place where archaeological theories can be tested. Furthermore, I think McNiven (2016) brings up some important notions too, with regards to how it is important, let alone ethically right, to include indigenous communities in archaeological research, and simultaneously to make it relevant for them. Additionally, interest in archaeological research among local communities may stimulate a desire to protect and manage cultural heritage (Skeates, 2000, p.55-69). When it comes to approaching archaeological material and attempting to interpret this in terms of what is related to human experience, indigenous communities’ perspectives are just as valid as the “western”. The latter of which is permeated by a more cartesian way of viewing the world in terms of what is “material” and “non-material” (Lyons and Casey, 2016, p.613; McNiven, 2016). The goal is to ideally lessen western cultural bias, not make it the sole foundation on which the archaeological material is interpreted. If we are to attempt to understand perspective of past humans who may have lived with a different understanding of the world than western archaeologists currently live with, then we need to expand the foundation of ways to relate to the world and material, precisely to avoid interpretations such as those that emerged with the early processualism where for example gender roles were assumed rather than determined (Lyons and Casey, 2016, p.612). Furthermore, the perspectives and understandings held by living cultures on material and their own past also carries intrinsic value. I think we can implement ethnographic sources while simultaneously acknowledge the limitations they carry. I would argue that the alternative, to *not* include ethnographic sources, is limiting because we would lose a very important tool and valuable perspectives, and I do not think we would be inclined towards less bias when analysing the archaeological record. Furthermore, ethnographic sources such as those described in chapter 2.1.2 shows creative ways of collecting and utilising these animals that we would perhaps not have considered had they not been documented ethnographically, because such uses are not necessarily preserved archaeologically.

3.2.1 Optimal foraging theory

Optimal foraging theory was developed within the field of behavioural ecology and contains economic and ecological models created with the aim of describing and explaining behaviour related to subsistence procurement, of which prey choice (concerned with variables affecting selection of prey) and central places (created to incorporate the transport of prey into the equation) are some examples that have been widely used within archaeology (Stephens and Krebs, 1986; Reitz and Wing, 2007; Nagaoka, 2019). As this theory is related to fitness in terms of subsistence, natural selection plays a large role, together with the assumption that humans will make “rational” or “optimal” choices in terms of net-return (benefit relative to cost) when selecting what resources to exploit (Stephens and Krebs, 1986; Nagaoka, 2019). Another important aspect of this theory is the development of ranking systems based on cost-benefit analysis of various resources, with larger prey often being ranked high, and smaller prey low because of the number of calories a large prey yields compared to a small one due to its large size. Costs can be factors such as energy expenditure (often given as kcal) for example in relation to the time spent searching for and pursuing prey, or by transporting resources back to a home base, while benefits include the energy gained from the resource (Stephens and Krebs, 1986; Nagaoka, 2019). Following these models, changes in faunal composition between relative proportions of high-ranking and low-ranking prey at an archaeological site can be due to for example environmental changes or changes in behaviour of prey, but also development of more efficient technology such as innovations that facilitate mass collection (Nagaoka, 2019, p.232-233). By mass collecting resources that when isolated are low-ranking, the accumulated nutritional yield can be comparable to high-ranking prey (Madsen and Schmitt, 1998; Thompson and Henshilwood, 2014a). The process in which access to high-ranking prey is decreasing, is called resource depression (Broughton, 2002; Prentiss, 2019, p.219).

Nagaoka (2019, p.234) points out that these models were developed by ecologists who, unlike archaeologists, can observe animal behaviour in real time, and thereby having a different foundation to test models and hypotheses. All that is left in the archaeological record is skeletal elements accumulated over large time spans that may further have been affected by various taphonomic processes (Nagaoka, 2019). Other criticism is related to how these models accentuate humans as predators, and that the role of larger animals as prey is emphasised at the expense of the smaller (Reitz and Wing, 2007). Furthermore, humans are not governed by ecological and economic factors alone, and it has been argued that such models represent a deterministic view of human behaviour in which the individual, and their choices is not reflected, and the complexity of culture is removed (Olsen, 1997; Reitz and Wing, 2007). Within the realm of subsistence, there are in addition to biological necessities tied to the human condition, also social and cultural aspects of food consumption (Reitz and Wing, 2007, p.251-254). This includes religious feasts and rituals that may follow, and/or construction and sustaining of social relations (Gopi, 2021). We cannot view humans as completely removed from the ecological environment, just as we cannot view them within this framework alone.

3.2.2 Testudines as viewed through Optimal foraging theory

Looking solely at tortoises as they are often the most abundant chelonians at South African sites, optimal foraging models rank these animals low due to their small size (Nabais and Zilhão, 2019). Several studies however, points out other aspects with these animals that according to the authors from a cost-benefit point of view are beneficial and can give return rates that are comparable to large animals: they are slow-moving and not dangerous, which makes them easy to collect by group members that are not able to participate in big game hunting, they are easy to process and does not require specialised technology, they can be stored alive due to slow metabolism and inability to escape, their shell can be used for other purposes, search time is substantially reduced if one knows where to look for them, or they can be collected opportunistically (Thompson, 2010; Thompson and Henshilwood, 2014b, 2014a; Blasco et al., 2016; Nabais and Zilhão, 2019). (Klein and Cruz-Uribe (2016, p.269) suggest that larger individuals were taken first because they would yield the highest food value and be the easiest to spot. Drawbacks with these animals are: they are slow growing, and their populations would likely be vulnerable to over-exploitation (Stiner et al., 2000; Thompson and Henshilwood, 2014a).

4. Materials and methods

The aim of this chapter is to express why the methods and measurements I used were selected and how the study was conducted to make it replicable and open to constructive criticism. This may seem an obvious statement, however, methods, terms and units are in many cases not explicitly defined and explained (Lyman, 1994a; Marean et al., 2001).

The overall organisation of this chapter is into three parts and is as follows: the first part (4.1) contains details on the materials analysed, and the excavation techniques and curation. The comparative collection is the focal point of the second part (4.2) as there are certain features of the tortoise anatomy that prompted me to alter some of the methods. The third part (4.3) is an overview of the methods and units that were applied to this study during the lab-work. This comprises identification and recording of skeletal elements and species, measurements, quantification, identification of taphonomic modifications, and chi-square test.

4.1 Materials, recovery and curation.

I analysed Testudines bones excavated from the Oakhurst layers during the 2010/2011 field seasons in the SapienCE/University of Witwatersrand research laboratory in Cape Town. I examined materials from the following units and quadrants: units JY through KAD/KADh1 in quadrant L11d; units JZ/JZh through KAE in M13a; and units JZ/JZh and KAD/KADh1 in M12a (**figure 4.1**).

The excavation of KDC was done by brush and trowel in 1x1 m squares divided into four 50x50 cm quadrantes (Discamps et al., 2020, p.1). Key artefacts were plotted using a Trimble VX Total Station while unplotted material and sediments/deposits were sieved through mesh-sizes 3.0 and 1.5 mm (Henshilwood et al., 2014, p.287) referred to as coarse fraction and fine fraction respectively. After the excavation the material was washed and sorted at a laboratory at Potberg in the De Hoop Nature Reserve, and is now curated at the Iziko South African Museum in Cape Town (Henshilwood et al., 2014, p.287). As Testudines bones were not plotted during excavation, the collection that was analysed here consists of Testudines specimens that were sorted out of bags containing unplotted bones, and material recovered from the coarse fraction.

There are several considerations with regards to the sample size that should be mentioned, first and foremost that the bones were recovered during test excavations of a relatively small and concentrated area (2.75 m^2) which is likely to comprise a fraction of the total site. Secondly, the collection of tortoises was upon arrival larger than what was originally anticipated, which, in combination with a time-constraint of one month to do the analysis, resulted in a compromise having to be made between the quantity of bones I could examine and to the extent of which I could analyse them in detail. The quadrants L11d and M13a were prioritised as they contained other faunal material previously analysed by Discamps et al. (2020), and was therefore a suitable foundation for comparisons. There was in addition to this some distance between them which allowed a somewhat broader area to be covered. The time frame further allowed data from two units in quadrant M12a to be gathered as well. Finally, not all units were excavated from every quadrant. While JZ/JZh to KAD/KADh1 appeared in all the analysed quadrats, this was not the case for JY and JYA, which was recovered only in L11d, and although the bottom unit KAE was excavated in both M12a and M13a, it was only analysed in the latter.

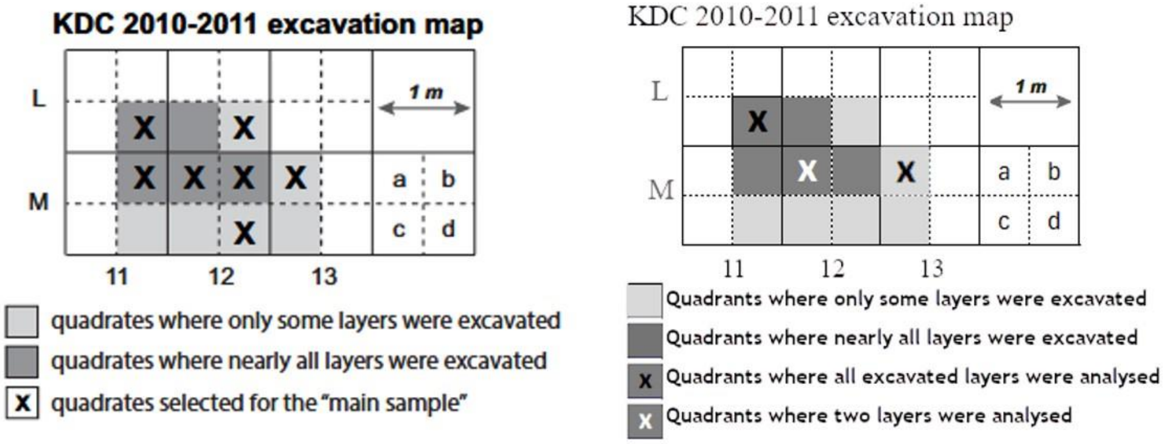


Figure 4.1. (a) taken from (Discamps et al., 2020, p.2) showing the quadrants from which their samples of large mammal remains came, and (b) the quadrants analysed in this study.

4.2 The comparative collection

The aim of this section is to describe the comparative collection and some observations regarding the use of certain tortoise skeletal elements for quantification that led to alterations of the analysis.

The Iziko Museum and the University of Cape Town provided comparative collection specimens. In addition to this, several individuals from the local community in Still Bay collected and donated multiple tortoise skeletons. The assemblage also included bones collected from various locations around Blombos Cave, near Still Bay, during the 2023 field season.

Exemplars of the following species comprised the comparative collection: *Chersina angulata, Homopus areolatus, Homopus femoralis, Stigmochelys pardalis, Psammobates tentorius, Psammobates geometricus* and *Pelomedusa galeata*. Although several of these are not found in the areas surrounding KDC today, they were still included in the case they should appear in the archaeological assemblage.

During the cleaning of the bones from around Blombos and Still Bay, it became apparent that some of the carapaces were asymmetrical. One of the tortoises had ten peripherals on one side and eleven on the other (**figure 4.2**), and an abnormal pair of pleurals where the pleural on the left side consisted of two fused bones while its counterpart on the right was of only one (**figure 4.3**). The carapace from a different individual (**figure 4.4**) was also asymmetrical. This triggered an awareness regarding the frequency of which such shell anomalies might occur among chelonians.

This led to concerns about whether this could be an issue during the identification process in terms of how readily some elements could be recognised in terms of specific elements, and additionally if such shell anomalies carry the potential of affecting the MNI count as symmetry is a prerequisite of this unit. This is to my knowledge a topic that has yet to be investigated. Together with the time constraint laid upon the analysis, this sudden arising uncertainty led to alterations of the data gathering. Namely that carapacial elements, with the exception of the nuchal and pygal, were not identified further down than to bridge, neural, pleural, or peripheral, which should still allow necessary information on taphonomic processes to be recorded, and they were excluded from the MNE and MNI calculation. Exceptions to this was in the case that individuals of clearly different sizes or species should appear in the collection and be identified through carapace elements as this logically would yield an MNI of ≥2.

Figure 4.2. Peripherals of a *Chersina angulata.* Left: articulated. Right: exploded. This tortoise has eleven peripherals on its left side, and ten on its right. Donated from an individual from Still Bay

Figure 4.3. Carapace of a *Chersina angulata*. Left: pleural nr.1-2 articulated with neural nr.2. Right: same tortoise exploded. Notice how the left pleural nr.2 is made up of two fused bones. This tortoise was donated from an individual from Still Bay.

Figure 4.4. *Chersina angulata* carapace with an asymmetrical suprapygal and neurals. Donated by an individual from Still Bay.

4.3 Methods

This sub-section is organised as follows: the first part is covering identification of skeletal element and taxon. The second describes the measurements of certain specimens. The third section is a despcription of the methods by which the specimens were quantified. The foruth part covers how taphonomic modifications were recorded. The final part is a short presentation of the chi-square test.

4.3.1 Identification of skeletal element and taxon

The specimens were first sorted from the bone- and fraction bags, which also contained the rest of the unplotted faunal material. They were then assigned an accession number starting with the site (KDC) followed by taxonomic family (T for *Testudinidae*) and a serial number. They were then compared to the reference collection and identified in terms of skeletal element and side based on morphological features, along with whether they were a complete element or a fragment of an element, to enable the calculation of the various quantification units. All carapace elements, apart from the easily recognisable nuchal and pygal, were identified as either neural, pleural, peripheral or bridge rather than down to the specific element. Specimens of the same skeletal element or group in the case of shell (i.e. pleural, neural, etc.), and same burning stage were recorded under the same accession number and bagged together to reduce time spent on each entry. The specimens that could not be identified to a specific element were recorded as either carapace, plastron, vertebra, pelvic/pectoral girdle or limb, or bulk recorded as shell <1cm, or >1cm. In their analysis of tortoise bones from Blombos Cave, Thompson and Henshilwood (2014b) bulk recorded the specimens where the maximum length was <1 cm. In this analysis all fragments <1 cm were also bulk recorded, except for the limbs/girdle elements of that size where 2/3 or more was preserved, to not overlook individuals that might be smaller in size due to age or species rather than fragmentation. The side from which the specimens came were together with sex identified when possible to enable the calculation of MNE and MNI. Reitz and Wing (2007) bring attention to how specimens that fit together should be approached in terms of whether they should be recorded individually or not, and that whatever is decided needs to be made clear. Specimens that could be refitted here were recorded as two specimens, but they were noted to fit and were recorded under the same accession number. This was intended to assist in the MNE calculation. Plastron elements are relatively easy to conjoin, and was done to aid in determining the sex, as males from some species tend to have a concave curvature and projecting epiplastra (Thompson and Henshilwood, 2014b).

Taxonomic identification was done with the aim of investigating the species composition of the KDC Testudines, the results of which could be suggestive of surrounding environments. (Sampson, 1998) mentions that there is no published systematic osteological atlas for South African tortoise species, which was as far as I am aware still the case at the time this study was conducted. The comparative collection was therefore crucial during this phase. As taxonomic identification of tortoises is substantially complicated by a number of factors such as differentiation based on traits that does not preserve archaeologically, or intraspecific variation being generally high in reptiles, the recording of lower taxa was conservative.

4.3.2 Measurements

Measurements of skeletal elements can be used to for example make inferences about climate change and predation pressure (Klein and Cruz-Uribe, 1983), and needs to be considered in relation to aspects such as sex, age, recovery techniques, sample size, individual variation and nutrition (Reitz and Wing, 2007, p.183-185). I measured limb and girdle elements with an analogue calliper to investigate the factors mentioned above, and to use eventual large size differences between exemplars of the same skeletal element in the MNE and MNI calculation.

4.3.3 Quantification: NISP, NSP, MNE, MNI, and the fraction summation approach

NISP and NSP was calculated in excel by adding all the identified specimens (to taxon and skeletal element), and all the specimens assigned to the order Testudines respectively. The use of NISP is not entirely without problems as the unit may be affected by several taphonomic and analytical factors (see chapter. 2.3.1). However, as this is a well-established measuring unit, it was calculated to allow comparisons with other studies. Furthermore, the collection NISP was measured from did not consist solely of the bones that were sorted into bone bags at the site when the excavation was done, but it also included the bones from the sieve with the aim of reducing selection bias (Discamps et al., 2020). The ratio between NISP and NSP

(NISP:NSP) was calculated to investigate whether certain units had higher or lower fragmentation rates, as higher fragmentation, up until the point where specimens are fragmented beyond recognition, can yield higher NISP values (Cannon, 2013).

MNE was calculated using a simplified version of the fraction summation approach to estimate the skeletal element abundance from the whole Oakhurst sequence, and MNI. This method as described by Marean et al. (2001) entails dividing each skeletal element into zones and estimate the how big of a portion of this zone that is preserved, which is entered into a computer program. Bones such as carpals and tarsals are recorded as a fraction of the total bone. All fractions of each skeletal element are then summed to obtain MNE. Also taken into consideration are factors such as size, side and sex. There are weaknesses with this approach, including the potential of estimating a MNE count that is below the actual MNE in the sample if one zone preserves more often than another (Marean et al., 2001, p.336). However, Thompson and Henshilwood (2014b, p.218) noted that tortoise bones tend to be found nearly complete, and when they do fragment, it is often at consistent portions and landmarks. Due to this, and to not spend copious amounts of time on each specimen, I used a somewhat simplified version of this approach, where all Testudines specimens were treated as carpals and tarsals, and given a score on a scale from 0.1 to 1.0 in terms of how big of a portion of the total skeletal element was preserved, rather than dividing the bone into zones and then assigning a score to each zone. The part of the skeletal element which the preserved specimen represented was also necessary to record to avoid undercounting the number of elements in the collection. For example, two right proximal humeri with a preserved fraction of 0.4 each, still constitutes two separate elements and yields an MNE of 2 despite the sum being 0.8. Side, size, sex, and species were also considered. The highest MNE count in each unit yielded the MNI for that unit.

To correct for variation in sample size between different layers and quadrants, and to allow for comparisons with the shellfish densities from the site, NISP and MNI were divided by the volume of soil excavated, given in litres, and is expressed as $NISP/l$ and MNI/l, and was calculated for each layer by dividing NISP, and MNI by the volume of soil excavated:

$$\rho = \frac{NISP}{V}$$

The same formula was used for MNI.

4.3.4 Identification and recording of taphonomic modifications

The *Atlas of taphonomic identifications* (2016) by Fernandez-Jalvo and Andrews, and descriptions and figures by Shipman and Rose (1983), were along with descriptions of tortoise specific modifications (Blasco, 2008; Thompson and Henshilwood, 2014b; Blasco et al., 2016), central to the identification of taphonomic modifications. Other works that were utilised during the data gathering includes classifications and descriptions of characteristics of hominin made percussionmarks (Blumenschine and Selvaggio, 1988; Capaldo and Blumenschine, 1994; Pickering and Egeland, 2006), trampling and cutmarks (Domínguez-Rodrigo et al., 2009; Reynard, 2014), and burning (Nicholson, 1993). A Leica M125 stereo microscope was used when I encountered specimens where anthropogenic modifications were suspected.

The burning stage of each specimen was recorded according to the scale described in sub-section 2.4.2, going from unburnt to calcified. They were later divided into "homogeneously burnt" (more or less the same stage across the whole bone), "heterogeneously burnt" (different stages appears on the same bone, and the location) and ambiguous, as some of the specimens were covered in residue or manganese or otherwise hard to determine. As these modifications may be ambiguous, a combination of different characteristics was used to identify the burning, mainly discolouration, cracking, polished surface, and ashy residue. It was especially the shell elements where the location was important to record as this can be used to say something about the processing. For example, if the shell is more burnt on the outside of the carapace than the plastron and the interior of the shell, this could mean that the tortoise was put on its back into the fire and cooked.

Linear marks and pits and perforations were also recorded, and the edges on the fragmented specimens were inspected as this may be related to butchering and processing activities. When a specimen contained one or several of these, that can for example be cut- or scrape marks, percussion pits or notches, tooth or talon marks or from trampling or root etching, it was examined under the microscope to look closer for characteristics that could help with identifying the likely nature of the mark.

Residue was recorded when present. This includes ash, but also ochre as this could be indicative of the tortoises being used for other purposes than for example food. In addition to this, while in the lab, PhD candidate Jasmin Culey and I mixed ochre with water and applied it to some of the shell elements from the comparative collection, both directly, and "incidentally". This was done to gain a better understanding of how ochre would look on bones compared to incidental specs. These particular bones were used in the instances where ochre residue was suspected.

When the specimens had surfaces that appeared polished, this was closer investigated under the microscope as such damage can indicate that people have licked or sucked on the bones (Thompson and Henshilwood, 2014b) or used the tortoise shells as bowls (e.g. (Sampson, 2000).

Other taphonomic modifications such as trampling, root etching and manganese staining was recorded, but not systematically as tenacity needed to be balanced with building up a sample size large enough to compare with KDC internally and other sites.

4.3.5 Chi-square test

PAST software (Hammer et al., 2000) was used to do a chi-square test to test if the observed differences between the NISP/l and NISP:NSP values for each layer were statistically significant. For each, the null hypothesis (Ho) is no relationship between the variables and alternative hypothesis (Ha) is there is a relationship between the variables. I report the $\chi 2$ test statistic, p-value, and adjusted residuals.

5. Results

Presented here are the results of the quantification, measurements and identification of taphonomic modifications. More details on the data foundation of which these tables and figures were created can be found in the Appendix.

5.1 Quantification

5.1.1 NISP, MNE, MNI: skeletal elements

The collection consisted of a total of 3088 Testudines specimens (**table 5.1**). 656 were larger than 1 cm but I could not identify them to a lower skeletal element than shell, and 1473 were smaller than 1 cm, making the total NSP=2129, these were excluded from the further analysis.

959 could be identified lower than to tortoise/tortoise shell (**table 5.2**). These 959 specimens were used to calculate the NISP, MNE and MNI counts below (**table 5.3**). The total MNE and MNI was 136 and 25 respectively (**table 5.3**).

The results presented in **table 5.2** shows that Testudines were found in all the units, with KAD/KADh1 containing the greatest number of specimens in absolute numbers in all three quadrants, and in total: n=543. JZh/JZh and JZA also contained the highest frequencies of specimens, n=103 and n=132 respectively. KAB and JZB had the lowest amounts in both quadrant L11d and M13a, while KAE contained the lowest frequency in total with 16 specimens.

Table 5.3 shows that in terms of NSP from the site, KAD/KADh1 contained the highest amount in sheer numbers, followed by KAC, JZ/JZh and JZA in decreasing order. The lowest amount was in KAE. In terms of MNE, KAD/KADh1 had the most with 51 elements, followed by JZA with 44, and JZ/JZh with 18. The highest number of individuals occurred in JZA which yielded six, while the second highest was KAD/KADh1 with five. The lowest MNI was in the units JY and JYA, both containing one each.

The ratio between NISP and NSP as expressed in **figure 5.1** shows that the lowest degree of fragmentation occurred in JY, followed by JZA, while KAC and JZ/JZh contained the highest. The chi-square test identified statistically significant differences in the fragmentation between layers ($\chi2$= 45, p-value= <.0001). The adjusted residuals reported in t**able 5.4** suggests the observed frequencies of units KAD/KADh1, KAE, JZA and KAC are different than expected.

Figure 5.2 shows the density of specimens in each of the units that were examined, with a) showing NISP/l, and b) MNI/l. The densest unit in terms of NISP was KAD/KADh1 The highest density occurred in unit KAD/KADh1, with 5.4 specimens per l, followed by JYA with 3.4. While the lowest density was in KAE with 0.6. In terms of MNI, KAB contained the highest density with an MNI/l of 0.26, followed by JZB and JYA, while KAD/KADh1 here contained the lowest density. The adjusted residuals of the chi square test of density between layers in terms of NISP/l, is shown in **table 5.5**. The chi-square test identified statistically significant differences in density between layers ($\chi2$= 82.87, p-value= <.0001).The observed frequencies of units KAD/KADh1, KAE, JZA and KAC are different than expected.

Of the skeletal elements in the collection, presented in **table 5.6**, 373 of the specimens were identified as pleural, making this the most abundant. Shell elements were in general in large numbers. Looking solely at the plastron, the hypoplastron had the highest NISP count

(20) while xiphiplastron had the highest MNE (14). When excluding the shell, the ischium becomes the greatest skeletal element in numbers both in terms of NISP (13) and MNE (11), but the ilium also occurred in similar quantities; 11 and 10 respectively. Fibula is the only limb not represented at all in the analysed part of the collection. Of the axial bones the vertebrae were in low numbers, there was recorded three specimens that further constituted an MNE of three, while the NISP count for the neurals, the carapace bones with which the vertebrae are fused, was 132. No cranial elements or fragments thereof were identified.

The results of the identification of sex in total yielded an MNI of four males and three females and came from the following units: JZ/JZh, JZA, JZB and KAD/KAdh1 (**Table 5.7**). **Figure 5.3** shows an example of a male identified by the concave curvature of the plastron and the projecting epiplastra.

Unit	NISP L11d	NISP M12a	NISP M13a	Total
JY	30			30
JYA	28			28
JZ/JZh	52	25	26	103
JZA	66	N/A	66	132
JZB	14	N/A	9	23
KAB	7	N/A	13	20
KAC	29	N/A	35	64
KAD/KADh1	228	238	77	543
KAE		N/A	16	16
Total	**454**	**263**	**242**	**959**

Table 5.1. Total number of identified Testudines specimens in each unit and quadrant,comprising all specimens that were identified to Testudines and lower, to specific skeletal element and the “non-ID2 elements both over and under 1 cm. N/A= unit in this quadrant contains material, but was not analysed here. Blank space= unit was not excavated in this quadrant. NSP is used here about all specimens, identified and non-identified (lower than Testudines).

Unit	NSP L11d	NSP M12a	NSP M13a	Total
JY	59			59
JYA	94			94
JZ/JZh	261	50	67	378
JZA	229	N/A	133	362
JZB	55	N/A	18	73
KAB	31	N/A	27	58
KAC	157	N/A	186	343
KAD/KADh1	679	747	248	1674
KAE		N/A	47	47
Total	**1565**	**797**	**726**	**3088**

Table 5.2. Number of identified specimens in each unit and quadrant. NISP is used here about all specimens over 1 cm that were identified to at least taxonomic family, and specific element or lower than tortoise/tortoise shell. N/A: this unit was notanalysed in this quadrant, but it was excavated; blank space: the unit was not excavated in this quadrant.

Unit	NSP	NISP	MNE	MNI
JY*	59	30	1	1
JYA*	94	28	***	1
JZ/JZh**	378	103	18	3
JZA	362	132	44	6
JZB	73	23	8	2
KAB	58	20	3	2
KAC	343	64	8	3
KAD/KADh1**	1674	543	51	5
KAE*	47	16	3	2
Total	**3088**	**959**	**136**	**25**

Table 5.3. NSP, NISP; MNE and MNI from Klipdrift Cave. NSP: includes all specimens, belonging to the Testudines order. Units marked with* and ** contains data from one and three quadrants respectively. This is the case for these units in all the further results***MNE was not obtained for JYA because it contained only carapace elements, which was not used in MNE calculations.

Unit	A	B
JY	3.3173	-3.3173
JYA	-0.26992	0.26992
JZ/JZh	-1.7075	1.7075
JZA	2.3669	-2.3669
JZB	0.084306	-0.084306
KAB	0.56942	-0.56942
KAC	-5.2627	5.2627
KAD/KADh1	1.8053	-1.8053
KAE	0.44594	-0.44594

Table 5.4. Adjusted residuals of the NISP:NSP ratio chi-square test between layers. Adjusted residuals are significant above or below z = 1.96 for α = 0.05. Positive adjusted residuals indicate the observed frequency is greater than expected and negative adjusted residuals indicate the observed frequency is less than the expected frequency.

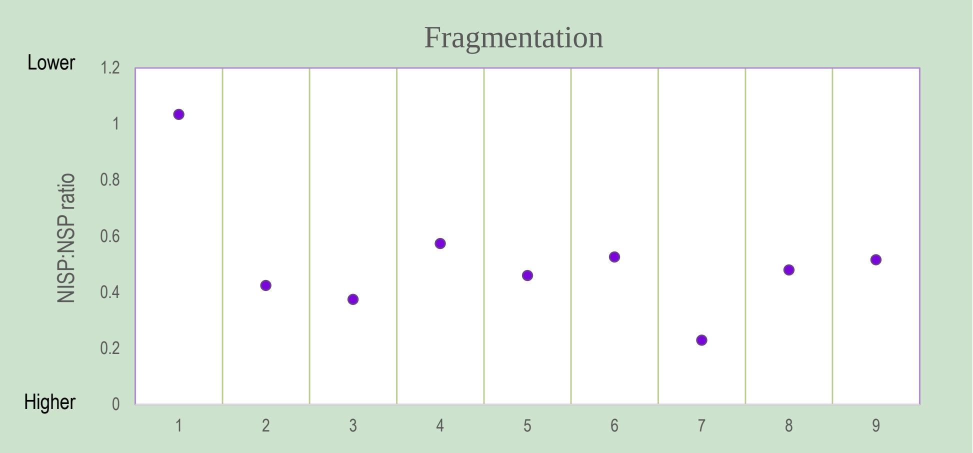


Figure 5.1. Fragmentation given as the ratio between NISP and NSP. The y-axis goes from higher degrees of fragmentation at the bottom, towards lower degrees at the top.

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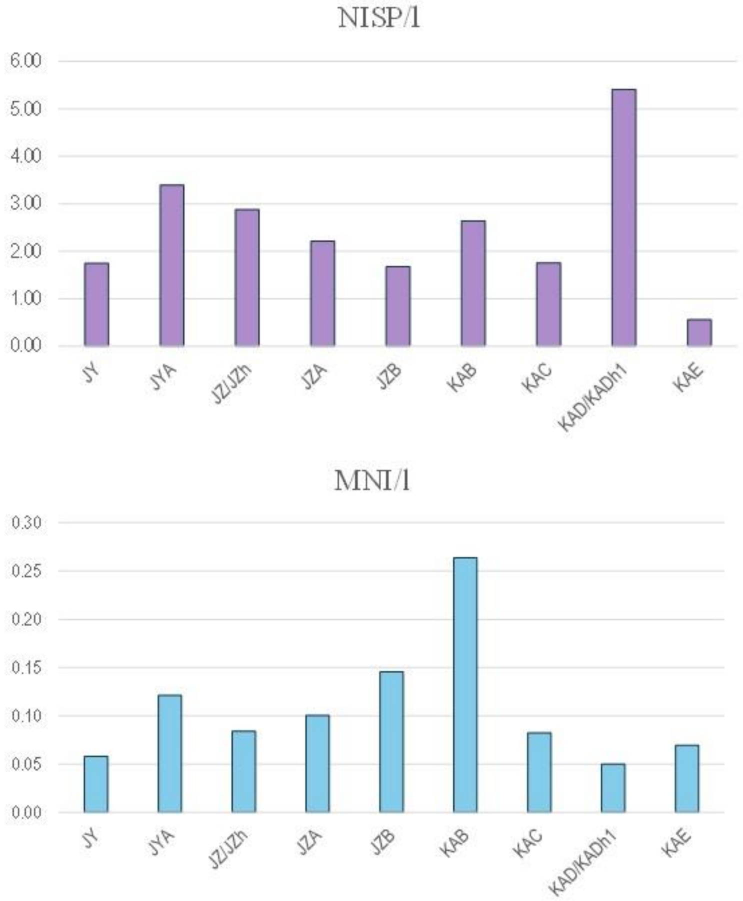


Figure 5.2. The density of identified tortoise specimens in each unit. Above: given as NISP per litre of excavated deposits. NISP in this context means number of specimens identified to at least taxonomic family, and specific element or lower than tortoise/tortoiseshell, larger than 1 cm. Below: MNI per litre of excavated deposits.

Unit	A	B
JY	-1.9892	1.9892
JYA	0.25472	-0.25472
JZ/JZh	-0.39423	0.39423
JZA	-2.4166	2.4166
JZB	-1.7247	1.7247
KAB	-0.23567	0.23567
KAC	-2.9254	2.9254
KAD/KADh1	7.169	-7.169
KAE	-6.264	6.265

Table 5.5. Adjusted residuals of the NISP/l chi square test.

Skeletal part	NISP	MNE
Cranium	0	0
Maxilla	0	0
Mandible	0	0
Vertebra	3	3
Atlas	0	0
Axis	0	0
Unidentified limb/gir	7	-
Scapula	7	7
Coracoid	8	8
Pubis	2	2
Ilium	11	10
Ischium	13	11
Humerus	7	7
Radius	6	6
Ulna	6	6
Femur	7	7
Tibia	3	3
Fibula	0	0
Unidentified plastror	49	-
Epiplastron	15	12
Entoplastron	10	10
Hyoplastron	16	10
Hypoplastron	20	13
Hyo/hypoplastron	9	-
Xiphiplastron	17	14
Unidentified carapac	8	-
Nuchal	5	3
Neural	132	-
Pygal	4	4
Pleural	373	-
Peripheral	221	-
Total	**959**	**136**

Table 5. 6. Skeletal part frequencies. The representation of each skeletal element at the in terms of NISP, and the MNE they constitute. All units and quadrants are combined here. NISP is used in this context about the number of specimens that were identified to skeletal element lower than shell. Note: MNE was not calculated for most of the carapace elements and is therefore excluded from the count.

Unit	MNI male	MNI female
JY		
JYA		
JZ/JZh	1	
JZA	1	2
JZB		1
KAB		
KAC		
KAD/KADh1	2	
KAE		
Total	**4**	**3**

Table 5.7. MNI of males and females in each unit, and from the site in total

Figure 5.3. Example of a male Chersina angulata from KAD/KADh1. Ventral view of two epiplastra and one entoplastron. Also note the two notches on each of the “roots” of the projecting gulars on the epiplastra.

5.1.2 Taxonomic abundance

Of the 3088 specimens analysed, 2129 were identified to the Testudines order, while 959 specimens were identified down to the family *Testudinidae* (**table 5.8**). These 959 were comprised by 851 specimens identified no lower than family *Testudinidae,* while 105 were identified down to *Chersina angulata*, and 3 specimens assigned to the genus *Homopus*. The angulate tortoise was found in every unit apart from JYA, while *Homopus* was found in one unit: JZA (see **figure 5.4** for examples of each species). **Table 5.9** is an overview of the taxonomic abundance in the Oakhurst sequence in total. Among the specimens identified to family *Testudinidae*, some were recognised as being different from both species above in texture and appearance (**figure 5.5**).

Unit	Taxon			
	NSP	NISP		
	Testudines	*Testudinidae* sp.	*Chersina angulata*	*Homopus* sp.
JY	29	29	1	-
JYA	66	28	-	-
JZ/JZh	275	94	9	-
JZA	230	88	41	3
JZB	50	15	8	-
KAB	38	15	5	-
KAC	279	59	5	-
KAD/KADh1	1131	512	31	-
KAE	31	11	5	-
Total	**2129**	**851**	**105**	**3**

Table 5.8. Taxonomic abundance in all the quadrants and units analysed here. NSP in this context comprises all specimens that were identified to the Testudines order, but not to a taxon, while NISP refers to all specimens identified to at least family level.

Taxon	NSP	NISP	Total
Testudines	2129		
Testudinidae sp.		851	
Chersina angulata		105	
Homopus sp.		3	
Total	2129	959	3088

Table 5.9. Taxonomix abundance at the site in total, all units and quadrants combined. NSP and NISP is used here as in table 5.8.

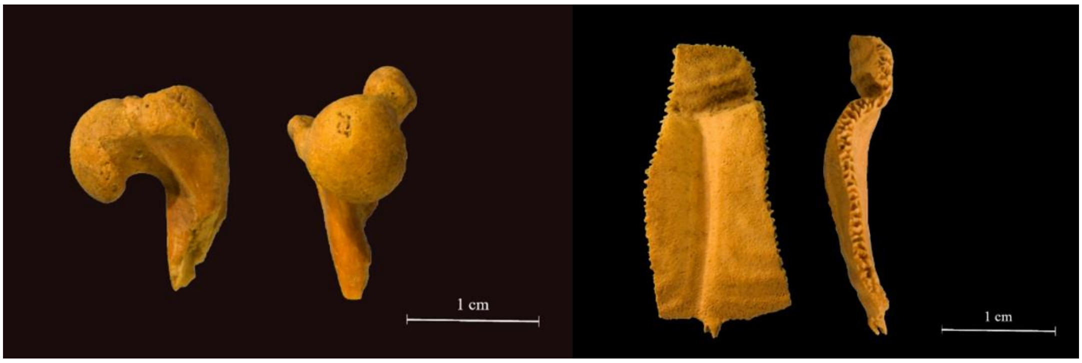


Figure 5. 4. Left: Example of Chersina angulata left proximal humerus, from unit JZB. Right: pleural from Homopus sp., front/side, unit JZA.

Figure 5.5. Various specimens of unknown species together with comparatives from *Chersina angulata.* Top to bottom: neural from KAD/KADh1; neural from KAD/KADh1; neural KAC; coracoid from JZA.

5.2 Measurements

A total of four humeri and five femurs were preserved well enough that the length could be measured (**table 5.10**). Some of these measurements were used in the MNI calculations.

Unit	MNI male	MNI female
JY		
JYA		
JZ/JZh	1	
JZA	1	2
JZB		1
KAB		
KAC		
KAD/KADh1	2	
KAE		
Total	**4**	**3**

Table 5. 10. The length and side of all measured humeri and femurs.

5.3 Taphonomic modifications

5.3.1 Burning

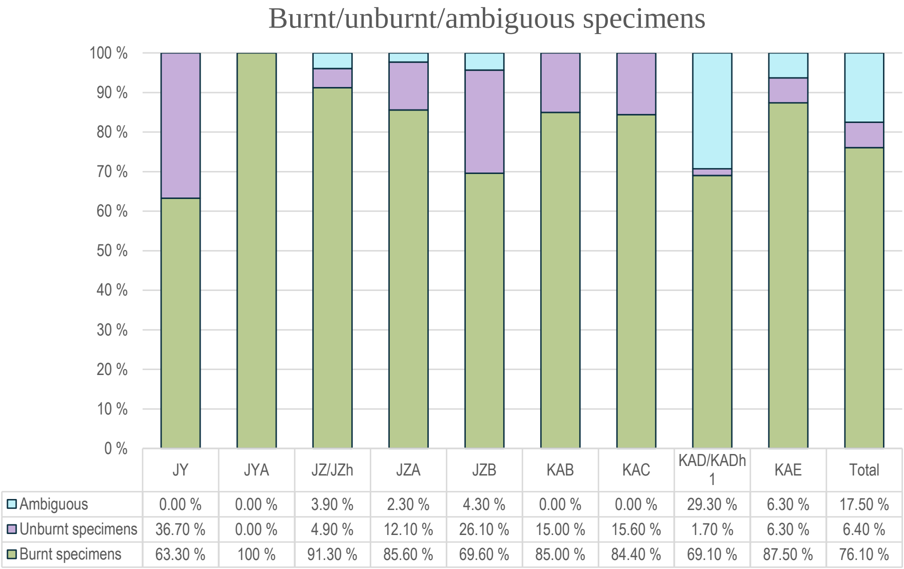
All the units contained high amounts of burnt specimens (**figure 5.6**). 100% of the specimens in JYA were recorded to have traces of thermal alteration, making this the highest. The second highest was JZ/JZh (91.3%), followed by KAE (87.5%) and JZA (85.6%). The hearth units JZ/JZh and KAD/KADh1 have the lowest amount of unburnt specimens (4.90% and 69.1%), with the exeption of JYA (0%). The lowest occurrence was in JY (63.3%) and KAD/KADh1 (69.1%). The latter contained the highest amount of specimens with unclear burning stage (29.3%), many of them due to ashy residue. When all units are combined, 76.1 % of the specimens in total displayed signs of being burnt.

Figure 5.7 shows the relative portion of the shells burnt in each unit compared to the relative portion of limbs/girdles/vertebrae that were burnt. In JY and JYA, only shells were burnt, and of these, 63.3% and 100 % were burnt respectively. In JZ/JZh, KAB, KAD/KADh1 and KAE, larger portions of the limbs/girdles/vertebrae were burnt, while it is the opposite for the rest of the units. The percentages of shells and limbs/girdles/vertebrae that are burnt from the Oakhurst sequence in total is approximately the same for each category as: ca.70%.

Figure 5.8 shows the amount of specimens with homogeneous colouration compared to heterogeneous colouration. JYA and KAD/KADh1 contain the largest proportion of homogeneous colouration, while JY, JZB and KAB contain the largest heterogeneously coloured proportion.

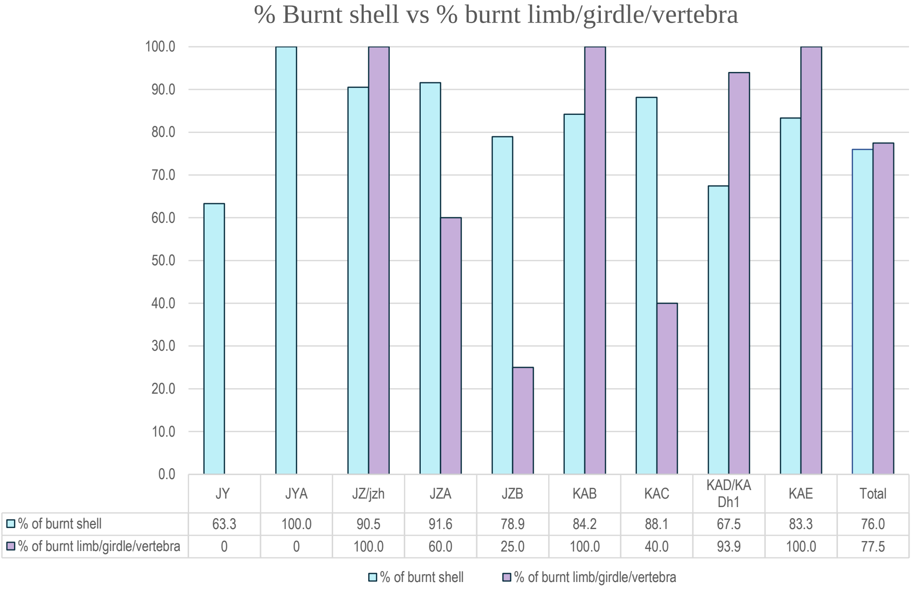
Of the homogeneously burnt specimens when all units are combined, 2-3 is the most frequent burning stage (44.9%) while stage 4-5 is the least (5.6%) (**table 5.11**). Highly burnt specimens (stage 4-5) appears in two units: JZ/JZh and KAD/KADh1.

The carapace specimens that were burnt heterogeneously displayed a random distribution of this particular modification (**figure 5.9a&b**). Two units, KAB and KAC, contained over 50% carapace specimens that were more burnt on the exterior.



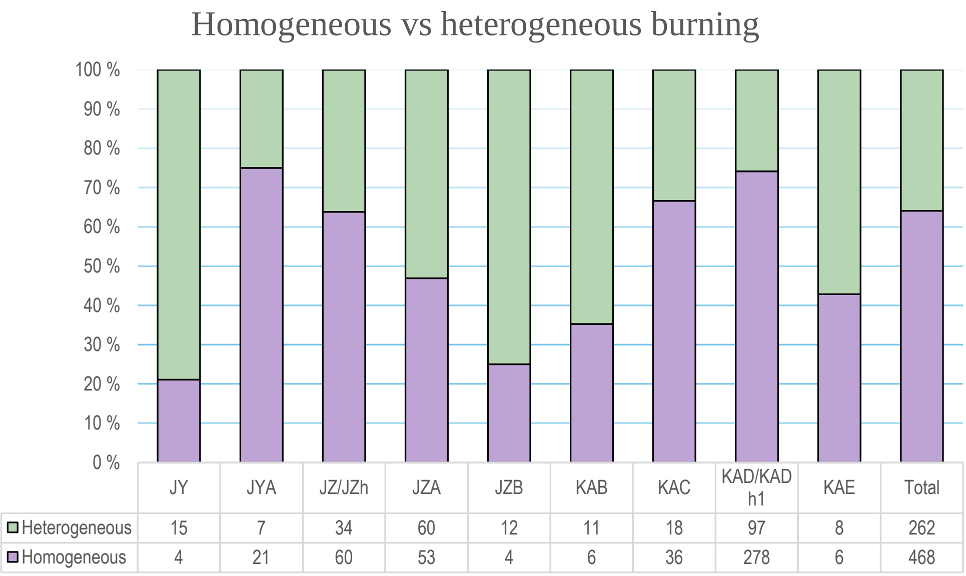
	JY	JYA	JZ/JZh	JZA	JZB	KAB	KAC	KAD/KADh 1	KAE	Total
🟦 Ambiguous	0.00 %	0.00 %	3.90 %	2.30 %	4.30 %	0.00 %	0.00 %	29.30 %	6.30 %	17.50 %
🟪 Unburnt specimens	36.70 %	0.00 %	4.90 %	12.10 %	26.10 %	15.00 %	15.60 %	1.70 %	6.30 %	6.40 %
🟩 Burnt specimens	63.30 %	100 %	91.30 %	85.60 %	69.60 %	85.00 %	84.40 %	69.10 %	87.50 %	76.10 %

Figure 5. 6. The percentage of burnt, unburnt and ambiguous specimens in each unit, and in total.



	JY	JYA	JZ/jzh	JZA	JZB	KAB	KAC	KAD/KADh1	KAE	Total
□ % of burnt shell	63.3	100.0	90.5	91.6	78.9	84.2	88.1	67.5	83.3	76.0
□ % of burnt limb/girdle/vertebra	0	0	100.0	60.0	25.0	100.0	40.0	93.9	100.0	77.5

Figure 5. 7. The percentage of the shell specimens that were burnt compared to the percentage of the limb/girdle/vertebra specimens in each unit and in total.



	JY	JYA	JZ/JZh	JZA	JZB	KAB	KAC	KAD/KADh1	KAE	Total
□ Heterogeneous	15	7	34	60	12	11	18	97	8	262
□ Homogeneous	4	21	60	53	4	6	36	278	6	468

Figure 5. 8. Distribution of homogeneous and heterogeneous burning among the burnt specimens in each unit and in total. Note: unburnt and ambiguous specimens are excluded.

Unit	Unburnt (stage 0)	Lightly burnt (stage 1)	Moderatly burnt (stage 2-3)	Highly burnt (stage 4-5)	Ambiguous	Total
JY	11 (7.3%)	0	4 (26.7%)	0	0	15
JYA	0	0	21 (100%)	0	0	21
JZ/JZh	5 (7.2%)	7 (10.1%)	48 (69.6%)	5 (7.2%)	4 (3.9%)	69
JZA	16 (22.2%)	24 (33.3%)	29 (40.3%)	0	3 (2.3%)	72
JZB	6 (54.5%)	3 (27.3%)	1 (9.1)	0	1 (4.3%)	11
KAB	3 (33.3%)	4 (44.4%)	2 (22.2%)	0	0	9
KAC	10 (21.7%)	8 (17.4%)	28 (60.9%)	0	0	46
KAD/KADh1	9 (2.0%)	69 (15.5%)	174 (39%)	35 (7.8%)	159 (29.3%)	446
KAE	1 (12.5%)	0	6 (75%)	0	1 (6.3%)	8
Total	61 (8.8%)	115 (16.5%)	313 (44.9%)	40 (5.7%)	168 (24.1%)	697

Table 5. 11. Distribution of homogeneously burnt specimens in terms of burning stages.

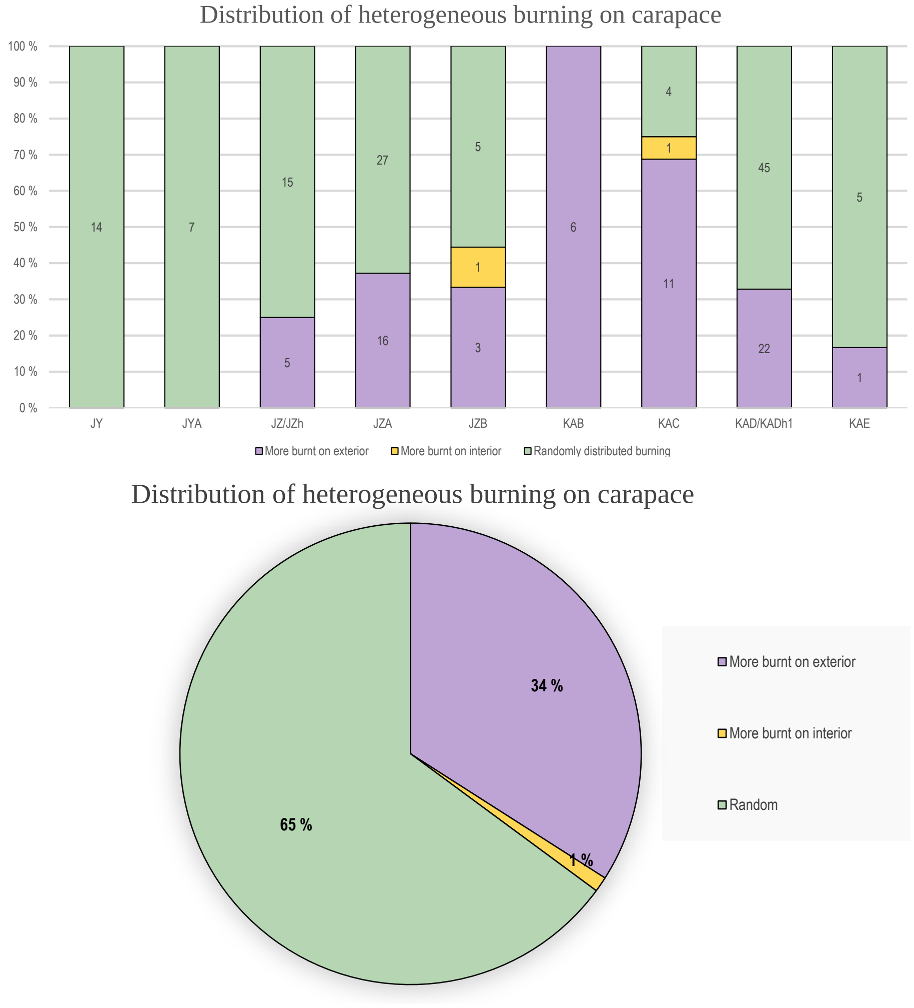


Figure 5. 9. Distribution of heterogeneous burning on carapace according to whether the Interior or the exterior displayed the highest burning stages. Random can for example mean burnt from the side. Top: the distribution in each unit, Bottom: the entire Oakhurst sequence.

5.3.2 Butchering: cutmarks, scrapemarks, and percussion pits and notches

Of the 959 specimens that were analysed, three had had incisions that were confirmed to be cutmarks. These were a complete scapula and two peripherals (**table 5.12** and **5.13**). The cutmark on the scapula was associated with some modifications that were likely to be trampling marks (**figure 5.10**). The bone also contained three small punctures, the agent of which was not determined. This bone was largely unburnt with some spots of manganese staining.

As for the two carapace specimens, they were both peripherals. and further had the cutmarks located on the exterior side. The specimen from JZB had a singular incision oriented horizontally on the tortoise, while the one from KAC had three incisions oriented vertically to the tortoise long axis. These peripherals were of different burning stages, but they both appeared more burnt on the exterior than the interior.

No scrapemarks were identified on any of the specimens.

None of the specimens had any pits or notches that could be confidently attributed to human activities, however there were 99 possible ones, with the majority in sheer numbers occurring in unit KAD/KADh1 (n=54), and the highest percentage in KAB (20%) (**table 5.12**). JZ/JZh and JZA also had high numbers of specimens and percentages with possible percussion modifications. The majority of these were on the shell and more or less evenly distributed between carapace and plastron elements. In addition to this, two girdle specimens also contained possible traces of this modification, while none of the limbs appeared to have any (**table 5.14**).

Unit	NISP confirmed cutmarks	NISP possible percussion pit/notch
JY	0/30 (0%)	0/30 (0%)
JYA	0/28 (0%)	0/28 (0%)
JZ/JZh	0/103 (0%)	14/103 (13.6%)
JZA	1/132 (0.8%)	15/132 (11.4%)
JZB	1/23 (4.4%)	3/23 (13%)
KAB	0/20 (0%)	4/20 (20%)
KAC	1/64 (1.6%)	7/64 (10.9%)
KAD/KADh1	0/543 (0%)	54/543 (9.9%)
KAE	0/16 (0%)	2/16 (12.5%)
Total	3/959 (0.3%)	99/959 (10.3%)

Table 5. 12. Frequencies of confirmed cutmarks and possible percussion pit/notches

Unit	Element	No. incisions	Location
JZA	Scapula	1	Distal half of prescapular process
JZB	Peripheral	1	Exterior
KAC	Peripheral	3	Exterior

Table 5. 13. Location of confirmed cutmarks, and the number of incisions

Figure 5. 10. Scapula from JZA displaying a cutmark, punctures and manganese staining.

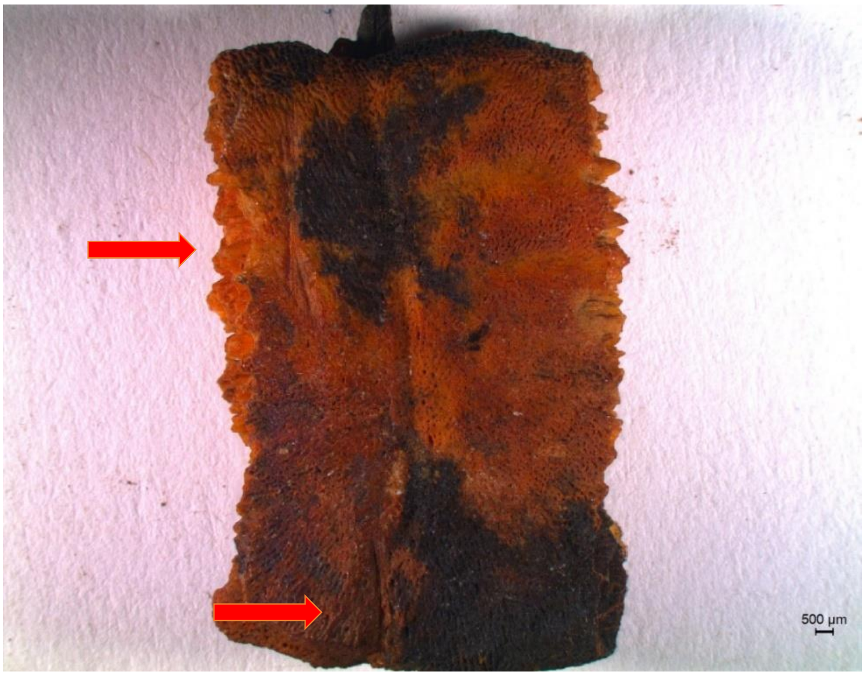


Figure 5. 11. Peripheral from unit KAC, with 3 incisions, and manganese staining.

Unit	Possible percussion pit/notch				Total
	Plastron	Carapace	Limb	Girdle	
JY					
JYA					
JZ/JZh	4	10			14
JZA	6	8		1	15
JZB	2	1			3
KAB	3	1			4
KAC	2	5			7
KAD/KADh1	31	22		1	54
KAE		2			2
Total	48	49		2	99

Table 5. 14. Number of specimens with possible percussion pits and/or notches.

Figure 5. 12. Top left: unit KAD/KADh1; bottom left: plastron form KAB; top and bottom right: Ilium, KAD/KADh1. All of these display possible percussion marks/ flaking.

5.3.3 Ochre residue, polishing and other modifications

None of the specimens were observed to have any traces of ochre residue beyond a few incidental specs.

None of the specimens contained any secure traces of polishing, apart from when associated with burning.

Of other modifications, manganese, trampling, ashy residue, root etching and rodent gnawing was present. The latter occurred on two specimens. Modifications of which the nature and cause is unknown was also found (**figure 5.13).**

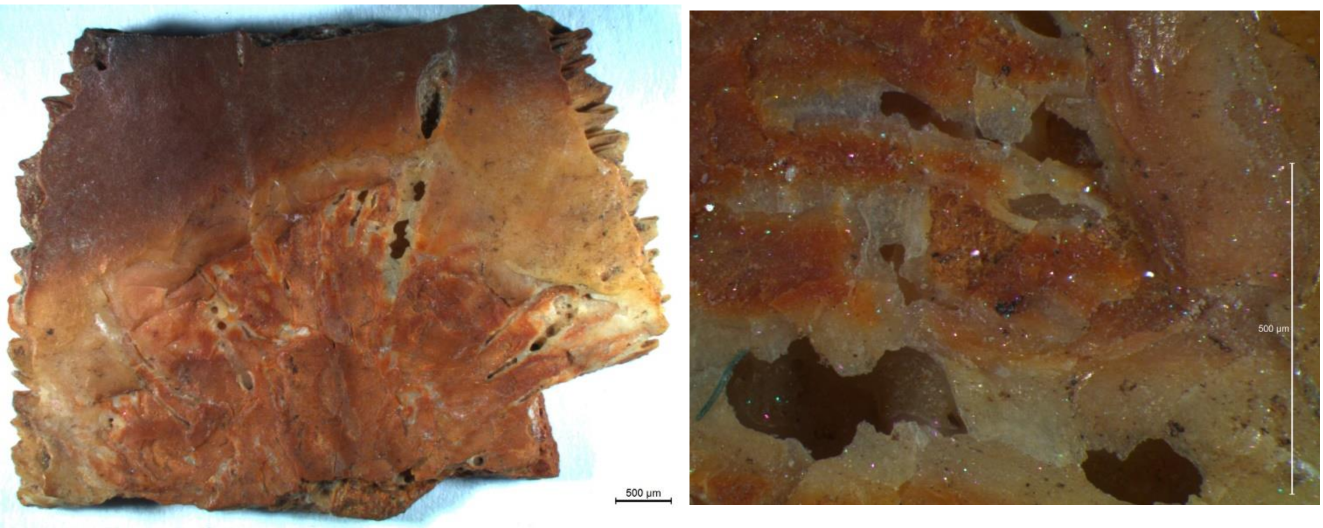


Figure 5. 13. Example of unknown modification. Carapace specimen From unit JZ.On the right: same specimen, but through a microscope.

6. Discussion

The overall aim of this thesis is to assess the role of the Testudines among the hunter-gatherers occupying Klipdrift Cave during the Oakhurst sequence, and further in the south-western Cape. To do this, this chapter is divided into two sections so that the Testudines material is considered first at the site internally, both between layers, and in relation to the rest of the archaeological material. This section covers the first three research questions as laid out in chapter 1, and comprises discussions of the likely agent of accumulation, the role of Testudines at the site, possible processing techniques, and paleoenvironment. In the second part, the fourth research question is in focus. Here I consider the role of Testudines in the Oakhurst period in the South-Western Cape, in which I discuss the KDC tortoises in relation to the eight other sites.

6.1 The Testudines of Klipdrift Cave

6.1.1 Agent of accumulation

Several features of the KDC Testudines remains suggests the agent of accumulation was human, namely the context, skeletal element representation, burning and bone surface modifications.

The overall association with artefacts of human origin throughout the layers puts the Testudines collection in an anthropogenic context. Furthermore, KDC is in contrast to open air sites such as those close to water sources to which several animal species may be drawn (Avery et al., 2004, p.148), a more sheltered site in a rocky area. Context and association with human artefacts alone however do not necessarily mean that humans were the accumulating source as there are other predators that can deposit bones in caves, such as roosting raptors or hyenas.

Sampson (2000) found that tortoise accumulations created by raptors tend to contain higher frequencies of cranial and axial elements while the representation of forelimbs and pectoral girdles is lower, whereas human made ones tends to contain higher amounts of carapace and plastron relative to the elements from within the shell, and lower representation of axial and cranial elements. When looking at skeletal element frequencies of the identified tortoises from KDC (**table 5.6**), they appear to fit with what can be expected from human made assemblages. This collection contained high NISP counts of shell (879), and high NISP (41) and MNE (38) counts of girdles. In terms of cranial and other axial elements the representation was low: n=0 and n=3 respectively. Although preservation may also play a part in what elements are there as the cranium is fragile. Thompson (2010, p.335) points out that in Sampson's study, the agent of accumulation is inferred rather than demonstrated in two of the cases he investigates, but she further notes that it provides a comparative framework. In the case of the human made assemblage from which Sampson draws his conclusions, it is archaeological and not based on actualistic observations of butchering and deposition of tortoise elements. This needs to be kept in mind as several post-depositional processed may also have affected the assemblage.

Thermal alteration of the bones can also be an indicator of human accumulations, with 30-40% burnt bones being typical of San-made assemblages according to Sampson (2000, p.785). The same concern as above applies to the burnt bones in his study as well. Furthermore, the agent of accumulation in his study is assumed to be San people from historical times, which, given there even are relative burning frequencies typical of human made assemblages, are not the same people as those who lived in the LSA. When combining all the layers and quadrants that were analysed from KDC, 76.1 % displayed signs of being burnt (**figure 5.6**). Considering each unit separately, thermal alteration was present on over 60% of the specimens in all of them, with some layers such as JZ/JZh and JZA containing well over 80%. These relative frequencies are much higher than Sampson's results. Burnt bones are fragile, meaning preservation could also have played a part. Furthermore, as bones could have been discarded or used as fuel, in addition to there being many variables affecting a bone in a fire, the frequency of burnt bones could be argued to vary between sites. The frequencies at KDC appear more similar to the results from Blombos Cave, in which 66.1% of the specimens were burnt (Thompson and Henshilwood, 2014b, p.221). Modern bush have been shown to kill great amounts of tortoises (Avery et al., 2004), however the fact that KDC is not an open air site also makes it unlikely that a fire accumulated these tortoises. That is not to say that they did not perish in a bush fire as the inhabitants of the cave may very well have exploited such an event to collect dead tortoises, but they were likely not deposited there as a direct result of the fire. The cutmarks and possible percussion marks (**table 5.12)** are also suggesting of a human agent.

The sample further lacks modifications by any biotic accumulating forces other than human, such as signs of digestion, punctures from the beak or claws of raptors or toothmarks from carnivores like hyenas. Only two specimens contained any clear signs of gnawing, but it was from rodents and not a larger carnivore that accumulates bones. Discamps et al. (2020) also noted that the sample of large mammals from KDC was little affected by carnivores. This should not be taken alone as evidence that there were no carnivore or scavenger activities taking place at the site, for as Reitz and Wing (2007) points out; the absence of modifications does not mean other animals were not there. Furthermore, pits and perforations of various origins are also often ambiguous and hard to identify. But, when this is combined with the overall context, frequencies of certain skeletal elements, amount of thermally altered bones and finally the presence of the possible and especially confirmed anthropogenic modifications, these fits with what could be expected of humans as the main agent of accumulation.

6.1.2 The role of the KDC tortoises

In this sub-section I consider the role to the tortoises from KDC first in terms of how they were utilised by discussing what the results of the taphonomic modifications suggest, followed by what their abundance, both between layers, and relative to other fauna/shellfish, indicates about their role in the hunter-gatherer groups that occupied the site during the Oakhurst-techno-complex.

6.1.2.1 Utilisation of tortoises at KDC

Various archaeological sites and ethnographic observations presented throughout this thesis show that Testudines is a resource that can be utilised in several ways beyond that of subsistence, including musical instruments, containers, bowls, pendants and prestige items. Identification of taphonomic modifications such as colouration due to ochre residue, drilled holes, grinding and polishing have been used to infer such uses. Being highly conservative when identifying taphonomic modifications was considered to be of great importance during the lab-work to lessen the risk of misidentifying and creating a foundation for the interpretation that at worst would be completely wrong. On the other hand, being too conservative may create a just as “wrong” interpretation of the past by instead masking actions that took place.

The tortoises did not display modifications that I found convincing enough to indicate any use beyond that of food, but this can also stem from a combination of inexperience from my side and a lack of experimental and actualistic studies on tortoises. No drilled holes were recorded on any of the bones, which indicates that they were not used as pendants to be worn around the neck, however **figure 5.3** shows two epiplastra with a notch each that prompted me to think about some of the necklaces in **figure 2.1** and whether wearing a shell over time would wear down the edges of the epiplastra where the straps friction against the plastron. But this is highly speculative.

No modifications (i.e. residue or striations) were identified that indicates that they were a part of the ochre use at KDC, not as storage containers or mixing bowls. Some bones did have red discolouration, but these were always within markings from root etching and therefore not systematically recorded. The representatives of the Ju/'hoansi people that Backwell and D'Errico (2021) interviewed, mentioned that they sometimes use tortoise carapaces to mix the ostrich eggs in as a part of the cooking process, and the KDC collection does include ostrich eggshells, which makes this type of use not unthinkable, but hard to confirm or deny. Furthermore, an unspecified San group observed by Fourie as referred to by Backwell and D'Errico (2021), were recorded to use tortoise shell as a part of the process of pulverising larvae in order to make poison for arrows. My intention is not to use ethnographic sources as direct analogies, but rather to draw attention to potential ways tortoises may be used. Whether such activities as exemplified here would leave any macro- or microscopic traces on the bones is unclear, but this might be possible to further investigate through experiments, or residue analysis.

Bone artefacts are found at KDC (Discamps et al., 2020, p.1), and there are ethnographic examples of Testudines bones being made into tools such as fishhooks (Emory, 1975). However, none of the remains analysed here appeared to have been modified into tools.

No traces of polishing or grinding, as found at other sites, was identified. From the comparative collection, which consisted solely of tortoises that had died from natural causes, the interior of their carapaces and plastrons naturally appeared smooth and polished and contains several striae-looking "streaks" of various depths, some of which are likely foramina and vascular canals (see **figure 2.14**). There are to my knowledge no experimental studies on smoothing, scraping and grinding on tortoise shells, and how this differs from their natural surface. Inskeep (1987, p.169) does mentions some tortoise shell fragments that are ground and polished to the extent that the inner "table" is visible. In the KDC collection, the cortex on the interior of some tortoise shell specimens is damaged (**figure 5.13**). However, when looking at them in the microscope, the interior surface appears irregular with no continuous striations visible, the surface looks more like it has flaked off, and the underlaying tissue was filled with small salt-like crystals. Therefore I do not think these bones represent tortoise shell specimens that have been scraped or ground. Inskeep (1987) further argues that since the tortoise bones form Nelson Bay Cave in the Wilton and Robberg layers were exclusively of shell specimens, they likely represented human choice to bring back the shell to be used as bowls rather than food. At KDC nearly all elements were represented, and in almost all layers (**table 5.6**). Shell specimens were in general overrepresented compared to limbs/girdles/vertebrae, but this is to be expected as they are also abundant in the skeleton (49± elements in the angulate tortoise). There is one layer that stands out with regards to this: JYA only contained carapace elements. On the one hand that could indicate that only carapace was brought back into the cave, either as a bowl or for other similar purposes. It may on the other hand be due to small sample size from a limited area. Furthermore, there was not identified any modifications on these specimens that indicated they had been used as bowls, but there were no cutmarks or percussion marks (neither confirmed nor suspected) that directly suggests that they were butchered either. All of these specimens were thermally altered, but they were either burnt on both sides or appeared to have been randomly burnt (**figure 5.6-5.7**). This suggest that if they were burnt once, it was likely through layers and/or as fuel/rubbish, but they could also have been burned twice, which could have obscured the "non-random" burning pattern that would appear when roasting the tortoise whole in the fire. Although burnt specimens were common throughout the entire sequence, many were also unburnt.which could point to them being used as something other than food, such as decorations or bowls. However, overlaying soft tissue may protect the bone from heat, and it is unclear how heat would travel through the keratinised scutes. I am not aware of any experimental studies that can clarify this.

The thermal alteration of the specimens is in any case the most striking taphonomic modification in the sample, both in terms of the amount of burnt specimens, and how it is manifested on them. The percentages of burnt specimens is notably high, both from the Oakhurst sequence as a whole (76.1%), and in each unit separately (**figure 5.9**) Bones can be burnt through cooking, discarding of rubbish, fuelling and bush fires. Furthermore, the experimental study by Bennett (1999) shows that heat can travel through layers and thermally alter osteological material long after it was deposited. Although it does not exclude bushfires as the source of some of the burning, the generally high amount of bones with homogeneous burning suggests this was at least not the sole source of fire damage, because the homogeneously burnt shell specimens are also burnt on the interior, which is unlikely to happen if the tortoise is burnt complete, and only once. Furthermore, modern observations of the aftermath of such processes on tortoise populations suggest that sweeping bushfires does not badly damage the bones below the scutes (Avery et al., 2004), while the bones at KDC were often burnt into the cancellous bone. To differentiate between the bones having been burnt as fuel, rubbish, or accidentally through layers however is hard. The bones associated with the hearths in JZ/JZh and KAD/KADh1 were likely discarded or burnt as fuel. These layers are also the only ones containing highly burnt specimens of the stages 4 and 5 (**table 5.11**), and disposal of rubbish and/or fuelling likely also explains why these two units contained such high abundance of specimens in general. The amount of burnt bones are also high in layers below the hearth units (in JZA and KAE), meaning burning through layers might explain at least some of this pattern. Layer JZB contains one of the lowest amounts of burnt specimens and is located between the hearth JZ/JZh and KAB and KAC (**figure 5.6**). The burning in the two latter layers is curious as they contain higher proportions of burnt specimens than JAB. KAB and KAC also contains the largest amounts of carapace specimens that are more burnt on the exterior (**figure 5.9**), of which KAB contains more specimens that are differentially burnt than homogeneously burnt in total (**figure 5.8**), which could suggest that this layer contains specimens that were mainly burnt through cooking, as opposed to from heat travelling through deposits. Furthermore, the amount of burnt bones that appears randomly burnt and homogeneously burnt from KAB and KAC, may have been burnt as fuel/rubbish and then cleared out of hearths that have not yet been excavated. Some of the specimens did display double colouration largely similar to what has been before (i.e. unburnt on the interior and burnt on the exterior) but these specimens disappear slightly among the randomly burnt bones.

Although the amount of cut marked tortoises is low in total (n=3), and not appearing throughout the entire sequence, their presence is in itself taphonomically demonstrating that activities likely related to butchery found place at the site. And although no secure percussion marks were identified, if the possible ones are indeed that, the high frequency of these supports this. I will come back to this in the processing sequence section of this chapter.

The skeletal element representation suggests the tortoises were brought to the cave complete, as nearly all elements are represented. The lack of extremities can be explained by various factors such as preservation and mesh size on the sieves.

These modifications observed on the tortoise material are indicating of the tortoises being brought in primarily as food. This is supported by the apparent lack of traces of residue, grinding, drilled holes and polishing or any other signs of use beyond that of food, the high amounts of burnt specimens, and the skeletal elements represented in the collection.

6.1.2.2 The role of the tortoises throughout the Oakhurst sequence

To investigate the role of the tortoises in the diet, both between layers, and relative to other fauna and shellfish, they are mainly discussed in terms of abundance in this sub-section.

There is difference between layers in sheer numbers, which for some may be a function of sample size. Especially KAE and KAB contains low NISP (identified to at least family, and skeletal element lower than shell, unless otherwise is specified). However, attention is drawn to the layers JZ/JZh, JZA and KAD/KADh1, of which KAD/KADh1 contains especially high numbers. The total amount of specimens from this layer, including <1cm and those that were not identified lower that “tortoise skeletal element”, was 1674 (**table 5.1**). The number of specimens that were analysed in detail from this unit was 543 (**table 5.2**). As the sample size of this unit was larger than the rest, however, this might skew the image, but NISP/l was calculated to correct this. The results (**figure 5.2**) show that KAD/KADh1 also contains the highest density of specimens with 5.41 NISP/l. The chi-square test between layers in terms of density (**table 5.5)** show this unit, together with JZA, KAE and KAC, to be significant. KAD/KADh1 is not dense when looking at MNI/l, nor is it especially striking when looking at the ratio between NISP:NSP (**figure 5.1**), but the chi-square test (**table 5.5**) shows that there is variation in fragmentation that might not be reflected in **figure 5.1**. Furthermore, there is still relatively high fragmentation in unit KAD/KADh1, possibly connected to this being a hearth unit, which could mean that there are fewer specimens that survived, and/or are recognised and included in the MNE and MNI count. Furthermore, looking at MNI alone (**table 5.3**), KAD/KADh1 still has the second highest. The data from the younger layer JZ/JZh1 comes from the same number of quadrants as KAD/KADh1, and this is perhaps the best foundation to draw comparisons between the younger and older sections of the Oakhurst sequence. The total number of specimens from this unit was 378 (**table 5.1-5.2**) of which 103 were analysed. The density in this layer was 2.88 NISP/l (figure **5.2**) while the MNI=3. JZ/JZh1 and KAD/KADh1 also had fairly similar fragmentation ratios, with the former being slightly higher (**figure 5.1**). The difference in density could suggest that more tortoises were collected in KAD/KADh1 than in JZ/JZh1. The higher density of specimens in these two units compared to the rest (with the exception of JZA and KAB) could be due to a heavier reliance on tortoises as a food source as well. Unit JZA contains data from two units, and still has numbers of specimens comparable to the two units with data from three quadrants. This has the highest MNI (n=6) and second highest NISP (n=132). It is not more or less dense than the majority of layers, but **figure 5.1** shows this unit also has the second lowest fragmentation ratio, which could mean more specimens were identifiable, and also explain why the NISP/l was not as high if the specimens were more complete. KAC has the highest fragmentation, which is also reflected in the chi-sqare test (**table 5.4**), despite this, the MNI is relatively high when compared to other units (n=3). It is possible that this unit should be denser, but the fragmentation may have obscured this. The fragmentation was the lowest in unit JY, which could be explained by it is also being among the least burnt layers.

Another explanation for variation between units in abundance is related to the spatial distribution of specimens. As mentioned above, Avery et al. (2004) refers to a site where tortoises were associated with hearths, which could explain the abundance at KDC in the hearth layers. This does not however explain the abundance in JZA, which, assuming strong association with hearths is true, could still be explained by hearths being located in the vicinity, but it may also be due to heavier exploitation of tortoises, which I will come back to as there are other indications of this. In many of the results, sample size is possibly putting certain units as the extremes, such as the MNI/l being highest in KAB despite there being an MNI of two, which is not very different from the other units (**table 5.3 and figure 5.2)**. The NISP/l and MNI/l is also high in JYA, while the NISP and MNI in this layer is among the lowest. But in general, the units JZ/JZh, JZA and KAD/KADh1 appears to be different from the rest as they contain the highest amounts of tortoises. It is also possible that JZA displays especially intensive collection of tortoises.

Compared to the main sample of large mammals from the coarse fraction and plotted remains (Discamps et al., 2020, p.4), the NISP is high, even with data from a much smaller area (**figure 2.8**). Their main sample yielded a total of 633 identified specimens to small herbivore, 228 large herbivores. The NISP for tortoises was 959, but the collection consists of 3088 Testudines in total if the NSP is included. This could in part be due to their unique anatomy, which makes them easily identifiable. The layers KAD/KADh1 and KAE contained higher proportions of large herbivores, but the former also contained high amounts of tortoise. Optimal foraging models rank tortoises low, but if mass collected, they may yield return rates comparable to larger game (see chapter 3.2.2). Calculations of the caloric yield was not possible with the sample size of the humeri I measured, but could in the future be calculated from the results Ryano (2014) obtained to investigate their contribution to the diet. Following optimal foraging models, a decrease in access to high-ranking prey is called resource depression (Prentiss, 2019, p.219). It does not seem like the high frequencies of tortoises in layer KAD/KADh1 reflects such a depression, as the number of large mammals here is also high.

In terms of shellfish, the upper layers JY, JYA and JZ also contains high densities, while JZA to KAC contain the lowest densities (Ryano et al., 2019, p.4). With the exception of KAE, similar results emerge from the tortoise material in certain aspects. KAD/KADh1 is the densest in terms of NISP/l (**figure 5.2**) and contains the second highest MNI (**table 5.3**). Looking at the MNI/l (**figure 5.2**), tortoises are increasing slightly in KAC, reaches a peak in KAB, and decreasing a little in JZB and further towards JZA, but still being higher than JZ/JZh1, in which the shellfish density pics up substantially. Looking purely at this graph, it could reflect tortoises being relied more heavily on as shellfish decrease, however this is highly uncertain, again due to sample size. Nevertheless, KAD/KADh1 and JZA both contains the highest amounts of tortoises, of which the latter is also among the lowest in shellfish. Together with the increase in densities of shellfish from layer JZA, there is a decrease in size of *T samaticus*, which was used to argue that the shellfish were possibly more intensively collected. As the MNI of tortoises was also high, this might suggest that they were also more intensively collected. However, as Ryano (2014) argues, the sizes of tortoise humeri throughout the layers does not indicate a predation pressure on the populations to the extent that their body size decrease throughout the Holocene. But that does not mean they were not more intensively collected than in the older part of the sequence, which the abundances in JZA may indicate.

The lithic composition in unit JZA was also different from the rest of the sequence in that it contained more flakes and less bladelets and cores. The two bottom layers KAD and KAE contains more quartz as raw material, more blades and cores (Ryano et al., 2017)

The relative microfauna density as shown in Discamps et al. (2020) is high in some of the layers where tortoise and shellfish, lithics, and fauna appears low, which could be explained by low occupation and/or less frequent visits to the site.

Although the sample size of the tortoises is likely causing some of the results to appear more significant than they in reality are, the densities of these animals, both in terms of NISP/l and MNI/l appears to be relatively stable compared to for example the shellfish. Some of the higher frequencies in NISP/l could be explained by more intensive collection, but it could also be due to the spatial arrangement at the site, with some of the highest densities of tortoise appearing near hearths. Layer JYA may however reflect more intensive collection of tortoises. The YD event between 12 800 and 11 500 cal BP, must have occurred between the upper layers JZB to JY. It is therefore not entirely unplausible that layer JZA, in which several differences in the other material also have occurred (i.e. shellfish and lithics), may reflect this event.

6.1.3 Tortoise processing sequence

From other sites with tortoises, a common processing sequence starts with the animals being put upside down into a fire, followed by their shells being broken up and the nutrients within being removed by cutting and scraping. The taphonomic modifications on the KDC tortoises appear less clear, with no clear pattern emerging, however many of the specimens did display modifications that might hint at similar technique.

In terms of burning (**figures 5.6-5.9**), the tortoises displayed high percentages in all layers. The patterning and how this appeared on the specimens was a challenge to categorise and systemise, as no clear pattern was emerging, and there were many variables to consider. As discussed in 6.1.2.1, this might point to a complex taphonomic history. The distribution of heterogeneous colouration, which has been used to argue in favour of tortoises being put upside down in the fire, appeared to be largely at random. Two layers, KAB and KAC, contained higher percentage of carapace specimens displaying more burning on the exterior, but KAC contained higher frequencies of homogeneously burnt specimens as well, suggesting the heat was distributed across the entire surface of these elements. The highest amounts of homogeneous burning occurred in the hearth units JZ/JZh and KAD/KADh1. When separated into the two categories: shell, and limbs/girdles/vertebrae, these two layers both contained high frequencies of burnt specimens (**figure 5.7**), and the shells did not appear to be more burnt than the rest of the skeleton. The layers JZA, JZB and KAC however had higher amounts of burnt shell than limbs/girdles/vertebrae, and JZA and JZB also had higher amounts of heterogeneous burning, of which some of the carapace elements were more burnt on the exterior. The results from JZA and JZB may on one hand suggest that the tortoises were being roasted within the shell, however the amount of random distribution was also high, in these layers. As some specimens did appear similar to what is described by others as indicating that they were put upside down in the fire, this might indicate that some were processed this way, but if the specimens were burned again after the initial cooking, this may have obscured the primary traces of the processing. Compared to the large mammals from KDC where the highest percentage of burnt specimens is 48.4 %, and the percentage for the site in total is 24.8% (Discamps et al., 2020, p.5), the tortoises seem substantially more burnt. One explanation for this could be high degree of misidentification on my behalf of this modification, as manganese was also observed in the collection, and soil can cause colouration of the bones. However, as the preservation of the bones at the site is good, and that when manganese was present, it appeared notably different on the burnt bones, it seems unlikely that these high percentages should be caused solely by misidentification. The difference could be related to taphonomic history. Discamps et al. (2020) also notes that the number of specimens from which their burning data is calculated does not include the thousands of small burnt fragments from the course fraction, whereas this thesis does. It could be related to how tortoise bones are smaller and survive differently. As Thompson and Henshilwood (2014b) notes, tortoise bones are frequently found complete. The bones analysed by Discamps et al. (2020) were highly fragmented, and 6.1% were complete or "sub-complete", mostly the small bones. Burnt bones are fragile and breaks easily. Furthermore, the large mammal bones contain percussion marks. If they were fractured to access marrow, they may have been fragmented into smaller, unrecognisable pieces.

The second stage of tortoise processing is when the shell is fractured open. On one hand this is a logical step, as there is no way of accessing the nutrients without breaking into the shell, but no there was no secure modifications that clearly demonstrates this. The number specimens with possible percussion pits and notches were high (n=99), but as this type of modification is also often highly ambiguous, they were only recorded as "possible percussion mark". Many of these are likely from misidentifications, although it is not unlikely that some of them are percussion marks as the tortoises needs to be opened somehow. This is further substantiated by that these marks were mainly recorded on the shell, with equal distribution between carapace and plastron specimens. If these marks are indeed percussion marks, it would appear that the shell is more heavily broken. A complete shell contains more elements in general, but the frequency of girdles/limbs with possible incidents of this modification (**table 5.14**) is low (n=2). Compared to the number of specimens with percussion marks among the large mammals (n=38/875) (**figure 2.8**), the number of tortoise specimens with possible percussion marks is very high. This might again be explained by the marks being something other than percussion marks, but it could also be due to the unique anatomy of Testudines, and that breaking into a bone from a mammal as opposed to tortoises, is not necessary to access nutrients unless for example marrow extraction is the aim.

The three specimens with cutmarks from KDC consisted of two peripherals, one from JZB and one from KAC, and one scapula from JZA (**table 5.12-5.13**). The two carapace specimens from KDC had their cutmarks located on the exterior, rather than the interior. There is to my knowledge no studies that offers any explanation for this. I emphasise that this is speculation based on anecdotal observations, but during preparation of the comparatives, the hard scutes were, with much difficulty, removed to access the bones. Could a feasible explanation behind the location of these cutmarks that some of the marginal scutes were removed to facilitate breaking into the shell? The scapula with a cutmark is the only one of these three specimens that appears similar to what is found at other sites where girdle and limbs were frequently displayed this modification (e.g. Blasco et al., 2016), which could suggest that it was removed by cutting it out from the tortoise. As it is ideal to avoid scraping the stone tool against the bone, to prevent the edges of the tool from becoming dull (Fernandez-Jalvo and Andrews, 2016), careful cutting could also explain absence of cutmarks, but the bones could also have been twisted off and pulled out. In terms of modifications suggesting that viscera and meat was scraped out, namely scrape marks, none were observed. The specimens from large mammals had more cutmarks than the tortoises (Discamps et al., 2020, p.5).

In conclusion, a possible, but not secure, processing sequence for these tortoises may be: the tortoises were put in the fire, fractured open and viscera and other nutrients were removed by hand, and possibly with tools as one cutmark indicates. The bones were then discarded or reused as fuel. Some might also possibly have been burned through deposits. It is also possible that some of these modifications is a result of confirmation bias. However, it is especially some of the burnt bones (which in the vast majority of cases were unambiguous in terms of identification), that were found in this cave context that suggest that burning was a part of the processing technique, despite many of these specimens also showing signs that points to rubbish disposal/fuelling and post-depositional burning.

6.1.4 Species and environment

Chersina angulata was identified in the sample, and the genus *Homopus* is also represented (**table 5.8-5.9**).

Chersina angulata appeared in all units apart from JYA. However, it is not unreasonable to suggest that at least some of the specimens may be attributed to this species, as there is continuity from the layers below to the layer on top (JY). As the two genetic lineages of this species in the east and west (ch. 2.4.1) has had little to no genetic mixing since the LGM, and that they further exploit slightly different vegetation with the western lineage being confined to fynbos and the southern tolerating a broader range of vegetation, the presence of this species suggest fynbos vegetation. The *Homopus* sp. in layer JZA could not be identified to specific species. If it is indeed the *Homopus areolatus*, which lives in the nature reserve today, it is strongly associated with the shrubbery vegetation fynbos and renosterveld.

No aquatic turtle or terrapin were identified. Of the aquatic turtles, they are highly vulnerable when they are laying eggs, which they do on sandy substrate. The area surrounding the cave is rocky in general, and even though the shellfish composition from the early Oakhurst phases at the site suggests a sand-covered rocky shore prior to the rise in sea level, this has likely not ever been a suitable habitat for aquatic turtles. Although a *Pelomedusa* was found in KDS(Henshilwood et al., 2014), which suggests a freshwater source, no specimens were attributed to this genus from KDC.

There were several specimens that could not be identified to species, but they were different from the rest of the specimens in texture and shape (**figure 5.5)**. This is worth mentioning as it shows that there is a possibility that there are species in the assemblage that are extinct or does not live in the area today. This could be explained by a higher biodiversity in the past, or exchange networks. Other possibilities include pathologies or variations between individuals as tortoises can vary a lot.

As the male and female angulate tortoise have slightly different activity patterns throughout the year, sex was recorded to see if there was any skewing in the collection that could suggest seasonality. It was also done to see if any size differences might have been due to sex rather than environment or predation pressure by humans. Four out of nine units contained specimens that could be assigned to sex (**table 5.7**), and none of these contained enough specimens that could be determined in order to calculate any meaningful ratio. JZA did for example contain an MNI of 3 in terms of sex but as the total MNI from the layer is 6, it is unknown whether the other half of the individuals would skew the ratio in any direction. Of the specimens on which the sex could be determined in total, the ratio between males and females is roughly equal.

6.2 The role of Testudines in Oakhurst hunter-gatherer societies in the south-western Cape

This section consists of two parts. I first discuss their role in terms of whether they are they are present or absent from the sites, and further why they seem to be abundant at some sites, while being rare or absent from others. The second part is a discussion of how these tortoises may have been used at these sites, and if the material can suggest anything on what Testudines may have meant to the Oakhurst humans.

6.2.1 The presence and absence of Testudines

Testudines at contemporary sites (chapter 2.2) as included in the literature can be categorised as follows: they are present and described, mentioned but not described or absent. They are present and described in Byneskranskop, Boomplaas Cave, Wilton Large Shelter, Nelson Bay Cave, and some in Matjes River Shelter. They are mentioned but not described further in the case of Melkhoutboom Cave. Lastly, they are absent from Oakhurst Shelter and Kangkara Cave.

Byneskranskop, Boomplaas Cave and Wilton Large Shelter contained an frequencies of tortoise that is either similar to, or substantially higher than at Klipdrift Cave. The initial MNI of 1113 (Schweitzer and Wilson, 1978) from Byneskranskop seems to have been lower than the total number of humeri measured by Klein and Cruz-Uribe (1983) later analysed, of which 647 came from the Okahurst layers alone. Layer 14, the tortoise layer which was hypothesised to contain tortoises collected after a wildfire event, had 265 humeri and is the largest of the Oakhurst units. It is not mentioned if these are both right and left humeri or one side, but the figure they present the MNI in (Klein and Cruz-Uribe, 1983, p.27) appears to match the numbers of humeri. In any case, the tortoises are the most abundant at Byneskranskop of all these Oakhurst sites, including KDC. None of the other sites where the tortoises are analysed display these abundances. Although, the sample size from KDC might not be large enough to indicate whether tortoises are actually abundant or not. However, as two and a “half” quadrants from KDC yielded an MNI of 25, it is not unlikely that adjacent squares would increase this number. If the tortoises from Byneskranskop are collected following a bushfire event, which potentially can kill thousands of tortoises, this is the only site where one can argue that an exploitation of an event like this took place in terms of abundance. KDC appears closer to Boomplaas Cave when looking at the NISP from the combined Oakhurst layers: 959 and 1610 respectively. However, the most similar site in terms of abundance is Wilton Large Rock Shelter. The dating at this site is uncalibrated, however layer 4 is stated to have contained large scrapers often made of quartzite (Deacon, 1972), which is typical of Oakhurst industry, while unit 3I to 3G represents a transitional period in terms of technology. Unit four contained an MNI of 5, while 6 (from JZA) was the highest MNI at KDC. The majority of layers at KDC contained between 1-3 MNI, which is similar to all the units at Wilton Shelter that are younger than layer 4. Another similarity between this site and KDC is in the skeletal element representation, where shell is abundant and there are no crania. Brain (1981, p.43) suggested that this may indicate the head was chewed and swallowed, but I think the lack of this element at both sites is more likely explained by preservation as the cranium is fragile, (which became very clear after handling the comparative collection), and the fragmentation from Wilton Shelter was high. Klipdrift Cave, Byneskranskop, Boomplaas Cave and Wilton Shelter also contain evidence of increased shellfish exploitation towards the younger layers at the site, and the two latter sites experience a shift from large mammals in the older layers to small/medium antelopes in the younger layers. This is similar to KDC, where shellfish is more abundant from the Oakhurst period, and although the changes in the mammal composition are subtle, also display a shift from larger to smaller mammals. Although there are variations in the tortoise abundances as well throughout the sequences at these sites, these appear to be more subtle.

There is a difference between not being mentioned in the literature and being absent from the site. This makes Kangkara Cave and Oakhurst Shelter difficult to consider, as is Melkhoutboom Cave, because Hewitt (1931) did not provide any descriptions of Testudines other than “tortoise carapace”. Testudines not being mentioned can be explained by factors such as excavation techniques, poor preservation of faunal material, Testudines not having been a common feature of the Oakhurst environment of these particular sites, and cultural choices. Melkhoutboom Cave had poor preservation of faunal material, while the absence of testudines at Matjes River Shelter may be explained by the fact that most of the food waste was disposed of (Sealy, 2006). However, Klein (1998, p.516) noted that tortoises were abundant at sites towards the west and north-west, while rare at all south-central sites, which they also have been historically. Nelson Bay Cave, Oakhurst Shelter, Kangkara Cave, and Matjes River Shelter are all located in this area (**figure 2.2**). Their absence from the literature may be because they were not found, or they were rare at these sites. At Nelson Bay Cave, there were recorded tortoises, but these were either found in younger layers, or not analysed, and they were noted by Klein to be uncommon. Matjes River Shelter does contain terrapin shells, but they were found associated with lithics of the Wilton industry.

6.2.2 Utilisation and collection of Testudines

The presence of Testudines at an archaeological site when accumulated by humans, can indicate that they were eaten, and/or used for items such as bowls, pendants, or containers, which is also discussed in short here. What has not yet been considered is how these animals may have been viewed by the people collecting them, whether they have carried any other meanings beyond that of being an object. This is also touched upon in this section.

The sites containing tortoises (i.e. Klipdrift Cave, Byneskranskop, Boomplaas Cave, and Wilton Large Rock Shelter) display variations in abundance. Byneskranskop contains high frequencies, while Boomplaas Cave is noted by Klein and Cruz-Uribe (2016) to be a site in which tortoises are rare. This is according to them also the case further east. It is therefore possible that people on the central south coast and further east were more inclined to collect tortoises opportunistically than to actively search for them.

The skeletal element representation from Byneskranskop includes humeri, femora and carapace (Schweitzer and Wilson, 1978; Klein and Cruz-Uribe, 1983), and shell and limb was also recorded at Wilton Large Rock Shelter. It appears that these sites together with KDC, contains both shell and elements from the skeleton within, which indicates these Testudines were at least brought complete to the site. Klein and Cruz-Uribe (1983) found that the mean size of tortoises from Byneskranskop was decreasing from layer 9 and up, which they argue is due to increased pressure on tortoise populations by humans, rather than climate changes affecting their growth. The same pattern was not observed by (Ryano, 2014) in the KDC collection, but the taphonomic data from KDC, and the reduction in size of tortoises at Byneskranskop, might together with the abundance suggest that the tortoises at these two sites were brought in as food. However, that does not mean they have not also served other purposes. The Oakhurst layers from Boomplaas Cave on the other hand consist of mainly carapace and plastron,. Inskeep (1987) postulated that if the skeletal element representation only includes carapace, then the tortoises were likely brought in with the purpose of it being a bowl. However, the tortoises from Boomplaas Cave were also burned more heavily on the exterior, which Faith (2011) attributes to cooking.

In the case of Melkhoutboom cave, Hewitt (1931) only mentions tortoise carapace in his description of artefacts, which, following Inskeep's reasoning, may point at a similar use, but this is highly uncertain.

Ethnographic sources such as those described in chapter 2.1.2 shows various examples of how tortoises can be collected, both as a targeted prey, and opportunistically. With the exception of Byneskranskop where the abundance, especially in layer 14, has been argued to possibly indicate collection after a wildfire event, it is hard to assess how the tortoises at the sites above were collected. This can range from spending time searching, such as done by the Ka'apor people, to luring or fishing tortoises out of their burrows, to collect them on encounter when foraging for other resources. Furthermore, both the Ka'apor people and various groups of Tupinambá acts as examples of how certain resources may be avoided, and how some may be targeted at specific times driven by cultural and social factors, regardless of the availability or search time required to locate them. The sites where tortoises are rare or not present could be because they were rarely encountered, but human choice also needs to be considered. However, as tortoises do occur at some of the south-western central sites, it seems unlikely that they were avoided in this case. The sites with an abundance, especially Byneskranskop, also lies in the part of the country where tortoises are more readily available. Ethnographic sources such as these also challenge the assumption that humans will always target high-ranking animals.

The cultural significance of Testudines is worth further investigating. I have considered two cultural aspects here in relation to the Oakhurst Testudines: ritualistic use; artistic use. This must not be read as a rigid division between different cultural roles Testudines can play.

The material from KDC did not yield any results that directly indicates use within the realm of what can be considered "ritualistic" or "artistic", however ritualistic behaviour may be hard to separate from non-ritualistic behaviour in the archaeological record. A meal for example may carry more meaning than that of covering nutritional needs (Gopi, 2021), and the choice of collecting a particular prey may be stimulated by cultural beliefs and traditions rather than on size or what is the most "rational" based on caloric yield (Balée, 1985). Whether or not the Tortoises from KDC, or any of the other Oakhurst sites were cooked or utilised in a religious setting or a feast, or if there was any symbolic meaning or cultural believes surrounding the collection of these animals has not been possible to determine. In terms of artistic use, no Testudines have displayed any carvings or ochre residue. None of the bones from the Oakhurst layers from any of the sites displayed any drilled holes. Nelson Bay

Cave contained some specimens that have been interpreted as pendants, but they were found in younger layers. Although bowls are mentioned, these were also from younger, or older layers than the Oakhurst as in Boomplaas Cave where one bowl was found from a Wilton layer and one in a Robberg layer. This makes it feasible that some carapaces from the Oakhurst layers may have been used as bowls, but at least in the case of KDC, the interior surface of the carapace and plastron specimens did not differ from the naturally polished-looking surface that the comparative collection displayed.

Rock art is a medium that carries various symbolic meanings. The South African rock art record contains depictions of human-animal interactions, but Testudines are rare. Negative evidence should be treated with great care, however, it is conspicuous that Testudines rarely appear in this form of expression. Could their absence perhaps be explained by how they are viewed by the people collecting them? As noted by Thompson (2010), all members of the group, including children and elders can collect animals like tortoises, which are small, pose no danger and can be done opportunistically. Nabais and Zilhão (2019) points out that diet breadth models are based on the assumption that humans prefer animals with larger body mass, which is why animals like tortoises often are ranked low. Animals that require more prestigious hunting techniques, higher risk of failure and injuries, such as the large Eland and various agile antelopes, are depicted in scenes associated with taming to facilitate easier capture (McGranaghan and Challis, 2016). Tortoises do not display a type of behaviour that would require making them docile to be easy to catch. Rain-making and animals tied to this among San groups has been shown in rock art, but in some of these cultures, there are also animals, such as tortoises, tied to the rain although they are not necessarily tied to rain-making (Deacon and Deacon, 1999). Which demonstrates that animals can carry meaning even though they are not necessarily recorded in rock art.

As the discipline of rock art studies lies on the peripheral of this thesis, I will not dive further into this, but I think it is a potentially interesting subject to investigate further, especially in terms of identity; who is it that creates the rock art, and why does are some motifs not represented?

7. Conclusions

The aim of investigating the role of Testudines within the hunter-gathers at Klipdrift Cave and the south-western Cape during the Oakhurst techno-complex was done through approaching the material with four research questions.

In terms of the first research question where the aim was to identify the main agent of accumulation of the Testudines specimens from the Oakhurst layers of KDC, the results of the analysis suggests that the main accumulators were human. This is reflected in the overall association of the specimens with human artefacts, skeletal element representation (especially the high frequencies of shell), large quantities of thermally altered specimens, cutmarks and possible percussion marks, lack of identified modifications of carnivore and/or predatory bird origin.

The second research question aimed to identify what Testudines were present at the KDC site, and how they were utilised and processed. Of the lower taxonomic levels, one species and one genus were identified: *Chersina angulata* and genus *Homopus*. No aquatic turtles or terrapins were found. The results of the taphonomic analysis shows that the history in terms of thermal alteration is complex and is potentially obscuring any clear answer to the second part of this research question. The lack of modifications suggesting that the bones were used for purposes such as pendants, bowls or containers, could mean that they were primarily brought in as food. It is not unlikely that the tortoises were first roasted on the fire, smashed open and then eaten. The bones may then have been discarded or burnt as fuel.

The third research question aimed at investigating whether the Testudines remains from the Oakhurst period at KDC reflects the climatic changes at that time and if any of these coincide with shifts in the rest of the material. The abundance of tortoises throughout the sequence appears to have been relatively stable with the exception of unit JZA and KAD/KADh1, where they appear to be slightly more abundant. Shifts in the shellfish composition and densities, changes in lithics, and large mammals are also associated with these layers, although the latter occurs in the lowest units KAD/KADh1, before the climatic changes of the YD. As the timing of this complex event, among other factors, is more unsure for the Southern Hemisphere, however, it remains uncertain whether changes in the KDC tortoise sample are tied to climatic events. It is clear that unit JZA differs from the rest of the sequence however, for example in terms of abundance and species composition., which is also evident in other finds from the site such as shellfish.

The fourth research question aimed to investigate the role of Testudines in the broader context of hunter gatherer societies in the Oakhurst period in the south-western Cape of South Africa. This appears to have varied among sites, which may be connected to the range these animals occupy. Most of the Testudines identified at the Oakhurst sites discussed here belong to the family *Testudinidae*. At Klipdrift Cave, Byneskranskop, Boomplaas Cave in the west, and Wilton Large Rock Shelter in the east, tortoises were present, but not always abundant. In the remaining sites: Oakhurst Shelter, Kangkara Cave, Nelson Bay Cave and Matjes River Shelter, Testudines were either rare, or absent from the literature. Excavation techniques, preservation may have played a part in this. It would appear however, that tortoises may have been collected opportunistically in the areas where they appear less abundant, while being more actively collected at the sites towards the west, which could be tied to their presence in the landscape rather than cultural choices. Ethnographic sources have shown that meaning attributed to animals does not necessarily preserve archaeologically, nor does lack of representation in rock art necessarily indicate that tortoises have not had any meaning beyond that of subsistence.

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Appendix

A.1 Chi square

Unit	A	B
JY	-5,7155	5,7155
JYA	0,64342	-0,64342
JZ/JZh	-1,8669	1,8669
JZA	-13,142	13,142
JZB	-4,3566	4,3566
KAB	-0,51743	0,51743
KAC	-11,99	11,99
KAD/KADh1	54,381	-54,381
KAE	-17,436	17,436

Chi squared			
Rows, columns:	9, 2	**Degrees freedom:**	8
Chi2:	82,869	**p (no assoc.):**	1,2912E-14
Monte Carlo p :	0,0001		

Fisher´s exact			
Not available			
Other statistics			
Cramer´s V :	0,25625	**Contingency C :**	0,24823

A. 1. 1. NISP/l.

Unit	A	B
JY	11,677	-11,677
JYA	-1,1924	1,1924
JZ/JZh	-14,391	14,391
JZA	19,578	-19,578
JZB	0,32934	-0,32934
KAB	1,9877	-1,9877
KAC	-42,521	42,521
KAD/KADh1	23,128	-23,128
KAE	1,4038	-1,4038

Chi squared			
Rows, columns:	9, 2	**Degrees freedom:**	8
Chi2:	45,001	**p (no assoc.):**	3,678E-07
Monte Carlo p :	0,0001		

Fisher´s exact			
Not available			
Other statistics			
Cramer´s V :	0,12072	**Contingency C :**	0,11985

A. 1. 2. NISP:NSP ratio.

A.2 Cutmarks

Unit	Element	Location/description	Burning
JZA	Scapula	Oriented transverse on distal half of prescapular process.	Stage 1, distal end of both processes
JZB	Peripheral	Exterior, going from either posterior towards anterior, or vice verca. The mark starts at a fractured edge of the bone where it appears thick, and narrowing and becoming more shallow towards the middle of the bone.	Stage 3 Interior and possibly 4 exterior
KAC	Peripheral	3 incisions, on the exterior, two of them are at the medial half of the bone, with one superimposed on the other, both oriented laterally. The underlying mark is possibly connected to the last incision, which is located on the lateral half of the bone.	Stage 0 interior and stage 2 exterior, extending slightly into interior

A.2.1. Confirmed cutmarks, descriptions and burning stage

A.3 Density

Unit	NISP	NISP/l	MNE	MNE/l	MNI	MNI/l	*V*
JY	30	1.74	1	0.06	1	0.06	17.21
JYA	28	3.39	*	*	1	0.12	8.25
JZ/JZh	103	2.88	18	0.50	3	0.08	35.76
JZA	132	2.21	44	0.74	6	0.10	59.80
JZB	23	1.67	8	0.58	2	0.15	13.75
KAB	20	2.64	3	0.40	2	0.26	7.59
KAC	64	1.75	8	0.22	3	0.08	36.49
KAD/KADh1	543	5.41	51	0.51	5	0.05	100.38
KAE	16	0.55	3	0.10	2	0.07	28.88
Total	959	-	136	-	25	-	-

A. 2. 1 All units and quads I analysed. NISP: number of specimens identified to at least taxonomic family, and specific element or lower than tortoise/tortoise shell, larger than larger than 1 cm . V= volume (l) of excavated deposit from quadrants analysed here.

A. 4 NISP, NSP, MNE and MNI data

JY

Taxon	**NSP&NISP L11d**	**NSP&NISP M12a**	**NSP&NISP M13a**	**Total NSP&NISP**
Testudines sp.	29			29
Testudinidae sp.	29			29
Chersina angulata	1			1
Homopus sp.				0

JYA

Taxon	**NSP&NISP L11d**	**NSP&NISP M12a**	**NSP&NISP M13a**	**Total NSP&NISP**
Testudines sp.	66			66
Testudinidae sp.	28			28
Chersina angulata				0
Homopus sp.				0

JZ/JZh

Taxon	**NSP&NISP L11d**	**NSP&NISP M12a**	**NSP&NISP M13a**	**Total NSP&NISP**
Testudines sp.	209	25	41	275

Testudinidae sp.	47	23	24	94
Chersina angulata	5	2	2	9
Homopus sp.				0

JZA

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.	163		67	230
Testudinidae sp.	53		35	88
Chersina angulata	10		31	41
Homopus sp.	3			3

JZB

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.	41		9	50
Testudinidae sp.	12		3	15
Chersina angulata	2		6	8
Homopus sp.				0

KAB

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.	24		14	38
Testudinidae sp.	7		8	15
Chersina angulata			5	5
Homopus sp.				0

KAC

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.	128		151	279
Testudinidae sp.	28		31	59
Chersina angulata	1		4	5
Homopus sp.				0

KAD/KADh1

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.	451	509	171	1131
Testudinidae sp.	217	229	66	512
Chersina angulata	11	9	11	31
Homopus sp.				0

KAE

Taxon	NSP&NISP L11d	NSP&NISP M12a	NSP&NISP M13a	Total NSP&NISP
Testudines sp.			31	31
Testudinidae sp.			11	11
Chersina angulata			5	5
Homopus sp.				0

A.3. 1. Taxonomic abundance in each unit and quadrant.

A.5 Quadrant M13a+L11d, Unit JZ/JZh-KAD/KADh1

UNIT: JZ/JZh

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra									0
Scapula	1								1
Coracoid									0
Pubis									0
Ilium									0
Ischium									0
Limb/girdle									0
Humerus									0
Radius	1								1
Ulna									0
Femur									0
Tibia		1							1
Fibula									0
Plastron							5		5
Epiplastron							3		3
Entoplastron	1						1		2
Hyoplastron								2	2
Hypoplastron	1								1
Xiphiplastron								1	1
Carapace									0
Nuchal									0
Vertebral		2			1	1			4
Pygal									0
Pleural		11	7	4			11		33
Peripheral	1	4	7			2	2	1	17
Bridge	1	1	2				3		7
Total	6	19	16	4	1	3	25	4	78

UNIT: JZA

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra						1			1
Scapula	2					1	1		5
Coracoid		1				4			5
Pubis									0
Ilium	1	1							2
Ischium	2					2			4
Limb/girdle									0
Humerus						1	1		2
Radius						1			1
Ulna	1								1
Femur	1						2		3
Tibia	1								1
Fibula									0
Plastron		1					2		3
Epiplastron							2		3
Entoplastron		1					1		2
Hyoplastron							1		1
Hypoplastron						1	3		4
Xiphiplastron						3	4		7
Carapace									0
Nuchal									0
Vertebral	4	4					4		12
Pygal							2		2
Pleural	6	4				1	32		45
Peripheral	6	7				1	2	3	24
Bridge							3		4
Total	24	19	10	0	0	16	60	3	132

UNIT: JZB

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra									0
Scapula									0
Coracoid						1			1
Pubis									0
Ilium									0
Ischium						1			1
Limb/girdle									0
Humerus		1							1
Radius									0
Ulna						1			1
Femur									0
Tibia									0
Fibula									0
Plastron									0
Epiplastron	1								1
Entoplastron							1		1
Hyoplastron							1		1
Hypoplastron							1		1
Xiphiplastron									0
Carapace									0
Nuchal									0
Vertebral						1	1		2
Pygal									0
Pleural	2					2	4		8
Peripheral							4		4
Bridge								1	1
Total	3	1	0	0	0	6	12	1	23

UNIT: KAB

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra									0
Scapula									0
Coracoid									0
Pubis									0
Ilium									0
Ischium									0
Limb/girdle	1								1
Humerus									0
Radius									0
Ulna									0
Femur									0
Tibia									0
Fibula									0
Plastron							2		2
Epiplastron									0
Entoplastron							1		1
Hyoplastron									0
Hypoplastron							2		2
Xiphiplastron							1		1
Carapace									0
Nuchal									0
Vertebral			2			2	1		5
Pygal									0
Pleural	1					1	4		6
Peripheral	2								2
Bridge									0
Total	4	0	2	0	0	3	11	0	20

UNIT:KAC

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra									0
Scapula									0
Coracoid									0
Pubis									0
Ilium									0
Ischium									0
Limb/girdle									0
Humerus									0
Radius						1	1		2
Ulna						2			2
Femur									0
Tibia							1		1
Fibula									0
Plastron									0
Epiplastron	2								2
Entoplastron									0
Hyoplastron			3						3
Hypoplastron									0
Xiphiplastron									0
Carapace							1		1
Nuchal									0
Vertebral		5	4			3	5		17
Pygal									0
Pleural	1	5	2			3	5		16
Peripheral	1	5	1			1	1		9
Bridge	4	1	2				4		11
Total	8	16	12	0	0	10	18	0	64

UNIT: KAD/KADh1

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra	1								1
Scapula	1								1
Coracoid							2		2
Pubis			1						1
Ilium		2					1	1	4
Ischium	2	1		1					4
Limb/girdle						1	3		4
Humerus									0
Radius		1					1		2
Ulna							1		1
Femur							1		1
Tibia									0
Fibula									0
Plastron		3	7	5	1		4	6	26
Epiplastron		1				1		2	4
Entoplastron						1		1	2
Hyoplastron	1		1	1	1	1		3	8
Hypoplastron	1		1				4	1	7
Xiphiplastron	1	1					1	3	6
Carapace			1					3	4
Nuchal		2					1		3
Vertebral	7	7	7				9	9	39
Pygal			1						1
Pleural	15	18	23	16	3	1	15	16	107
Peripheral	16		13				22	4	55
Bridge	1	2	3			4	10	2	22
Total	46	38	58	23	5	9	75	51	305

A.6 Quadrant M12a+ M13a+L11d Unit JZ/JZh and KAD/KADh1

UNIT: JZ/JZh

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra									0
Scapula	1								1
Coracoid									0
Pubis									0
Ilium		2							2
Ischium		1					1		2
Limb/girdle									0
Humerus	1								1
Radius	1								1
Ulna									0
Femur									0
Tibia		1							1
Fibula									0
Plastron							7		7
Epiplastron							3		3
Entoplastron	1						2		3
Hyoplastron								2	2
Hypoplastron	1					1	1		3
Xiphiplastron						1		1	2
Carapace									0
Nuchal									0
Vertebral		6			1	1	1		9
Pygal									0
Pleural		14	8	4			12		38
Peripheral	1	6	7			2	4	1	21
Bridge	1	1	2				3		7
Total	7	31	17	4	1	5	34	4	103

A.6. 1 Burning data for unit JZ/JZh

UNIT: KAD/KADh1

Element	Homogeneous burning					Unburnt	Heterogeneous burning	Burning unclear	Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5				
Vertebra	1								1
Scapula	1								1
Coracoid							2		2
Pubis			1						1
Ilium	1	2	1				1	1	6
Ischium	2	3	1	1					7
Limb/girdle						1	4		5
Humerus	1								1
Radius		1					1		2
Ulna		1					1		2
Femur	1		1				1		3
Tibia									0
Fibula									0
Plastron		5	8	5	1		11	13	43
Epiplastron		3				1		3	7
Entoplastron	1					1		1	3
Hyoplastron	1		1	1	1	1	2	4	11
Hypoplastron	1	1	1				5	2	10
Xiphiplastron	1	1					2	3	7
Carapace			1					3	4
Nuchal	1	2	1				1		5
Vertebral	14	18	16	2			9	19	78
Pygal			1					1	2
Pleural	25	45	40	21	3	1	21	60	216
Peripheral	16		13				22	43	94
Bridge	2	3	3			4	14	6	32
Total	69	85	89	30	5	9	97	159	543

A.5.2. Burning data for unit KAD/KADh1

Unit	NISP	Number of burnt specimens	Number of unburnt specimens	Number of specimens with ambiguous burning
JY	30	19 (63.3%)	11 (36.7%)	0
JYA	28	28 (100%)	0	0
JZ/JZh	103	94 (91.3%	5 (4.9%)	4 (3.9%)
JZA	132	113 (85.6%)	16 (12.1%)	3 (2.3%)
JZB	23	16 (69.6%)	6 (26.1%)	1 (4.3%)
KAB	20	17 (85.0%)	3 (15.0%)	0
KAC	64	54 (84.4%)	10 (15.6%)	0
KAD/KADh1	543	375 (69.1%)	9 (1.7%)	159 (29.3%)
KAE	16	14 (87.5%)	1 (6.3%)	1 (6.3%)
Total	959	730 (76.1%)	61 (6.4%)	168 (17.5%)

A.5.3. Burnt, unburnt and ambiguous burning.

Unit	NISP	Homogeneous burning	Heterogeneous burning	Unburnt (stage 0)	Ambiguous
JY	30	4 (13.3%)	15 (50%)	11 (36.7%)	0
JYA	28	21 (75%)	7 (25%)	0	0
JZ/JZh	103	60 (58.3%)	34 (33%)	5 (4.9%)	4 (3.9%)
JZA	132	53 (40%)	60 (45.5%)	16 (12.1%)	3 (2.3%)
JZB	23	4 (17.4%)	12 (52.2%)	6 (26.1%)	1 (4.3%)
KAB	20	6 (30%)	11 (55%)	3 (15.0%)	0
KAC	64	36 (56.3%)	18 (28.1%)	10 (15.6%)	0
KAD/KADh1	543	278 (51.2%)	97 (17.9%)	9 (1.7%)	159 (29.3%)
KAE	16	6 (37.5%)	8 (50%)	1 (6.3%)	1 (6.3%)
Total	959	468 (48.8)	262 (27.3%)	61 (6.4%)	168 (17.5%)

A.5. 4. Homogeneous, heterogeneous, unburnt and ambiguous

Unit	Carapace more burnt on the exterior	Percentage of carapace more burnt on exterior	Carapace more burnt on the interior	Percentage of carapace more burnt on interior	Randomly distributed burning on carapace	Percentage of randomly distributed burning on carapace	Total heterogeneosly burnt carapace
JY					14	100	14
JYA					7	100	7
JZ/JZh	5	25			15	75	20
JZA	16	37.2			27	62.8	43
JZB	3	33.3	1	11.1	5	55.6	9
KAB	6	100					6
KAC	11	68.8	1	6.3	4	25	16
KAD/KADh1	22	32.8			45	67.2	67
KAE	1	16.7			5	83.3	6
Total	64	34	2	1.1	122	64.9	188

Unit	Plastron more burnt on the exterior	Percentage of plastron more burnt on exterior	Plastron more burnt on the interior	Percentage of plastron more burnt on interior	Randomly distributed burning on plastron	Percentage of randomly distributed burning on plastron	Total heterogeneosly burnt plastron
JY	1	100					1
JYA							
JZ/JZh	6	46.2			7	53.8	13
JZA	7	53.8			6	46.2	13
JZB	3	100					3
KAB	3	60			2	40	5
KAC							
KAD/KADh1	6	30	1	5	13	65	20
KAE							
Total	26	47.3	1	1.8	28	50.9	55