Typology and Use-Wear of the Palaeolithic Stone Tools from the Recent Excavations (2015 to 2023) of Shanidar Cave (Iraqi Kurdistan)

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A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

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Declaration

This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface and specified in the text.

I further state that no substantial part of my thesis has already been submitted, or is being concurrently submitted for any such degree, diploma or other qualification at Liverpool John Moores University or any other University or similar institution except as declared in the Preface and specified in the text.

It does not exceed the prescribed word limit.

Further, I state that no AI tools were used in the production of this thesis.

Abstract

Shanidar Cave, Iraqi Kurdistan, is among the most significant Neanderthal sites. Excavations by Ralph Solecki in the 1950s unearthed the remains of at least ten Neanderthals and associated Middle Palaeolithic Mousterian stone tools which have played a crucial role in our understanding of Neanderthal behaviour. Solecki also identified Upper Palaeolithic deposits containing Baradostian tools (broadly equivalent to the Aurignacian industry) separated from the Neanderthal layer by 1 metre of sediment, which he interpreted as reflecting a 10,000-year hiatus. Recent excavations (2015 – present) using single-context excavation, with three-dimensional plotting of all artefacts bigger than 2 cm, have improved our understanding of the site's inhabitants.

Lithics recovered from Shanidar Cave were identified and attributed to typological class. The results of typological analysis show that there is a contextual overlap between typologically Mousterian and Baradostian artefacts, and that there is no evidence for a hiatus in occupation at the site. Blades and bladelets, tool forms not usually associated with Neanderthals, were recovered from secure contexts dating to MIS 5a including from contexts containing Neanderthal skeletal remains.

Use-wear analysis conducted using a DINO-LITE Edge digital microscope showed that 106 lithics retain evidence of use. The materials worked include wood, hide, meat and bone, bone, horn and plants. There is no significant difference in worked materials between MIS 5 and MIS 3 at Shanidar Cave. The results of typological analysis at Shanidar Cave suggest that assigning a particular tool industry to a particular hominin group may be problematic, which has implications for the wider region. The results of use-wear analysis suggest that there are no behavioural differences between MIS 5 hominins and MIS 3 hominins at Shanidar.

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Merlin (left) and Cosmo (right)



Hamrin Barzani (Left)



Rowan Sherwani (Left), Mohammed Barzani (Right)



Zendin Barzani (Right)



Sherzad Hassan (Left)



Part of the Shanidar Caves Team with the facial reconstruction of Shanidar Z



Part of the Shanidar Caves Team receiving an award from the Kurdistan Regional Government

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Chapter 1 – Introduction

1.1 Background

Located within the Zagros Mountains of Northern Iraqi-Kurdistan, Shanidar Cave has long captured the attention of archaeologists for its unique and extraordinary record of human occupation (Figure 1-1). The site is best known for the remains of at least ten Neanderthals (*Homo neanderthalensis*) and accompanying stone tools (lithics), the study of which has contributed to debates surrounding Neanderthal capacity for thought and compassion (Pomeroy *et al.*, 2020; Solecki, 1971, 1975; Trinkaus, 1983). In addition, Shanidar Cave also preserves evidence of Upper Palaeolithic and Epipalaeolithic occupations and associated lithics (Solecki, 1958; Solecki *et al.*, 2004).

Shanidar Cave is situated at a geographic crossroads between Eurasia and the Levant. Its occupants—Neanderthal and anatomically modern humans (*Homo sapiens*) alike—would have faced varied ecologies that demanded flexible technological and social responses. In this region, lithic technology was not merely a reflection of environmental constraints but also a medium through which knowledge, tradition, and innovation were transmitted (Scerri *et al.*, 2014; Solecki and Solecki, 1994). Understanding the functional aspects of tools is therefore essential to interpreting how past populations adapted to their environment, organised their labour, and transmitted cultural knowledge (Keeley, 1980; Semenov, 1964, 1970; van Gijn, 2014).

Use-wear analysis (also referred to as microwear analysis or traceology) is a methodological approach that examines the microscopic traces left on stone tool edges and surfaces through the tool's use in a specific task (Odell, 2006; Tringham *et al.*, 1974; Vaughan, 1985). These traces — polishes, striations, edge rounding, and microfractures — develop in characteristic ways depending on the worked material and the motion involved, whether hide scraping, wood working, plant processing, or butchery. This functional perspective moves beyond the classic typological approach to lithic analysis whereby tools are categorised according to their morphology (Bordes, 1961a, 1961b; Semenov, 1970). Use-wear analysis allows archaeologists to reconstruct the actual behaviours and tasks carried out at archaeological sites.

The application of use-wear analysis at Shanidar Cave is particularly promising because of the site's long temporal sequence and well-stratified lithic assemblages from both Middle Palaeolithic Neanderthal (c. 100 kya – 55 kya) and Upper Palaeolithic *Homo sapiens* contexts (c. 55 kya – 32 kya) (Pomeroy *et al.*, 2020), which offers a unique opportunity to examine tool use between different human species and points in time. his thesis undertakes a detailed use-wear analysis of the lithic artifacts from Shanidar Cave recovered from recent excavations (2015 – 2023).

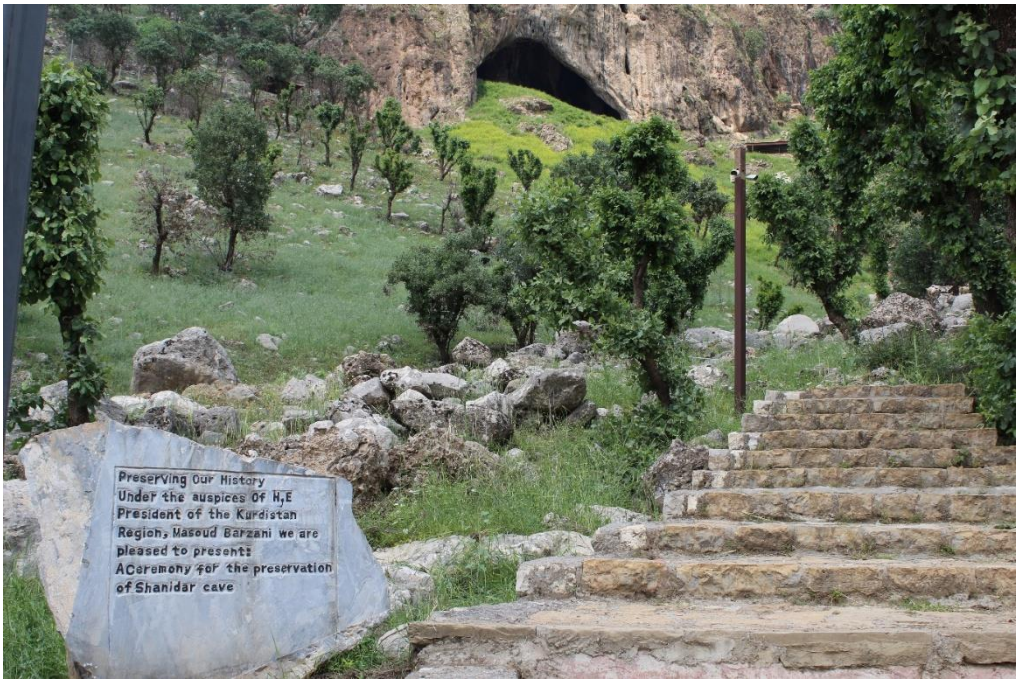


Figure 1-1: *Shanidar Cave, photographed from the entrance to the site, May 2022. (Photo by M. Hitchcock)*

1.2 Research Questions and Aims

The Shanidar lithic assemblage is significant with regards the study of Neanderthals and anatomically modern humans due to the site's long temporal sequence. As such, the research questions are:

1) What is the typological composition of the Shanidar lithic assemblage, and where are these tools situated within the site?
2) Where tools are recovered, do they retain evidence of use? If so, what types of wear are represented, and where are these tools located within the site's stratigraphy?

3) Is the lithic assemblage from Shanidar Cave typologically similar to assemblages from other sites in the Zagros? How do the activities performed at these sites (as represented in the use-wear) compare?
4) What can be understood about the occupants of Shanidar Cave through analysis of the lithics? Do behaviours and activities change throughout time and with different hominins?

Traditional typological studies attribute particular tool forms to specific periods, species, and climates (Andrefsky Jr, 2007; Bordes, 1961a, 1961b; Finlayson *et al.*, 2023; Shea, 2013, 2014). The first research question aims to establish the makers of particular tools and the persistence of certain forms in order to determine whether there are any significant differences in typology through time. The second question is concerned with how tools were used, and whether there is any variation in activities through time. The third question aims to determine the differences (if any) in how tools were made and used at Shanidar Cave in comparison to other sites in the region. Building on the previous three questions, the fourth question permits discussion of the capacities, capabilities, and cultural expression of *Homo neanderthalensis* and *Homo sapiens*.

1.3 Thesis Structure

This thesis consists of eight chapters inclusive of this Introduction. Chapter 2 covers our current understanding of Neanderthals and anatomically modern humans. Hominin behavioural complexity and material culture is discussed, and comparisons are made between the two species. Past research from Shanidar Cave is presented, highlighting the significance of the site to palaeoanthropology, and a simplified stratigraphy based upon Shanidar's Harris matrix is proposed.

Chapter 3 discusses the state of knowledge with regards use-wear and residue analyses. This chapter details the development of the field and ongoing debates.

Chapter 4 provides the methods for the study. This chapter is broken down into three main components: the experimental methods, fieldwork methods, and the laboratory methods.

The results of the study are outlined in Chapters 5 and 6. Chapter 5 presents the results of the experimental series designed for the study. Chapter 6 provides the results of the archaeological analyses on the Shanidar Cave material: typological analysis, use-wear analysis, and residue analysis. These results are discussed in Chapter 7.

Finally, the answers to the research questions are summarised in Chapter 8, which covers the implications of such and makes recommendations for future research.

Chapter 2 – Species and Site

Following the publication of Charles Darwin's *On The Origin of Species* (Darwin, 1859) and later *The Descent of Man, and Selection in relation to Sex* (Darwin, 1871), the position of humans as above and separate to the natural world became increasingly questioned. Until this time, many people believed that humans were created, per the story of Creation in Genesis 1. As a result, Darwin's theories were widely ridiculed and outright disregarded by many in Victorian society (Brooke, 2003; Scotland, 1986) until the discovery of 'peculiar' human remains from Germany (Busk, 1861; King, 1863, 1864; Trinkaus and Shipman, 1993). This chapter covers the species and time periods relevant to the research and introduces the archaeological site of Shanidar Cave. The current state of knowledge surrounding the capabilities and limitations of *Homo neanderthalensis* and *Homo sapiens* is discussed and the relevance to Shanidar Cave is presented.

2.1 The Discovery of Neanderthals

A human-like skeleton with a 'remarkably peculiar' brow was discovered in a lime quarry at Feldhofer Cave in the Neander Valley, Germany in 1856 (Neander 1, see Figure 2-1). In August 1857 It was presented to the Lower Rhine Medical and Natural History Society in Bonn where it was claimed that the remains belonged to an antediluvian person (i.e. before the biblical flood) (Schaaffhausen, translated in (Busk, 1861; Tattersall, 2015).

Some scholars at the meeting disagreed however, arguing that the skeleton was that of a deformed Cossack cavalryman who would have been lost in the region during the Napoleonic wars (Madison, 2016, 2020; Mayer, 1864; Tattersall, 2015). Researchers in England including Henry Huxley and Charles Darwin took an interest in the specimen believing that it might represent one of the "missing links" between man and apes (Huxley, 1863); Darwin, 1871). In the English translation of the paper announcing the discovery of the Neander specimen, palaeontologist George Busk issued a call for more fossils so as to resolve the dispute (Schaaffhausen, translated in Busk, 1861; Madison, 2016).



***Figure 2-1**: The Neander 1 cranium as photographed at the Neanderthal Museum, Germany, June 2019. (Photo by M. Hitchcock)*

A skull had been recovered earlier in the vicinity of Forbes' Quarry on the eastern side of the Rock of Gibraltar in 1848 (Gibraltar 1, see Figure 2-2), but its potential significance was not understood until Busk's appeal after which it was sent to him in London. Busk recognised that the Gibraltar specimen resembled the skull from Germany and subsequently published his findings, labelling the remains as 'pithecoid' i.e. apelike (Busk, 1864a).On the suggestion of his colleague Hugh Falconer, Busk considered naming the new species *Homo calpicus* (Calpe being the ancient name for Gibraltar) (Falconer, 1864, in (Keith, 1911), however, the geologist William King published his analysis of the Neander specimen before Busk was able to study the Gibraltar skull in detail (King, 1863, 1864). King named the species *Homo neanderthalensis*.



Figure 2-2: *(Left) Forbes Quarry, reported location of Gibraltar 1's discovery, photographed June 2022. (Right); Gibraltar 1 skull, photographed at the Natural History Museum, London, May 2021. (Photos by M. Hitchcock)*

2.2 Early Discussions on Neanderthals

In the past, Neanderthals have not been viewed as complex or intelligent beings with the same capacities as *Homo sapiens* (Madison, 2020; (Madison, 2020; Peeters and Zwart, 2020; Schoenemann *et al.*, 2026). Indeed, 19th century descriptions of the species compare them to apes and supposed "wild races" (e.g. Indigenous Australians) (Busk, 1861; Busk, 1864a; Falconer, 1864, in Keith 1911). The features which separated them from humans including robust brow ridges on elongated skulls, stocky bodies and stout limbs, were interpreted as vestiges of a more 'primitive' lifeform, rather than being ecological adaptations (see Figure 2-3) (Harvati, 2010; Nowell, 2023; Papagianni and Morse, 2015; Trinkaus and Shipman, 1993).



***Figure 2-3**:"The Neanderthal Man" by Ernest Griset (1844-1907) in Harper's Weekly, July 19, 1873. The male individual is depicted wearing furs and holding a club, the female individual is depicted as sleeping amongst beasts, and the cave floor is littered with bones of other creatures, implying a wild and predatory existence. They would not be considered as equal and 'proper' in 19th century society (Linsley, 2013; Dunae, 1980). Public domain*

The image of Neanderthals as brutish, "uncouth and repellent" beasts continued into the 20th century (Straus Jr and Cave, 1957). This view was certainly not helped by Marcellin Boule's interpretation of the most complete Neanderthal skeleton found at the time from La Chapelle-aux-Saints in southern France. Boule, then director of the Institute of Human Palaeontology in Paris, determined that the individual was a Neanderthal male who had lived to roughly 50 years old before dying of a blow to the head (Boule, 1911). He argued that the appearance of the braincase of the La Chapelle individual evidenced the intellectual inferiority of the species compared to *Homo sapiens*, and that the "backward position" of the foramen magnum of the skull in addition to the "simian arrangement" (i.e. monkey-like) of the cervical vertebrae suggested a hunched and forwardly inclined posture (Boule, 1908, 1911, 1912, 1923; Hammond, 1982) (Figures 2-4 and 2-5). However, the La Chapelle skeleton had been found in a fragmentary condition and the skull reconstructed prior to Boule's analysis. As a result, Boule had to refer also to other, less complete skeletons (including those from Neander and Gibraltar) to inform his reconstruction (Trinkaus, 1985). Later studies have suggested that the La Chapelle individual had suffered from osteoarthritis or degenerative joint disease of the vertebrae plus a number of other pathologies, leading some to argue this as the reason for Boule's conclusions (Trinkaus, 1985). However, bearing in mind that Boule's reconstructions were based upon multiple different Neanderthal specimens, others have argued that Boule chose to depict the Neanderthals as "others" so as to not take a side in the ongoing debates around evolution (Hammond,

1982; Sommer, 2006). Nevertheless, Boule's depictions continued to inform ideas about Neanderthals even as more discoveries were being made (Straus and Cave, 1957; Trinkaus, 1985). Indeed, the public perception of Neanderthals as unsophisticated, unintelligent animals has persisted to present day (Frayer, 2019).

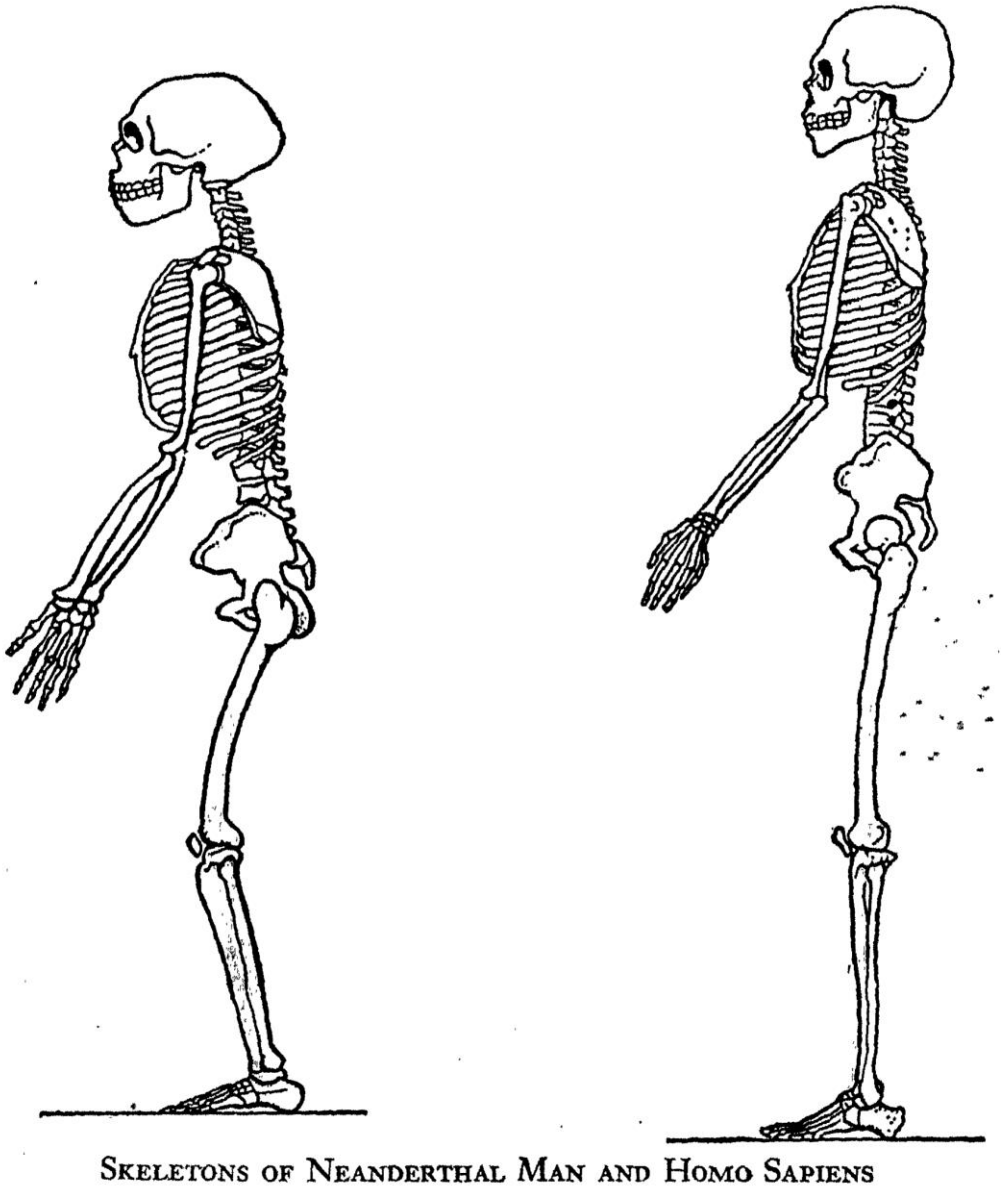


Figure 2-4: *Marcellin Boule's reconstruction of Neanderthal and* Homo sapiens *posture, after Boule (1912). Note the forward projecting skull in the Neanderthal. Other differences are observable in the femoral angle and the position of the bones of the lower leg. Wikimedia Commons (Public domain)*

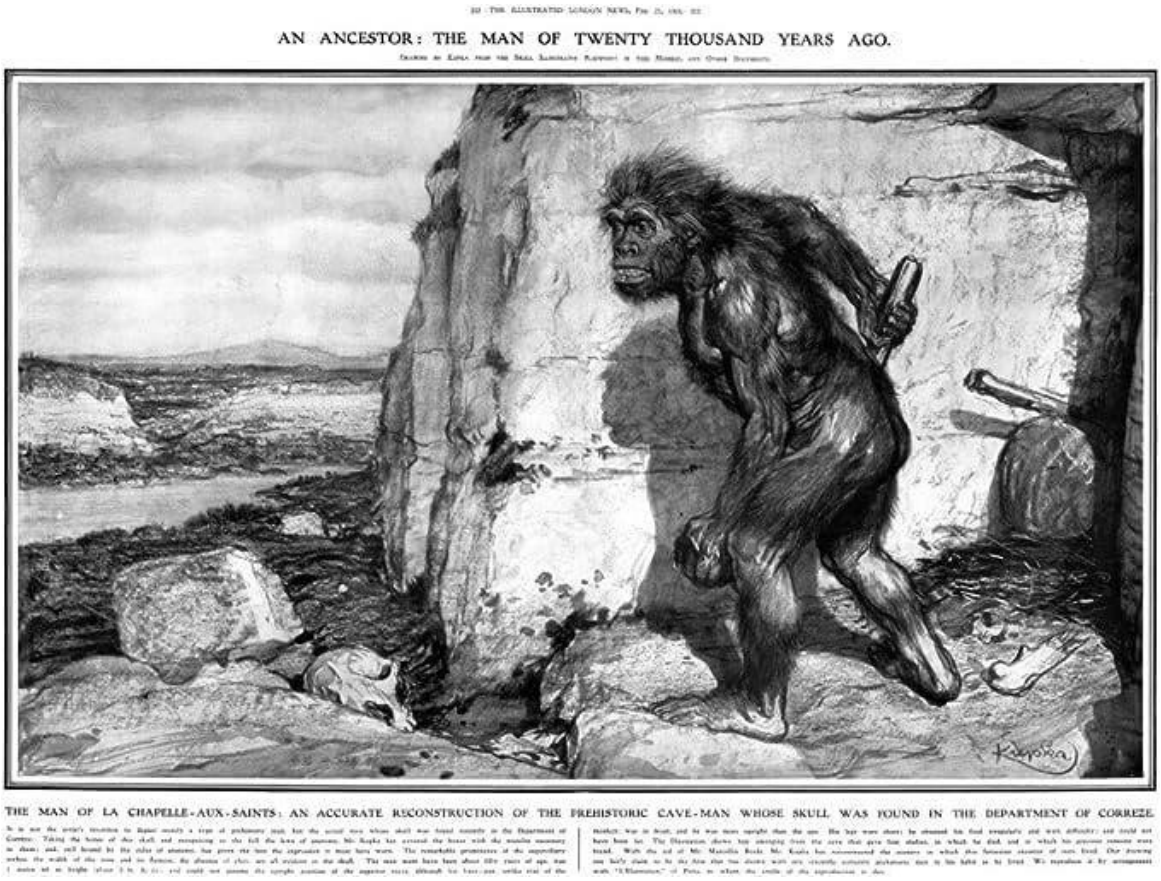


Figure 2-5:*"The Beginnings of Humanity. The Inhabitant of the La Chapelle-aux-Saints Cave during the Mousterian period" by Fantisek Kupka (arguably inspired by the work of Boule). Illustrated London news, February 27, 1909 (Public domain)*

While excavations at Neanderthal sites continued throughout the early 20th century (e.g. at Devil's Tower, Gibraltar (Garrod, 1928), Kebara Cave, Mount Carmel, Israel (Garrod and Bate, 1937), Teshik-Tash, Uzbekistan (Weidenreich, 1945), among others) none of these findings initially altered the public's perception of Neanderthals.

Arguably, it was not until the excavations at Shanidar Cave that the stereotype perpetrated by Boule would truly begin to shift (Solecki, 1957, 1960, 1961, 1971, 1975, 1977). The initial excavations at Shanidar Cave yielded the remains of at least 10 Neanderthals (see section 2.5.1). It was not solely

the volume of the remains which was of interest, rather the perceived behaviours of these individuals. In particular, Shanidar Four was thought to have been deliberately buried on a bed of flowers (see section 2.5.1) (Hunt *et al.*, 2023; Leroi-Gourhan, 1975; Solecki, 1975). The idea of Neanderthals as compassionate beings is one which went against the established view of the species.

The work of Straus and Cave (1957) was another major contribution to the reassessment of Neanderthals. Their work showed that the La Chapelle Neanderthal suffered from several ailments including arthritis, which would account for his stooped and hunched posture, rather than this being a species-wide feature. This finding led to the further humanisation of Neanderthal anatomy as posture, brain size and hand dexterity were proven to be comparable to that of *Homo sapiens (*Sawyer and Maley, 2005; Weaver, 2009). Neanderthals at this time were still seen as direct ancestors of *Homo sapiens* rather than a distinct lineage (Brace *et al.*, 1946; Brose and Wolpoff, 1971).

This would shift following the acceptance of the Out of Africa model of *Homo sapiens* dispersal (Cann *et al.*, 1987; Stringer and Andrews, 1988). This study proposed that groups of *Homo sapiens* began radiating out of Africa and into the neighbouring Near East where they encountered Neanderthals c.120,000 years BP, with a second event occurring around c. 60,000 years BP. The mechanisms behind the expansion are unknown but it is hypothesized to have occurred following an interstadial (warming) event during which

African flora and fauna spread into the Middle East and the humans followed (Mondal *et al.*, 2016; Stringer and Andrews, 1988).

By placing the origins of *Homo sapiens* in Africa, and the origins of the Neanderthals in Europe, Neanderthals were established as a side-branch to *Homo sapiens*, rather than direct ancestors (Holliday *et al.*, 2014; Stringer, 2012a; Stringer and Andrews, 1988). This was later confirmed following the sequencing of the Neanderthal genome (Krings *et al.*, 1997). While initially their results stated that there had been no admixture between Neanderthals and *Homo sapiens*, this was later rectified by subsequent studies, which identified gene flow occurring between the species (Briggs *et al.*, 2009; Meyer *et al.*, 2012; Prüfer *et al.*, 2014).

Studies on the Middle to Upper Palaeolithic transition saw this period as a cultural revolution during which the cognitive and cultural superiority of *Homo sapiens* was established, while the Neanderthals went extinct (Klein, 1989, 1995, 2001; Mellars, 1989, 1996, 1999; Tattersall and Chauhan, 1995). Facets of supposed modernity (e.g. blade technology, microliths, broad dietary spectrum, alteration and management of dwellings, use of complex tools and the production of art) were argued to show that Upper Palaeolithic *Homo sapiens* were far removed from earlier forms of hominin (Bar-Yosef, 1998, 2002, 2007; Mellars, 1989, 1996, 1999; Mellars and Tixier, 1989; White *et al.*, 1982).

The work of McBrearty and Brooks (2000) firmly established that the facets of modernity which had been used to justify an Upper Palaeolithic revolution

had been present in the Middle Stone Age (MSA) of Africa (associated with earlier *Homo sapiens*) as well as with Neanderthals during the Middle Palaeolithic. The advancements in our understanding of Neanderthals in the 21st century have shown that they were not dissimilar to *Homo sapiens* during the Upper Palaeolithic. A full discussion of the capabilities of both species will be presented in section 2.3.

2.2.1 Chronology of Neanderthals

Neanderthals were initially perceived as either a direct ancestor to ourselves (Brace *et al.*, 1964; Brose and Wolpoff, 1971) or an evolutionary dead-end (Boule, 1911, 1923; Hammond, 1982; Lewin, 1997). Following the establishment of the Out of Africa theory (Stringer and Andrews, 1988) as well as the sequencing of the Neanderthal genome (Krings *et al.*, 1997), the place of Neanderthals as a side branch on the evolutionary family tree and as a minor contributor to the modern human genome was confirmed.

Neanderthals are thought to be a Eurasian species with no evidence for their presence in Africa (Chen *et al.*, 2020; Harris *et al.*, 2023). It should be noted that Mousterian type tools are known from MSA sites in Northern Africa, although it is argued that these were developed independently by *Homo sapiens* (see section 2.3.4) (McBurney, 1967; McBurney *et al.*, 1986; Reynolds, 2018; Scerri, 2017; Will and Scerri, 2024). Neanderthals are thought to have evolved from a form of Eurasian *Homo heidelbergensis*, a lower Palaeolithic

species (Mounier and Caparrós, 2015; Mounier and Lahr, 2016; Stringer, 2012a, b).

Neanderthals are now known to be a deeply rooted species, with evidence for the earliest Neanderthals argued to originate from the Sima de los Huesos, Burgos, Spain at c. 430 kya (Arsuaga *et al.*, 2014; Hublin, 2009). It should be noted however, that genetic data of these individuals shows that they may in fact be another sister species rather than early Neanderthals (Meyer *et al.*, 2016). However, other early Neanderthals are noted from Swanscombe, UK at c. 400 kya (Marston, 1937; Stringer and Hublin, 1999) and Steinheim, Germany c. 320 kya (Buzi *et al.*, 2021; Wolpoff, 1980). Neanderthals thus existed from roughly c. 400 thousand years ago until c. 40 thousand years ago when they went extinct.

2.2.2 Chronology of *Homo sapiens*

The earliest discovery of archaic *Homo sapiens* came from the Cro-Magnon rock shelter in the Dordogne, France in 1868 (Broca, 1868a, b; Lartet, 1868). The remains of *Homo sapiens*, associated stone tools and faunal material including perforated animal teeth and shells were discovered at the site. This would be the first time a hominin resembling extant humans would be discovered from deep history. Thus, early reconstructions of Cro-Magnon 1 showed him as 'modern' looking and strongly contrasted from early depictions of Neanderthals (e.g. Figure 2-5) (Boule, 1908, 1911, 1912, 1923; Hammond, 1982). Given the social attitudes towards various races in the early

and mid-20th century, it is unsurprising that this view did not shift for some time (Fuentes, 2021; Hawkins, 1998).

The origins of *Homo sapiens* were argued to begin some c. 200,000 years ago (Brown *et al.*, 2012; McDougall *et al.*, 2008; Sahle *et al.*, 2014; Smith *et al.*, 2007). This date has since been pushed back to c. 300,000 years BP following the discovery of hominin remains from Jebel Irhoud, Morocco (Bergmann *et al.*, 2022; Hublin *et al.*, 2017). These individuals, while showing several archaic traits are argued by the researchers to possess characteristics which firmly associate them with *Homo sapiens*.

Apidima Cave, Greece is argued to have the earliest evidence for Homo sapiens outside of Africa (c. 210 Kya) (Harvati *et al.*, 2019), although this is contested (de Lumley *et al.*, 2020). The earliest accepted evidence for *Homo sapiens* outside of Africa comes from the sites of Qafzeh and Skhul, Israel, dated to c. 100,000 kya (Grant, 2018; Shea and Bar-Yosef, 2005). *Homo sapiens* reached northern Europe c. 55,000 years BP and quickly radiated across the globe (Hublin *et al.*, 2020; Pederzani *et al.*, 2024).

2.3. Neanderthal and *Homo sapiens* Behaviours

Despite the initial view of Sapiens as superior to the Neanderthals, modern research has indicated that there were very few differences between species (d'Errico, 2003; d'Errico *et al.*, 1998; McBrearty and Brooks, 2000; Soressi, 2007; Soressi and d'Errico, 2007; Soressi *et al.*, 2013). A summary

of various behaviours exhibited by Neanderthals and *Homo sapiens* is presented below.

2.3.1 Diet

The ability to exploit a wide variety of animal and plant species was argued to be a facet of modernity (Binford, 1984; Binford, 2014; Henshilwood *et al.*, 2001; Klein, 1995; Steele and Klein, 2013; White *et al.*, 1982). Neanderthals were viewed as obligate scavengers, only able to exploit medium-large mammals whilst *Homo sapiens* were capable of exploiting a wide array of flora and fauna. It is now established that both species were capable of such (e.g. (Stiner, 1994).

2.3.1.1 Neanderthal Diet

The view of Neanderthals exploiting predominantly large mammalian prey developed early into the study of the species. This was likely due to the discovery of large mammalian skeletal material in early Neanderthal sites (de Puydt and Lohest, 1887; Garrod, 1928). The species typically associated with Neanderthals include ibex (*Capra* sp.), red deer (*Cervus elaphus*), and narrow-nosed rhinoceros (*Stephanorhinus hemitoechus*) (Figure 2-6) (Blasco, 2008; Blasco and Peris, 2012; Nabais and Zilhão, 2025; Richards *et al.*, 2000b; Smith, 2015).

The prevailing school of thought for many years was that Neanderthals were obligate scavengers with limited to no hunting capability (Binford, 1982, 1985; Stiner, 1994; Stiner, 1991). However, that Neanderthals were hunters is now

well established (Bicho *et al.*, 2000; Gaudzinski-Windheuser *et al.*, 2018; Marín *et al.*, 2017; Patou-Mathis, 2000; White *et al.*, 2016). Sites such as La Cotte, Jersey, serve to highlight the complexities of Neanderthal hunting stratagems, with Neanderthals using geological features in the landscape to ambush and trap larger prey such as mammoths (*Mammuthus* sp.) (Smith, 2015). Complex hunting stratagems are also evidenced in the seasonal hunting of ungulates at Amalda Cave, Spain (Yravedra and Cobo-Sánchez, 2015) or of reindeer in Abri du Maris, France (Daujeard *et al.*, 2019). Neanderthals are also known to have utilised complex hunting tools including wooden spears (both alone and with a lithic tip). The use of complex tools and the ability to plan complex hunts serves to highlight the complexities of this species (Allington-Jones, 2015; Hutson *et al.*, 2025; Leder *et al.*, 2024; Mateo-Lomba *et al.*, 2024; Milks *et al.*, 2019; Oakley *et al.*, 1977; Shaw *et al.*, 2012; Shea, 1988, 1990; Thieme, 1997).

Isotopic evidence from Neanderthal skeletal remains highlight that mammalian fats and proteins were large components of their diets, especially in northern latitudes (Naito *et al.*, 2016; Richards *et al.*, 2000b). The consumption of animal products has been argued by some to have been a catalyst for the complex evolution of the hominin lineage, with nutritious fats and meats allowing the brain to evolve and expand (Aiello and Wheeler, 1995; Ben-Dor *et al.*, 2011).

In addition to the exploitation of medium-large mammals, Neanderthals are evidenced as having a broad dietary niche. These include avifauna, aquatic

species, plants and small game (Barkai *et al.*, 2017; Blasco, 2008; Blasco and Peris, 2009, 2012; Blasco *et al.*, 2016; Kabukcu *et al.*, 2023).



***Figure 2-6**: Pair of West Asian Ibex (*Capra aegagrus*) photographed in the vicinity of Shanidar Cave, May 2024. Ibex was a common food source for Neanderthals. (Photo by N. Wilson)*

2.3.1.1 Avifauna

The ability to capture birds was long assumed beyond the capability of Neanderthals due in part to the perceived lack of complex projectile tools (Klein, 2001; Klein *et al.*, 2004). In recent decades, it has been shown that Neanderthals were not only capable of capturing avian prey but routinely exploited birds for food and other resources (e.g. talons and feathers). Species exploited range from cave dwelling species such as pigeon (Columbidae) and choughs (Pyrrhocorax pyrrhocorax) (Blasco and Peris, 2009; Blasco *et al.*, 2016), as well as wetland species such as goose (*Anser* cf. *albifrons),* cormorant *(Phalacrocorax carbo)* and duck (*Anas platyrhynchos*) (Goffette *et al.*, 2024).

The means by which Neanderthals caught these avian species is unknown, but theories include ambush (e.g. waiting for a suitable time such as when the birds were nesting) or using bait, although these ideas are based upon ethnographic rather than archaeological evidence (Blanco *et al.*, 2021; Blasco *et al.*, 2016; Finlayson, 2019). The use of netting has been hypothesised as the method for hunting birds by *Homo sapiens*, but it is rarely associated with other hominin species (Shea, 2006). However, the creation of workable string has recently been evidenced in French Neanderthal sites (Hardy *et al.*, 2020; Hardy, 2008; Prince, 2000).

2.3.1.2 Aquatic Fauna

As with avifauna, the exploitation of aquatic resources was previously argued as too complex for Neanderthals (Henshilwood *et al.*, 2001; Klein and Steele, 2008; Lombard, 2007). It is now known that Neanderthals exploited a range of species including fish such as tuna (Thunnini), sea bream (Sparidae), and moray eel (Muraenidae); shellfish such as brown crab (*Cancer pagurus*) and spider crab (*Maja squinada*); molluscs such as limpets (*Patella* spp.), mussels (e.g. *Perna perna*), and clams (e.g. *Ruditapes decussatus*); as well as marine mammals including dolphin (Delphinidae) and seal (Phocidae) (Brown *et al.*, 2011; Cortés-Sánchez *et al.*, 2011; Nabais *et al.*, 2023; Stringer *et al.*, 2008; Villa *et al.*, 2020; Zilhão *et al.*, 2020).

Neanderthals were also known to have swum and dived – the condition known as surfers' ear which develops following continued exposure to marine pressures and conditions is evident from several Neanderthal skulls (Trinkaus *et al.*, 2019; Villa *et al.*, 2020). The means by which Neanderthals accumulated marine species was likely from seasonal scavenging and gathering along coastlines (García-Escárzaga *et al.*, 2026).

2.3.1.3 Small Game

Lagomorphs (e.g. European rabbit, *Oryctolagus cuniculus*) are found in abundance in numerous Middle Palaeolithic contexts (Arriaza *et al.*, 2017). Direct evidence for exploitation of lagomorphs in the Middle Palaeolithic is limited in comparison to that for exploitation of larger mammals however (Carvalho *et al.*, 2018; Lloveras *et al.*, 2011). It has been hypothesised that the

presence of lagomorphs and other rodents in Middle Palaeolithic contexts is due to hunting by small-medium cave-dwelling carnivores such as owls (Strigiformes) or lynx (*Lynx* sp.) (Andrews and Cook, 1990; Stiner, 1991). However, cut marks and evidence of burning on lagomorph bones e.g. at Gorham's Cave, Gibraltar, show that Neanderthals were capable of exploiting them (Brown, 2011).

It should be noted that the presence of rabbits and other lagomorphs/rodents in archaeological sites may also be simply due to habitat preferences. The discovery of burrows at cave sites, including at Shanidar confirms this (Hunt *et al.*, 2023).

Remains of amphibians and reptiles are also common in Middle Palaeolithic contexts (Blasco, 2008; Nabais and Zilhao, 2019; Speth and Tchernov, 2002; Stiner *et al.*, 2000). Damp spaces and fresh water within karstic caves may have drawn these species in, or they may have brought in by other predators such as raptors. However, the exploitation of tortoise (*Testudo* sp.) is evidenced by cut marked and burnt bones and pieces of tortoiseshell from several Middle Palaeolithic contexts in sites including Bolomor, Spain (Blasco, 2008), Figueira Brava, Portugal (Nabais and Zilhão, 2019) and Kebara Cave, Israel (Speth and Tchernov, 2002). Tortoise might have been viewed as an easy prey item because they are slow moving, storable and because of their ability to survive for a duration without food or water (Figure 2-7)



Figure 2-7: *Mediterranean spur-thighed tortoise (*Testudo graeca*) photographed in the vicinity of Shanidar Cave, May 2022. This species was exploited by Neanderthals at numerous sites including Shanidar Cave. (Photo by M. Hitchcock)*

2.3.1.4 Plants

Reconstructions of Neanderthal diets have determined that a nutritional strategy based entirely on animal protein and fats would be detrimental to health due to the lack of fibre and vitamins that are predominantly or solely derived from vegetation (Hockett, 2012). Without an omnivorous diet, individuals would likely suffer from several health conditions, especially during pregnancy. Plants are limited in the archaeological record due to taphonomic processes – as organic material, they are less likely to preserve (Aranguren *et al.*, 2007; Piperno *et al.*, 2004). However, burnt plant matter has been recovered from Middle Palaeolithic contexts at sites such as

Kebara Cave, Israel, and from Shanidar Cave itself (Henry *et al.*, 2011; Kabukcu *et al.*, 2023; Lev *et al.*, 2005). In addition, studies of dental calculus, soils, and stone tools have shown that plant remains were incorporated widely in the diets of Mousterian groups (Albert *et al.*, 2000; Hardy and Moncel, 2011; Henry *et al.*, 2011; Madella *et al.*, 2002).

It should be stated that the dietary capacity of Neanderthals was not static and would likely change temporally and spatially. Neanderthals residing in colder climates such as in the northern range of their territories are much more likely to have had a higher meat consumption than those further south where plant materials were more readily available (Jennings *et al.*, 2011). The complexities diets of Neanderthals show that they were capable of exploiting a wide range of species using traps, complex tools and forward planning.

2.3.1.2 *Homo sapiens* Diets

As discussed above, the view of Neanderthal diets was seen as less diverse than that of Upper Palaeolithic *Homo sapiens* (see McBrearty and Brooks, 2000; Binford, 1981, 1984; Hinshelwood et al., 2001; Lombard, 2007). While it can be stated that the diets of *Homo sapiens* at times were diverse, this would vary from site to site and throughout time. For instance, the Upper Palaeolithic site of Gough's Cave evidenced routine consumption of red deer and aurochs with little variation or evidence for the consumption of plants (Richards *et al.*, 2000a). This is reflected in the diets of other Upper Palaeolithic sites such as Riparo Tagliente, Italy (Gazzoni *et al.*, 2013) and

Vindija Cave, Croatia (Brajković and Miracle, 2008). This is not to say that Upper Palaeolithic diets were not diverse. As evidenced below, Upper Palaeolithic *Homo sapiens* exploited a wide array of flora and fauna.

2.3.1.2.1 Avifauna

Evidence for *Homo sapiens* exploiting avifauna has its origins in the Middle Stone Age. Sites such as Diepkloof Rock Shelter, South Africa preserve butchered bird remains dated to earlier than c. 60 kya (Steele and Klein, 2013). The exploitation of birds at the site is further evidenced by the presence of modified ostrich eggshells (Texier *et al.*, 2013). Other sites in South Africa including Sibudu Cave (Val *et al.*, 2016) and Bushman rock shelter (Badenhorst and Plug, 2012) also provide evidence for the butchery of birds.

The exploitation of birds in the Upper Palaeolithic does become more apparent when compared to the MSA. A wide range of species were exploited during the Upper Palaeolithic, presumably both for meat and for feathers, as has been argued for Neanderthals (Blasco and Peris, 2009; Blasco et al., 2016; Finlayson, 2019). Species of waterfowl were routinely exploited at sites including Grotta Romanelli, Italy, Grotta del Santuario della Madonna a Praia a Mare, Italy and Trou de Chaleux, Belgium (Goffette *et al.*, 2020; Tagliacozzo and Gala, 2001) suggesting routine wetland foraging stratagems. Other sites such as Pavlov I, Czechia, show direct human modification on at least four species of bird, with 15 other species also being recovered from the site, showing broad exploitation strategies (Bochenski *et al.*, 2009). A preference for pigeon is inferred from the butchered remains from Manot

Cave, Israel (Ujma *et al.*, 2025). Other species such as swans or raptors were also exploited at the site but in lesser numbers. As is the case with Neanderthals, the means by which these species were caught is unknown, but the use of netting and traps has been suggested (Wadley, 2010).

2.3.1.2.2 Aquatic Fauna

As is the case with avifauna, marine species were exploited from the MSA onwards. Coastal foraging is inferred from a number of South African sites including Ysterfontein 1 (Klein *et al.*, 2004), Diepkloof Rock Shelter (Steele and Klein, 2013), Pinnacle Point (Jerardino and Marean, 2010; Marean, 2010; Marean *et al.*, 2007) and Sea Harvest and Hoedjiespunt (Volman, 1978). Species exploited vary from mussels and limpets to crabs and whelks. Fish exploitation during the MSA prior to c. 50,000 years is limited. Two South African sites, Blombos Cave and Klasies River main site (Van Niekerk, 2011) show the routine exploitation of fish. Further, McBurney (1967) states that Tuna was exploited at the Hauah Fteah, Libya during MIS 5e (McBurney *et al.*, 1986). It should be noted that Van Niekerk argues that the low volume of fish remains in MSA sites likely represents environmental processes rather than a lack of exploitation.

The routine exploitation of cape fur seal (*Arctocephalus pusillus*) is also evidenced from the Klasies River main site. Age profiles show that individuals were hunted during the birthing season when they are beached and at their most vulnerable (Ratshinanga *et al.*, 2025). This stratagem has also been

hypothesized for Neanderthal exploitation of seals at sites such as Gorham's Cave, Gibraltar (see section 2.3.1.2) (Stringer et al., 2008).

The exploitation of cetaceans during the MSA is limited to a number of sites in Southern Africa. This has been argued to be random scavenging events rather than targeted exploitation (Mesfin *et al.*, 2022). The limited number of cetacean bones within caves may reflect carcass transport decisions (Domínguez-Rodrigo, 2002; Hatton *et al.*, 2020). The butchering of beached whale remains (unknown species) has been noted at Blombos Cave and Pinnacle Point, South Africa (Henshilwood *et al.*, 2001; Kyriacou *et al.*, 2014). Butchered dolphin (*Delphinus delphis*) remains were also excavated from Blombos cave (Henshilwood et al., 2001).

By the Upper Palaeolithic, the exploitation of coastal resources becomes more apparent. While the exploitation of marine resources during the MSA can be argued to be opportunistic (Mesfin et al., 2022), the Upper Palaeolithic is argued to show more structured exploitation. The isotopic analysis from Kendrick's Cave, Wales evidences the routine exploitation and consumption of fish (Richards *et al.*, 2005). This is also apparent from the Belgian sites of Trou de Chaleux, Trou du Frontal and Trou du Sureau. A range of species were exploited at this site but a preference for salmon (*Salmo salar*) was inferred by the researchers (Van Neer *et al.*, 2007). A total of 18 Aurignacian sites in Northern Spain evidence routine fish exploitation (Adán *et al.*, 2009). Species varied from ocean species including rays (*Raia* sp.) and plaice (*Pleuronectes platessa*) to freshwater species such as salmon (*Salmo*

salar) and brown trout (*Salmo trutta*). The exploitation of cetaceans in later Upper Palaeolithic sites has also been suggested based on the presence of whale barnacles at sites along the French coast (Pétillon, 2016).

The exploitation of coastal and marine species by *Homo sapiens* is evident from the MSA onwards. Upper Palaeolithic exploitation can be argued to be more routine than that of MSA exploitation, the use of these species by humans has a long history (Mesfin *et al*., 2022). With regards the species exploitated, there is little to no difference between the subsistence strategies of Sapiens and Neanderthals (see section 2.3.1.2).

2.3.1.2.3 Small Game

The exploitation of slow-moving prey is well documented in the MSA. This comes mainly in the form of tortoise remains which are butchered or burnt. As stated in section 2.3.1.3, tortoises are seen as slow moving, easy prey and could in theory be collected by children. Sites such as Ysterfontein 1 or Blombos cave, South Africa show routine exploitation of tortoise through cut marked bones and burnt carapaces (Henshilwood *et al.*, 2001; Thompson and Henshilwood, 2014). In addition to slow moving prey, fast moving small mammals are also present in a number of MSA contexts. The exploitation of mole rat (*Heterocephalus glaber*) and lagomorphs are noted from Pinnacle Point, South Africa (Armstrong, 2016) and Panga ya Saidi, Kenya (Prendergast *et al.*, 2023). Due to the speed and small size of these animals, it has been

hypothesised that traps such as snares were used to catch them (Thompson and Henshilwood, 2014; Wadley, 2010).

During the Upper Palaeolithic, the systematic exploitation of slow-moving prey such as tortoise was argued to be a signifier for rapid population growth. Stiner et al (2000) evidence that as population size increases, the average dimensions of tortoise reduces. Direct evidence for the exploitation of tortoise is also evident from sites such as Baaz Rockshelter, Syria (Napierala *et al.*, 2017) and Klissoura cave, Greece (Starkovich, 2009).

As with tortoise exploitation, the exploitation of fast-moving prey, mainly lagomorphs, becomes apparent in the Upper Palaeolithic. Fa et al (2013) argue that the exploitation of rabbit was crucial for the survival of *Homo sapiens* in Iberia, accounting for the largest proportion of biomass across a number of sites. Further, sites such as Coimbre Cave, Spain and Picareiro Cave, Portugal evidence direct exploitation of lagomorphs (Hockett and Bicho, 2000; Yravedra *et al.*, 2017).

The exploitation of small prey (either fast or slow) has been associated with *Homo sapiens* since the MSA, becoming more apparent in later prehistory. The dependence on tortoise and lagomorphs in the Upper Palaeolithic has been suggested to be crucial to the development of humans during this time (Fa et al., 2013).

2.3.1.2.4 Plants

Plant remains do not often survive well in archaeological contexts due to issues of preservation (Aranguren et al., 2007; Piperno et al., 2004) however, they have been shown to be crucial to maintaining a healthy lifestyle, both in the present and in prehistory (Hockett, 2012).

Middle stone age plant consumption is evidenced in the form of phytoliths and starch grains from sites in South Africa (Esteban *et al.*, 2018; Larbey *et al.*, 2019). Beyond this, evidence for plant consumption is limited, but based on ethnographic data was likely habitual (Mothupi and Shackleton, 2025).

Evidence for the consumption of plants in the Upper Palaeolithic is well established. Isotopic evidence from the site of Taforalt, Morrocco suggests that plants were the dominant food source (Moubtahij *et al.*, 2024). This is also reflected in sites in Sri Lanka (Bourgon *et al.*, 2026), Niah Caves, Borneo (Barker and Farr, 2007) and the Shuidonggou site, China (Guan *et al.*, 2014). Further, the work Aranguren et al. (2007) shows that starch grains at Upper Palaeolithic sites such as Bilancino II, Italy and Kostenki 16–Uglyanka, Russia were exploited in such a manner that could be reflective of producing flour. It should be noted however that Kabukcu et al (2023) argue that Neanderthals were grinding seeds to make a sort of paste at c. 73 kya.

The presence of plant microfossils at numerous Upper Palaeolithic sites further suggest that plant consumption was habitual – e.g. Cova de les Cendres, Spain (Martinez Varea and Badal Garcia, 2018), Ghar-e Boof, Iran (Baines *et al.*, 2015), Dolní Věstonice, Czechia (Pryor *et al.*, 2013), among others

(Sobkowiak-Tabaka and Kufel-Diakowska, 2019; Tyldesley and Bahn, 1983). A reliance of plant materials and the production of flour have not yet been evidenced at Neanderthal sites (see section 2.3.1.2.4).

Both Neanderthals and *Homo sapiens* have been evidenced to exploit a wide range of flora and fauna. This goes against the notion that the diets of Upper Palaeolithic *Homo sapiens* were much more varied than that of MSA *Homo sapiens* or Neanderthals (Binford, 1984; McBrearty and Brooks, 2000; White *et al.*, 1982). The ability to exploit a wide array of resources and possibly to use traps or complex tools to acquire said resources show the capacity of both hominin species. As such, if a species is capable of such a broad and complex diet, it stands to reason that they would be capable of producing and utilising complex tools, as well as developing intricate and varied forms of cultural expression.

2.3.2 Cultural Expression

Cultural Expression can be described as the ways through which individuals or groups develop and express their unique identity through tangible and intangible mediums (Tylén *et al.*, 2020). Cultural expression can take multiple forms, including the static (e.g. cave paintings, monuments, engravings) or the mobile (portable art, stories, songs). Scholars have argued that representation of cultural expression is limited prior to the Upper Palaeolithic (Bar-Yosef, 1998, 2002; Conard and Bolus, 2003; Conard *et al.*, 2006). This may be in part due to issues of preservation (both in terms of the

temporal but also with material from colder latitudes more likely to be lost to time due to glaciation). Further, the supposed "revolution" which occurred at the end of the Middle Palaeolithic has all but been disproven (McBrearty and Brooks, 2000).

Cultural expression is argued to have been exhibited by hominins as far back as the Lower Palaeolithic. For example, an engraved shell from Java, Indonesia has been argued to be the creation of *Homo erectus* around c. 500,000 years before present (BP). This shell was engraved in a "zigzag" pattern, and the lines serve no obvious function (Joordens *et al.*, 2015). *Homo heidelbergensis* (another Lower Palaeolithic hominin) chose stones containing fossils whilst producing hand-axes (e.g. that from West Tofts, Norfolk, UK, c. 500,000 to 300,000 years BP) (Flanders and Key, 2023). *Homo naledi* is also argued to have produced abstract patterns in the form of engravings (c. 335,000 to 221,000 years BP), although the claims made by the authors are not widely accepted (Berger, 2015; Berger *et al.*, 2025; Martinón-Torres *et al.*, 2024) Cases for cultural expression in Neanderthals and *Homo sapiens* are presented below.

2.3.2.1 Neanderthal Cultural Expression

As discussed in section 2.3.1, Neanderthals demonstrated complex hunting strategies and as such are inferred to have had some capacity for communication (Dediu and Levinson, 2018; Johansson, 2015). The discovery of Neanderthal hyoid bones evidenced their ability to speak (Arensburg *et*

al., 1989) although the extent to which Neanderthals could converse as modern humans do is impossible to quantify but it has been argued that they possessed at least a crude "proto language" (Stringer, 2012). The care for juvenile, elderly, and disabled individuals as evidenced from Shanidar Cave supports this (Solecki, 1971).

Examples of Neanderthal static cultural expression is limited. Neanderthal engravings are reported from two sites, these being La Roche-Cotard, France, and Gorham's Cave, Gibraltar. The markings from La Roche are in the form of grooves created by rubbing fingers into soft limestone. Optically stimulated luminescence (OSL) dating places the engravings as having been created c. 57,000 years before present, before the arrival of *Homo sapiens* in Europe (Marquet *et al.*, 2023). The engraving at Gorham's Cave consists of several cross hatched lines thought to have been created using a lithic (Rodríguez-Vidal *et al.*, 2014). The attribution of this engraving to Neanderthals has been debated however given its location within the site amongst a collection of Upper Palaeolithic cave art and engravings and issues with dating at the site, which is being reassessed (Balbín *et al.*, 2000; Finlayson *et al.*, 2023; Higham *et al.*, 2014; Zilhão and Pettitt, 2006).

Evidence for Neanderthal paintings is limited to three sites in Spain: La Pasiega (Hoffmann *et al.*, 2018), Maltravieso (Standish *et al.*, 2025), and Ardales (Cantalejo, 2006). These include a stencilled hand and a complex image including a partial depiction of an animal both made in ochre. Uranium series (U-th) dating places at least some of the material at each site

to before c. 65,000 years before present and thus before the arrival of *Homo sapiens* into Iberia, however, the dating of these materials and the interpretation of Neanderthals as their makers has been contested (White *et al.*, 2020). It should be stated that animal depictions and stencilled hands are common in Upper Palaeolithic art.

With regards mobile art, the case for personal crafts/items is not well established across the Neanderthal world. However, oddities such as unique or engraved stones, fossils, or animal bones with decorative incisions have been excavated from some Middle Palaeolithic contexts (Álvarez-Alonso *et al.*, 2025; Marshack, 1989; Mateo-Lomba *et al.*, 2024; Romandini *et al.*, 2014; Soressi and d'Errico, 2007; Zilhão, 2012; Zilhão *et al.*, 2010). As these items appear to serve no utilitarian purpose it has been suggested that they were personal effects, collected or created by Middle Palaeolithic populations simply for their aesthetic value (Navazo Ruiz *et al.*, 2024).

Traces of ochre have been found at numerous Neanderthal sites, the majority of which have yielded no evidence for the production of static art, and such it has been interpreted as having been used for personal adornment (Soressi and d'Errico, 2007; Zilhão et al., 2010; Álvarez-Alonso et al., 2025). Decorating oneself with pigment is a practice seen in modern hunter-gatherer societies and as such is also inferred for archaic *Homo sapiens* groups. This self-modification has been argued as being another 'modern' behaviour (Watts, 2009, 2010). Ochre may serve other benefits such as providing protection from the sun, as an insect repellent, or as an aid in the tanning of hide

(Basedow, 1925; Nielsen *et al.*, 2012; Peile, 1979; Wadley *et al.*, 2004; Watts, 2009).

Neanderthals have been argued to have spaced out their dwellings into specific zones for activities such as sleeping, food preparation or flint knapping (e.g. Abric Romaní) (Vallverdú *et al.*, 2010). Evidence for the construction of walls, windbreaks and huts has been argued from several Middle Palaeolithic sites (de Lumley and Boone, 1976; Demay *et al.*, 2012; Vaquero, 2022; Vaquero *et al.*, 2017; Yar and Dubois).

The discovery of Neanderthal "Jewellery" has been evidenced from a number of Middle Palaeolithic sites (Peresani *et al.*, 2011; Rodríguez-Hidalgo *et al.*, 2019; Romandini *et al.*, 2014). Jewellery in this sense is a wearable item set apart from typical garments in that it serves no apparent function such as offering protection from the elements. Examples include perforated raptor talons which may have been strung to be hung around the neck or attached to other clothing. These have been documented from numerous Middle Palaeolithic sites (Rodríguez-Hidalgo et al., 2019; Romandini et al., 2014). Additionally, butchery marks on skeletal elements from certain avian species e.g. choughs (*Pyrrhocorax pyrrhocorax*) could imply selection of specific-coloured feathers (Figure 2-8) (Blasco *et al.*, 2016; Garofoli, 2017). The wearing of jewellery has been argued as reflective of an idea of identity, both of the self and/or as part of a group (Meneganzin and Killin, 2025). The presence of ornate decorative items associated with buried individuals in later prehistory

have been argued to reflect status, it is possible Neanderthal society was similar (Vanhaeren and d'Errico, 2005).

Further, evidence from Shanidar Cave suggests the continuation of culture. The Shanidar 4 mortuary cluster is made up of at least five individuals, which were all placed into a small area over a time span of decades or perhaps a few hundred years. The argument could be made therefore for some sort of oral history as subsequent generations of Neanderthals returned to the site and deposited their dead in the same location within the cave (Barker and Hunt, 2023; Pomeroy *et al.*, In Press).



Figure 2-8: *Pair of Red-billed choughs (*Pyrrhocorax pyrrhocorax*) at the entrance to Shanidar Cave, May 2024. Choughs are believed to have been exploited by Neanderthals for their striking black iridescent plumage. (Photo by M. Hitchcock)*

2.3.2.2 *Homo sapiens* Cultural Expression

By the Upper Palaeolithic cases for cultural expression are significantly better established and accepted than those from the Middle Palaeolithic (Bar-Yosef, 2002, 2007). Upper Palaeolithic *Homo sapiens* are known to have routinely utilised ochre for personal adornment and the decorating of personal effects (Watts, 2009). Some Upper Palaeolithic sites preserve complex frescos depicting animals, abstract shapes and human figures (Barton *et al.*, 1994; Bicho and Villaverde, 2007; Breuil, 1907; Cartailhac and Breuil, 1906). While Neanderthals are evidenced as utilising ochre both for personal adornment and for paintings, the extent of art in the Upper Palaeolithic is much more established (Lawson, 2012). However, this may again be due to factors of preservation.

In addition to static art, carved figurines in bone and ivory were produced by *Homo sapiens (Beck, 2000; Kind et al., 2014)*. Bone and ivory were also fashioned into beads for personal adornment at sites including as Stajnia Cave, Poland (Talamo *et al.*, 2021), Üçağızlı Cave, Turkey (Stiner *et al.*, 2013), Haua Fteah, Libya (Barker *et al.*, 2012). The wearing of jewellery can reflect status, a sense of self or identification as part of a specific group (Meneganzin and Killin, 2025.

As has been established above, the idea of a rapid cultural shift towards the end of the Middle Palaeolithic was unfounded (summarised in McBrearty and Brooks, 2000) with almost all of the supposed "facets" of modernity being evidenced not only by extinct hominins but also by MSA *Homo sapiens*.

Archaic *Homo sapiens* at the Kalambo falls site in Zambia have been evidenced to have created wooden structures as far back as c. 476 kya (Barham *et al.*, 2023). Further, the occupants of Border Cave, South Africa created sleeping areas out of woven grasses (Sievers *et al.*, 2022; Wadley *et al.*, 2020). Further, the production of decorative items is evidenced from the engraved ochres from Blombos Cave, South Africa (c. 75 kya) (Hatton *et al.*, 2020; Hayes, 2010; Henshilwood *et al.*, 2009), the engraved ostrich eggs from Diepkloof Rockshelter, South Africa (c. 60 kya) (Parkington *et al.*, 2005) and the ochre crayons and shell beads from gar Sibudu Cave, South Africa (d'Errico *et al.*, 2008; Wadley, 2005a), among others (Assefa *et al.*, 2018; Cooke, 1971; Miller, 2019). Therefore, the emergence of cultural expression in *Homo sapiens* has its origins in earlier prehistory and not in the Upper Palaeolithic.

Both Neanderthals and *Homo sapiens* have been evidenced as having complex cultural and personal behaviours including the production of art, capacity for speech and the decorating of oneself. The development of art in the Upper Palaeolithic is more pronounced than that of the Middle Palaeolithic (Lawson, 2012). This again may be due to issues of preservation, differences in culture and differences in capacities. Regardless, both Neanderthals and *Homo sapiens* during the Palaeolithic were capable of complex personal and interpersonal behaviours. As a result, it is likely that both species were capable of developing and utilising tools in a complex manner. This provides a relevant framework for aims 1 and 2 of this study.

Perhaps the most complex of cultural behaviours is in those behaviours related to death, discussed below.

2.3.3 Mortuary Practices

An understanding of death has been observed in several animal species including elephants (*Loxodonta* sp./ *Elephus* sp.), dolphins (Delphinidae), and chimpanzees (*Pan troglodytes*) (Goldenberg and Wittemyer, 2020; King, 2013). It has been argued that the difference between animal and human behaviours around death is that human practices have a spiritual element (Pettitt *et al.*, 2006). Though mortuary behaviour has been argued for *Homo naledi* (Berger et al., 2015; Martinón-Torres et al., 2024), there is currently no established evidence for the burying of the dead prior to the Middle Palaeolithic.

2.3.3.1 Neanderthal Mortuary Practices

The case for intentional burial by Neanderthals is ever-growing (Akazawa *et al.*, 1995; Akazawa, 2002; Balzeau *et al.*, 2020; Been and Barzilai, 2024; Dibble *et al.*, 2015; Hovers *et al.*, 1995; Rendu *et al.*, 2014; Solecki, 1975, 1977). There remains some resistance to this however (Gargett, 1989, 1999). Perhaps the most compelling evidence for Neanderthal burial comes from cave sites including Shanidar Cave (see section 2.5.1) (Solecki, 1971, 1975; Pomeroy et al., 2020, in press; Hunt et al., 2023).

Neanderthal burial is also inferred from La Chappelle-aux-Saints, France, where a Neanderthal skeleton was found within a pit context. That the individual was deliberately interred is supported by the condition of their remains compared with those of animals, which were weathered and damaged by scavengers implying exposure (Rendu *et al*., 2014). Across Europe there are currently 27 Neanderthal burials with a further 15 potential burials in the Levant (Been and Barzilai, 2024; Been *et al.*, 2017; Maureille and Knüsel, 2022). A number of these Neanderthal burials contained apparent grave goods in the form of shells, faunal remains (e.g. pairs of ibex horncores at Teshik Tash, Uzbekistan) or lithics, adding to the case for deliberate burial and potentially ritualistic behaviours (Akazawa *et al.*, 1995; Akazawa, 2002; Okladnikov, 1949; Valladas *et al.*, 1999). Neanderthals also occasionally engaged in cannibalism or cultural defleshing at sites such as Krapina, Croatia (Ferna *et al.*, 1999; Garralda and Vandermeersch, 2000; Garralda, 2008; Yustos and de los Terreros, 2015). This behaviour has also been evidenced in *Homo heidelbergensis* and *Homo sapiens (Bello et al., 2015; Bello et al., 2017; Marsh and Bello, 2023; Saladié et al., 2012)*. It is difficult to state whether this behaviour was a funerary practice or a subsistence practice however – some researchers have suggested that Neanderthals consumed the flesh of other Neanderthals during times of famine (Arens, 1979; Bahn, 1992).

2.3.3.2 *Homo sapiens* Mortuary Practices

Homo sapiens burials are apparent in Africa sites from c. 160,000 years BP, spreading to the Levant by 100,000 years BP (Been and Barzilai, 2024; d'Errico and Backwell, 2016; Gargett, 1989; Riel-Salvatore and Gravel-Miguel, 2013; Stringer *et al.*, 1989). Levantine *Homo sapiens* appear to have not buried their dead deep within caves as is the case with Neanderthals but opted instead for placement in rock shelters or cave openings. The bodies of *Homo sapiens* were often flexed in a foetal-like posture whereas Neanderthal burials are argued to be less uniform (Been and Barzilai, 2024). Grave goods are associated with burials of both species; however, it has been claimed that those recovered from *Homo sapiens* burials are more complex, especially into the Upper Palaeolithic. These include perforated animal teeth and beaded garments in contrast to lithics and unmodified faunal remains in Neanderthal burials (Riel-Salvatore and Gravel-Miguel, 2013). Ritualistic cannibalism is a well-documented occurrence in the later Upper Palaeolithic fossil record (Bello *et al.*, 2016; Bello *et al.*, 2015; Marsh and Bello, 2023).

Again, treatment of the dead has been argued as an aspect of modernity (Mellars, 1989, 1999). However, the case for Neanderthal burials is ever growing and thus dispels the concept of an Upper Palaeolithic Revolution (Been and Barzilai, 2024; Been *et al.*, 2017; Gargett, 1989, 1999; McBrearty and Brooks, 2000). Little to no differences are observed between the species with regards the treatment of the dead.

2.3.4 Tool Assemblages

The Lower, Middle, and Upper Palaeolithic periods were initially divided by the sophistication of their tools (Clark, 1969). Lower Palaeolithic hominins produced the hand-axe, Middle Palaeolithic hominins created flake tools on prepared cores, and Upper Palaeolithic hominins created blade-based tools which were more standardised than past forms (Bordes, 1953, 1961a, 1961b; Semenov, 1970; Wargo, 2009). For the purposes of this study the Lower Palaeolithic industries will not be discussed as there is no record of a Lower Palaeolithic occupation within Shanidar Cave.

2.3.4.1 Neanderthal Associated Tool Assemblages

The Mousterian is the tool industry most commonly associated with the Middle Palaeolithic period and the Neanderthals across the range of their territory. It is also associated with some Middle Stone Age industries in northern Africa as well as in western Asia (Bordes, 1961a, 1961b; De Mortillet, 1873, 1885; McBurney, 1967; Ruebens *et al.*, 2015). The presence of Neanderthals in Africa is as yet unevidenced, as such it is likely that *Homo sapiens* independently developed this industry (Dibble *et al.*, 2013; Douka *et al.*, 2014; Reynolds, 2018).

The Mousterian is defined by flake-based tools on prepared cores, such as Mousterian points, side scrapers, and denticulates (Garrod and Bate, 1937; Bordes, 1961a, b). The 'tool kit' for Mousterian assemblages is vast by comparison to earlier industries, with the classification system established by Francois Bordes defining more than sixty forms of tools associated with

Neanderthals in France alone (Bordes, 1961a). Bordes argued French Mousterian tools could be further divided into five industries (Ferrassie Mousterian, Quina Mousterian, Typical Mousterian, Denticulate Mousterian and Mousterian of Acheulean tradition) representing five tribes of Neanderthals due to morphological differences seen in the Mousterian assemblages of France.

This theory has since been contested on the basis that morphological variation in lithics more likely reflects access to raw material and necessity rather than regional and territorial variation in manufacture (Binford, 1982; Shea, 2014; Wargo, 2009). Indeed, the variations in tool forms seen by Bordes have been described as stages along a process following use, resharpening and reuse, rather than distinct tool forms (Dibble, 1987a, 1987b).

The Mousterian was not a static industry but evolved over time as well as throughout the range of Neanderthal territories. Regional variants include Eastern/Central and Western Mousterian of Europe, which are notable for the presence of double-faced knives and single-faced side scrapers respectively (Otte, 2017). In the Near East, the main forms of the Mousterian are the Levantine Mousterian - determined by the high dominance of Levallois technique with a high focus on Levallois point production and retouch (Centi and Zaidner, 2022; Garrod, 1934; Hovers, 1998; Oron *et al.*, 2026; Sharon and Oron, 2014), the Caucasus Mousterian (sometimes called the Micoquian) - which is typified by the use of highly diverse scrapers as well as bifacial, asymmetrical knives (Doronicheva *et al.*, 2022; Golovanova and Doronichev,

2003; Golovanova *et al.*, 2017) and finally the Zagros Mousterian of which the material from Shanidar Cave is interpreted as being (Blanco-Lapaz *et al.*, 2022; Reynolds *et al.*, 2022; Skinner, 1965; Solecki, 1953; Solecki and Solecki, 1994). The Zagros Mousterian was first described by Dorothy Garrod following excavations at Hazar Merd Cave, Iraqi-Kurdistan (then Iraq) (Garrod, 1930). The main features of this industry were the development of various points and side scrapers. This was further developed through the work of Dibble (1984, 1987a, 1995) who determined that the variation in scrapers and points at Zagros Mousterian sites represented a reduction sequence rather than variations in intended morphology. This was further expanded on by Lindly (1997) who established that Zagros Mousterian sites all feature a high degree of retouch, argued to reflect a highly mobile lifestyle, where lithic raw material is limited.

The use of the Levallois technique of core-reduction whereby flakes are routinely removed from a core leading to a prepared platform is commonly associated with the Mousterian, especially in Europe, but this technique predates the initial Mousterian (Bordes, 1950, 1953). Evidence for the Levallois technique in Asian Neanderthal sites is less established than that from European assemblages but still present (Golovanova *et al.*, 2025; Lindly, 1997; Reynolds *et al.*, 2022; Skinner, 1965).

Neanderthals are most commonly associated with the Mousterian but are also associated with transitional industries. The are the tool industries which arise at the end of the Middle Palaeolithic and present characteristics not

seen in the earlier Middle Palaeolithic (e.g. the use of blades or bone tools). One such example is the Châtelperronian. This industry is typified by the presence of curved, backed blades in addition to a significant number of bone tools (Bar-Yosef and Bordes, 2010; d'Errico *et al.*, 2003; Djakovic *et al.*, 2024; Ruebens *et al.*, 2015; Zilhao *et al.*, 2006). This industry was originally attributed to *Homo sapiens* but is now thought to be associated with late surviving Neanderthals (Harrold, 2000; Henrion *et al.*, 2023; Higham *et al.*, 2010; Hublin *et al.*, 2012; Mellars *et al.*, 2007).

Bone tools have traditionally been attributed to assemblages associated with *Homo sapiens*, however, in recent years bone tools have been recovered from Neanderthal sites (Baumann *et al.*, 2022; Doyon *et al.*, 2025; Hoffecker, 2018; Mateo-Lomba *et al.*, 2024). The use of bone or wooden implements by Neanderthals is likely much more archaic than current evidence supports and the lack of evidence is due to issues of preservation.

In addition to the Châtelperronian, other transitional industries such as the Szeletian (Allsworth-Jones, 1986; Hauck *et al.*, 2016; Mester, 2018; Richter *et al.*, 2016), Bohunician (Oliva, 1984; Valoch, 2000) and Streletskian (Bataille, 2017; Bataille *et al.*, 2018) have also been attributed to late surviving Neanderthals. The Uluzzian and Lincombian-Ranisian-Jerzmanowician (LRJ) had previously been attributed to late surviving Neanderthals, however, skeletal evidence at these sites has been used to determine the makers of these industries as made by *Homo sapiens* (Abrams, 2024; Bietti and Negrino, 2007; Hublin, 2017). These industries highlight the issues of attributing a species

to a specific tool industry when more than one species of hominin is apparent in the region.

The emergence of *Homo sapiens* has traditionally been linked to the expansion of the Aurignacian industry into Eurasia (White *et al.*, 1982). European Upper Palaeolithic technologies are typified by blade production rather than flake production (Kozlowski, 2001). The origins of blade production (e.g. a flake which is at least twice as long as it is wide) are now established as occurring well before the Upper Palaeolithic (discussed in McBrearty and Brooks, 2000). The record for blade production in European Middle Palaeolithic assemblages is well established with material dating as far back as 300 kya (Conard, 1990; Révillion, 1995; Révillion and Tuffreau, 1994). Some later European sites evidence blade and bladelet production associated with Late surviving Neanderthals (Roussel *et al.*, 2016) as such the argument can be made that the production of blades by Neanderthals may have been a learned behaviour. However, this does not account for the earlier existence of blades in Neanderthal associated contexts. This may therefore suggest independent innovation (Barkai *et al.*, 2005; Derevianko, 2010, 2016; Kozlowski, 2001; Kozlowski and Otte, 2000).

2.3.4.2 *Homo sapiens* Associated Tool Assemblages

The earliest lithic assemblages associated with *Homo sapiens* are those of the MSA which are argued to have been developed from the Acheulean, a Lower Palaeolithic bifacial industry (Wurz, 2013). As in the European Middle Palaeolithic, the Levallois technique became a common method of tool

production in Africa (Reynolds, 2018). The typical MSA assemblage can contain blades, retouched flakes, end and side scrapers as well as bone tools (Wadley, 2005b; Will and Scerri, 2024). Spear tips and other forms of projectiles are noted from sites including Gademotta, Ethiopia shortly after the emergence of *Homo sapiens* as a species c. 279,000 years before present (Sahle *et al.*, 2014). The use of microliths is also noted from around c. 70,000 years BP though this tool type is more typically associated with later *Homo sapiens* (Ambrose, 2002).

The MSA is also broadly equivalent technologically to the Mousterian of Eurasia. African assemblages classified as Mousterian were based on the similarities in composition to those of Eurasian assemblages (e.g. burins, side-scrapers, notches, denticulates and occasional Mousterian points) (Braidwood and Howe, 1960; McBurney, 1967). Certain industries such as the pre-Aurignacian of Libya, the Aterian of NW Africa and the Lumpeban of Zambia are noticeably different than Mousterian assemblages (Scerri, 2017; Will and Scerri, 2024). When skeletal remains are associated with MSA lithic assemblages, the remains are attributed to *Homo sapiens* (e.g. Hublin et al., 2017).

Current evidence indicates that Neanderthal populations did not enter Africa and as such, the development of these industries is believed to have developed independently in MSA *Homo sapiens* (Chen *et al.*, 2020; Dibble *et al.*, 2013; Hawks, 2021).

Upper Palaeolithic populations in Eurasia became synonymous with blade-based industries (Conard, 1990; Conard and Bolus, 2003; Kozlowski and Otte, 2000; Otte and Kozlowski, 2011; Stringer and Andrews, 1988). Blades are now established as being developed in MSA and MP assemblages and as such as not a hallmark of Upper Palaeolithic 'enlightenment'. Table 2-1 compares behaviours between Neanderthals and *Homo sapiens*.

2.4 Neanderthal Extinction and the Dominance of *Homo sapiens*

The reasons for the extinction of the Neanderthals circa c. 50,000 to 35,000 years ago is one of the most debated topics in archaeology (e.g. Trájer, 2023). It has been argued that Neanderthals disappeared shortly after the arrival of *Homo sapiens* into Eurasia (Higham et al., 2014). Suggested reasons for the demise of Neanderthals include climate change (Finlayson, and Carrión, 2007), competitive exclusion (Banks et al., 2008; Knecht, 1997; Pétillon et al., 2011; Shipman, 2015a; Wroe et al., 2004), assimilation (Smith et al., 2005), disease (Houldcroft and Underdown, 2016), volcanic eruptions (Fitzsimmons et al., 2013), demographic weakness (Degioanni et al., 2019), and the domestication of dogs (Benecke,1987, Shipman, 2015b).

Following the extinction of the Neanderthals (as well as other Middle Palaeolithic hominins such as the Denisovans), *Homo sapiens* became the sole surviving member of the *Homo* clade. During later prehistory, this species went on to colonise the remainder of the globe.

***Table 2-1**: Comparison of behaviours of Neanderthals and Upper Palaeolithic* Homo sapiens

Behaviour	**Neanderthal**	**Evidence**	**Upper Palaeolithic *Homo sapiens***	**Evidence**
Diet	Broad dietary niche exploiting medium-large mammals, megafauna, avifauna, herpetofauna and small mammals, in addition to the consumption of plant matter	Blasco and Peris, 2012; Stiner, 2004; Hardy and Moncel, 2011; Lev et al., 2005; Stringer et al., 2008; Speth and Tchernov, 2002; Zilhão et al., 2010, 2020	Broad dietary niche exploiting medium-large mammals, megafauna, avifauna, herpetofauna and small mammals, in addition to the consumption of plant matter	Cachel, 1997; Hinshelwood et al., 2001; Lombard, 2007; Marean et al., 2007; Shipman, 2015b; Val et al., 2019
Cultural expression	Occasional use of ochre; limited evidence for engraving, painting, personal adornment using feathers, furs and minerals. Collection of 'interesting' objects and decorating. Potential evidence for structures	Hoffmann et al., 2018 ; Marquet et al., 2023 ; Navazo-Ruiz et al., 2024 ; Radovčić et al., 2015 ; Romandini et al., 2014 ; Zilhão et al., 2010	Routine use of structures within settlements. Jewellery in the form of shell, ivory and bone beads. Paintings and mobiliary art common	Bicho et al., 2007; Beck, 2000; Cartailhac and Brueil, 1906; Goring-Morris et al., 2003; Iakovleva et al., 2012; Wadley et al., 2004; Watts, 2010
Mortuary practices	Burials - all ages, men and women, no uniform posture. Faunal remains as grave goods. Placed within the cave. Cannibalism	Been and Barzilai, 2024 ; Dibble et al., 2015 ; Rendu et al., 2017 ; Okladnikov, 1949	Burials - all ages, men and women, foetal position. Complex grave goods such as beads, ochre, shells, as well as fauna. Placed in rock shelter or cave opening. Cannibalism	Been and Barzilai, 2024; Bello et al., 2015, 2017; Marsh and Bello, 2023; Riel-Salvatore and Gravel-Miguel, 2013
Tool use	Prepared core industry (Mousterian) typically using the Levallois method. Typical assemblage consisting of points, side scrapers, blades and flakes. The use of wooden tools as digging sticks and spears is established. The use of bone tools is not common until the later 'transitional industries. Use of blades is established.	Bordes, 1950, 1953, 1961a ; Hoffecker, 2018 ; Mateo-Lomba, 2024 ; Leder et al 2024. ; Thieme, 1997 ; Hutson et al., 2025	Blade based industry (Aurignacian). Typical assemblage consisting of blades, bladelets and end scrapers. Use of projectiles such as bows, slings and harpoons. The use of wooden tools as digging sticks and spears is established, with spear throwers also being developed in this time. Use of bone and antler common.	Knecht, 1997; Kozlowski and Otte, 2000; Mellars, 2006; Pétillon et al., 2011; Shipman, 2015b; Wadley, 2005; Wurtz, 2013

2.5 Shanidar Cave

2.5.1 Initial Excavations 1951-1960

Shanidar Cave is a large, south-facing karstic cave located on the Baradost Mountain of the Zagros range located in north-eastern Iraqi Kurdistan (36°50' N, 44°13' E). The cave sits at an elevation of 745 metres. It extends back approximately 40 metres and measures around 53 metres at its widest point. The cave is situated 2.5 km away from the Greater Zab River and can be viewed from the riverbank. Shanidar Cave is one of several archaeological sites in the region.

Shanidar Cave became significant to Palaeolithic research following a series of excavations between 1951 and 1960 by the American archaeologist Ralph Solecki (Solecki, 1953, 1955, 1957a, b, 1958, 1960, 1961, 1963, 1971, 1975, 1977). Solecki's 14 metres deep trench (Figure 2-9) yielded the remains of 10 Neanderthal individuals including males, females, and juveniles (Solecki, 1955, 1963, 1971; Trinkaus, 1983; Stewart, 1977). It has been proposed that the Shanidar Neanderthals can be split into two possible groups based upon their skeletal morphology. Trinkaus (1983) states that the Neanderthals from Marine Isotope Stage (MIS) 5 (c. 71,000 to 100,000 years BP at Shanidar) are "Eastern Neanderthals" which share morphological traits with earlier Near Eastern and European Neanderthals, including a heavier brow ridge. The MIS 3 (c. 30,000 to 60,000 years BP at Shanidar) Neanderthals are described as "Classic Neanderthals" with less robust features but like "typical Neanderthals" (Trinkaus, 1983).

The site has one of the largest concentrations of hominin remains anywhere in the world (other hominin-dense sites include Sima de los Huesos, Spain; Dmanisi, Georgia and Rising Star Cave, South Africa (Arsuaga et al., 1997; Berger et al., 2015; Rightmire et al., 2006). The Shanidar Neanderthals are notable not only for their abundance but also the perceived cultural behaviours attributed to these individuals. Shanidar 1 survived to older age despite numerous debilitating health conditions such as partial blindness, deafness, a club foot, worn teeth, and an amputated arm (Trinkaus, 1983; Trinkaus *et al*., 2019). Given the harsh survival conditions of the Middle Palaeolithic, this individual would not have been able to reach a relatively old age alone. As such, the interpretation of this scenario was that the group associated with Shanidar 1 cared for him until the time of his death. Further, the cranium and arm of Shanidar 1 have been argued to have been purposefully manipulated after death (Pomeroy *et al*., 2020).

The remains of Shanidar 4 were associated with clumps of pollen from flowering plants, which were interpreted as having been placed deliberately under the body, implying a complex degree of mortuary behaviour not previously known to Neanderthals (Leroi-Gourhan, 1975; Solecki, 1975, 1977) (Figure 2-10). However, the degree to which the "flower burial" reflects complex behaviour has since been questioned. Current research suggests that the pollen was either introduced by burrowing bees or was from plants placed to cover the body (Hunt *et al*., 2023). This individual was interred in the same area as at least four other Neanderthals, over a span of decades

(possibly hundreds of years), suggesting a cultural significance to the site (Barker and Hunt, 2023; Hunt *et al*., 2023; Pomeroy *et al*., 2020, in press). The remains of Shanidar 1 and 4 have been used by researchers to highlight the humanity of Neanderthals. Shanidar 3 by contrast may have been killed by a fellow Neanderthal or potentially an anatomically modern human (Trinkaus, 1983), showing that interpersonal conflict was still very present in the Middle Palaeolithic. Shanidar A is also interpreted as having been killed by another hominin, the size and morphology of the wound is consistent with a wooden spear (Pomeroy *et al*., in press).

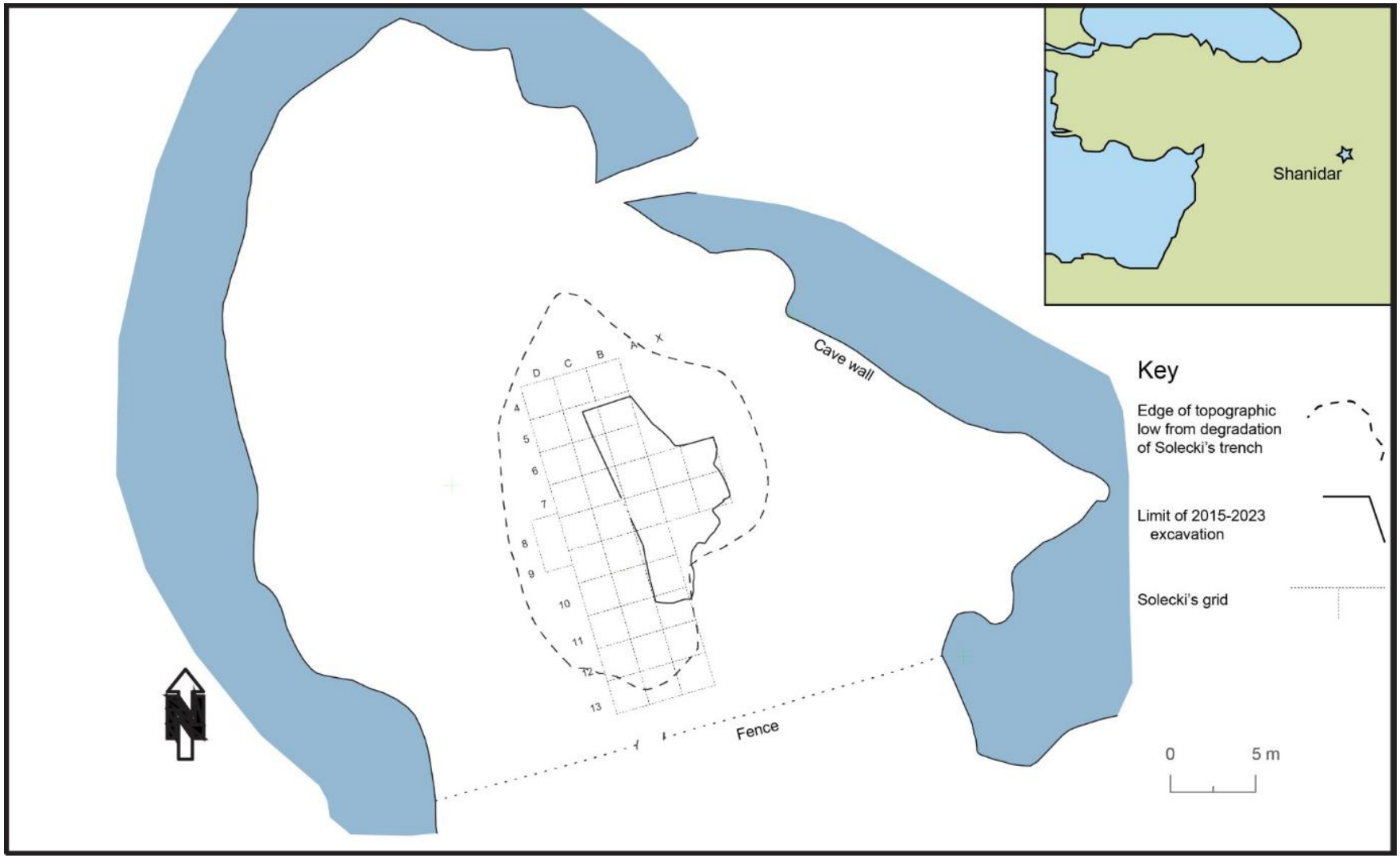


Figure 2-9: *Site plan for the ongoing excavations at Shanidar. Solecki's grid is highlighted, with the re-excavation sat within it. (Image produced by R. Lane)*



Figure 2-10: *A scale reconstruction of the Shanidar 4 burial cluster, housed at the Museum of Human Evolution, Burgos, Spain, Mar 2022 (Photo by M. Hitchcock)*

It has been hypothesised that Shanidar Cave acted as a "summer camp", with the hominins visiting the site in the warmer months, likely subsisting on Ibex before moving down into the plains during the winter (Solecki and Solecki, 1994; Lindly, 1997). Shanidar Cave has also been interpreted as a mortuary site, where subsequent generations of Neanderthals returned to inter their dead (Pettitt et al., 2006; Pomeroy et al., 2020; Barker and Hunt, 2023).

Following his excavations, Solecki split the cave into four distinct layers (Table 2-2). Layer D was the largest layer and contained all ten Neanderthal remains, nine which were recovered in the initial excavations and one juvenile individual later identified during analysis of the faunal assemblage (Figure 2-11) (Solecki, 1963; Cowgill *et al*., 2007). Layer D also contained Mousterian tools resembling those in assemblages from other southwest Asian sites (Solecki, 1963). Based upon radiocarbon dating, Solecki hypothesised that there was a 10,000-year hiatus in occupation between Layer D and the overlying Layer C (Solecki, 1971; Reynolds et al., 2018, 2022). Layer C was described as an Upper Palaeolithic occupational layer with the lithics being comparable with Aurignacian though they were dubbed "Baradostian" for the mountain on which Shanidar is situated (Solecki, 1955, 1958, 1971). The Baradostian industry was later recognised in other UP sites in the region (Hole and Flannery, 1968; Olszewski, 1993). The industry is flake-orientated, with a focus on burins, side-scrapers, points, and retouched blades (Solecki, 1958). Solecki's definition was later expanded by Hole and Flannery (1967) to also

include retouched bladelets.

***Table 2-2**: Archaeological periods from Shanidar Cave (after Solecki 1961.1963, 1971, 1975)*

Layer	Date	Species	Tool Typology	Technocomplex
A	c. 7 kya – 1950s	*Homo sapiens*	Neolithic-Modern	-
B1	c. 11 kya	*Homo sapiens*	Zarzian	Epipalaeolithic
B2	c. 12 kya	*Homo sapiens*	Zarzian	Epipalaeolithic
C	c. 35 -29 kya	*Homo sapiens*	Baradostian	Aurignacian
D	c. 100 - 45 kya	Neanderthal	Non-Levallois Mousterian	Mousterian

The lithic assemblage from Layer C has been described as similar to Levantine Aurignacian industries and to a lesser extent European Aurignacian industries (Reynolds et al., 2018). No human remains were recovered from Layer C but given the Aurignacian-style tools, Solecki determined that it was associated with *Homo sapiens.*

Layer B is split in two contexts and is associated with a Proto-Neolithic cemetery dated to c. 10,650 years ago containing the remains of at least 35 individuals (Solecki et al., 2004). Layer A covers the Holocene up to the 1950s when Shanidar Cave was still occupied by nomadic shepherds even as Solecki was excavating.

The initial goal of Solecki's excavations was to establish the lithic sequence of the site (Solecki, 1953, 1955). In addition to this, faunal and pollen studies were

also conducted. With regards to fauna, the majority of the assemblage was made up of remains of ovicaprids, including West Asian ibex (*Capra aegagrus)* which still lives on the Baradost Mountain to this day. Other herbivore species identified included aurochs (*Bos primigenius*), wild boar (*Sus scrofa*), and red deer (*Cervus elaphus*). Carnivores were represented by remains of wolf (*Canis lupus*), golden jackal (*Canis aureus*), and brown bear (*Ursus arctos*) (Campana and Crabtree, 2019; Evins, 1982).

The pollen analysis conducted by Leroi-Gourhan (1975) found evidence of almond (*Prunus* sp.), pine (*Pinus* sp.), and oak (*Quercus* sp.) (Figure 2-12). These species are known to have been exploited by hominin groups at other sites (Allington-Jones, 2015; Leder et al., 2024).

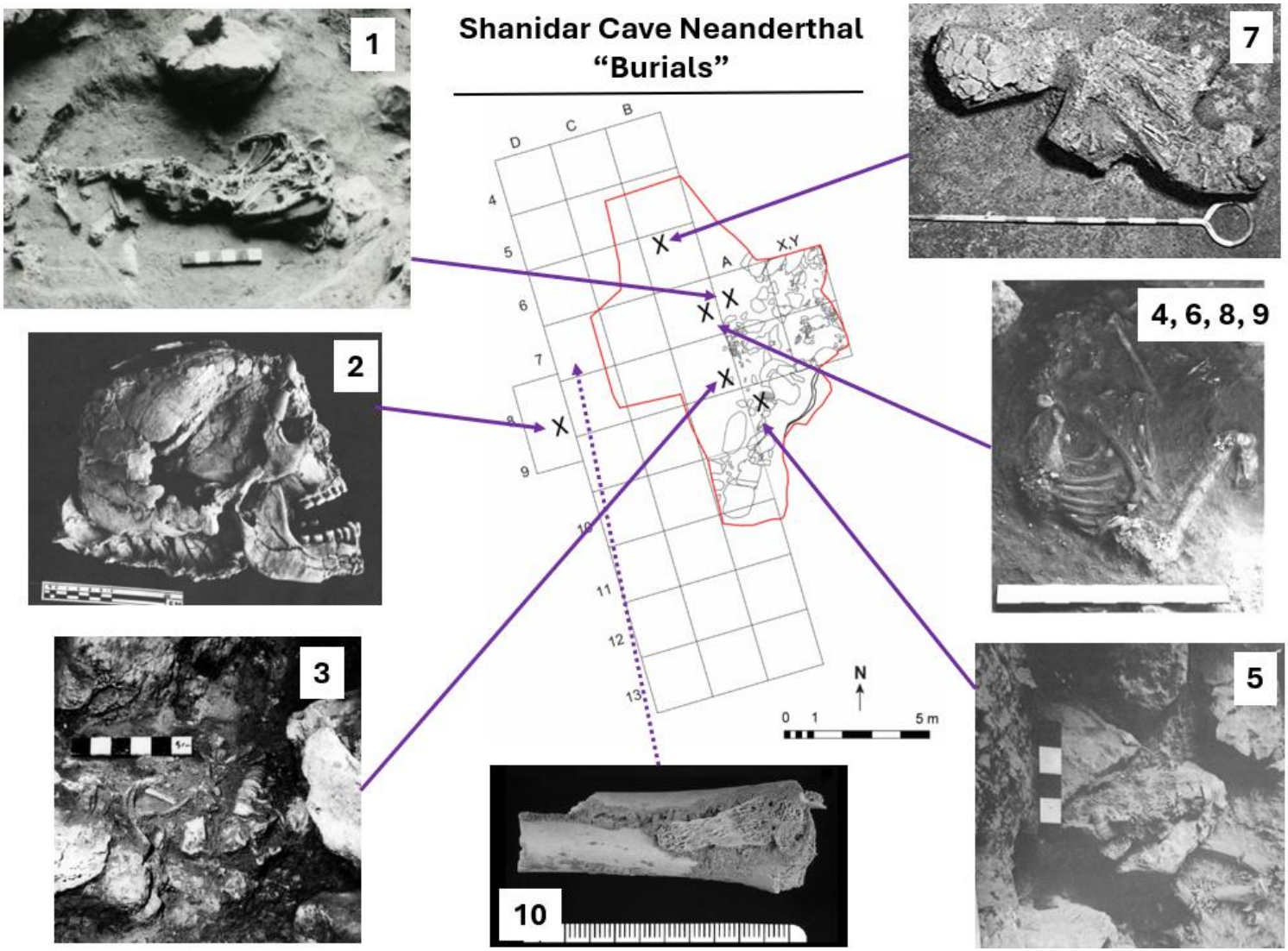


***Figure 2-11**: Location of Neanderthals 1-10 which were recovered by Solecki. The location of each individual is laid over Solecki's original site plan. (Image produced by E. Pomeroy)*



Figure 2-12: *View of Shanidar Cave from the base of the slope, Sep 2022. A wide array of flora can be seen including slender thistle (*Carduus tenuiflorus*), Persian oak (*Quercus macranthera*), and yarrow (*Achillea millefolium*). (Photo by M. Hitchcock)*

2.5.2 Recent Excavations

Solecki did not excavate after 1960 due to ongoing conflict in the region (Solecki, 1975). The Kurdish Regional Government approached Professor Graeme Barker from the University of Cambridge to restart excavations in 2011. Preliminary survey work was conducted in 2014, with the excavations beginning in earnest in 2015. Excavations have taken place every year since, except for in 2020 and 2021 due to the global Covid-19 pandemic. The focus of the new excavations was to re-examine the stratigraphy and establish a chronology for the cultural layers and Neanderthals described by Solecki. The seasons 2015 – 2023 focused on the "Eastern Extension" of Solecki's trench as this is where the majority of the Neanderthals were found (except for Shanidar 2 and 10) (Figures 2-13 and 2-14). As the current excavations trace the original trench set out by Solecki, the excavation area is considerably smaller, and thus this would likely impact the number of artefacts recovered. The recent excavations have seen the application of modern methods including single-context excavation and techniques and as the number of tools recovered are limited, they can be studied in much greater detail (Reynolds et al., 2016).

The majority of the lithic material recovered from the original and from the current excavations are made from grey chert (Solecki, 1955, 1963). To date, no local sources of this material have been identified. The implication is therefore that the occupants of the site carried chert some distance to Shanidar Cave.



Figure 2-13: *View of the deep sounding (phases 10-12) from the top of the trench. Approximate location of Shanidar Z is to the right of the image, under the pallet, Sep 2022 (Photo by M.Hitchcock)*



Figure 2-14: *View of the current excavation area, looking towards the mouth of the cave, Sep 2022. (Photo by M. Hitchcock)*

2.5.3 Post-Solecki Discoveries

The most significant findings from the recent excavations of Shanidar Cave are the discoveries of the Shanidar Z and Shanidar A Neanderthals as well as the evidence for inter-personal violence among these individuals (Pomeroy et al., 2020, in press) (Figure 2-15).

Additionally, further evidence for complex behaviours by Neanderthals such as the cooking of plant material (Kabukcu et al., 2023) and complex hide-removal "fine- skinning" processes has been uncovered (Campana and Crabtree, 2019).



***Figure 2-15**: Ribs of Shanidar A in situ, May 2022. Element is a rib and was recovered near the bottom of MIS 5a. (Photo by M. Hitchcock)*

2.5.4 Stratigraphy of the Site

The cave sediments (see Figures 2-16– 2-21) are predominantly matrix-supported silty sandy breccias, featuring some large angular boulders, openwork breccias, sand, gravel and boulder gravel units. Behind an entrance rampart, the sediments of the cave form a fan emanating from the Eastern Rift (Figure 2-16). The fill of the cave is well stratified but given sharp dips in certain locations, any attempt to plot age/depth curves is complicated (Hunt *et al*., 2023). The ongoing excavations have exposed sediments likely to date to MIS 3 (Figure 2-17), MIS 4 (Figure 2-18), and the middle of MIS 5 (Figures 2-19 – 2-21). Midden material from the shepherd

occupation described above, as well as material recovered by Solecki are thought to have been deposited within the trench after these excavations. An overview of the site's stratigraphy is presented in Figure 2-22.

For the purpose of this study the site was divided into 12 broad contextual phases based on the site's Harris matrix to allow for approximations of lithic locations to known markers such as the position of Neanderthal bodies (see Table 2-3). The reason for this is that the matrix is extremely sizable, and currently incomplete and there are very few dates.

The upper ~4 metres of the exposed sequence are associated with palaeosol formation and weathering. These layers are mainly formed from clay and calcium carbonate enrichment, with root pores with weak blocky structure (Hunt *et al.,* 2023). They are thought to date to MIS 3. The lower section of the exposed stratigraphy is marked by strongly developed horizons featuring basal calcretes and is associated with MIS 5c. The contexts near the Shanidar 4 cluster preserve a layer of cross-bedded silty sands showing three palaeosols consistent with strong weathering in temperate environments. The layer is provisionally attributed to the end of MIS 5a. Geoarchaeological investigation of the contexts is ongoing (Hunt, 2024).

***Table 2-3**: Harris matrix phases and associated locations and dates*

General Area	MIS Stage	Phase	Age
Unstratified	-	**0**	**-**
Top of cave, Holocene	MIS 1	**1**	0-10,700
Latest Baradostian	MIS 3	**2**	35-42,000
Baradostian above Shanidar 5	MIS 3	**3**	42-52,000
Shanidar 5	MIS 3	**4**	52-56,000
Early Baradostian: Below Shanidar 5,? location of Shanidar 1 and Shanidar 3	MIS 3	**5**	56-58,000
Late Mousterian: Below Shanidar 1, 3, 5	MIS 3 early	**6**	58-61,000
Below Shanidar 3, Above Shanidar 4 cluster	MIS 4	**7**	62-70,000
Shanidar 4 burial cluster (Shanidar 4, Shanidar 6, Shanidar 8, Shanidar 9, Shanidar A, Shanidar B)	MIS 5a	**8**	70-75,000
Above Shanidar Z	MIS 5a	**9**	70-75,000
Shanidar Z	MIS 5a	**10**	70-75,000
Shanidar A	MIS 5a	**11**	70-75,000
Below Shanidar A	MIS 5c	**12**	80-100,00

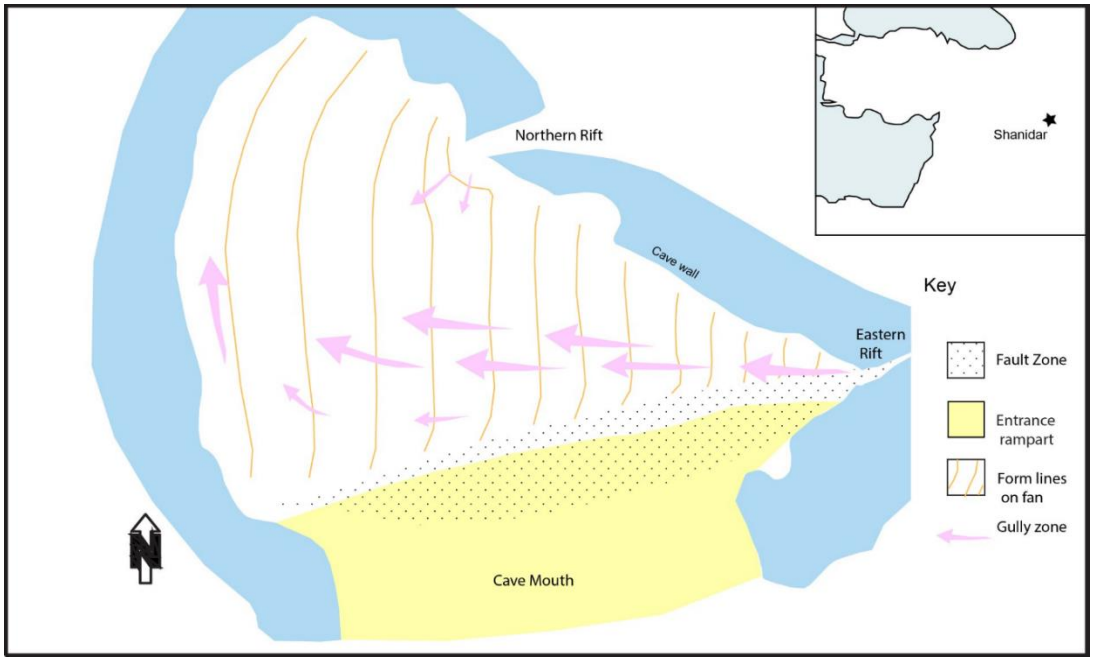


***Figure 2-16**: Plan showing the Geomorphology of the site. The main sources of sediment in the cave are (1) the Eastern Rift, which was the source of most of the fine-grained sediment, via wash, mudflow and streamflow (which at times caused gullying) - these gave rise to the general fan-shape of the sediment pile during the Pleistocene, sloping down from the Eastern and Northern rifts towards the west wall of the cave. (2) the fault zone in the cave roof and the cliff above the entrance, which were the source for most of the boulders and debris-avalanche deposits in the cave fill and which gave rise to the entrance rampart, against which the fan deposits from the Eastern rift are embanked. (Image produced by C.O. Hunt)*



***Figure 2-17:** Photo showing MIS 3 sediments along the Northern side of the Eastern Extension. Shanidar 1 lay in the palaeosols that sloped down from the top half of the lower red division of the ranging rod. (Photo by C.O. Hunt)*



***Figure 2-18**: Photo showing MIS 4 sediments. The boulders fell in MIS 4, with the sands above being later MIS 4. Shanidar Z lay a way below the boulders, hence the protective materials below the boulders. (Photo by C.O. Hunt)*



***Figure 2-19:** Photo showing group of semi-superimposed fireplaces under excavation in the corner of the trench, in that middle darker layer in 5c. (Image by C.O. Hunt)*



***Figure 2-20**: Photo showing MIS 5c sediments. MIS 5b is right above the dark layer near the top of the ranging rod and the pale layer at the base of the ranging rod is the top of MIS 5d. The 5c deposits are heavily pedogenically altered (calcitised) wash and ash, mostly, and containing occasional large fireplaces. There are three dark layers which are very highly organic, almost sapropelic. The dark layers would have been from times when it was very wet in winter and probably never dried out in the summer, allowing this kind of organic preservation. There are fireplaces in these too. The two paler layers between reflect periods of Mediterranean-style summer-dry climate. (Photo by C.O. Hunt)*



***Figure 2-21**: Photo showing MIS 5a deposit after removal of Shanidar Z and Shanidar A - the mid brown layer in the top half of the image. Shanidar Z was a bit over halfway up this layer. Shanidar 4 almost at the top, Shanidar A close to the bottom. Rockfall from MIS 4 is the pale layer right at the top. Shanidar 4 must have been just under it. The big diamond-shaped rock and the pale rocky layer partly below it are MIS 5b and the top of 5c is the dark sediment below this (Image by C.O. Hunt)*

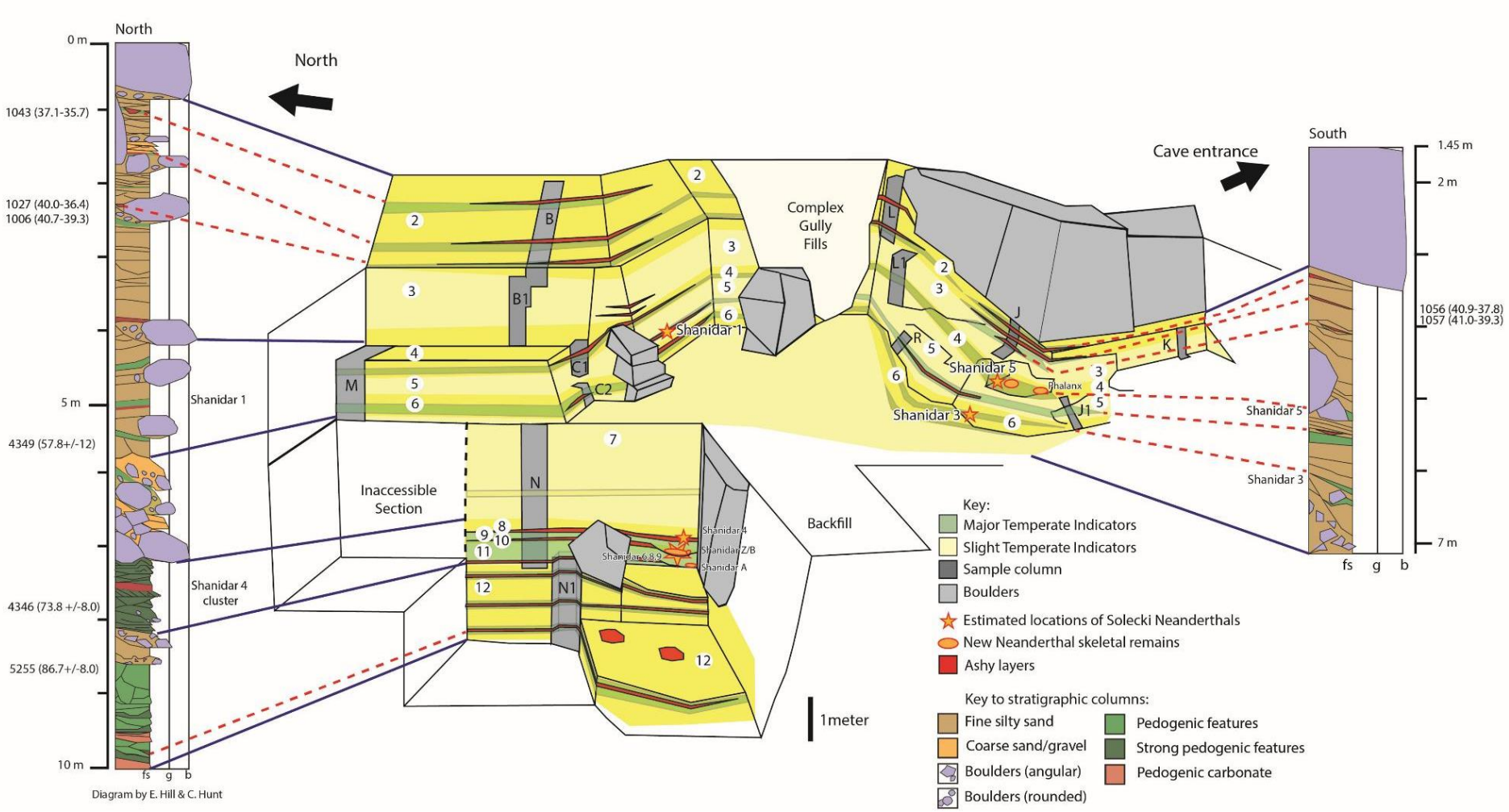


Figure 2-22: *Layout of the East side of the trench and representative stratigraphic columns (Image by E. Hill and C.O. Hunt*

2.6 Conclusion

In this chapter the two hominin species associated with Shanidar Cave, *Homo neanderthalensis* and *Homo sapiens*, have been introduced, from their respective discoveries to the current state of knowledge. Debates and current understandings surrounding the behavioural complexity of these species are discussed, providing a reference for the subsequent chapters. The prevailing school of thought for many years, on the difference between Upper and Middle Palaeolithic populations – the "Cultural Revolution" - has been addressed and the lack of differences between these two species has been highlighted. Additionally, the archaeological context for this work is outlined with an exploration of past and current research into Shanidar Cave.

The following chapter serves as a literature review surrounding the origins and development of, and ongoing debates regarding use-wear studies.

Chapter 3 – Use-Wear Analysis and Residue Analysis

3.1 Lithic Analysis

The previous chapter covered the discovery of the Neanderthals in the late 1800s and discussed the current state of knowledge regarding this species of human. A summary of the study of anatomically modern humans is also provided, and the behaviours of both species is compared and contrasted. The site of Shanidar Cave was presented and it's significance to Palaeoanthropology was discussed.

This chapter will review in brief the history of lithic analysis and why the development of use-wear analysis was critical for our understanding of Palaeolithic behaviour patterns. Critically, the conception and development of use-wear studies as a discipline is complicated and it is important to understand the context before the state of knowledge can be assessed. The main methodologies behind the development of the field, these being low-power and high-power microscopy, are also discussed.

3.1.1 19th Century Origins

Stone tools (lithics) have always been viewed as of significant cultural importance despite the mystery of their origins (Odell, 2006). Formerly accepted ideas for where lithics originated range from the arrows of elves, the remains of the gods' lightning bolts or fossilised storms (Goodrum, 2002).

By the time Europeans expanded into the 'New World' of America and recovered stone tools used by modern hunter-gatherer societies, those found in antiquity were associated with similar people from the past (Odell, 2006).

The earliest accepted classification system for determining the antiquity of artefacts was Thomsen's Three Age system (Heizer, 1962). This typology was developed before the recognition of Neanderthals. The established ages were Stone, Bronze, and Iron. The Stone Age was subdivided into Palaeolithic (old Stone Age) and Neolithic (new Stone Age) in 1864, with the Mesolithic (middle Stone Age) being identified later (Lubbock, 1865). Attempts were made during the 19th Century to determine the function of stone tools, mostly based on form or shape, something we would now term 'speculative function' (Lubbock, 1865; Nilsson, 1868). The role lithics were deemed to have played in the lives of prehistoric people during this period was based on ethnographic data (discussed in Stemp et al., 2016). The prehistoric sites studied around this time became the subject of culture history, separating populations into distinct cultural groups based on the shape of particular lithics and the presence or absence of specific tool forms within an assemblage (Binford, 1984; Clarke, 1969).

With speculative function, assumptions are made as to the use of a tool. In use-wear analysis, first developed in the mid-19th Century, analysis of breakages, scars, striations, polishes, and residues on a stone tool is used to obtain a "reasonably accurate reflection" of not only how a tool was used, but what material it might have been used on, and the action associated

with such (Olausson,1980; Vaughan, 1981). In the earliest studies, however, there was a lack of experimental replication of stone tool use which is now regarded as an essential component of use-wear research (e.g. Moir, 1914; discussed in Olausson,1980, Stemp et al., 2016). These studies were undertaken macroscopically or with the aid of a magnifying glass (summarised in Oluasson, 1980).

3.1.2 Early - Mid 20th Century

The first large scale systematic study on lithic microwear was undertaken between the 1930s and the 1950s by Sergei Semenov (1964). Semenov used methods previously established for assessing wear on modern metal tools, applying the technique to bone and lithic artefacts from different time periods. Semenov used both a higher power and a low power microscope. A binocular microscope (stereomicroscope) allowing for magnifications up to 180x was used for viewing striations and edge chipping. A monocular compound microscope with perpendicular incident lighting was used to examine use-polishes at magnifications between 300-400x (Semenov, 1964; Vaughan, 1981). That he utilised two different microscopes differentiated his work from that of many contemporary researchers (Semenov, 1964; Bordes 1950; Olausson,1980; Sonnenfeld 1962; Witthoft 1959).

Semenov's process was split into three phases (Semenov, 1964; MacDonald, 2026). First the archaeological tool was analysed both macroscopically and microscopically on all edges to find any potential alterations which would

inform as to a hypothetical function. This was then followed by knapping a replica of the tool in question and using it for the hypothesised activity. Finally, the wear traces on both specimens were compared. If the wear traces were deemed a match, then the proposed action could be accepted provisionally (Semenov, 1964; Vaughan,1981). If the traces were incompatible, the process was repeated until they matched. To substantiate his results, Semenov also ensured to assess any natural damage through experimentation such as exposing prepared tools to the elements, as well as by recording multiple variables such as rock type and material worked (Semenov, 1964).

The work of Semenov was introduced to the wider world following the translation of his book *Prehistoric Technologies* from Russian into English (1964) although the work was not accepted without criticism, with issues surrounding replicability being the focus. However, it has been stated that some of these issues may have been in part due to errors in translation, with such being addressed in later publications (Bordes ,1974; MacDonald and Sanger 1968; Semenov, 1970).

During the 1960s understanding of lithic assemblages was also improved through the introduction of a standardised typology developed by the geologist Francois Bordes (Bordes, 1961a, b; Clarke, 1969). Speculative function still influenced the understanding of stone tool technologies, for example, scrapers were named as such due to their perceived role as a

hide-working tool – as was found from ethnographic studies (Binford and Binford, 1966; Bordes, 1961a; Sonnenfeld, 1962; discussed in Olausson,1980).

Systematic investigation of the uses of prehistoric technologies arrived in the west during a time of theoretical and methodological change within the discipline of archaeology. 'New Archaeology' or 'Processual Archaeology' was developed towards the end of the 1950s (Phillips and Willey, 1953). This form of archaeological theory implied that the goals of archaeology were those of anthropology and that studies of past cultures should reflect this. New Archaeology followed the previous culture history phase of archaeological theory and aimed to bring a more scientific understanding to the discipline of archaeology (e.g. Binford, 1962; Clarke, 1973; Schiffer, 1975; Renfrew, 1973). The creation of stone tools became regarded as people making items designed for a specific purpose stemming from environmental and cultural stimuli, rather than a reflection of one's cultural background (Binford, 1981, 1982; Hayden, 1979; Kamminga, 1982).

3.1.3 1970s and 1980s

Following the development of Processual Archaeology and the translation of Semenov's *Prehistoric Technologies* (1964), the 1970s and 1980s saw the rapid development of use-wear studies as a discipline (Donahue, 1988; Hayden, 1979; Kamminga, 1982; Keeley, 1977, 1980; Keeley and Newcomer, 1977; Odell, 1980; Tringham et al., 1974; Vaughan, 1981, 1985). Some studies, however, still focused on how efficient a tool was for a task

rather than exploring the different ways it might have been used (e.g. Bordes, 1974).

The methods established by Semenov were further developed by practitioners leading to a more comprehensive understanding of use-wear studies. For example, Kamminga (1982) developed a large experimental reference assemblage working materials native to Australia to more accurately determine the uses of archaeological tools from indigenous Australians. Keeley (1980) developed a reference collection for polishes and utilised even higher power microscopy (500x magnification) to allow for distinction between polishes on archaeological tools. Experimentation became commonplace during this period, including the use of blind tests, whereby a replica tool would be worked on an unknown material by a third party for the practitioner to evaluate having not witnessed the activity. Ethnographic data was widely adopted, and different microscopes with different capabilities and magnification powers were used in order to view all wear traces present on a tool (Keeley, 1974,1980; Keeley and Newcomer,1977; Odell, 1980; Kamminga, 1982; Vaughan, 1981, 1985; discussed in Stemp et al., 2016; Oluasson, 1980; Shea, 1987). In addition, the scanning electron microscope (SEM) was introduced to use-wear studies at this time (discussed in Frahm, 2014). The benefits of the SEM are its high magnification (>10,000x), high resolution and depth of field allowing for greater distinction between wear types. The main issues surrounding use of the SEM are that specimens must be under a certain size dependent upon

the specific machine, as well as the necessity to coat them to make them conductive, meaning that SEM analysis can be destructive to archaeological material (e.g. Anderson, 1980; Mansur-Franchomme, 1983; discussed in Olausson, 1980). Finally, the types of raw materials used in experimental reconstructions of tools were expanded beyond worked flint/chert to include other material types such as obsidian, basalt, quartz and bone (Adams, 1988, Odell, 1980; Richards, 1988; Sussman, 1985, 1988; see also Grace, 1996).

Perhaps one of the most significant advances for the study of microwear was the first international conference on use-wear in 1977 at Simon Fraser's University, Canada. A major criticism of the discipline had been a lack of standardisation. Descriptions of wear patterns, in particular the initiations and terminations of scars had no standardised terminology across studies (Gallagher, 1977; Bordes, 1974). A group of attendees aimed to create a universal nomenclature for these scar patterns, which was named the 'Ho Ho Classification' for the Chinese restaurant in which they met (Kamminga et al., 1979). The classification defines four major scar terminations one may see when analysing use-wear: feather, hinge, snap, and step (see Table 3-1 and Figure 3-1). The variation in termination is dependent on the force applied and the material worked. Larger and deeper scars are associated with harder worked materials (e.g. bone) and smoother, thin scars are indicative of softer worked materials (e.g. plant matter). Two main forms of initiation are described, these being cone and bending (Kamminga et al., 1979). Cone initiations are caused by significant stress to one concentrated point along a

lithic's edge, resulting in a cone-like feature at the point of impact. Bending initiations occur when stress is applied to a broader contact area forcing the edge of the lithic to "bend" until it snaps. As such, the initiation area of the scar will be straight or convex. The Ho Ho Classification continues to be utilised in present day studies (see section 4.4.3; e.g. Marreiros et al., 2020; Lohse and Sammons, 1999; Olausson, 1990; Stemp 2001; Stemp et al., 2016; MacDonald, 2026).

Though terminology became standardised, microscopy did not. The 1980s saw advocates for either low-power or high-power methodologies champion their methods, oftentimes by critiquing alternative methods rather than by developing their own (Odell, 2004; Olausson, 1980; Stemp *et al.,* 2016). It has been suggested that infighting may have resulted in a limited number of new practitioners joining the discipline following this period and thus contributed to a decline in the overall volume of publications by the 2000s (Stemp *et al*., 2016) (see Figure 3-2).

Table 3-1: *Termination types as defined by the Ho Ho committee (Kamminga et al., 1979)*

Termination type	Description of termination type	Material hardness associated with termination type
Feather scar	Smooth, thin, tapers into tool surface	Softer materials
Hinge scar	Rounded, blunt end where the force of the fracture turned away from the tool's surface before detaching	Middle hard materials
Step scar	End in a sharp 90-degree step, abrupt break	Hard materials
Snap scar	Edge breaks off entirety	Hard materials

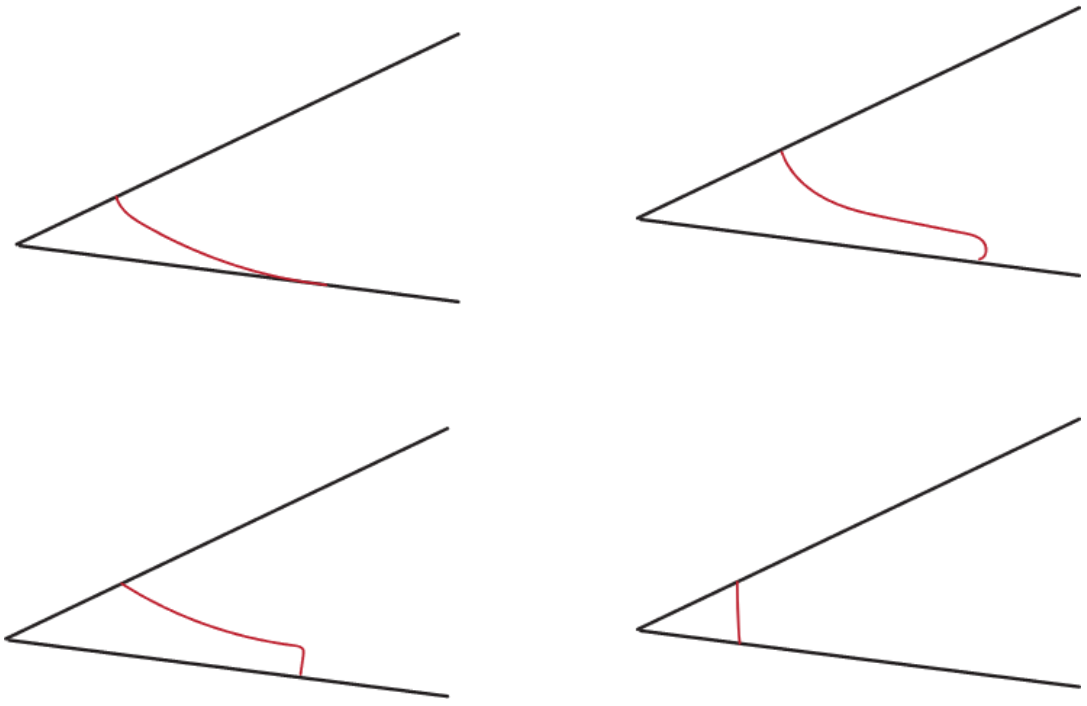


Figure 3-1: *Termination types as defined by the Ho Ho Committee (Hayden, 1979). Top Left: Feather, Top Right: Hinge: Bottom left: Step, Bottom Right: Snap*

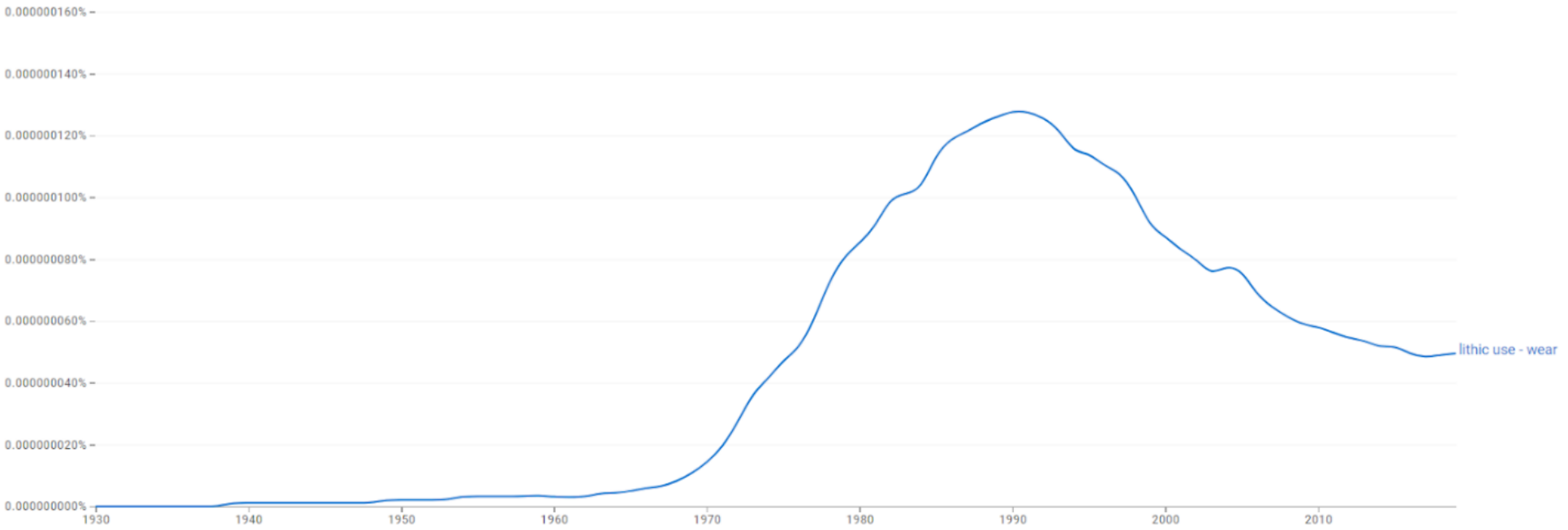


Figure 3-2: *Percentage of publications globally published in each year since 1930 with the phrases 'use-wear' in the title. The graph remains similar if other terms such as 'microwear' or 'traceology' replace use-wear. A clear increase can be seen from mid-1960s, peaking in the 1990s with the acceptance of both high power and low power microscopy. The decline in the 2000s has been argued as resulting from fewer practitioners joining the discipline due to infighting (Stemp et al., 2016)*

3.1.4 1990s - Present

Use-wear analysis saw a refinement of techniques in the 1990s into the 2000s (e.g. Yamada, 1993; LeMoine, 1994; Lohse and Sammons, 1999; Barceló et al., 2000; Clemente and Gibaja*, 2009)*. For example, the use of digital intelligence systems to aid in the assessment of wear formation was established. These included the use of a comparative artificial neural network which was trained to identify slight differences in wear patterns caused by working different materials in order to assist with identification of wear patterns on archaeological tools (Barceló et al., 2000). Other forms of artificial intelligence included the use of Expert systems which used rule-based reasoning in order to determine how archaeological tools may have been used prior to deposition (Grace, 1993, 1996; Lohse and Sammons, 1999). These systems were criticised by some for because they could only analyse small areas of a lithic at a time, and also that the data input into the system would be based on the understanding of the researcher which could be wrong or biased (discussed in Stemp *et al.,* 2016).

Methodologies including blind tests continued in this period and results were largely more reliable than those of previous studies due to the inclusion of more analysts (Bamforth et al.,1990; Evans, 2014; LeMoine, 1993; Shea, 1991; Grace, 1996). Another avenue of research which saw significant advancement in this time was the study of non-use related damage to archaeological material e.g. trampling damage or fluvial movement (Burroni et al.; 2002; Grosman et al., 2011; Che and Hosfield, 2020; MacDonald, 2026;

see section 4.4.5). Post-depositional damage can obscure and/or mimic wear traces on tools and remains an issue impacting use-wear analysis (Stemp, *et al*., 2016; MacDonald, 2026).

Both low and high-power microscopy were accepted as valid avenues of research during the 1990s, with many practitioners opting to use both to allow a more comprehensive understanding of the actions and materials associated with a stone tool (Grace 1990; Marreiros et al., 2020; Odell, 2006; Olausson, 1980; Stemp 2001, Stemp et al., 2016; MacDonald, 2026).

3.1.5 Low Power Microscopy

The low power method typically utilises a stereomicroscope (also binocular or dissecting microscope) which can be successfully operated at magnifications of up to 160x but typically is used between 20x and 60x (Odell, 2006). The artefact is illuminated using incident light that strikes it at a diagonal angle - enhancing shadows and the depth of field required to interpret features stereoscopically (Marreiros et al., 2015). The precision of the low power technique was highlighted through the use of blind tests, as discussed above. The use of these tests has shown that a skilled analyst can determine the location of wear, direction of use and action conducted (Odell and Odell-Vereecken, 1980). The low power method cannot effectively allow determination of the exact material worked, but a hardness scale (the 'soft-hard scale') developed by Odell (1979) is used to describe

the wear when present, with the main categories for the worked material being soft, medium, medium-hard and hard (see also Odell, 2006).

The use of a scale allows the low power user to determine the severity of the use-wear on a lithic and based on its features (e.g. size of scars and terminations, extent of polish formation, striation concentrations) can give indications of how and on what the tool was utilised. The main benefit for the low power technique is its simplicity, with the protocols and equipment being easy to understand (Marreiros *et al*., 2015; Grace, 1996). Once one is familiar with the microscope and the methods, scanning an artefact for wear can be relatively speedy, with the result being that large assemblages can be processed efficiently (Marreiros *et al*., 2015). One drawback for this method however is the potential difficulty in separating intentional retouching and non-intentional edge damage, but this can be overcome to some extent by improving the analyst's knowledge on this subject (Keeley, 1980). Although using Odell's soft-hard scale aids in analysis, the high-power method (section 3.1.6) is widely regarded as significantly more precise in this regard (Keeley, 1977, 1980; Keeley and Newcomer, 1977; Vaughan, 1985).

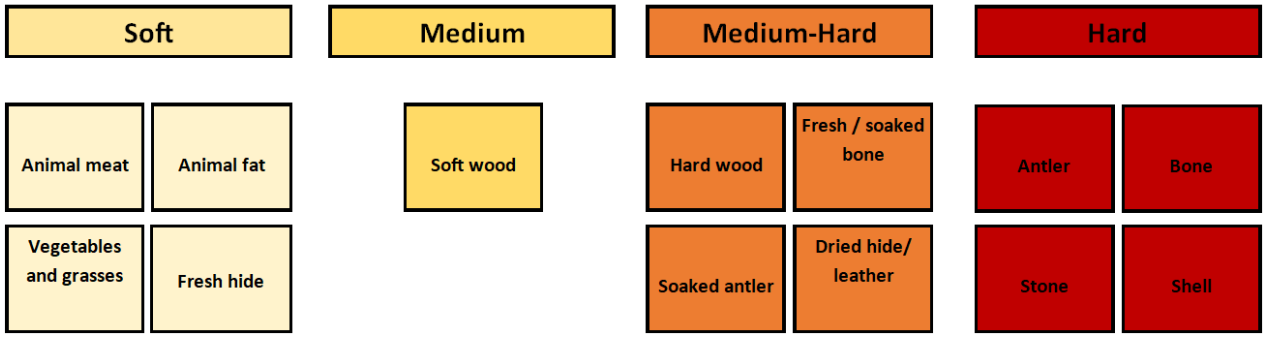


***Figure 3-3**: Odell's hardness categories, after Odell (1979*

3.1.6 High Power Microscopy

The high-power method uses a binocular metallurgical microscope (Marreiros et al., 2015; Keeley, 1980; Vaughan, 1985). Incident light is directed at 90° (light-field illumination) or at 45° (dark-field illumination) to the artefact's surface. Light-field illumination is effective for better assessing surface topography at magnifications over 100x (Keeley 1980; Odell, 2006; Grace, 1996). Dark-field illumination is better suited for assessing marginal and surficial features, usually at slightly lower magnifications than light-field illumination. The main strength of this method is the ability to determine and discriminate types and forms of polish and striation, allowing one to accurately determine the exact use of a tool, as well as the material worked (Keeley, 1974, 1980; Vaughan, 1981, 1985; Van Gijin and Lammers-Keijsers, 2010; Marreiros *et al.*, 2014).

Another benefit is the ability to use relatively high magnifications. Magnifications can vary between make and model of microscope, but most high-power microscopes are capable of magnifications of over 500x. This is made possible due to the increase in illumination provided by the incident lighting (Mansur, 1982). High-power microscopy also allows the analyst to examine a tool for residue, i.e. anything adhering to the tool's surface, for example blood, ochre, fur, and so on. It is possible to view larger residue deposits at lower magnifications; however, because smaller deposits can be missed this is not common practice. Regardless as to the method, residues can often be mistaken for or can obscure evidence of abrasive wear. This is particularly so at higher magnifications where some wear and residues can appear very similar. As such, the importance of cleaning the tool is stressed, especially prior to high-power microscopy (Keeley, 1980; Vaughan, 1981, 1985).

Semenov and colleagues described cleaning their artefacts before coating them in magnesium powder (1964), however Keeley used a more aggressive cleaning protocol (1980). Artefacts would be cleaned using white spirit, followed by washing with ammonia-based cleaners, then immersed in warm hydrochloric acid (HCl, 10% concentration) and solutions of sodium hydroxide (NaOH, 20-30% concentration) before finally being placed in an ultrasonic cleaning tank (Keeley 1980; Odell, 2006). Many practitioners were critical of such cleaning regimes, stating that the edge and surface topography of the lithic would be altered (Fullola i Percot and Rodón i Borràs, 1990). Since

Keeley (1980) published this method, the use of chemical cleaning agents has declined. Soap and water in an ultrasonic bath is regarded as sufficient by many use-wear practitioners (e.g. Odell, 2004; Vaughan, 1985; Fullola i Percot and Rodón i Borràs, 1990; Fullager, 2013; Fullager and Jones, 2004; see section 4.4.1).

The biggest limitation of the high-power method is the time needed to observe an artefact. In low-power tests conducted by Odell and Odell-Vereecken (1980), the average observation time was 5 minutes per tool analysed. By comparison, in a blind test conducted by Uranth *et al*. (1986) using high power microscopy, participants spent an average of 90 minutes per tool (see also Odell, 2006; Grace, 1996; MacDonald, 2026). A summary and comparison of both methods is outlined in Table 3-2.

***Table 3-2**: Comparison of high and low power microscopy*

Method	Equipment	Magnifications	Benefits	Limitations
Low Power	Stereomicroscope	2x - 160x	Simple, quick, accessible	Cannot determine exact worked material
High Power	Binocular metallurgical microscope (incident lighting)	100x - 500+x	Potentially accurate diagnosis of worked materials, high magnification	Time consuming, cleaning protocols may damage lithic

3.1.7 Residues

The study of residues adhering to a lithic's surface was traditionally seen as a separate avenue of research from use-wear studies (Grace, 1996; MacDonald, 2026), whereas now it is seen as an essential facet of such (Evershed, 2008; Venditti et al., 2019; Doronicheva et al., 2022; Fullager, 2013; Fullager and Jones, 2004; Loy, 1983, 1993; Rots et al., 2016).

Initial research into residue analysis began in the 1970s and 1980s, with a focus on plant matter analysed using low- power microscopy, as well as the identification of phytoliths and starch grains (Anderson, 1980; Shafer and Holloway, 1979). Initial studies into animal traces were also finding traces of hair, skin tissue, blood, and feather barbules (Loy, 1983, 1993; Loy and Wood, 1989; Hardy and Garufi, 1998). The study of residues was further developed through to the present with a refinement of established techniques being the main driving cause for the development, as well as the combination of residue analysis with use-wear studies (Barton et al., 1998; Fullagar, 2013; Fullagar and Jones, 2004; Rots et al., 2015, 2016). Residues located on stone tools are studied using a purpose-built comparative collection and where possible the use of advanced techniques including simple biochemical test, histology, atomic spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, Raman spectroscopy, gas or liquid chromatography, mass spectroscopy (GCMS/ LCMS) as well as genetic and protein analyses (Fullagar, 2013; Fullagar and Jones, 2004; Evershed, 2008; Loy, 1993).

3.2 Middle – Upper Palaeolithic Behavioural Evidence from Use-Wear and Residue Studies

Use-wear studies of Middle and Upper Palaeolithic assemblages are still far less numerous than studies on lithics from later periods. This might be due to preservation issues, with traces of wear and residues less likely to be preserved on older material (Langejans, 2010; Grace, 1990; Pedergnana and Ollé, 2020). It may also be the result of bias, with the assumption being that older material would not preserve evidence, and wear and residues are therefore not looked for. Additionally, there are fewer Palaeolithic sites than those of later prehistory, and even fewer archaeologists excavating these sites. As such, one could expect fewer studies on earlier material.

Evidence for the behavioural and cultural complexities of Middle Palaeolithic hominins is apparent in the available use-wear studies. The fact that hominins could use fire is well established (Sorensen et al., 2014, 2018; Wadley et al., 2020), although it is unknown by what means they initially manipulated fire; either through the direct creation of it using tools or by utilising naturally occurring fire (e.g. from wildfires). Use-wear studies have highlighted potential fire-starting implements in Mousterian assemblages (Sorensen et al., 2014, 2018). Additionally, traces of wear on lithics from Middle Palaeolithic sites have highlighted the complexities of Middle Palaeolithic diets: e.g. exploitation of plant, fish and bird (Hardy and Moncel, 2011; Hardy et al., 2013, 2020). Additionally, the creation of craft materials such as string, hide, and wooden tools is evidenced from several use-wear studies (Doronicheva et al., 2022; Hardy and Moncel, 2011; Hardy et al., 2013; Navazo-Ruiz et al.,

2023). Residues have suggested that Neanderthals were capable of creating composite, hafted tools, however, no conclusive evidence of Neanderthal projectile technology has been found to date (Shea and Sisk, 2014; Schmidt et al., 2024). Finally, recent studies have highlighted the use of bone tools and shell tools in the Middle Palaeolithic (Bauman et al., 2022; Mateo-Lomba et al., 2024; Vaquero et al., 2017).

Results from use-wear studies on Upper Palaeolithic tools show that these tools were worked in the same way and using the same materials as those worked in Middle Palaeolithic assemblages (see Table 3-3), with only slight differences in terms of processing those materials.

Table 3-3: *Examples of behaviours determined from use-wear studies at Middle Palaeolithic and Upper Palaeolithic sites*

Behaviour	Middle Palaeolithic	Upper Palaeolithic
Fire-making	Sorensen et al., 2014, 2018	Sorensen et al., 2014, 2018
Bone/ shell tools	Bauman et al., 2022 ; Mateo-Lomba et al., 2024 ; Vaquero et al., 2017	Knecht, 1993; Riordan et al., 2023; Tartar, 2012
Hide processing	Doronicheva et al., 2022; Navazo Ruiz et al., 2023; Zilhão et al., 2017	Aleo et al., 2021 ; Adovaiso et al., 1996 ; Hardy, 2008
Small game processing	Hardy et al., 2013,	Hardy, 2008, 2016
Bird processing	Hardy and Moncel, 2011	Hardy, 2008, 2016
Plant processing	Hardy and Moncel, 2011	Aranguren et al., 2007 ; Donahue, 1988 ; Revedin et al.,2010
Wood processing	Doronicheva et al., 2022; Hardy and Garufi, 1998; Navazo Ruiz et al., 2023; Zilhão et al., 2017	Donahue, 1988; Calvo, 1997; Moss, 1983a,
Animal product processing	Doronicheva et al., 2022; Hardy and Moncel, 2011, Hardy et al., 2013; Navazo Ruiz et al., 2023; Zilhão et al., 2017	Donahue 1988; Moss, 1983

3.3 Conclusion

This chapter provides an overview of the origins and development of use-wear studies from their conception to the present day. A brief overview of the differences between low and high-powered microscopy is also detailed. An introduction to residue analysis with regards lithics is also presented. As stated in section 3.2, detailed use-wear and residue analyses of Middle Palaeolithic and Upper Palaeolithic assemblages are currently extremely limited in number. This may be as a result of the issues surrounding the discipline in the 1980s (see Stemp et al., 2016), or it could relate to preservation issues, the assumption of preservation issues, or assumptions about the behaviours of particular species.

The following chapter will cover the methods used in the experimental series, and methods applied to the analysis of the archaeological materials from Middle Palaeolithic and Upper Palaeolithic deposits from Shanidar Cave.

Chapter 4 – Methods

4.1 Introduction

This chapter provides an appraisal of the methodological approaches adopted in this thesis. These are split into three categories: experimental, fieldwork, and laboratory methodologies.

Until the middle of the 20th Century, lithic analysts typically assumed that form was equal to function, for example, a scraper could only be used for scraping (e.g. Bordes, 1961a). Research has indicated however that this is an oversimplification and that archaeological lithic assemblages should be assessed in detail to determine the use of each tool (see Chapter 3; Semenov, 1964; Keeley, 1980; Odell, 1981). This can be achieved by creating an experimental reference collection of worked tools representing different categories of use-wear, which can then be compared and contrasted with the archaeological material (Marreiros et al., 2014, 2015; Keeley, 1980; Vaughan, 1985). Therefore, an experimental reference collection of worked tools was produced using materials equivalent to those known to have been exploited in the Palaeolithic of the Zagros. This chapter describes the microscopical, analytical, and data collection procedures used within both the experimental study and in the assessment of the archaeological material from Shanidar Cave.

4.2 Experimental Methods

Using a comparative collection of prepared flakes worked on known materials formed the backbone of most major studies in the field of use-wear and as such there is a wealth of comparative data available (Keeley, 1980; Keeley and Newcomer, 1977; Odell, 1979; 1980, 2006; González-Urquijo and Ibáñez Esteves, 1994; Vaughan, 1981; Adams, 2014; Bamforth et al., 1990; Marreiros et al., 2015; Kamminga et al., 1979). The experimental series developed for the purposes of this research allowed for comparison to the literature and served to strengthen both the conclusions of this study and the researcher's skills as an analyst.

4.2.1 Materials

The materials selected can be broadly separated into two main categories: those used for subsistence and those used for craft (Table 4-1).

***Table 4-1**: List of worked materials*

Subsistence	Craft
Raw meat (and bone)	Hide (fresh and dry)
Cooked meat (and bone)	Bone (fresh and dry)
Fish	Antler
	Horn
	Hard wood
	Soft wood
	Other plant matter (tree bark)
	Shell

4.2.1.1 Subsistence

Subsistence relates to those actions directly associated with the need to produce and consume food – this can be seen as the most basic human requirement aside from the consumption of water. Materials worked for the purpose of this study were raw and cooked meat and associated fat and bone, as well as meat, bone, and scales from fish. Animals consumed at Shanidar Cave and at other sites in the Zagros region are presented in Table 4-2.

Table 4-2: *Presence table for faunal studies in the Zagros region after Hole, 2012; Hole and Flannery, 1967; Turnbull ,1975; Otte et al., 2007; Evins, 1980.*

Site	Shanidar Cave (MP)	Warwasi (MP/UP)	Yafteh (MP/UP)	Ghar-e Boof (MP/UP)
Wild goat/ibex (*Capra aegagrus*)	X	X	X	X
Gazelle (*Gazella* sp.)	X	X	X	X
Red deer (*Cervus elephus*)	X	X	X	X
Roe deer (*Dama dama)*	X	X	X	X
Aurochs (*Bos primigenius*)	X	X	X	X
Wild boar (*Sus scrofa*)	X	X	X	X
Tortoise (*Testudo graeca*)	X	X	X	X
Brown bear (*Ursus arctos*)	X	X	X	
Wolf *(Canis lupus*)	X	X	X	
Fox (*Vulpes vulpes*)	X			X
Leopard (*Panthera pardus*)	X		X	X
Fish (indeterminate species)	X		X	X
Land snail *(Assyriella* sp.)	X		X	

Faunal studies from Shanidar Cave are limited. Faunal remains analysed by Evins (1980) from Solecki's Mousterian Layer D evidenced a wide range of species present at Shanidar Cave during the Middle Palaeolithic, including wild goat (*Capra aegagrus*), wild boar (*Sus scrofa*), aurochs (*Bos primigenius*), red deer (*Cervus elephus*), fox (*Vulpes vulpes*) and tortoise (*Testudo graeca*) (see Table 4-2). Of these, only wild goat, wild boar, and tortoise had evidence of exploitation by hominins in the form of charring and cut marks. Cut marks on ibex remains from Layer D were later studied in depth by Campana and Crabtree (2019). There has been no published analysis to date of fauna associated with later phases or from recent excavations.

Wild goat, deer and wild boar are species commonly identified as having been exploited at Neanderthal sites in Europe and Asia (Speth and Tchernov, 2002; Romandini et al., 2023; Nabais and Zilhão, 2025; de los Terreros et al., 2014; Yravedra and Cobo-Sánchez, 2015). For example, in the Zagros region, exploitation of these species is also known from Mousterian deposits at Ghar-e Boof Cave, Yafteh Cave, and Warwasi Cave in Southern Iran. The continued exploitation of these medium-large ungulates is also evident in the Upper Palaeolithic faunal assemblages from these sites, with Yafteh and Warwasi described as "overwhelmingly goat" (Hole and Flannery, 1967; Turnbull ,1975; Otte et al., 2007). Because other medium-large mammalian species are represented in lesser numbers, suggesting only occasional exploitation, and because experimental studies have shown that there is no difference in the wear traces left from the processing of different kinds of meat, it was not deemed necessary to work meat from more than one representative species (Keeley, 1980; Moss, 1983; Vaughan, 1985; Odell, 2004). Goat meat was not readily or consistently available locally in the UK however. As such, meat from sheep (*Ovis aries*) was deemed a suitable proxy because the anatomy of sheep and goats is similar and as such, they are difficult to differentiate in the archaeological records (Salvagno and Albarella, 2017). Untreated raw meat, fat, and bone was worked on the day of purchase to simulate butchery activities. To simulate the working of cooked meat and bone, the material was placed in a conventional oven and cooked at 200° C for 1 hour.

In addition to mammalian prey, the studies from Ghar-e Boof and Yafteh describe the presence of fish remains (Otte et al., 2007; Mashkour et al., 2009). Fish remains including vertebrae have been found at Shanidar Cave, but these have not yet been analysed (Reynolds et al., 2018; N. Wilson, pers. comm., 2024). These are likely to be from a Cyprinid (carp)which are abundant in the Greater Zab river in the vicinity of the cave (E. Hill, pers. comm., 2022). The exploitation of freshwater and marine species by Neanderthals and anatomically modern humans is established (Villa et al., 2020; Brown et al., 2011; Cortés-Sánchez et al., 2011; Nabais et al., 2023; Stringer et al., 2008; Adán et al., 2009; Petillion et al., 2016; Mesfin et al., 2022). Hominins are not the only means by which animal remains (of any species) can be transported into the cave environment and without direct evidence of exploitation by hominins in the form of cutmarks, burn marks, etc it can be difficult to say for certain that a certain species was consumed by hominins (Andrews and Cook, 1990). However, Hardy and Moncel's (2011) use-wear analysis of Mousterian tools at Payre, France showed that the creators of the tools were indeed butchering fish. The fish chosen to represent the freshwater species from Shanidar Cave was basa (*Pangasius bocourti*). Where cooked fish was required, the basa was cooked in a conventional oven at 170° C until cooked through.

4.2.2.2 Craft

Craft relates to tasks which are not immediately essential for survival, which reflect a society that is not solely focused on subsistence. Such materials might include animal hide, bone, antler, horn, shell, and wood which could be used to create clothing, tools, shelter, decorative items, etc. Whilst bone can be utilised in subsistence activities e.g. the splitting of a bone to access marrow for consumption, it can also be used as a tool or ornament (Odell, 2006). The creation of ornamental items in particular has been argued to reflect mental complexity in hominins, so these behaviours have previously been associated only with *H. sapiens* (see discussion in McBrearty and Brooks, 2000). However, recent studies have shown that Neanderthals were also capable of creating ornamental objects and items that might not have served a obvious practical function (e.g. Marquet et al., 2023; Rodríguez-Vidal et al., 2014; Soressi and d'Errico, 2007; Majkić et al., 2018; see section 2.3.2).

The working and use of hides is believed to have its origins in the Lower Palaeolithic (Gilligan, 2010). Use-wear analyses have demonstrated the practice during the Middle Palaeolithic (Hayden 1993; Gilligan, 2007; Wales, 2012; Hardy and Moncel, 2011; Aleo et al., 2021; Tartar et al., 2022). Evidence for skinning (as suggested by the presence of cut marks on the phalanges of ibex) has been found at Shanidar Cave (Campana and Crabtree, 2014). Other species could also be used for hide, for example, evidence from Yafteh Cave suggests that leopards (*Panthera pardus*) were skinned during the Upper Palaeolithic (Mashkour et al., 2023), and there is evidence in

Europe of hominins skinning brown bears (*Ursus arctos*) (Romandini, 2018). Given the abundance of caprid remains in the Zagros faunal assemblages and the direct evidence for ibex skinning at Shanidar goat hide was chosen to represent hide working activity. However, it was not possible to obtain fresh goat hide for the 'fresh hide' experiments, so a chamois leather produced from the hide of a domestic goat (*Capra hircus*) and soaked overnight in a mixture of lamb fat and water was used as a proxy. For dry hide, an unaltered chamois leather was worked.

Oak is one of the "principal local trees" in the region of Shanidar Cave, in addition to plants in the genus *Juniperus* (Fiacconi and Hunt, 2015). Vernet (1981) identified fragments of Aleppo pine (*Pinus halpensis*) near to the body of Shanidar 4, but pine is rare in the assemblage otherwise (E. Asouti and C. Kabukcu pers. comm. to C.O. Hunt, 2022; see also Leroi-Gourhan, 1975 and Kabukcu et al., 2023; Table 4-3). Palynological studies in the region are limited to those studies on Shanidar and as such a wider picture of the species of wood available in the Zagros is not available. Pine is known to have been worked by Neanderthals and older hominins as seen in the crafting of the Schöningen spears (Thieme, 1997; Leder et al., 2024). Further, use-wear studies have evidenced wood working at multiple Mousterian sites including Payre, France (Hardy and Moncel, 2011) and Kulna Cave, Czechia (Dermeková et al., 2026). Wood working is also apparent in Upper Palaeolithic lithic assemblages (e.g. Viala et al., 2020). Due to the available evidence, oak (*Quercus robur*) and pine wood (*Pinus sylvestris*) were deemed suitable

material for the wood working experiments with oak representing hard wood and pine representing soft wood. Both were obtained from a wood in Lancashire, UK.

Land snails are a common occurrence in cave sites, typically drawn into these environments due to the high levels of humidity (Mannino, 2020). They can also be brought in by humans. Snails can serve two purposes, their flesh can be consumed, and their shells can be worked to produce beads and other ornamental items. Evidence for the consumption of snails in the Palaeolithic is noted at various sites including the Haua Fteah, Libya (c. 40 – 15 kya) (Barker et al., 2012, Hill et al., 2015), Ksar'Aqil, Beirut (c. 23-22kya) (Mellers and Tixier, 1989) and Cova de la Barriada, Spain (c.31.3 – 26.9 kya) (Fernández-López de Pablo et al., 2014). The oldest evidence for the consumption of snails comes from Border Cave, South Africa, where land snails were routinely cooked and consumed between c. 170 kya and 70 kya (Wojcieszak et al., 2023). All of these sites are associated with *Homo sapiens*. To date, no direct evidence exists for Neanderthals consuming land snails, however, in Iberia, it has been evidenced that Neanderthals seasonally subsisted on marine molluscs including sea snails as far back as c. 115 kya (e.g. *Stramonita haemastoma*) (Cortés-Sánchez et al., 2011; García-Escárzaga et al., 2026).

The use of snails as ornaments (evidenced by perforations in the shell) is observed in multiple Middle Stone Age sites including Blombos Cave, South Africa (c. 78 – 72 kya) (d'Errico et al., 2005, 2015), Border Cave, South Africa

(c. 74 kya) (d'Errico and Backwell, 2016) and Smuggler's Cave, Morrocco (c. 96 kya – 115 kya) (Dibble et al., 2012, Jacobs et al., 2011) among others (Steele et al., 2019). Though uncommon in Middle Palaeolithic sites, perforated snail shells have been found in Mousterian contexts at the Levantine sites of Skhul (c. 110 kya) and Qafzeh, Israel (c. 92 kya), (Bosch et al., 2015; Garrod and Bate, 1937; Taborin, 2003). At both sites these ornaments are associated with burials and in the case of Qafzeh, one of the shells also retained evidence of ochre staining. In contrast, hundreds of worked shells have been excavated from Upper Palaeolithic sites including Ksar'Aqil, Beirut (c. 23-22kya) (Mellers and Tixier, 1989) or Üçağızlı Cave, Turkey (c. 41 – 29 kya) (Stiner et al., 2013). In the Zagros, shell beads have been found in Upper Palaeolithic Baradostian contexts at Yafteh Cave and at Shanidar Cave itself. (Otte et al., 2007; Hunt et al., 2017; E. Hill, pers. comm, 2022). The snails from both sites are freshwater species, those from Yafteh identified as *Melanopsis praemorsa,* and those from Shanidar as *Assyriella sp (*E. Hill, pers. comm, 2024).

The durability of marine snail shells is similar to that of these river snails. As such, periwinkles (*Littorina littorea)* obtained from Merseyside, UK, were cleaned, dried, and worked using a drilling motion with the aim of creating a perforation. It is likely that lithics or bones were used to bore into shells rather than tools made from softer materials such as wood.

4.2.1.3 Unevidenced Materials

In addition to those materials known to have been exploited by the inhabitants of Shanidar Cave and the wider Zagros region, there was undoubtably an array of other resources available in the landscape which may also have been exploited and worked using lithics. As evidence survives at other Palaeolithic sites however some of these materials were worked as part of the experimental series as discussed below.

4.2.1.3.1 Plant Matter

The working and/or consumption of plant matter is established at Palaeolithic sites across Europe and Asia, and such it is assumed that the hominins from Shanidar Cave utilised these resources in much the same way (Hockett, 2012; Lev et al., 2005; Henry et al., 2011; Kabukcu et al., 2023; Tyldesley and Bahn, 1983; Sobkowiak-Tabaka and Kufel-Diakowska, 2019). Charred remains and/or pollen of plants including pistachio (*Pistacia* sp.), grasses (Poaceae sp.), and wild mustard (Brassicaceae sp.) have been recovered from excavated sediments (Leroi-Gourhan, 1975; Fiacconi and Hunt, 2015; Kabucku et al., 2023; Table 4-3). Ethnographic evidence would suggest that plant working would not necessarily be evident in the microwear of the Shanidar lithics because plants could have been processed by hominins without much reliance on complex tools – hands or digging sticks could suffice (Henry et al., 2014; Leder et al., 2024). Currently there is no published palynological data for other Neanderthal or *Homo sapiens* sites in

the Zagros making comparisons of activities between sites in the region difficult. Plant material is associated with *Homo sapiens* at a number of sites worldwide however including Pavlolv I, Czechia (c. 26 kya) (Adovasio et al., 1996), Ohalo II, Israel (c. 19 kya) (Nadel et al., 1994) and Blombos Cave, South Africa (c. 75 kya) (Vanhaeren et al., 2013) (see also Soffer, 2004; Henry et al., 2014).

Worked plant fibres can be indicative of cordage (Soffer, 2004; Hardy et al., 2020). Evidence for cordage in the Palaeolithic is limited (Adovaiso et al.,1996; Nadel et al., 1994; Hardy, 2008, 2016) and is mostly inferred from the presence of perforated objects which are assumed to have been strung. Examples include shells, as described above; raptor talons, which have been found at multiple Middle Palaeolithic sites across Europe e.g. Mandrin Cave, France, Rio Secco Cave, Italy, and Krapina, Croatia (see Romandini et al., 2014; Radovčić et al., 2015), and red deer (*Cervus elaphus*) canine teeth (see d'Errico et al., 1998). Plant fibres might also be used in the creation of clothing, bags, or bedding, meaning that they are likely amongst the most common and essential of materials within hunter-gatherer groups, however, they are also among the least likely to preserve to the modern day (Brown, 1991; Whiteheart and Hardy, 2016). Twisted plant fibres have been recovered from just two Neanderthal sites, both in France: Abri du Maras and La Grotte du Portel (Hardy et al., 2020; Prince, 2000). It is suggested that young branches would have been collected in the spring months and the outer bark removed to reveal the softer phloem or inner bark from which long bast

fibres could be peeled. These would be "pounded" before being twisted to make workable cords (Hardy et al., 2020). For the purposes of this study branches of oak and pine were sawed open using a hand saw to reveal the phloem which was then worked.

Table 4-3: *Identified flora from Shanidar Cave and inferred use. After Leroi-Gourhan, 1975; Fiacconi and Hunt, 2015; Kabucku et al., 2023 (Pers. comm. From E. Asouti to C. Hunt)*

Species	Inferred use
Wild mustards (Brassicaceae sp.) (charred)	Consumption
Pistachio (Pistacia sp.)	Consumption, crafting
Grass (Poaceae sp.)	Crafting
Oak (Quercus sp.)	Crafting
Pine (Pinus sp.)	Crafting
Ash (Fraxinus sp.),	Crafting
Almond (Prunus amygdalus)	Consumption, crafting

4.2.1.3.2 Horn and Antler

The use of animal resources for tool production is thought to have originated as far back as the Lower Palaeolithic. Antler and horn can be used without modification as "soft hammers" to shape and retouch stone tools (Pitts and Roberts, 1997; Stout et al., 2014). Horn can become a vessel for drinking or carrying as is common in later prehistory, but there is only one potential example from the Palaeolithic (c. 31 kya) which is an incised horn sheath from a woolly rhino (*Coelodonta antiquitatis*) recovered from the Siberian permafrost (Sikora, 2019). Horn sheaths, comprised of keratin, do not

tend to survive in the archaeological record however (O'Connor et al., 2015; Mahan et al., 2023).

Antler and horn can also be modified using lithics to create tools such as projectile points or strikers (Tejero et al., 2016; Semenov, 1970). Antler, horn, and bone tools are often found in conjunction with Upper Palaeolithic tool industries including the Magdalenian or Gravettian industries of France (Tejero et al., 2012, 2016; Tartar, 2012; Lefebvre et al., 2023; Erostarbe-Tome, 2023; Knecht, 1993). The use of these resources in the Middle Palaeolithic by contrast is inferred by circumstantial evidence, usually the presence of certain species within a faunal assemblage (Niven et al., 2012, 2013; Costamango et al., 2006; Jaubert, 1999; Villa and d'Errico, 2001).

Horn and antler were worked both wet and dry. The wet horn and antler were submerged in water for 24 hours prior to working. Experimental studies have suggested that dry horn and antler are particularly difficult to work and would damage the lithic before any modification to the material could occur (Keeley, 1977; Keeley and Newcomer, 1977; Costamagno et al. 2019; Dilley, 2021). Dry materials were worked because there is no direct archaeological evidence to confirm this practice.

The antler was from a red deer (*Cervus elephus*) and the horn was from buffalo (*Bubalus bubalis*), a large bovid serving as a proxy for aurochs (*Bos primigenius*). Red deer and aurochs have been documented at Shanidar Cave and/or in the wider Zagros (see Table 4-1; Evins, 1980; N. Wilson, pers. comm, 2024).

4.2.2 Experimental Lithics

Flakes were produced by direct percussion using a quartzite hammerstone. The raw material used was Turonian-Coniacian flint recovered from Cromer, Norfolk, UK, which is considered high-quality flint for knapping (Hosfield, pers. comm, 2019). The majority of the Shanidar lithic assemblage is made up of chert implements with a limited number of red jasper tools. Red jasper is readily available near to Shanidar Cave along the Greater Zab River. The nearest source of chert to Shanidar Cave however is thought to be located in the Barzan region further along the river and closer to the Iranian border (Reynolds et al., 2018, 2022). There have been multiple attempts by the Shanidar Caves Project team to locate chert sources closer to the cave, including during the 2022 and 2023 field seasons, but these have proven fruitless.

Jasper was obtained from the Shanidar Cave talus slope at the beginning of the 2022 season and flakes were used to work meat and bone. Jasper proved difficult to knap because it was impossible to predict the direction of fracture patterns due to the material being relatively coarse and grainy (Hallsworth and Knox, 1999; Aleo, 2023). Furthermore, flakes did not hold their working edge for long when used. Images of wear patterns were taken using a Tomlov DM9 digital microscope, but the microscope was damaged on the return to the UK and thus these images were lost. The damaged microscope was replaced with another of the same make and model for future seasons. It was not possible to recreate these experiments in subsequent field seasons due to time constraints and different project priorities.

4.2.2.1 Comparisons of Flint and Chert

Flint and chert are fine grained microcrystalline variants of quartz (i.e. their crystalline structure can only be viewed under microscope), with chert slightly coarser grained (Folk and Weaver, 1952). They both register between 6.5 – 7 on the Mohs hardness scale which compares the scratch resistance of minerals on a relative scale (Mohs, 1812). The difference between the two materials lies in where they are formed: true flint occurs in Chalk beds, whereas material derived from other Limestones is typically called chert (Jukes-Brown, 1888; Perry Jr, and Lefticariu, 2003; Boggs, 2009). They both fracture conchoidally (Clemente Conte and Gibaja Bao, 2009; Aubry et al., 2016). Experimental work by Aleo (2023) has shown that wear traces on chert and flint tools are indeed similar in terms of pattern. There is "minimal" difference in the coverage, in that wear on flint covers less of the worked edge than wear on chert especially where polish is concerned. Further, Aleo states that a flint reference collection is suitable for a chert lithic assemblage or vice versa. As such, flint was deemed a suitable proxy for the chert tools found in the Shanidar Cave assemblage.

4.2.2.2 Comparisons of Flint and Jasper

Jasper is a cryptocrystalline form of quartz (i.e. its fine crystalline structure cannot be seen without the aid of an electron microscope) (Hallsworth and Knox, 1999). As with chert/flint, jasper is typically between 6.5 and 7 on the Mohs hardness scale and can be knapped in a similar fashion

(Schmidt, 2009). Most variants of jasper are fine grained like chert/flint (Kostov, 2010). It stands to reason that the formation of wear should be similar to those produced on chert/flint. Indeed, Xhauflair et al. (2020) found that breakage patterns of red jasper and flint implements were similar. Aleo (2023) found that a flint reference collection was suitable for analysing quartz-based tool assemblages. Further, the work of Marko et al. (2025) shows that the use-wear patterns on flint and jasper tools from Malý Faraon Mesolithic rock shelter in Czechia show no differences in terms of visible wear. Therefore, it was not deemed necessary to repeat the jasper experiments from the 2022 season as the flint reference collection would suffice.

4.2.3 Experimental Process

Each material was worked in a specific action using two fresh flakes. All experiments were conducted outdoors on a clean metal table covered by a plastic tarp. The same table was used for every experiment and was cleaned in between experiments and the plastic tarp replaced. Some researchers have claimed that the hygiene of prehistoric peoples would have been poor and as such experimental reconstructions must account for this; for example, by adding grit, sand or soil to the materials prior to them being worked, or by working them on the floor (summarised in Keeley, 1980). As our understanding of prehistoric peoples has improved, especially where Neanderthals are concerned, we now understand that these people understood their environment and potentially also understood the medicinal properties of

plants (Shipley and Kindscher, 2016). It could be inferred then that these people might also have had a concept of cleanliness and may not have kept their food lying on the ground (Binford, 1982; Barham et al., 2023; Sievers et al., 2022). The secondary benefit of maintaining the cleanliness of the experimental area was that any microscopic alterations to the experimental tools would be caused solely by the material being worked in that specific action and not by any other factors.

A specific working edge was selected and marked using a Sharpie pen (arrows highlighting the point of contact with the material worked). The category of material and motion was also recorded on the tool using the Sharpie. Following Ibáñez and Mazzucco (2021), 20 minutes of working any material is sufficient to show alteration to the lithic, even on softer materials such as fat or meat. Thus, material was worked for a total of 20 minutes. Because working harder material (bone, wood) can cause serious changes to the worked edge even after a short period of time, work was stopped after 10 minutes and the flake was cleaned. Initially, flakes were cleaned with dish soap and warm deionised water in an ultrasonic bath and left to air dry prior to analysis as is standard practice (Cesaro and Lemorini, 2012; Fullager, 2013). Flakes were then photographed on both faces (ventral and dorsal) using a DINO-LITE Edge microscope at magnifications of 50x, 100x, and 230x so as to reveal all wear traces. Actions were then repeated for a further 10 minutes and cleaned and photographed again with a view to determining whether wear traces would be more pronounced.

Some researchers argue that cleaning in deionised water is not sufficient to reveal all traces of wear particularly where tools retain residue, and as such some prefer to clean tools using a hydrochloric acid (HCl) solution to remove any and all adherents (e.g. Donahue, 1988; Hamon and Plisson, 2008). In a series of blind tests, Rots et al. (2016) demonstrated that experimental lithics that had not been adequately cleaned of residue could be misinterpreted in terms of use. Where archaeological lithic assemblages are concerned, however, analysis of residue is important to the understanding of how tools were made or used, and it can also provide contextual or environmental information (Monnier et al., 2013; Pedergnana and Ollé, 2018). Removing residue therefore is only appropriate in studies where the sole focus is on use-wear. This practice of using highly acidic materials has been heavily criticized since the early days of use-wear not only because it can lead to the loss of residues, it can also damage wear traces, especially polishes (see Keeley, 1980; Vaughan, 1985; Fullola i Percot and Rodón i Borràs, 1990; Fullagar, 2013). Because the exact worked material was already established and experimental flakes already analysed, the loss of residue and/or damage to wear traces was of lesser consequence. As such, a second, later wash in acid provided the opportunity to assess the impact of the cleaning method. All used flakes were soaked in 10% HCl solution for 15 minutes to remove any adhering material before being rinsed with warm deionised water and left to air dry.

One bone was worked for a total of 40 minutes to determine whether the appearance of wear would become more intense with a longer duration of work. The lithic flake was then soaked in 10% HCl solution for 20 minutes. After the 40-minute mark scar formations remained similar to those on tools worked for 20 minutes (Figures 4-1 and 4-2), but the worked edge became entirely useless and no further modifications could be made to the bone itself, suggesting that lithics were not used for this duration of time on harder materials such as bone (Evans et al., 2014; Stemp et al., 2016).

The flakes produced for the experiment were not hafted and were used in the hand. To minimise injury, thick gloves were worn, as well as safety goggles as specified in the risk assessment. A definition of each of the motions carried out is presented in Table 4-4 and a summary of worked materials and the chosen motion for each experiment is listed in Table 4-5.

Shortly after the development of the discipline of use-wear studies two schools of thought emerged with regards to controls. One position was that every possible facet of information should be considered, including the exact angle of attack, the force applied, the degree of rotation, and so on (Odell, 2006). The alternative view was that prehistoric people working a hide were probably unconcerned with the precise angle the tool was held at; rather, the tool would have been held and likely altered during use in a manner that best suited the task at hand (Keeley, 1980). This study takes the latter approach.

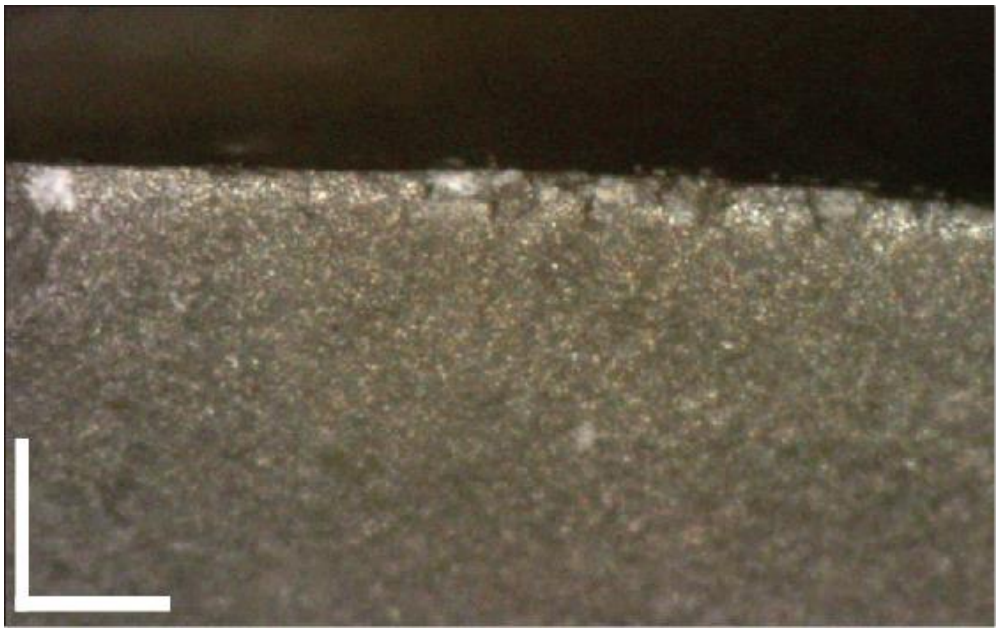


***Figure 4-1**: Experimental lithic used on fresh bone in an engraving/cutting motion (20 minutes) following cleaning in HCL-10% solution. 230x magnification, scale 200 µm. Bright pitted polish can be seen along worked edge.*

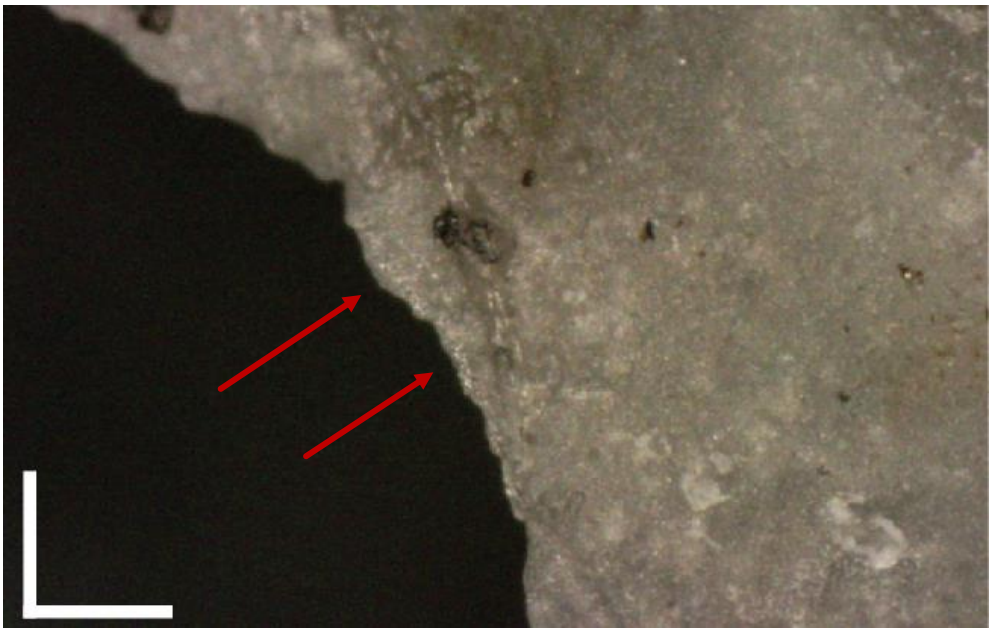


***Figure 4-2:** Experimental lithic used on fresh bone in an engraving/ cutting motion (40 minutes) following cleaning in HCL-10% solution. 230x magnification, scale 200 µm. Bright pitted polish can be seen along worked edge (indicated by the red arrows). There is no observable difference in the amount of polish or in the degree of pitting between the tool used for 20 minutes and the tool used for 40 minutes*

Table 4-4: *Description of selected motions and examples from use-wear studies*

Motion	Description of motion	Sample use-wear evidence
Cutting/ Engraving	A motion in which the flake is moved horizontally from point A to point B in one solid movement and then lifted and repeated	**Clacton-On-Sea, UK** (Keeley, 1980) **Schöningen, Germany** (Rots et al., 2015) **Payre, France** (Hardy and Moncel, 2011) **Abri du Maras, France** (Hardy et al., 2013) **Little Muck Shelter, South Africa** (Sherwood and Forssman, 2024) **Gran Dolina, Spain** (Pedergnana and Ollé, 2020)
Sawing	A back-and-forth motion in which the lithic is moved from point A to point B and back to A without the lithic breaking contact with the worked material	**Clacton-On-Sea, UK** (Keeley, 1980) **Moorehead Circle, UK** (Riordan et al., 2023) **Gran Dolina, Spain** (Pedergnana and Ollé, 2020)
Drilling/Awling	A rotational movement working a fine point on a lithic. Can be fully rotational or back and forth. Drilling relates to this action when it is used on bone, shell or wood. Awling relates to hide working	**Clacton-On-Sea, UK** (Keeley, 1980) **Little Muck Shelter, South Africa** (Sherwood and Forssman, 2024) **Gran Dolina, Spain** (Pedergnana and Ollé, 2020) **Abri du Maras, France** (Hardy et al., 2013) **LSA Ostrich egg beads (multiple sites, South Africa)** (Werner and Miller, 2018)
Scraping/ Debarking/ Descaling/Peeling	An abrasive, unidirectional dragging or pushing motion. Can be away from or towards the person using the tool. (e.g. removing connective tissue from animal skin to produce a dry hide). This motion applied to fish or wood is described as descaling or debarking respectively	**Clacton-On-Sea, UK** (Keeley, 1980) **Schöningen, Germany** (Rots et al., 2015) **Gran Dolina, Spain** (Pedergnana and Ollé, 2020) **Payre, France** (Hardy and Moncel, 2011) **Fumane, Italy** (Aleo et al., 2023)

Table 4-5: *Breakdown of experiment categories and materials*

Category	Action	Material
Raw Meat	Cutting	Lamb shank (*Ovis aries)*
Raw Meat + Bone	Cutting	Lamb shank (*Ovis aries)*
Raw Meat + Bone	Sawing	Lamb shank (*Ovis aries)*
Cooked Meat	Cutting	Lamb shank (*Ovis aries)*
Cooked Meat + Bone	Cutting	Lamb shank (*Ovis aries)*
Cooked Meat + Bone	Sawing	Lamb shank (*Ovis aries)*
Dry Bone	Cutting	Lamb femur (Dry) (*Ovis aries)*
Dry Bone	Drilling	Lamb femur (Dry) (*Ovis aries)*
Fresh Bone	Cutting	Lamb femur (*Ovis aries*)
Fresh Bone	Drilling	Lamb femur (*Ovis aries*)
Fresh Fish	Cutting	Basa (*Pangasius bocourti*)
Fresh Fish	Descaling	Basa (*Pangasius bocourti*)
Cooked Fish	Cutting	Basa (*Pangasius bocourti*)
Fresh Hide	Cutting	Chamois leather (soaked in lamb fat)
Fresh Hide	Scraping	Chamois leather (soaked in lamb fat)
Fresh Hide	Awling	Chamois leather (soaked in lamb fat)
Dry Hide	Cutting	Chamois leather
Dry Hide	Scraping	Chamois leather
Dry Hide	Awling	Chamois leather
Shell	Cutting	Common periwinkle (*Littorina littorea*)
Shell	Drilling	Common periwinkle (*Littorina littorea*)
Soft wood	Cutting	Pine (*Pinus sylvestris*)
Soft wood	Sawing	Pine (*Pinus sylvestris*)
Soft wood	Debarking	Pine (*Pinus sylvestris*)
Hard wood	Cutting	English oak (*Quercus robur*)
Hard wood	Sawing	English oak (*Quercus robur*)
Hard wood	Debarking	English oak (*Quercus robur*)
Soft wood bast	Peeling	Pine (*Pinus sylvestris*)
Hard wood bast	Peeling	English oak (*Quercus robur*)

Category	Action	Material
Dry horn	Cutting	Buffalo (*Bubalus bubalis*)
Dry horn	Drilling	Buffalo (*Bubalus bubalis*)
Dry horn	Scraping	Buffalo (*Bubalus bubalis*)
Wet horn	Cutting	Buffalo (*Bubalus bubalis*)
Wet horn	Drilling	Buffalo (*Bubalus bubalis*)
Wet horn	Scraping	Buffalo (*Bubalus bubalis*)
Dry antler	Cutting	Red deer (*Cervus elephus*)
Dry antler	Drilling	Red deer (*Cervus elephus*)
Dry antler	Scraping	Red deer (*Cervus elephus*)
Wet antler	Cutting	Red deer (*Cervus elephus*)
Wet antler	Drilling	Red deer (*Cervus elephus*)
Wet antler	Scraping	Red deer (*Cervus elephus*)

4.3 Fieldwork Methods

Field seasons at Shanidar Cave typically last 4-6 weeks, with a small team working in the cave itself and in the field lab. In the cave, larger lithics are recorded in situ in 3 dimensions using a total station before being systematically excavated by trowel. The material from Shanidar Cave is excavated following a strict single-context protocol. All artefacts are handled minimally to reduce contamination. These larger lithics (>3cm) are noted as "special finds" and constitute the smaller part of the lithic assemblage. The researcher has been involved in the project only since 2022, so all material recovered in previous excavations may have been subject to different methods of recovery. However, methods have not changed significantly since 2015 (Reynolds et al., 2016).

4.3.1 Wet Sieve

The majority of the smaller lithics recovered are obtained from wet sieving. All excavated sediment (other than that sampled for analysis) from the cave is brought down to the field lab, left to soak in fresh water overnight and is then cleaned in a large flotation machine. The material is then left to dry in the sun until completely dry. The material is then sorted into subfractions such as bone, lithic, charcoal, stalagmite, and shell. It should be noted that the limited exposure to UV is not significant enough to affect any possible residues (Michel and Rots, 2022).

A test was conducted to determine whether cleaning lithics in a wet sieve would cause damage to an edge mimicking that caused by intentionally working it. An experimentally produced chert flake was used to cut bone for 45 minutes resulting in significant wear as would be expected (Ibáñez and Mazzucco, 2021). This lithic was then marked using a permanent marker and added to sediment returning from the cave. The washing procedure was typical as described above. Washing was stopped so that the lithic could be analysed at intervals of 2, 5, and 10 minutes. The preservation of wear remained the same, meaning that it can be accepted that cleaning using a wet sieve does not impact the preservation of use-wear traces.

4.3.2 Transport of Materials

Lithics were initially analysed in the field lab using a field microscope (Tomlov DM9) and preliminary notes as to the wear of the objects was recorded. The Tomlov field microscope was eventually changed for a DINO-LITE Edge AM7515MZ7 microscope on the advice of an experienced

practitioner, because the DINO-LITE had a greater field of magnification (up to 230x) than the Tomlov (up to 60x), as well as a polariser which removes the natural reflectivity of the stones themselves (P. Bye-Jensen, pers. comm., 2023).

Each lithic is stored in an individual sample bag with all relevant information (context, excavation date, find number, etc) recorded on them. These are then stored in larger bags and grouped by Harris matrix phase. They are then placed in a cardboard box for transportation. All materials removed from site need to be approved by the Regional Director of Antiquities and other officials of the Kurdistan Regional Government such as the Director-General of Antiquities. All archaeological material requiring specialist analysis is granted a temporary export licence, and the licence also has to be approved by the Head of Security at Erbil Airport, who is part of the Kurdistan Regional Government Security Services. Upon arrival in the UK, the material is delivered to the appropriate researcher. Bags of lithics were then separated into plastic boxes and catalogued by year of excavation. This allowed for easy analysis of the material from any excavation season. The boxes were kept in a secure location, in a cool room and out of direct sunlight. All lithics were added to a central database made using Microsoft Excel which provided all contextual information per lithic, as well as giving each a unique identifier number, used only for the purpose of this study.

4.4 Laboratory Methods

All knapped lithics larger than 1cm excavated from Shanidar Cave from 2015 to 2023 were analysed, totalling 857 lithics. Having established with reference to the Harris matrix that 200 lithics were unstratified or from cleaning contexts these were rejected from the study leaving a total number of 657 analysed microscopically.

Through macroscopic and microscopic analysis, material composition, colour, percentage of cortex remaining, presence or absence of residues, presence or absence of wear, type of wear and degree of wear were also examined and recorded.

4.4.1 Cleaning of Archaeological Material

As described above, cleaning of archaeological material followed standard practice and aimed to minimise the loss of any potential residues which were also to be identified for the purpose of this study. Lithics were initially cleaned using dish soap and warm deionised water in an ultrasonic bath and left to air dry prior to typological and microscopic analysis.

A small sample of analysed lithics (n=49) were washed a second time using 10% HCl solution to again assess the impact of cleaning method on observations of wear. So as not to destroy potential residues, the lithics selected were those identified in the first round of analysis as having no visible wear, lithics with manganese that might have covered wear traces, and lithics that had been identified as having worked hard materials such as bone

or wood. These were selected because bone working and wood working can be differentiated through observation of the polish, with the former creating a pitted polish and the latter a domed polish. It has been argued that cleaning with acid makes pitting more apparent (Keeley, 1980; Munt et al., 2023). These lithics were soaked separately for a total of 15 minutes each.

Wear traces were not found on any of the lithics that had no visible wear in the first round of analysis, nor were they found on the lithics with manganese. Following cleaning using acid the interpretation of one tool was changed. This was a Mousterian point from Phase 5 (ID: 317) that had been identified as having worked a medium material, specifically wood, due to the presence of hinge scars. Upon re-analysis a very greasy, smooth polish was also identified (rather than the bright, domed polish associated with wood) alongside the scars meaning that whilst the worked material could still be interpreted as of medium hardness it was more likely to be animal horn. As a result, it might be argued that this supports the use of acid cleaning in lithic use wear analysis. However, it could be argued that the updated interpretation is merely reflective of an increased familiarity with the material following experimental work on horn. As expected, cleaning in hydrochloric acid resulted in the removal of all adherents to the lithics (discussed in section 6.3.1). So as to mitigate the loss of contextual information the resulting wash was retained and analysed leading to the identification of animal and plant fibres. However, information as to the exact point of contact between the fibres and lithics was lost. Furthermore, had the lithics been submerged for longer

than 15 minutes the fibres might also have been destroyed. It can be argued therefore that cleaning with soap and water is not just sufficient (interpretations remained consistent in 98% of cases), it prevents the potential loss of valuable information.

4.4.2 Typology of Archaeological Material

Lithic fragments which had no obvious shape and were smaller than 1cm were excluded from the analysis, as were unstratified lithics. This resulted in a total of 399 lithics which were identified typologically. Lithics were sorted according to types established in standardised texts (e.g. Shea, 1987, 2013; Odell, 2006; Keeley, 1980) and with reference to previous studies on the Shanidar material and from the wider Zagros region (Lindly, 1997; Skinner, 1965; Akazawa, 1975; Reynolds et al., 2018, 2022; Ghasidian, 2014; Ghasidian et al., 2019, 2024). The exact typology of each tool was also checked with the aid of a typology specialist, Dr Tim Reynolds. Definitions of each type are provided in Table 4-6.

Side scrapers can be sub-divided into four distinct categories based on the degree of reduction (Table 4-7). Single-edge side scrapers can be defined as knapped flakes which are retouched along one edge only. Double-edge side scrapers are those scrapers which have been worked to such an extent that a second edge is retouched so as to continue the use of the tool. Convergent side scrapers are those scrapers which have had repeated cycles of retouch on both faces to the extent that they converge into a

heavily retouched point. Finally, transverse side scrapers are created from convergent side scrapers – the distal end (i.e. the edge opposite to the convergent point) is retouched to create a new working edge. Transverse side scrapers are argued as representative of the final stage of utility of a side scraper (Bordes, 1961; Dibble, 1984, 1987a, 1987b, 1995; Debénath and Dibble, 1994).

Lithics were measured using rubber-tipped callipers to determine the length, width and thickness of each tool. This aided in the classification of tools which are defined by dimensions, for example elongated Mousterian points which have a length to width ratio of 2:1 or bladelets which are less than 50 mm in length. This is standard practice in lithic studies (Shott and Trail, 2010). Taking measurements also permitted comparison of trends between contexts at Shanidar Cave as well as trends between Shanidar and other sites in the Zagros region (per research aims 3 and 4). Measurement data also provides a reference for other researchers.

***Table 4-6**: Definitions of tools identified at Shanidar Cave*

	Tool type	Description	Sources
Middle Palaeolithic forms	Mousterian point	A large triangular flake made on a prepared core with a pointed edge produced by retouch	Garrod and Bate, 1937; Bordes, 1961; Skinner, 1965; Debénath and Dibble, 1994; Shea, 213; Golovanova et al., 2025
	Elongated Mousterian point	As above but with a length that is twice that of its width or more	Garrod and Bate, 1937; Bordes, 1961; Skinner, 1965; Debénath and Dibble, 1994; Shea, 2013; Golovanova et al., 2025
	Side scraper	A flake with at least one steeply retouched edge, at an acute angle to the direction of flake removal, can be sub-divided (see Table 4-6)	Garrod and Bate, 1937; Bordes, 1961; Skinner, 1965; Debénath and Dibble, 1994; Shea, 2013; Golovanova et al., 2025

	Tool type	Description	Sources
Upper Palaeolithic forms	Unretouched blade	Elongated flakes which are equal to or greater in length than they are twice in width, no retouch	De Mortillet, 1873, 1885 ;
	Retouched blade	As above, but featuring some degree of retouch	De Mortillet, 1873, 1885
	Unretouched bladelet	A small blade whose length is equal to or greater than twice its width but does not exceed 50 mm	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014
	Retouched bladelet	As above, but featuring some degree of retouch	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014
	Dufour bladelet	A bladelet featuring fine, semi-abrupt retouch and a curved profile	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014; Shea, 2013
	Unretouched point	Thin, triangular flakes that converge at a point	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014
	Retouched point	As above, but featuring some degree of retouch	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014; Sisk and Shea, 2014
	El Wad point	A bladelet blank which has been worked to a symmetrical point	Bar-Yosef, 1970; Brézillon, 1977
	End scraper	Flake with continuous retouch on one end, usually with a slightly rounded face	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014; Debénath and Dibble, 1994; Sisk and Shea, 2014
	Bladelet core	A cobble of rock which is deliberately prepared and reduced in order to produce bladelets. Characterised by long, thin removals	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014; Sisk and Shea, 2014
	Crested blade	A long, thin blade characterized by a prominent ridge, showing intentional flaking	De Mortillet, 1873, 1885 ; Sisk and Shea, 2014; Sisk and Shea, 2014
Multi-industry forms	Unretouched flake	A removal from a core, with no cortex	Bordes, 1961; Debénath and Dibble, 1994
	Retouched flake	As above, but featuring a degree of retouch	Bordes, 1961; Debénath and Dibble, 1994
	Cortical flake	Whole flakes with a degree of cortex remaining on the tool's dorsal face, indicative of initial stages of core reduction	Bordes, 1961; Debénath and Dibble, 1994
	Flake core	A cobble of rock which is deliberately prepared and reduced in order to produce flakes. Characterised by short, wide removals	Bordes, 1961; Shea, 2013; Debénath and Dibble, 1994
	Notch	Flakes which have been retouched with a semi-circular indentation along an edge	Bordes, 1961; Shea, 2013; Debénath and Dibble, 1994

	Tool type	Description	Sources
	Denticulate	Flakes which have been retouched with numerous semi-circular indentations in close proximity	Bordes, 1961; Shea, 2013; Debénath and Dibble, 1994
	Informal tool	A tool form which does not fit any of the other established categories. Also referred to as blanks	Bordes, 1961; Debénath and Dibble, 1994; Shea, 2013
	Awl	Flakes which have two short, retouched edges which converge into a point	Bordes, 1961; Debénath and Dibble, 1994; Shea, 2013
	Burin	A flake which features at least one thin, elongated flake removal. The thin removal is referred to as a burin spall	Bordes, 1961 ; Shea, 2013; Debénath and Dibble, 1994

Table 4-7: *Subcategories of side scrapers (after Bordes, 1961, Dibble, 1987, 2017; Debénath and Dibble, 1994)*

Tool type	Description
Single-edge side scraper	A tool with one retouched working edge
Double-edge side scraper	A tool with two retouched working edges
Convergent side scraper	A tool with two retouched edges which converge into a point
Transverse side scraper	A convergent side scraper with a retouched distal end

4.4.3 Use-Wear Analysis

The Shanidar Cave lithics were analysed 'stratigraphically blind' in the laboratory, i.e. contextual information was not checked prior to analysis in order to prevent bias as to the kind of wear that should be expected relating to the archaeological period, the tool industry whether Mousterian or Baradostian, and the perception of the capabilities of associated hominins. Again, the intelligence of *H. sapiens* has traditionally been thought to be superior to that of *H. neanderthalensis*, although work in recent decades has

called this into question (Garofoli, 2017; Baumann et al., 2022; Nielsen et al., 2012; Vanhaeren et al., 2006, 2013; section 2.3).

Lithics were first analysed using a low-power Zeiss DV4 stereomicroscope at magnifications of between 12x and 40x to determine the presence of any wear or residues. The high-power DINO-LITE Edge microscope was then used at magnifications of 40x to 230x to examine those lithics preserving wear in more detail, as some traces of wear, especially polish, only truly become visible at magnifications over 200x (Keeley, 1970; Odell, 2004). Photographs were taken using the DINO-LITE on which the level of magnification and location of wear was recorded.

4.4.3.1 Types of Wear

The action of working different materials has different results on a tool's edge. As such, a number of potential wear traces can be observed on any archaeological stone tool and sometimes more than one material can be identified from those traces. The main categories of wear patterns are striations, scarring, smoothing, rounding, and polishing. The type of wear associated with a certain material and motion is outlined in Table 4-7, and further information as to how to identify each type of wear and associated actions is provided in Tables 4-8 to 4-11. The descriptions of wear and associated actions are in line with those accepted by the Ho Ho Committee (Kamminga et al., 1979; see section 3.1.3, Table 3-1). Using Odell's (1979, 2006) reference images and hardness scale (Figure 3-3), Keeley's (1980)

reference images and descriptions, and the experimental series designed from this study as a point of comparison (section 4.2) it was possible to assess the type and degree of wear and to determine the likely material worked.

Table 4-8: *Types of wear*

Wear type	Description	Source
Striations	Minute lines, scratches, or grooves in the texture of the stone tool caused by coming into contact with a hard material e.g. hard wood, bone	Semenov (1964); Keeley (1980); Mansur (1982); González-Urquijo and Ibáñez, (1994), Odell (2006); Ibáñez and Mazzucco (2021)
Scarring	Radial fissures/fractures along the worked edge of a tool caused by contact with medium to hard materials e.g. soft wood, bone. Also referred to as 'edge damage'	Keeley (1980); Vaughan (1981); Odell (2006); Ibáñez and Mazzucco (2021) González-Urquijo and Ibáñez, (1994)
Smoothing	The wearing-down of an area to produce a regular surface/ flatter texture with limited roughness.	Semenov (1964); Fullagar (2013); Ibáñez and Mazzucco (2021) González-Urquijo and Ibáñez, (1994)
Rounding	The evolved form of edge smoothing. Occurs following constant abrasion using medium-hard materials e.g. hide, soft wood	Semenov (1964) ; Vaughan (1985)) González-Urquijo and Ibáñez, (1994)
Polishing	Light-reflective surface abrasion caused by working soft, medium, and hard materials e.g. meat, hide, bone. The consistency, reflectivity and viscosity of a polish is caused by the material worked	Semenov (1964); Keeley (1980); González-Urquijo and Ibáñez, 1994 Ibáñez and Mazzucco (2021)

Table 4-9: *Striation action evidence (after Keeley, 1980; Odell, 2006; Vaughan, 1981; González-Urquijo and Ibáñez, 1994)*

Location of striations	Action
Perpendicular or diagonal to edge	Transverse
Parallel or diagonal to edge	Longitudinal

Table 4-10: *Scarring action evidence (after Keeley, 1980; Odell, 2006; Vaughan, 1981; González-Urquijo and Ibáñez, 1994)*

Location of scarring	Scar density	Action
Unifacial on closest edge	Discontinuous	Transverse
Bifacial on both edges	Continuous (Dense)	Longitudinal
Bifacial with large scars	Discontinuous	Chopping
Bifacial	Continuous (Dense)	Boring/drilling

Table 4-11: *Rounding action evidence (after Keeley, 1980; Odell, 2006; Vaughan, 1981; González-Urquijo and Ibáñez, 1994)*

Location of rounding	Action
Rounding of edge facing worked material	Transverse
Equal on both surfaces	Longitudinal

Table 4-12: *Polish material evidence (after Keeley, 1980; Odell, 2006; Vaughan, 1981; González-Urquijo and Ibáñez, 1994)*

Polish type	Reflectivity	Surface texture	Surface topography	Density	Associated material
General weak polish	Dull but brighter than actual flint	Smoother than actual flint	Grainy	Thin, along immediate edge of tool	Meat
Bone polish	Very bright	Very smooth	Very pitted, possible deep grooves	Dense	Bone
Wood polish	Very bright	Smooth	Possible domes	Widespread	Wood
Reed polish	Very bright	Smooth	Possible domes	More Widespread than wood	Reeds
Hide polish	Dull	Smooth but less so	Greasy	Very widespread; associated with edge rounding	Hide/skin

4.4.3.2 Post-Depositional Modifications

In addition to wear formed through the use of a tool, tools can be altered by post-depositional processes (Stapert, 1976; Shackley, 1974; Sala, 1986; Burroni et al., 2002; Baillet et al., 2025; Macdonald, 2026). The behaviours of the site's inhabitants can cause damage to discarded lithics, for example, where hominins create fires, or where the ground surface becomes trampled due to movement (McBrearty et al., 1998; Shea and Klenck, 1993; Halbrucker et al., 2021; Olausson, 1983). Other processes include: chemical action e.g. soil acidity/ alkalinity eroding the tool surface (Rottlander, 1975); soil abrasion, whereby the natural movement of soil around the lithic causes striations and/or scars (Brink, 1978); UV light exposure, which can cause bleaching which would obscure polishes (Michel and Rots, 2022); and fluvial processes, whereby moving water within a site can transport a lithic from its original location potentially causing breakage from it crashing into other materials – these breakages can mimic edge rounding or scarring (Harding et al., 1987; Shackley, 1974; Chu and Hosfield, 2020). Finally, a lithic may also become scratched, broken, etc, during the excavation. These processes can obscure or destroy any traces of use (Keeley, 1980; Moss, 1983; Levi Sala, 1986). A method proposed to determine the degree of post-depositional edge alteration is in the measurement of dorsal ridge rounding introduced by Shackley (1979) and further developed by Donahue and Burroni (2002, 2004). This method assesses rounding on a flake's dorsal ridge (i.e. the line separating two surfaces on the dorsal face of a flake) through comparison of a "mint condition" flake to determine how much

material is lost from the original. As time in sediment increases so does the degree of ridge rounding though the degree to which flakes are altered is not uniform. Arguably, however, this method is applicable only to experimental lithic assemblages where the original size of the ridge is known, as it impossible to know the size of the original ridge in an archaeological tool (Bustos-Pérez Díaz and Baena, 2019). It does not account for variability in the knapping process. Wear deriving from natural processes can appear similar to those formed through direct use, but they lack any standardisation in direction, orientation and in the size and location of fracture scars. This is how intentional and natural wear can be differentiated (Tringham et al., 1974; Burroni et al., 2002).

The sediment of Shanidar Cave has a relatively small (10-20%) quartz content. As such, it is hypothesised that the degree of natural wear will be minimal (C. Hunt, pers. comm, 2025). Indeed, there were no instances of moderate to high post depositional modification on any tool within the archaeological assemblage.

4.4.4 Residue

Residue can be defined as any foreign object adhering itself to the lithic. This can be organic e.g. blood, feather, lipids, or plant matter; or inorganic e.g. manganese oxide, silica from plant phytoliths and calcium carbonates. For the purposes of this study, the residues of interest are those that can be associated with human action such as butchery residues, hafting

adhesives, ochre, or plant material. The local climate of Shanidar is hot semi-arid with seasonal wetting and drying of the sandy cave sediments by vadose waters resulting from winter rain and snowmelt. Thus, the sediments are strongly oxidised (except in the lowest part of the exposed sequence which is drier), meaning that oxidation would degrade any potential organic adherents to lithics. As such, the preservation of residues was not expected from Shanidar Cave.

Any tool preserving visible residue was photographed prior to cleaning of the lithic. Samples of residues were removed using a pipette and deionised water for analysis by specialists (Fullager, 2013). Because the most commonly found residue at Palaeolithic sites (including Shanidar) is ochre, fragments of ochre recovered from excavated sediments at Shanidar were photographed using the DINO-LITE to allow for comparison (Hunt, 2024, pers. comm; Reynolds et al., 2018, 2022).

4.5 Conclusion

This chapter has detailed the methods used to develop and analyse the experimental series, methods of recovery and initial analysis of lithics in the field, and methods of detailed analysis of lithics in the laboratory. Such methods are derived from established literature and applied to Shanidar for the first time. Experimental materials worked reflect the palaeoenvironment of the Shanidar region during the Palaeolithic. An outline of post-depositional modifications one might find on a lithic from an archaeological assemblage

is also presented. The following chapter provides the results of the experimental component of this thesis.

Chapter 5 - Results I: Experimental

5.1 Introduction

The previous chapter outlined the methodologies employed in creating and utilising the experimental series of lithics, and the methodologies employed in recovering and analysing lithics in the field and laboratory. Wear traces associated with specific actions and movements are also described. This chapter presents the results of the experimental work using a selection of materials representative of those likely to have been worked by the ancient peoples of Shanidar Cave.

As stated in Chapters 3 and 4, the use of experimental data in use-wear studies is long-established, and as such there is a wealth of comparative information available to the analyst (e.g. Keeley, 1980; Odell, 2006; Vaughan, 1981). Therefore, for the purpose of this study only two flakes per material and action were used, for a total of 82 experiments. All raw data from the experimental series are provided in Appendix 1. Wear terminology is in accordance with the Ho Ho classification (Kamming et al., 1979). Definitions are provided above in Tables 3-1 and 4-7.

Some practitioners argue that cleaning worked lithics with soap and water is not sufficient to reveal wear traces, and as such prefer to use hydrochloric acid (HCl) to remove any and all adherents (discussed in section 4.2.3). All 82 experimental lithics were washed a second time using HCl-10% solution and reanalysed using the same methods and equipment established in Chapter 4. Interpretation of wear traces did not change for any tool.

5.2 Raw Meat

The cutting of meat, which is regarded a soft material, produces very limited alterations to the worked edge (Odell, 1979). Shallow and narrow striations can form although these tend to be limited in number. Such striations were observed on experimental lithics (Figure 5-1). The working of meat also produces a bright, greasy polish which could be seen along the surface edge above magnifications of 200x. It is easily distinguished from other polishes (bone polish, hide polish, etc) due to its brightness.

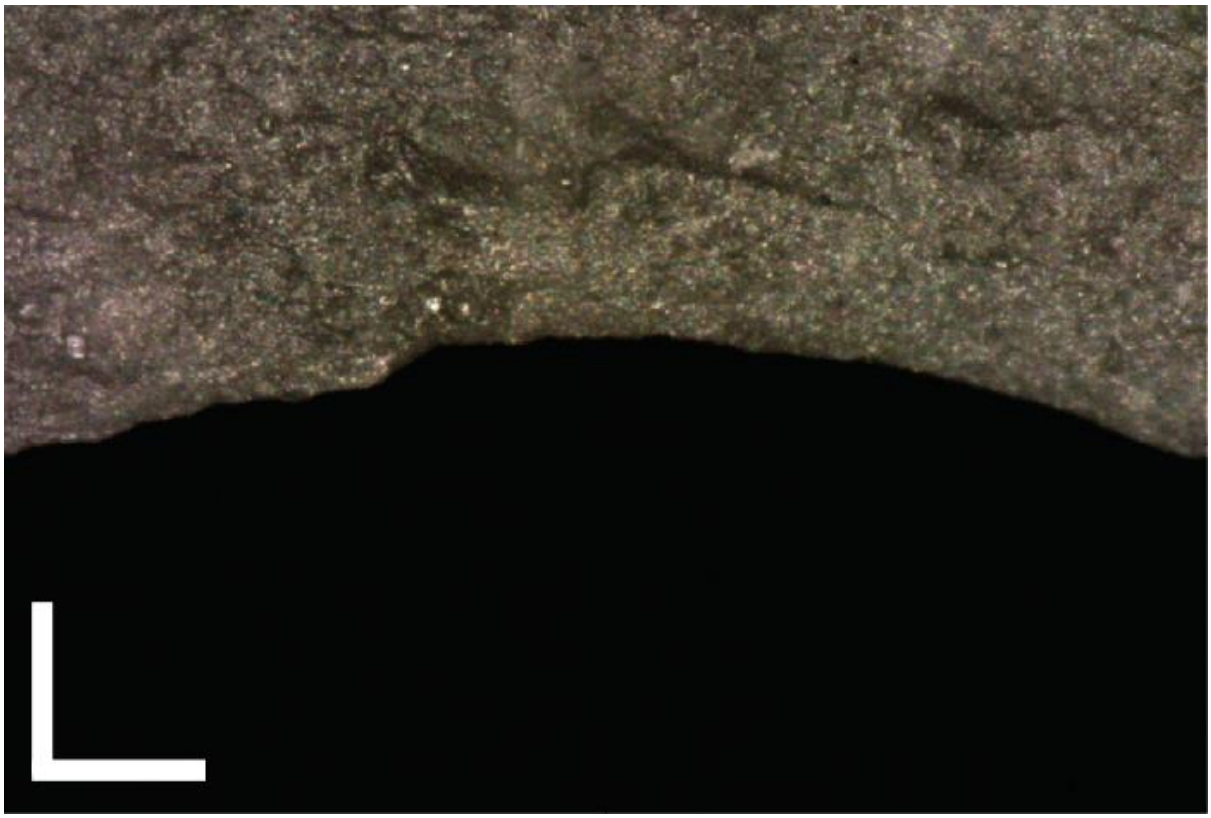


Figure 5-1: *Experimental lithic used on raw meat (20 minutes), 230x magnification, scale 200 µm. Faint striations and bright meat polish can be seen*

5.2.1 Raw Meat with Bone

The working of raw meat with occasional contact with bone produced similar results to that of working just raw meat. The bright, greasy polish was again noted at magnifications above 200x (Figure 5-2). There was a significantly greater impact on the integrity of the worked edge itself compared to working with raw meat without bone. Small-medium scars developed on the worked edge and were clearly visible at lower magnifications (50x). The scars were mostly feather scars with a couple of isolated hinge scars.

Where protrusions were noted on the lithic edge prior to use, these were worn down and rounded. Sawing as opposed to cutting resulted in a higher degree of edge damage, as well as an increase in polish formation along both ventral and dorsal faces of the tool. The sawing action produced an undulating (discontinuous) pattern along the worked edge formed of large hinge and step scars.

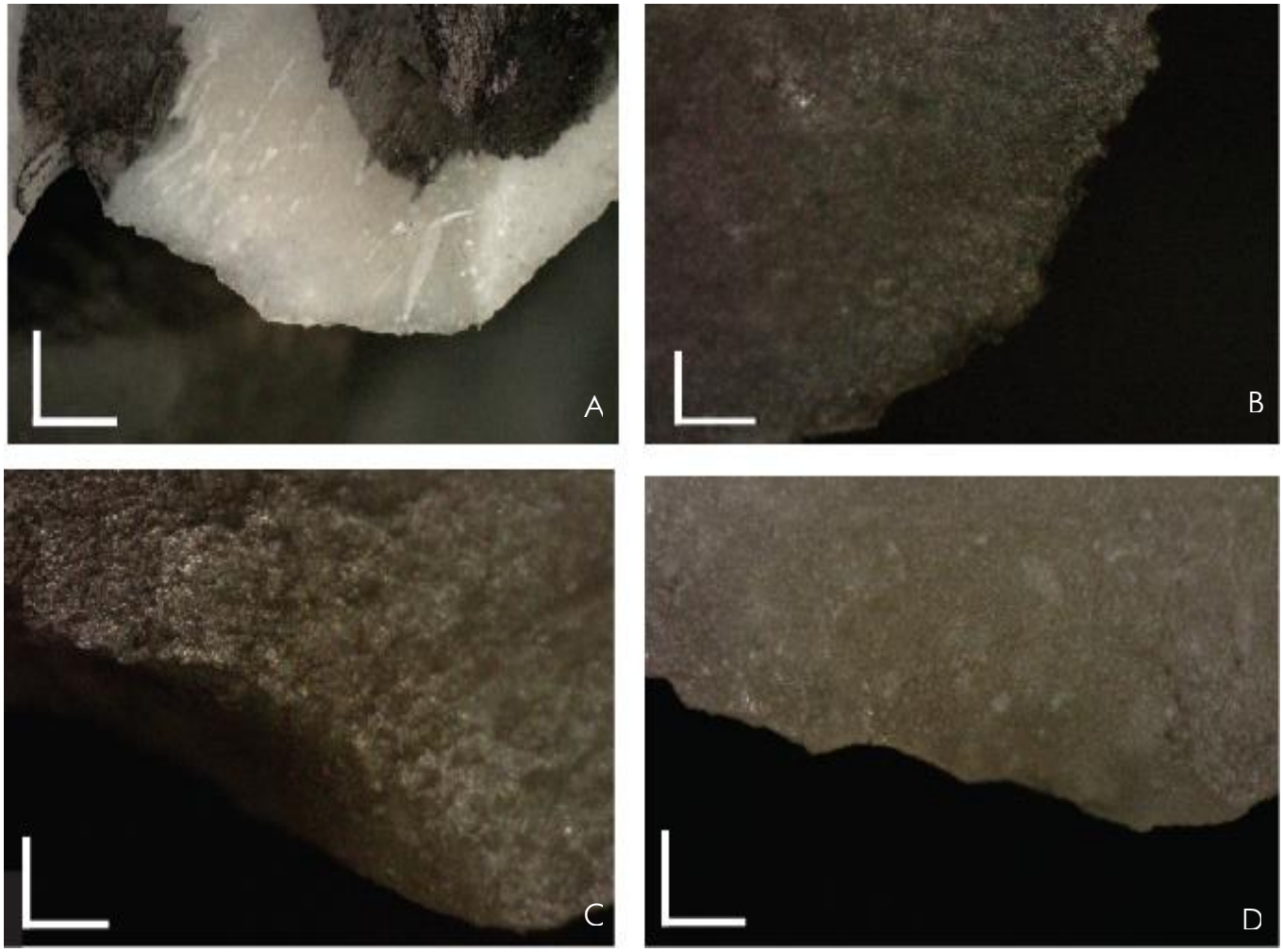


***Figure 5-2**: Experimental lithics used on raw meat with bone (20 minutes). A: Cutting action, 50x magnification, scale 1.0 mm. Continuous feather scarring along worked edge. B: Cutting action, 230x magnification, scale 200 µm. Continuous scarring and dull polish along worked edge, with brighter spots into the lithic. C: sawing action, 230x magnification, scale 200 µm. Dull polish and brighter spots along worked edge. D: sawing action, 230x magnification, scale 200 µm. Large undulating hinge and step scars and associated bright polish spots along worked edge.*

5.3 Cooked Meat

The working of cooked meat produced similar alterations to raw meat. Edge damage was non-existent or limited (Figure 5-3). Some smaller scars were noted approaching the 20-minute mark, observable even at 50x

magnification. These appeared to be feathered in cross section. Striations were very few and were also narrow and shallow. Meat polish was noted on one of the specimens, but this was less pronounced than the polish produced by working raw meat.

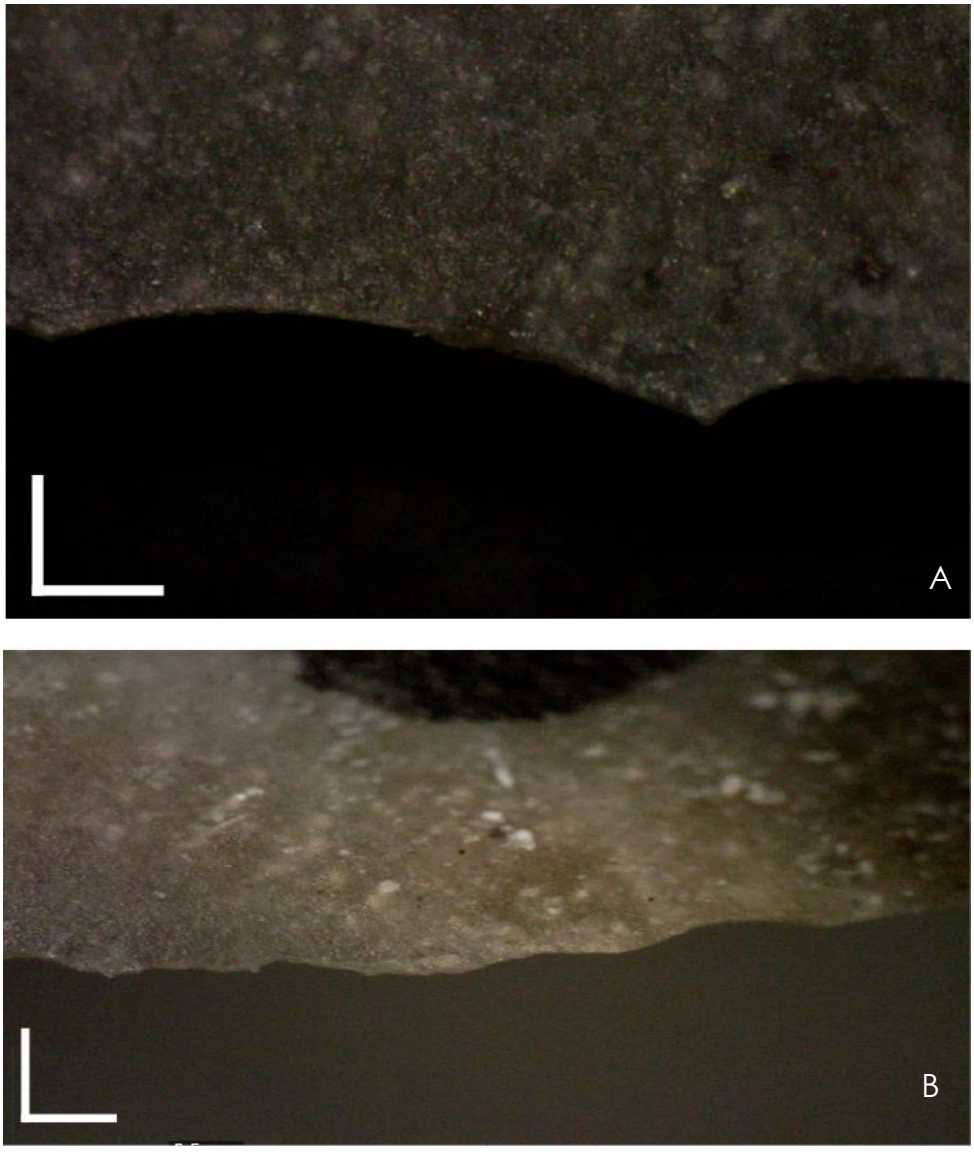


Figure 5-3: *Experimental lithic used on cooked meat using a cutting action (20 minutes), 230x magnification. A: Scale 200 µm. Limited polish formation. B: Scale 0.5 mm. Shallow and narrow striations, limited edge damage.*

5.3.1 Cooked Meat and Bone

The cooked meat and bone presented similar wear to that of the raw meat and bone. Polish was again present but limited by comparison with raw meat. Cutting produced limited edge damage with some striations and scarring (both hinge and step) (Figure 5-4). Sawing produced semi-continuous scars on the worked edge (Figure 5-5). The undulating scar damage was observable on both faces.

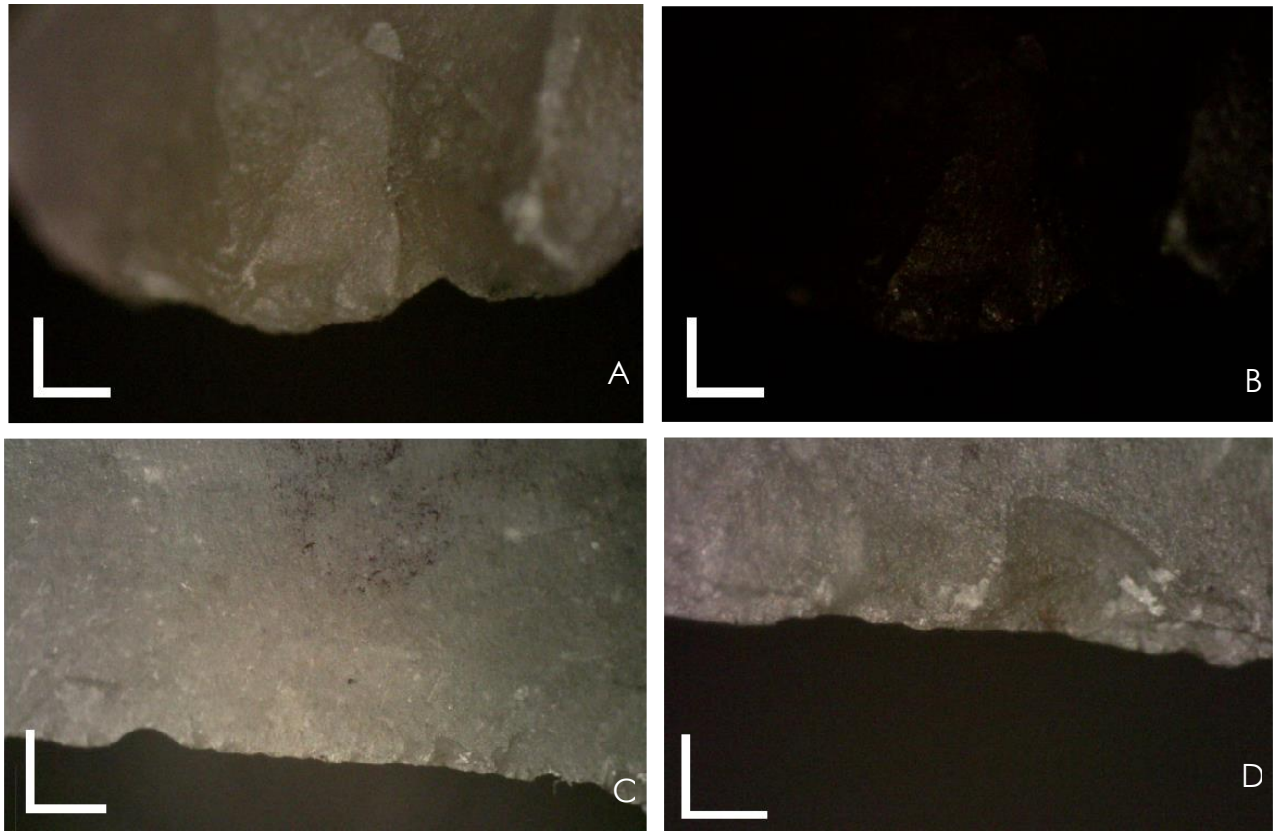


Figure 5-4: *Experimental lithics used on cooked meat and bone using a cutting action (20 minutes). A, B: 230x magnification, scale 200 µm. Presence of bright polish at normal and low light levels. C: 50x magnification, scale 0.5 mm. Large hinge and step scars and smaller striations. D: 230x magnification, scale 200 µm. Enlarged step scar with limited edge polish.*

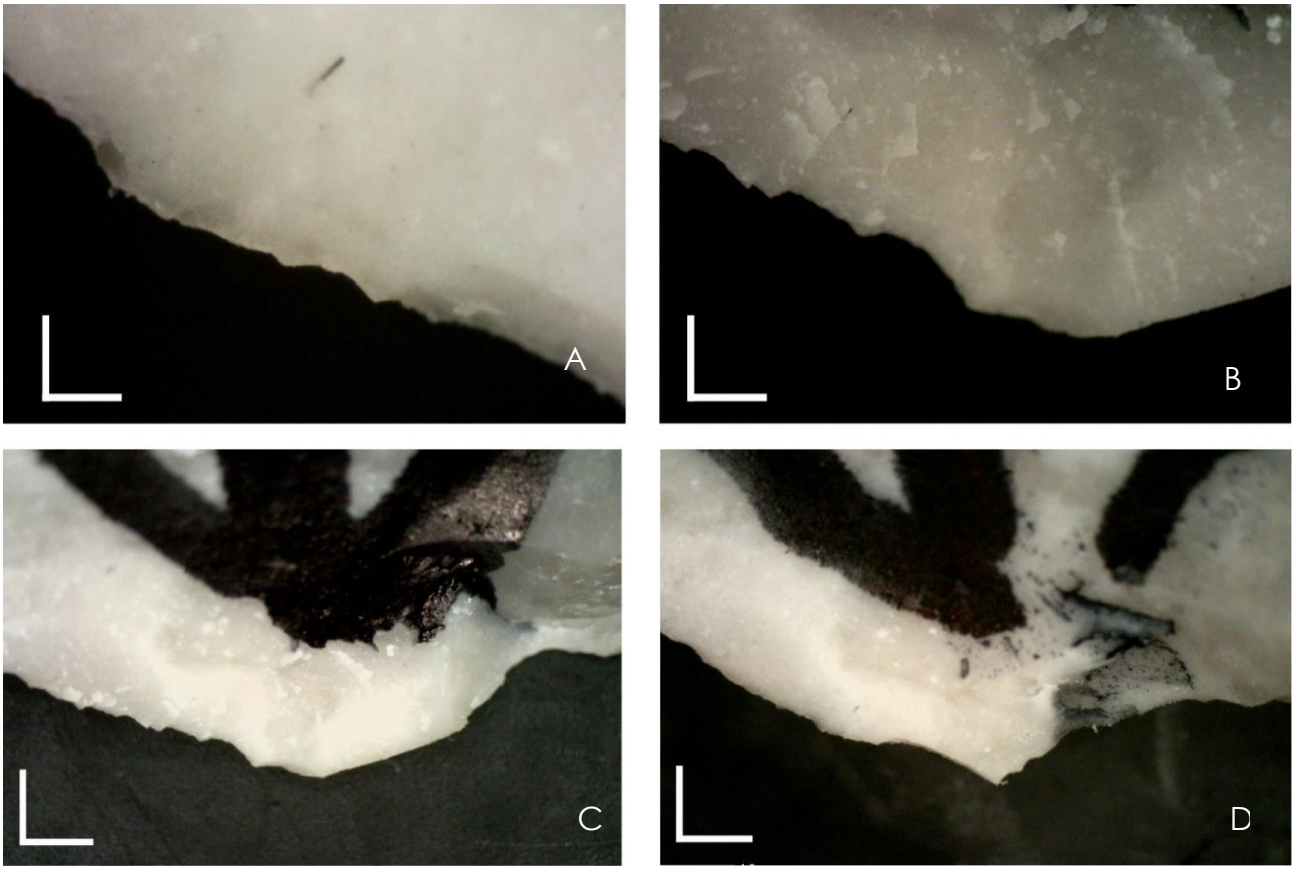


Figure 5-5: *Experimental lithic worked on cooked meat and bone using a sawing action (20 minutes). A: 230x magnification, scale 200 µm. Unmodified lithic. B: 230x magnification, 200 µm. Large undulating step scars. C: 50x magnification, scale 0.5 mm. Unmodified lithic. D: 50x magnification, scale 0.5mm. Large snap and step scars.*

5.4 Bone

5.4.1 Dry Bone

The engraving of dry bone resulted in bright, greasy polish, distinguishable from meat polish due to the numerous small pits which were observed at higher magnification (>200x) (Figure 5-6). Striations were common and appeared on both faces as did large, deep, step and hinge scars. The scarring was substantial and could be seen even at lower

magnifications as having significantly altered the morphology of the working edge.

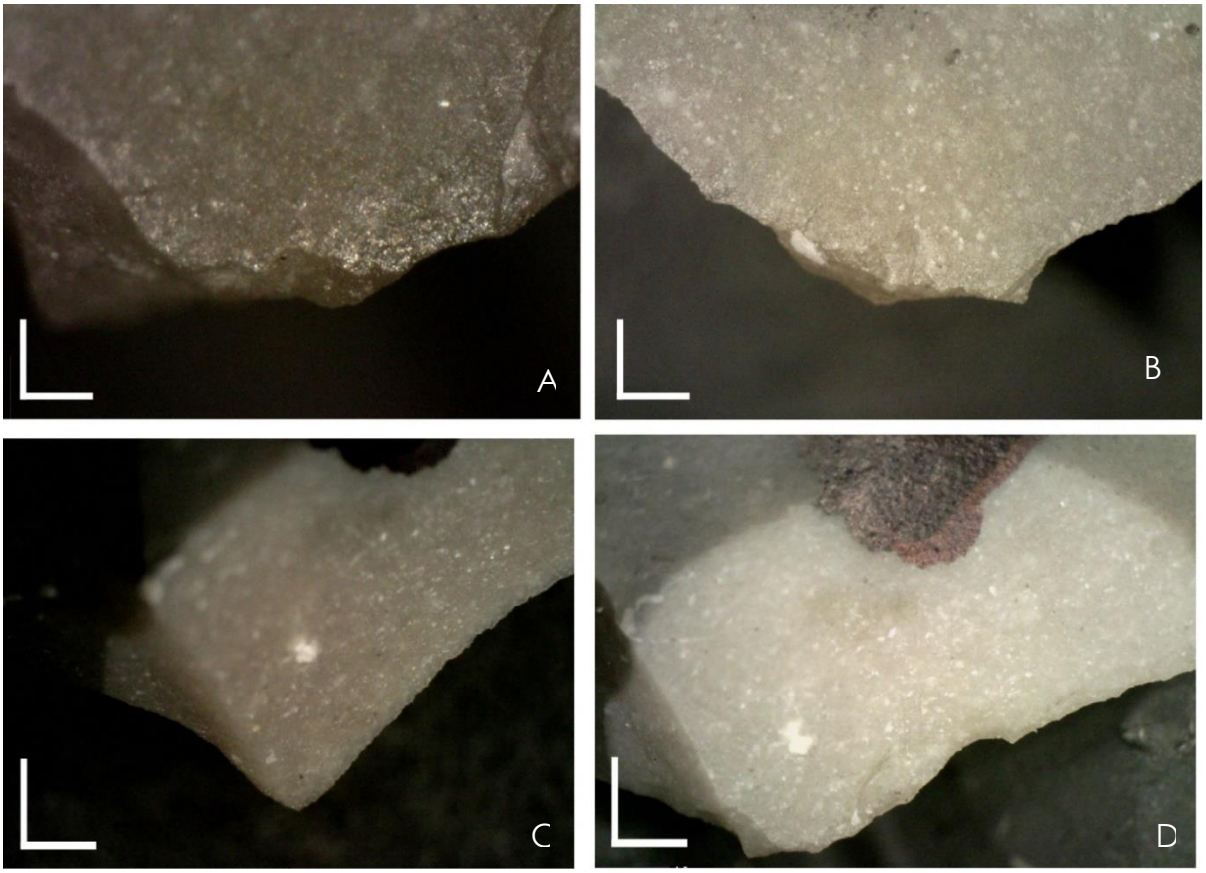


***Figure 5-6**: Experimental lithic used on dry bone using an engraving motion (20 minutes). A: 230x magnification, scale 200 µm. Bright, greasy polish with numerous pits. B: 100x magnification, scale 0.5 mm. Striations can be seen occurring at 90° from edge. C: 50x magnification, scale 1.0mm. Unworked lithic. D: 50x magnification, scale 1.0 mm. Large, deep, hinge and step scars; blunting of worked edge*

Drilling or boring into the dried bone resulted in large step scars with an associated snapped edge across the tip of the tool. The tip was worked to such an extent that no polish could be detected (Figure 5-7). A number of striations could be noticed occurring horizontal to the worked tip. Following 10 minutes of work, the implements were significantly altered and after 20

minutes of work, the edge was damaged to such an extent that the implement was essentially useless.

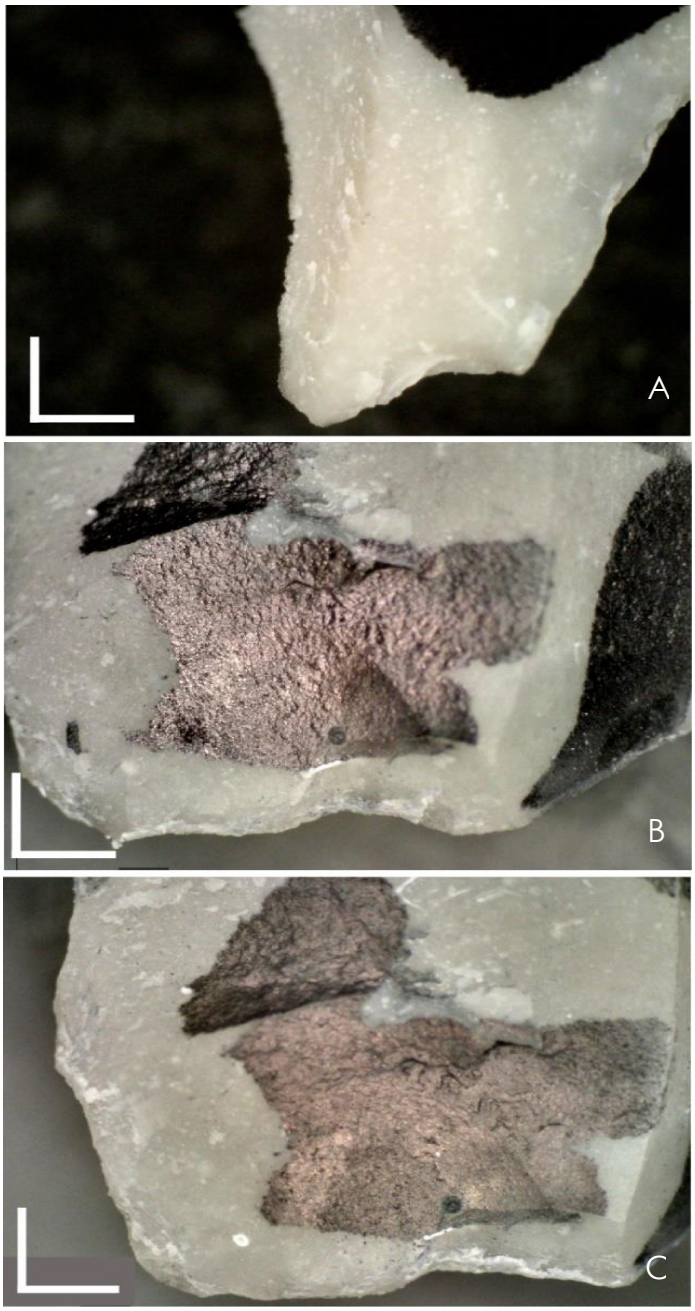


Figure 5-7: *Experimental lithic worked on dry bone using a drilling motion, 50x magnification, scale 1.0mm. A: Unworked lithic. B: After 10 minutes blunting of the edge occurs. C: After 20 minutes, edge is destroyed*

5.4.2 Fresh Bone

The engraving of fresh bone yielded similar results to that of dried bone. Striations could be seen at lower magnifications (50x) (Figure 5-8), occurring in a condensed area at oblique angles to the worked edge. Once again, large, deep hinge and step scars could be seen along the worked edge. Polish was again noted at higher magnifications (230x) (Figure 5-9), but its morphology appeared more like that of meat polish than that of dry bone polish as the distinctive pitting associated with the latter was present but minimal.

As with dry bone, drilling fresh bone resulted in severe edge damage and no polish or striations could be clearly detected at low magnification (50x) (Figure 5-10). Polish could be seen on the worked edge and further into the lithic at higher magnification (230x). Scars were snap or step in nature and were relatively large.

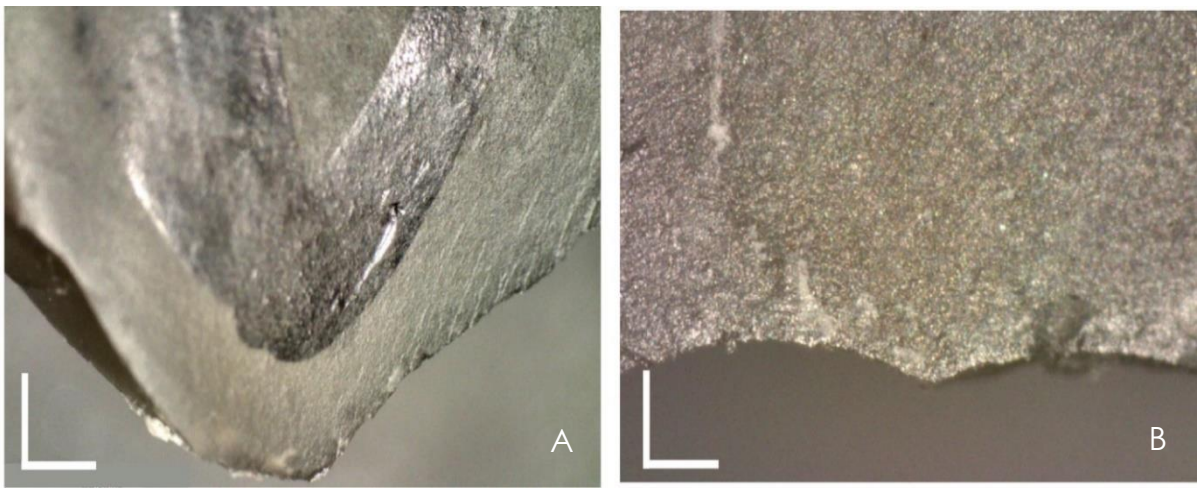


Figure 5-8: *Experimental lithic used on fresh bone using an engraving motion (20 minutes). A: 50x magnification, scale 1.0 mm. Striations occurring at right angles to the worked edge. B: 230x magnification, scale 200 µm. Bright polish and large scar along worked edge. Pitting is limited compared to the polish produced by dry bone working, it is greasy and bright, appearing closer to meat polish.*

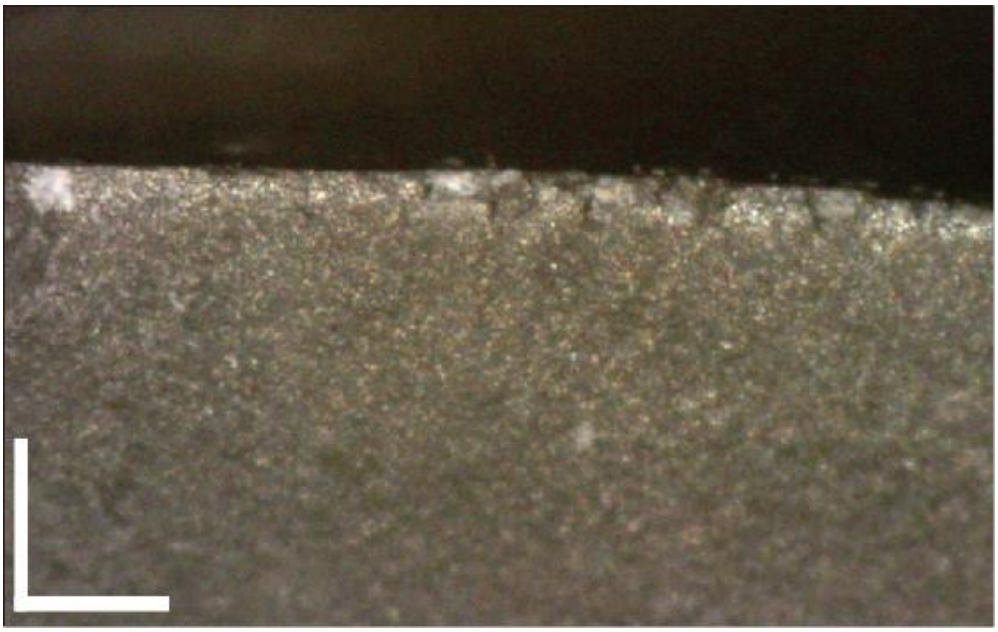


Figure 5-9: *Experimental lithic used on fresh bone in an engraving/cutting motion (20 minutes) following cleaning in HCL-10% solution. 230x magnification, scale 200 µm. Bright pitted polish can be seen along worked edge.*

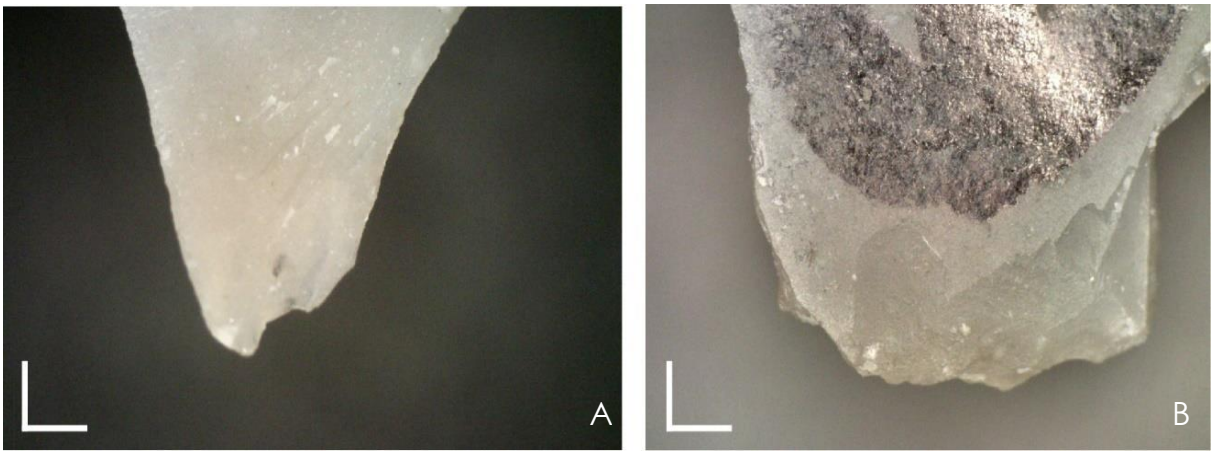


Figure 5-10*: Experimental lithic worked on fresh bone using a drilling motion (20 minutes). A: 50x magnification, scale 1.0 mm. Severe edge damage. B: 230x magnification, scale 200 µm. Bright polish at worked edge and further into the lithic.*

5.5 Fish

5.5.1 Fresh Fish

The processing of fresh/raw fish resulted in little edge damage with few striations and limited scarring. Polish was apparent and was bright and greasy with minimal pitting (Figure 5-11). Streaks were noted within the polish occurring in a linear pattern at oblique angles to the worked edge which differentiates the polish from that caused by fresh and cooked meat and bone. The cutting action caused small feather scars occurring in a discontinuous pattern along the worked edge.

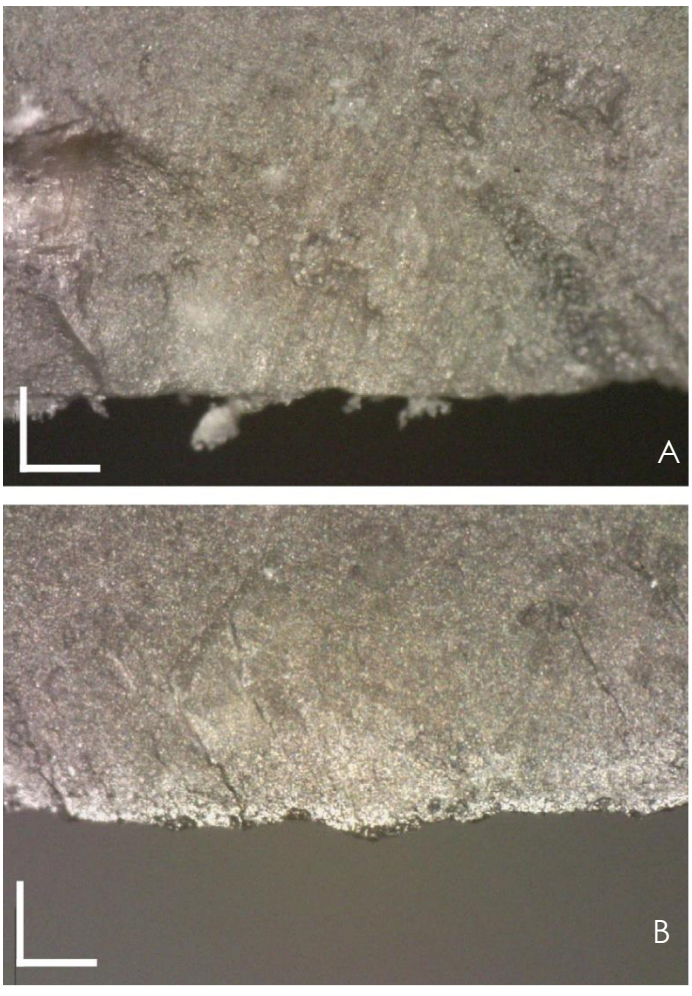


***Figure 5-11**: Experimental lithics used on raw fish (20 minutes). A: Cutting action, 50x magnification, scale 1.0 mm. Linear polish. B: Descaling action, 230x magnification, scale 200 µm. Bright, greasy polish in linear bands, and discontinuous scarring*

5.5.2 Cooked Fish

Cutting cooked fish produced contradictory results. One tool produced next to no polish (Figure 5-12), whilst the other produced a substantial amount of bright, greasy polish even after substantial cleaning protocols. Scarring and striations were present but minimal on both tools.

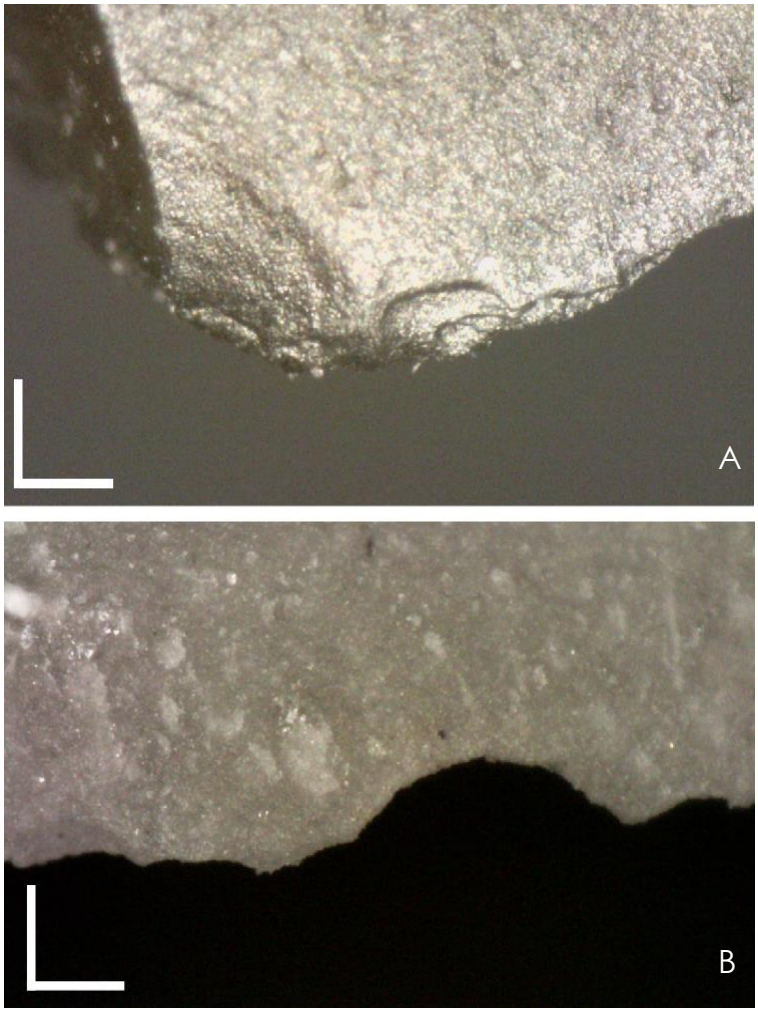


Figure 5-12: *Experimental lithics used on cooked fish using a cutting action (20 minutes), 230x magnification, scale 200 µm. A: Bright, greasy polish with linear streaks. B: Minimal polish, minimal edge damage*

5.6 Hide

5.6.1 Fresh Hide

The working of fresh hide resulted in significant edge rounding even after 10 minutes of work. By 20 minutes substantial alteration to the edge could be seen (Figure 5-13). Polish was observed on the scraping implements, but this was a slow forming polish and was seen only approaching 20 minutes of work. The morphology of the polish is similar to that of meat polish, given the natural lubricant of the animal's fat. Polish was more apparent along the ventral face of the working edge (Figure 5-14).

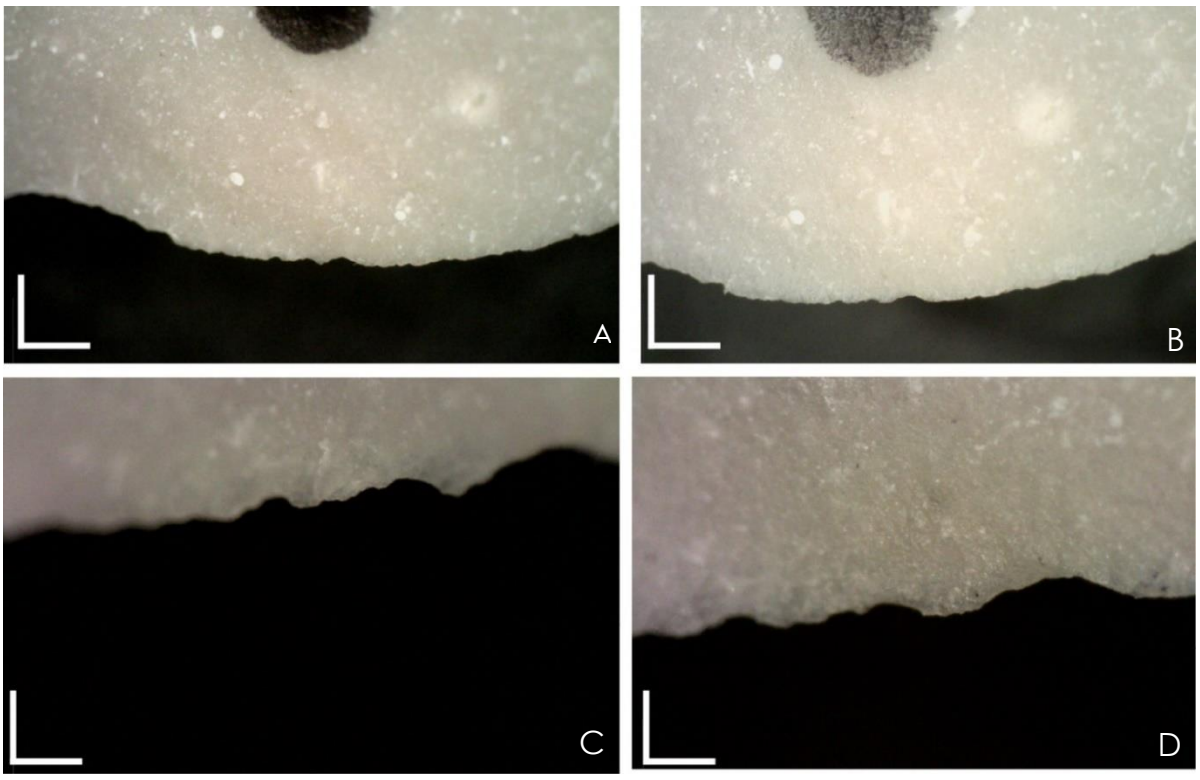


***Figure 5-13**: Experimental lithic used on fresh hide using a scraping action (20 minutes). A: 50x magnification, scale 1.0 mm. Unworked lithic. B: 50x magnification, scale 1.0 mm. Rounded edges with smoothed protrusions. C: 230x magnification, scale 200 µm. Unworked lithic. D: 230x magnification, scale 200 µm. Rounded edges, smoothed protrusions, limited polish*



***Figure 5-14**: Experimental lithic used on fresh hide using a scraping action (20 minutes), 230x magnification, scale 200 µm, ventral surface. Presence of polish and edge rounding. Polish is generally bright and has some degree of pitting*

The cutting of fresh hide again resulted in the development of greasy polish, although to a lesser extent than that produced from scraping. Limited hinge fractures were noted, however, the degree of edge rounding on tools used for cutting appears more severe than that on tools used for scraping, especially at the 20-minute mark (Figure 5-15).

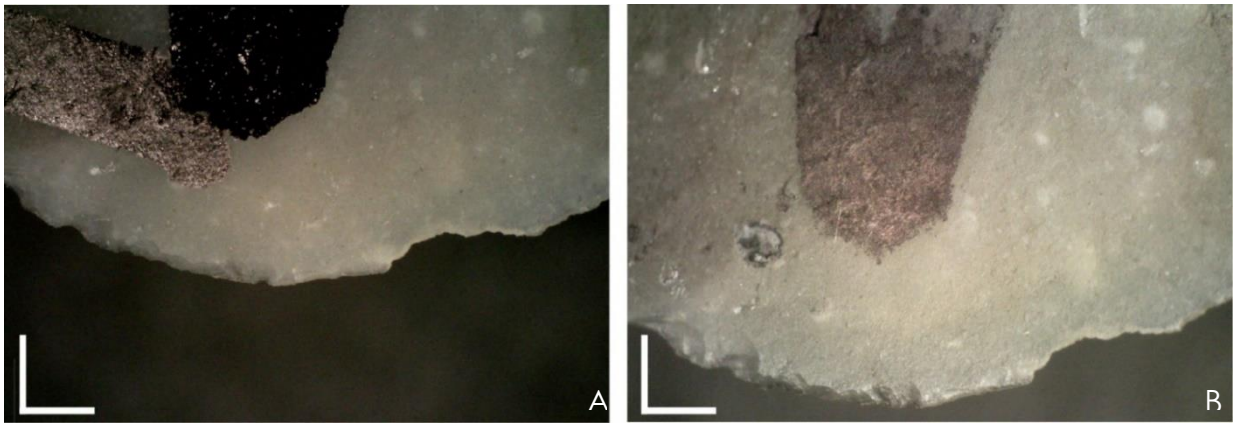


***Figure 5-15:** Experimental lithic used on fresh hide using a cutting motion (20 minutes), 50x magnification, scale 1.0 mm. A: Unworked lithic. B: Significant edge rounding, some polish*

Awling fresh hide produced the same form of greasy polish as seen with cutting and scraping, but the spread of polish was far more extensive, being found across the majority of the worked tips. The original tips of the tools were both broken during the action. What remained became rounded over time, as is seen with the previously described hide-working motions (Figure 5-16).

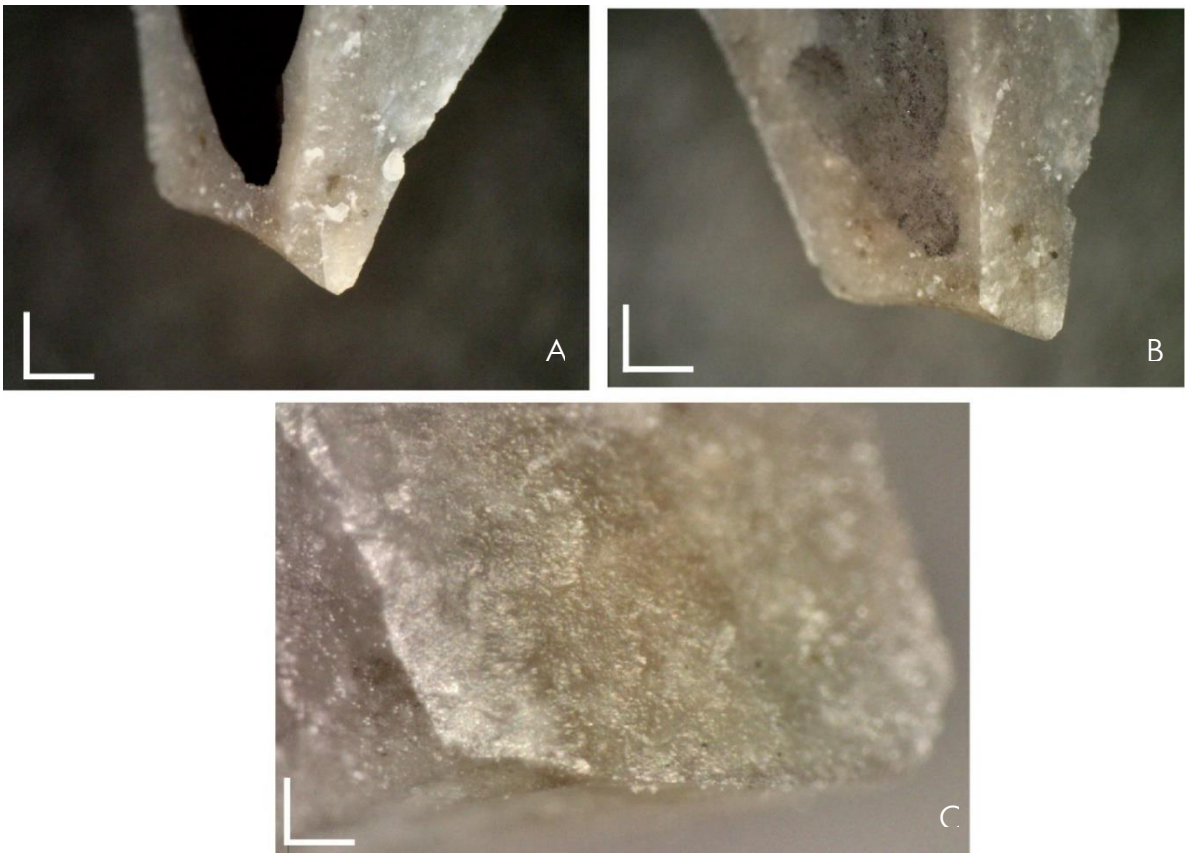


Figure 5-16: *Experimental lithic used to awl fresh hide (20 minutes). A: 50x magnification, scale 1.0 mm. Unworked lithic. B: 50x magnification, scale 1.0 mm. Rounding of tip, limited striations perpendicular to such. C: 230x magnification, scale 200 µm. Extensive polish across tip and well away from the worked edge higher upon the lithic. Polish is bright and greasy*

5.6.2 Dry Hide

The effects of scraping dry hide were like those of fresh hide. There was a significant degree of rounding along the worked edge which was notable even at lower magnifications (50x) (Figure 5-17). Polish formation did occur as with fresh hide; however, the spread of the polish was lesser. Additionally, the polish was duller, and pits could be seen at higher magnification (230x).

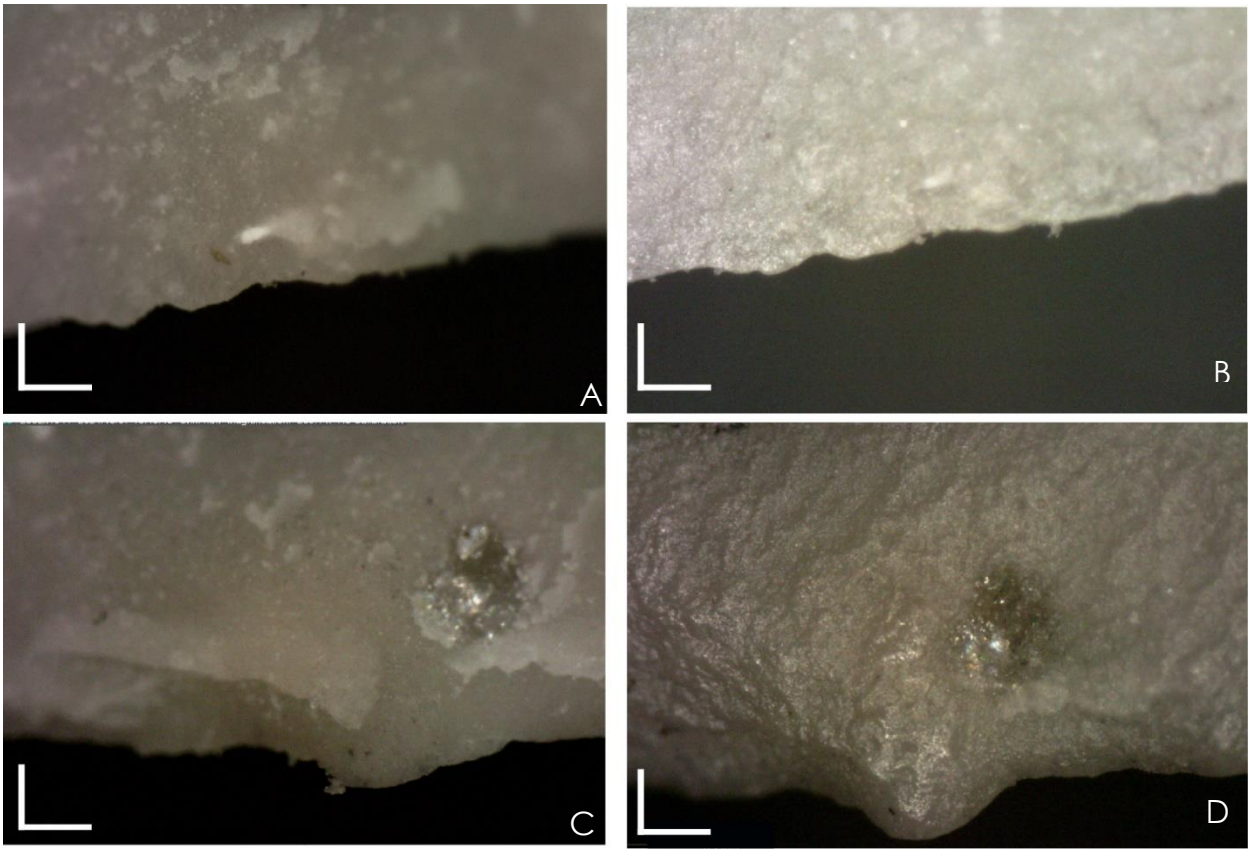


***Figure 5-17**: Experimental lithic used on dry hide using a scraping action (20 minutes). A: 100x magnification, scale 0.5 mm. Unworked lithic. B: 100x magnification, scale 0.5 mm. Rounding of worked edge and presence of polish. C: 230x magnification, scale 200 µm. Unworked lithic. D: 230x magnification, scale 200 µm. Rounding of worked edge, polish in clearer view*

Cutting dry hide once again produced a pitted polish (Figure 5-18). The appearance was again less greasy than polish caused by fresh hide. Edge alterations were noted in the form of small discontinuous feather scars. Additionally, the degree of edge rounding was more pronounced than with fresh hide.

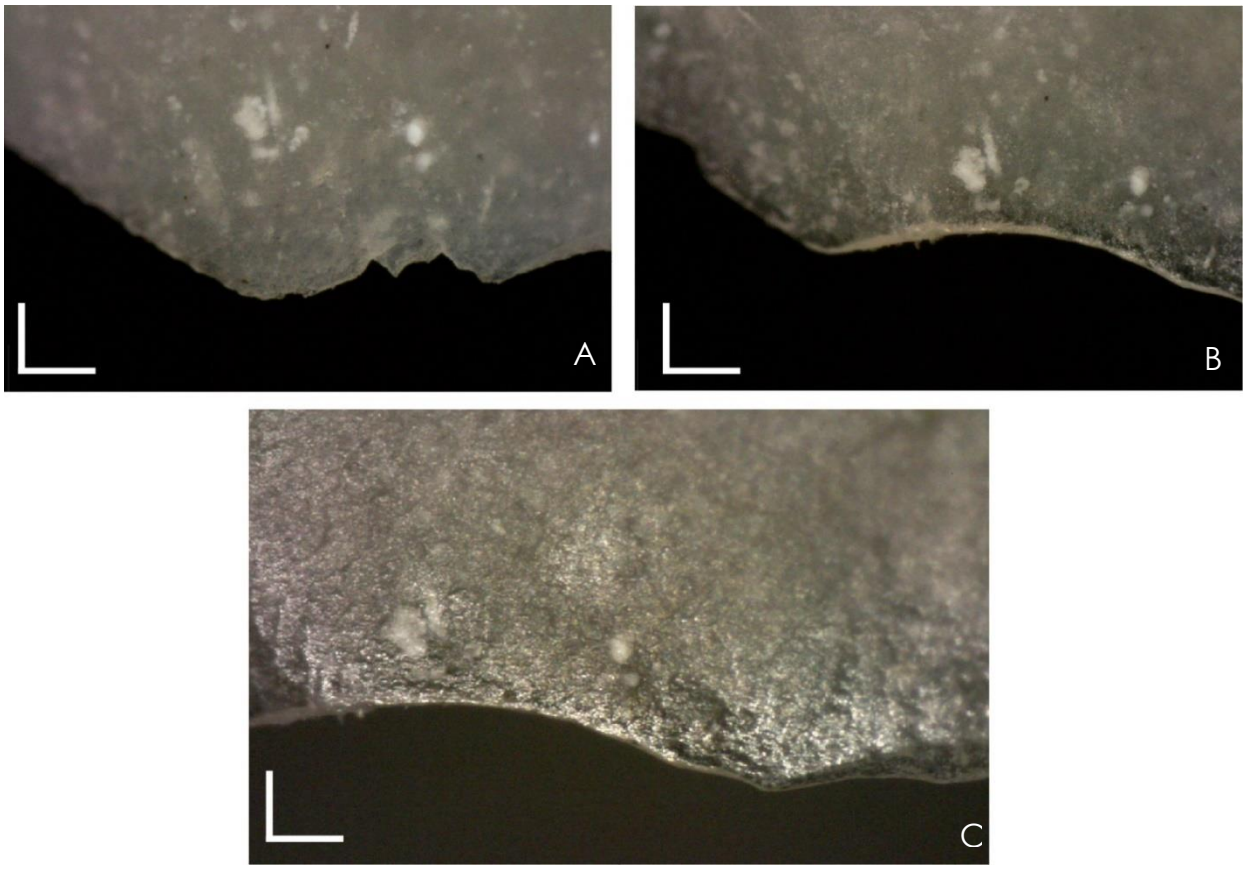


Figure 5-18: *Experimental lithic used on dry hide using a cutting action (20 minutes), 230 magnification, scale 200 µm. A: Unworked lithic polarised to highlight effects of rounding. B: Original working edge reduced by c. 200 µm, polarised to highlight effects of rounding. C: Rounded edge and highly pitted polish*

Awling dried hide produced large discontinuous hinge scars in addition to rounding down the working tip of the tool (Figure 5-19). The degree of this was more pronounced than in fresh hide, likely due to the lack of natural fats increasing the amount of friction. This also might explain why the polish differed from that of fresh hide polish, which is similar to meat polish. Polish from dry hide is less greasy and does not extend far away from the edge. Some pitting was also noted.

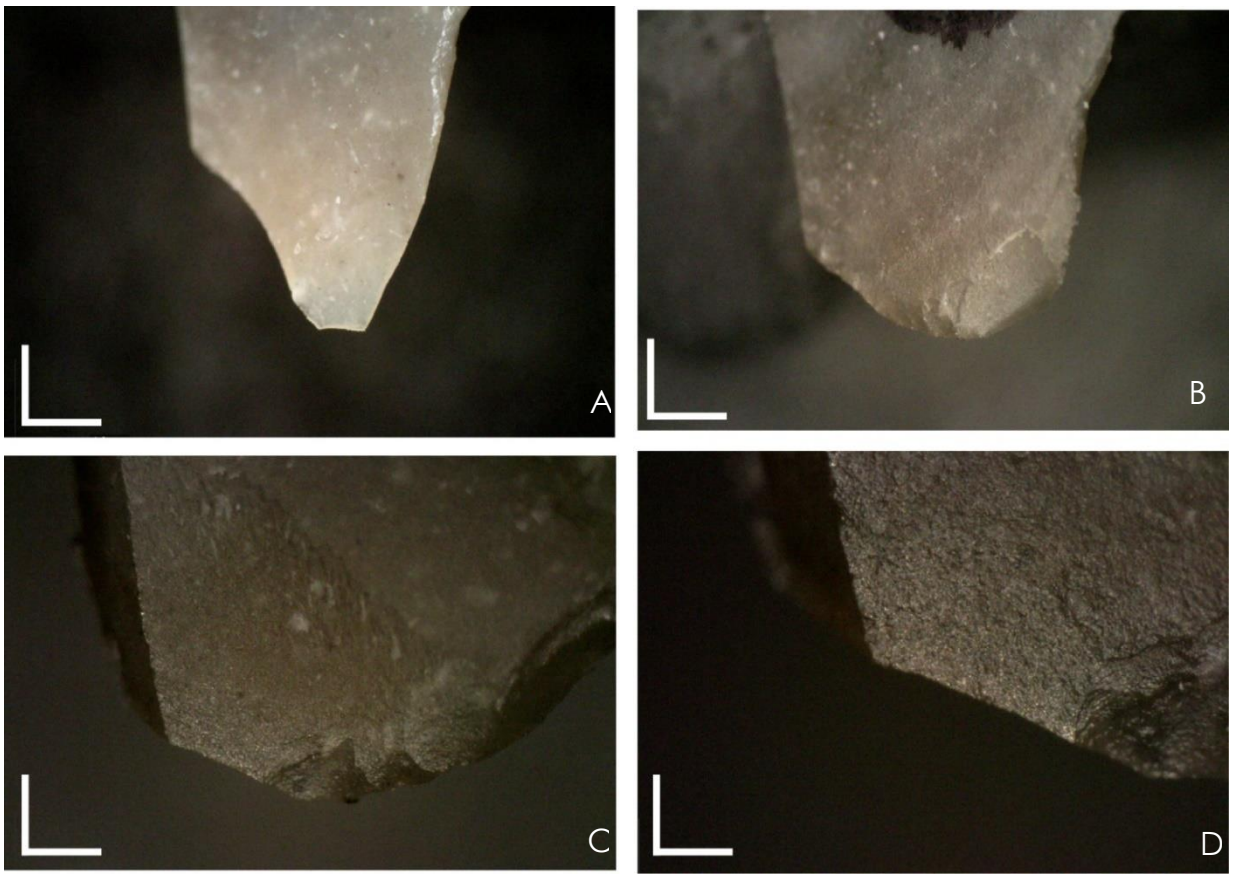


***Figure 5-19**: Experimental lithic used to awl dried hide (20 minutes). A: 50x magnification, scale 1.0 mm. Unworked lithic. B: 50x magnification, scale 1.0. Significant loss of original working tip, larger feather scars, rounding of remaining edge. C: 230x magnification, scale 200 µm. Large damage scars, some polish. D: 230x magnification, scale 200 µm. Pitted polish on worked edge*

5.7 Shell

The working of shell produces breakage patterns similar to those produced through the working of bone (see section 5.4). The presence of continuous, large, deep step and hinge flake scars stemming from the working edge was noted in the engraving experiments, even at lower magnifications (50x) (Figure 5-20). Engraving shell produced very little in the way of polish, however, some was noted at the highest magnification (230x) on one of the lithics (Figure 5-21). This polish was relatively matt and was missing the typical pitting associated with bone polish. It was not greasy, likely due to the material being mineral in nature.

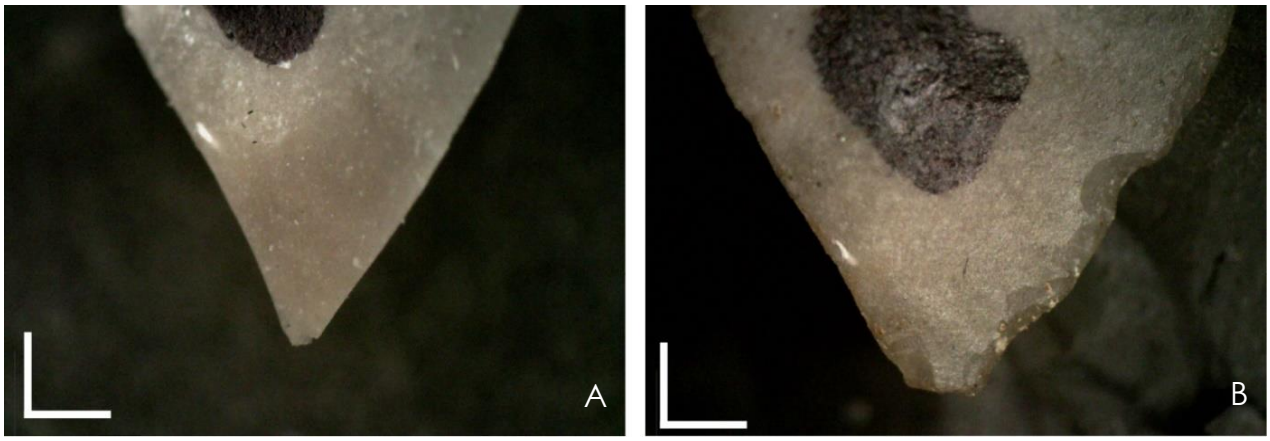


***Figure 5-20**: Experimental lithic used on shell using an engraving motion (20 minutes), 50x magnification, scale 1.0 mm. A: Unworked lithic. B: Large, deep step and hinge scars around contact edge*

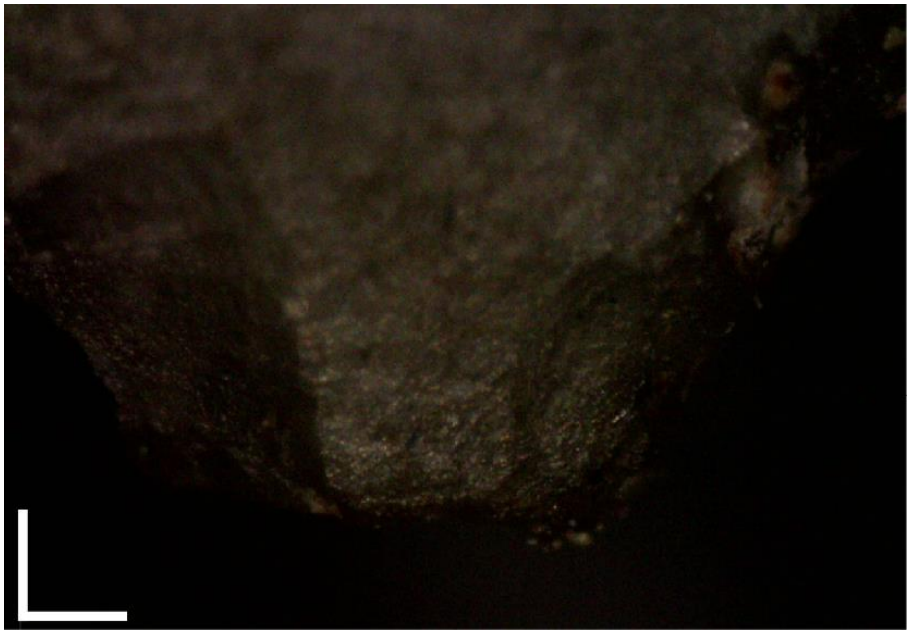


***Figure 5-21**: Experimental lithic used on shell using an engraving motion (20 minutes), 230x magnification, scale 200 µm. Dull, matt polish*

Drilling shell produced a significantly rounded edge following which rendered the lithic unusable by 15 minutes of work. The tip was snapped and the remaining portion showed multiple step fractures. The drilling action produced no notable polish, likely in part due to the catastrophic alteration to the working tip (Figure 5-22).

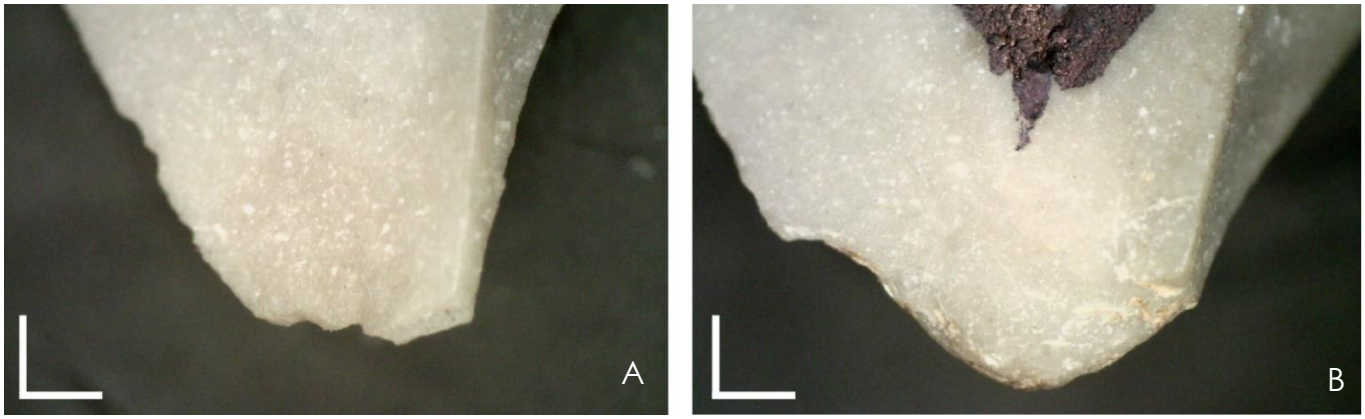


***Figure 5-22**: Experimental lithic used on shell using a drilling motion (20 minutes), magnification 50x, scale 1.0 mm. A: Unworked lithic. B: Significant edge rounding*

5.8 Wood

5.8.1 Hard Wood

The working of hard wood produced large, deep hinge and step scars, which would be expected given the hardness of the worked material. No notable scar patterning could be distinguished to differentiate wood working from the working of other hard materials such as shell or bone. Polish was noted and was widespread, with lithics in all three action categories showing a degree of such, the highest amount of polish associated with sawing. The polish was smooth and bright and featured sporadic 'domes' (per Keeley, 1980) throughout its composition (Figure 5-23).

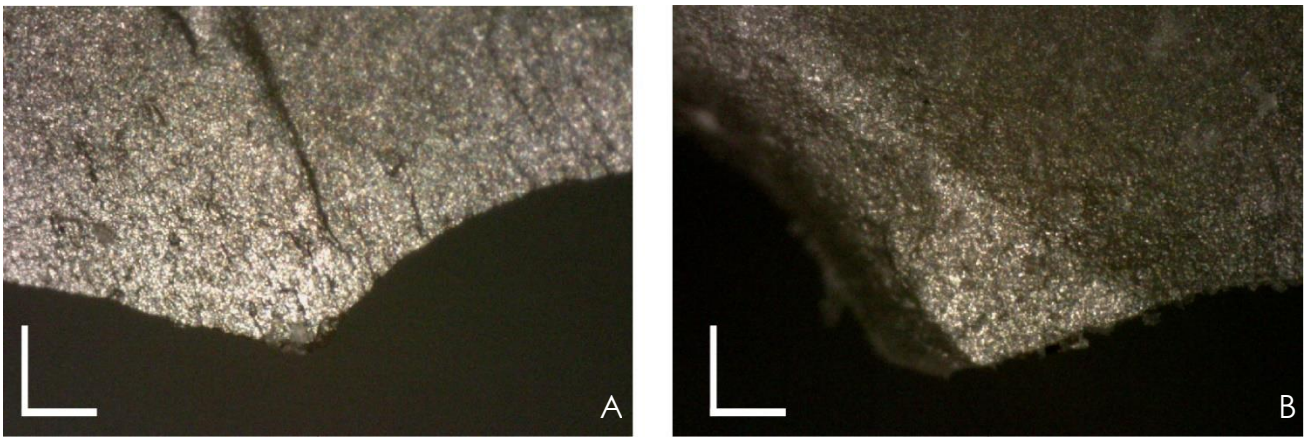


Figure 5-23: *Experimental lithics used on hard wood using a sawing action (20 minutes), 230x magnification, scale 200 µm. A, B: Bright, smooth polish on each tool*

Sawing hard wood produced large semi-circular hinge scars and isolated larger step scars along the worked edge. The general effect is one of undulating scars (Figure 5-24). Striations were noted on one of the tools. By

contrast, the cutting action on hard wood produced a limited amount of scarring but did round and wear down the edges of both worked tools. In addition, striations were noted on one of the tools (Figure 5-25).

Debarking hardwood produced very limited edge alteration. A few striations were noted further from the worked edge than with other materials. Several small, isolated hinge scars developed. It is noted that the degree of scarring was more prevalent on the ventral edge of the worked tools.

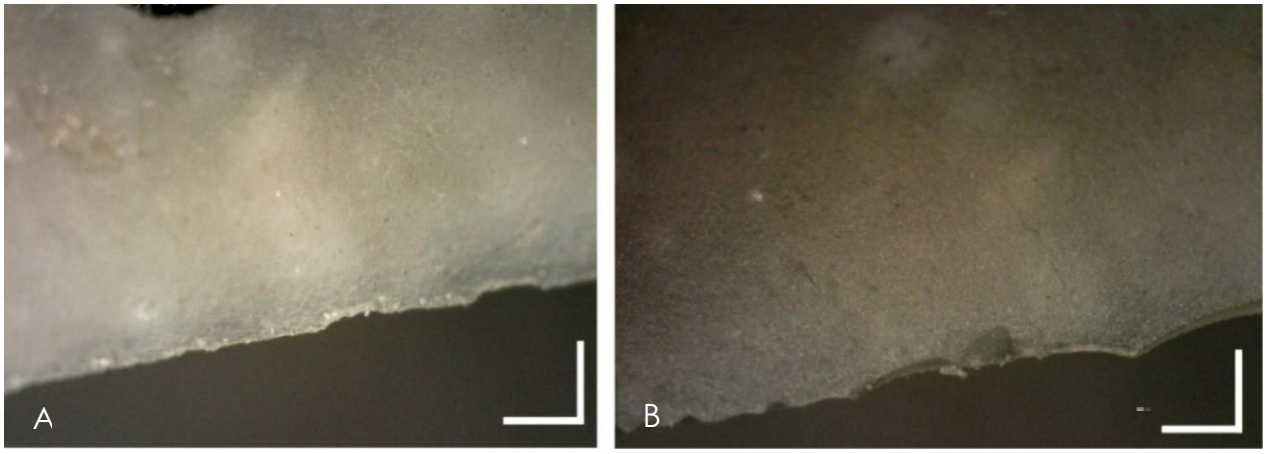


Figure 5-24: *Experimental lithic used on hard wood using a sawing action (20 minutes), 100x magnification, scale 0.5 mm. A: Unworked lithic. B: Small semi-circular scars and larger, deeper scars*

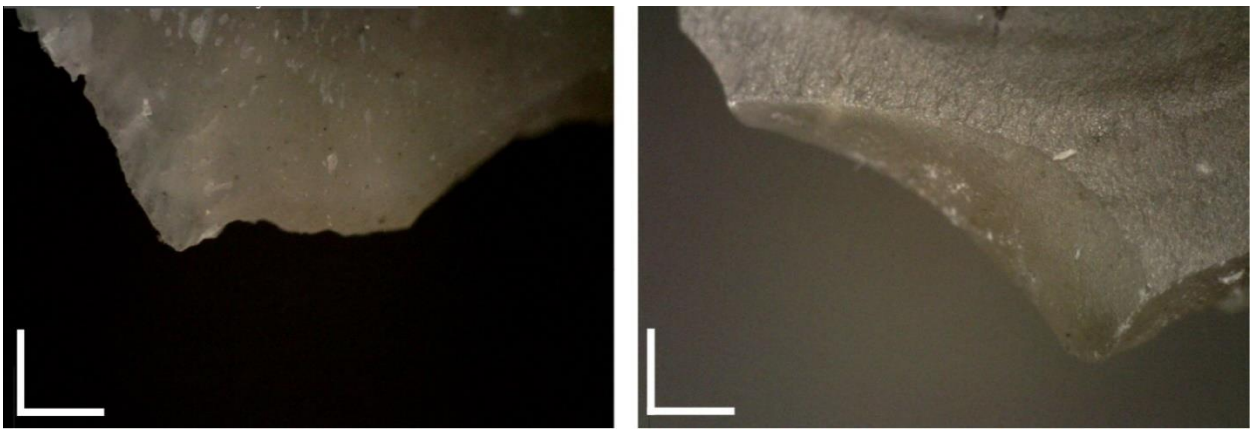


Figure 5-25: *Experimental lithic used on hard wood using a cutting action (20 minutes), 100x magnification, scale 0.5 mm. A: Unworked lithic. B: Striations and significant edge rounding*

5.8.2 Soft Wood

As with hard wood, sawing soft wood produced an undulating pattern of hinge scars (Figure 5-26). Therefore, this wear appears to be synonymous with the action of sawing, rather than associated with a specific worked material.

Again, as with hard wood, bright and smooth wood polish featuring doming was noted for soft wood (Figure 5-27). Debarking soft wood also produced very limited edge alteration (Figure 5-28). A few striations were noted further from the worked edge than with other materials (e.g. bone). Some step scars and some degree of rounding was noted but less so than with other materials.

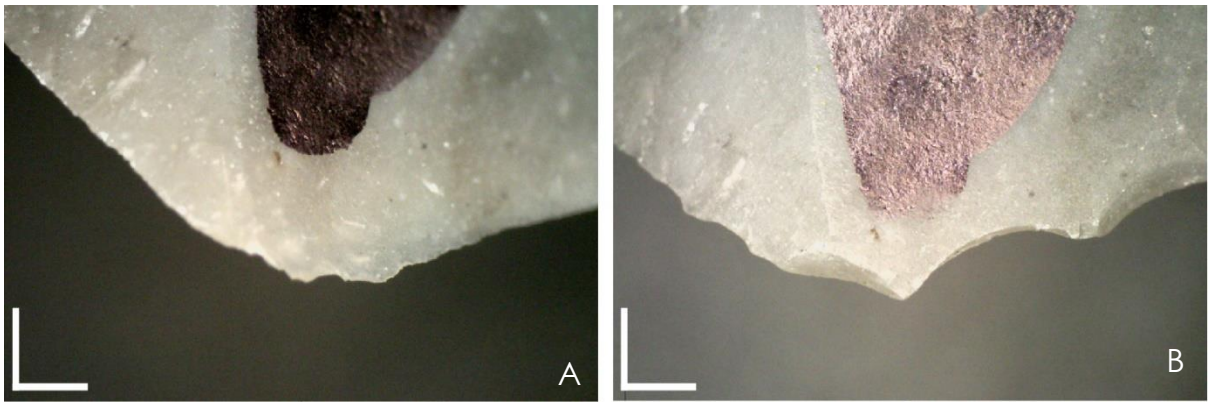


***Figure 5-26**: Experimental lithic used on soft wood using a sawing action (20 minutes), 50x magnification, scale 1.0 mm. A: Unworked lithic. B: Small semi-circular hinge scars in an undulating pattern*

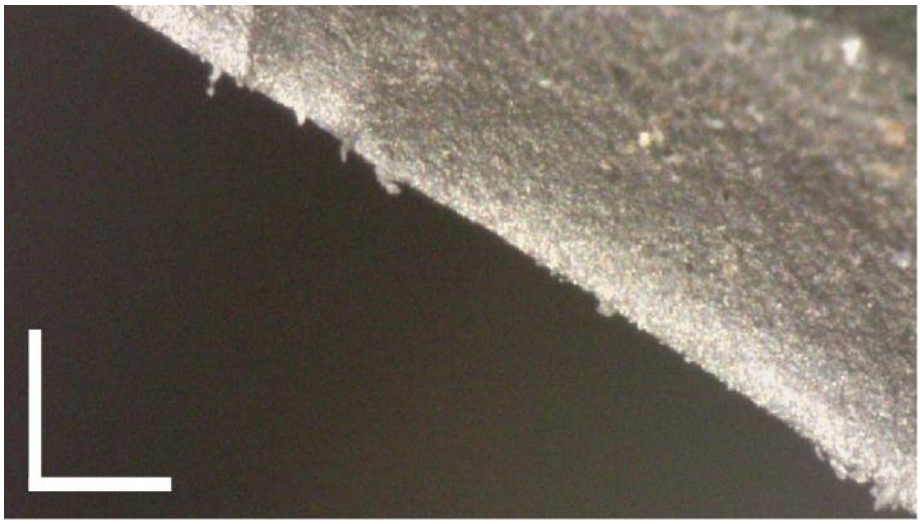


***Figure 5-27**: Experimental lithic used on soft wood using a cutting motion (20 minutes), 230x magnification, scale 200 µm. Bright polish along worked edge*

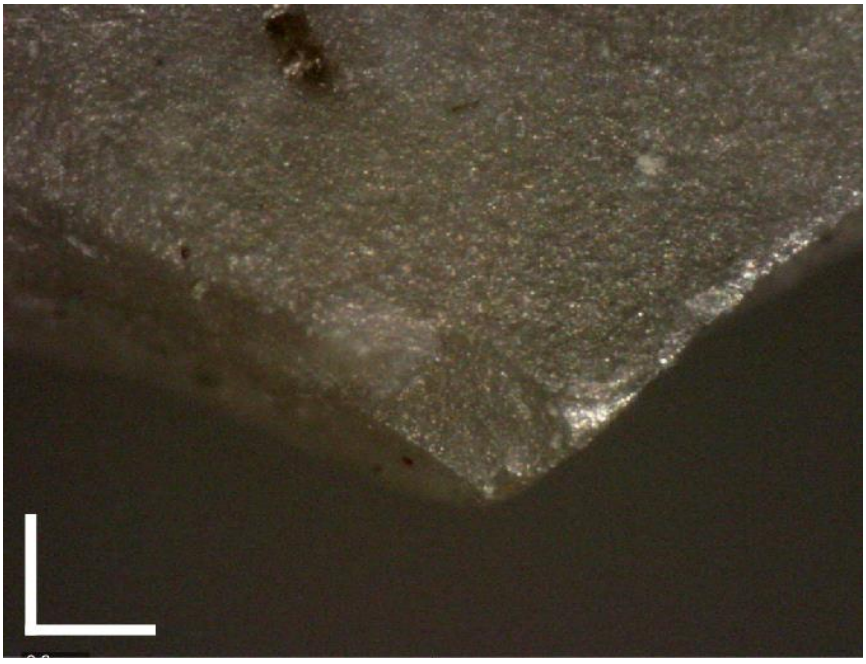


***Figure 5-28**: Experimental lithic used to debark soft wood (20 minutes), 230x magnification, scale 200 µm. Bright polish along worked edge*

5.9 Plant Fibres

5.9.1 Hard Wood Fibres

Working hard wood fibres resulted in medium hinge scars occurring along the worked edge (see Figure 5-29). These scars were mostly present on the dorsal face with minimal edge alterations noted on the ventral surface. A degree of edge rounding could be seen but this was less apparent than the edge rounding caused by the scraping/debarking of hard wood (see 5.8.1). No polish was visible, even at higher magnifications. Striations were faint and occurred at 90 degrees to the working edge.

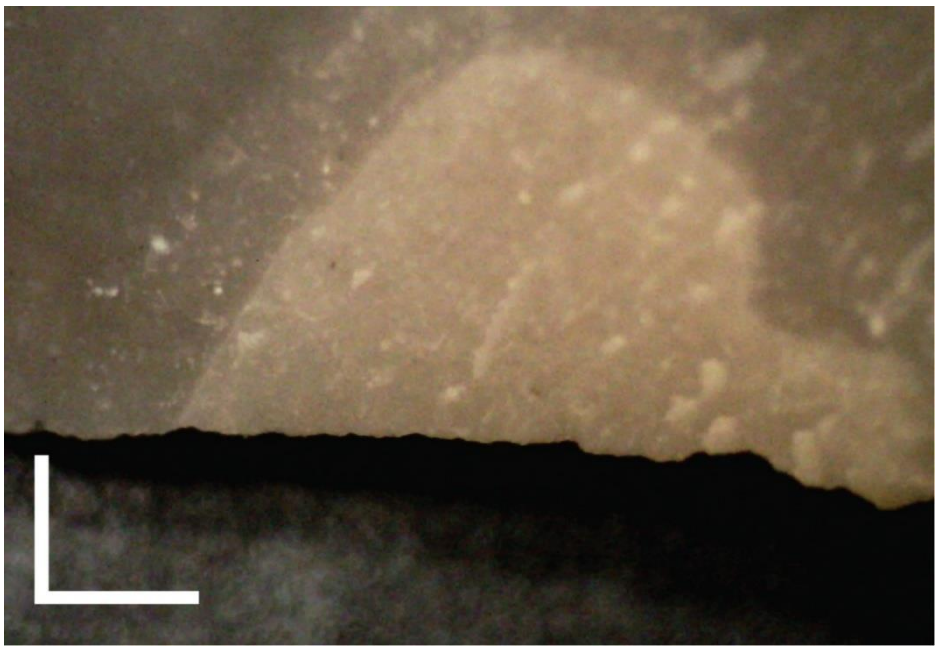


***Figure 5-29**: Experimental lithic used to peel Oak bast fibres for 15 minutes, 50x magnification, 1mm scale. Worked edge with hinge scars and limited edge rounding.*

5.9.2 Soft Wood Fibres

Working soft wood fibres resulted in very limited edge alteration (see Figure 5-30). A few feather scars could be seen, as well as very faint striations, occurring at 90 degrees to the worked edge. A significant degree of polish was visible at the highest magnifications (see Figure 3-31). This polish was very bright and glossy and occurred away from the worked edge.

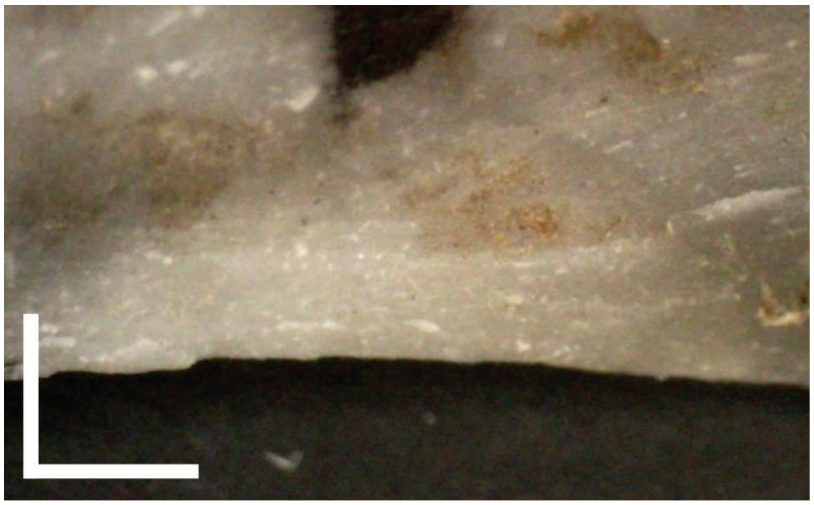


***Figure 5-30**: Experimental lithic used to peel pine for 15 minutes, 50x magnification, 1mm scale. Limited edge alteration with small feather scars and small striations.*

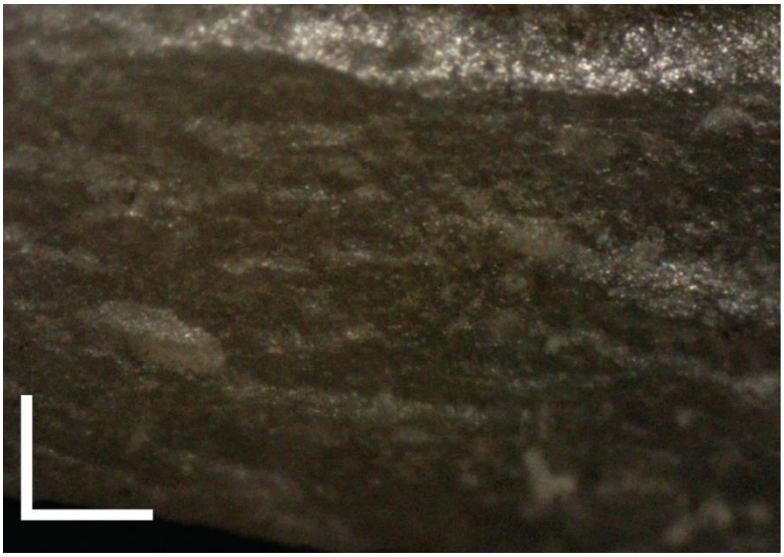


***Figure 5-31:** Experimental lithic used to scrape pine for 15 minutes, 230x magnification, scale 200 µm. Very bright glossy polish stretching away from worked edge*

5.10 Antler

5.10.1 Dry Antler

The cutting of dry antler produced a wear pattern not dissimilar to that produced by bone working (see 5.4). Continuous large scars, mostly step and hinge terminations, formed along the worked edge (see Figure 5-32). Polish was observed at higher magnifications (see Figure 5-33). This polish was generally dull with a limited amount of pitting.

Drilling dry antler again produced a similar wear pattern to drilling bone with larger step scars. The motion caused the lithic tip to snap. There was also a notable degree of crushing which wore down the remaining working edge (see Figure 5-34).

Scraping dry antler resulted in large hinge and step scars along the worked edge (see Figure 5-35). Some striations were visible at 90 degrees to the edge. Dull polish was visible on the ventral face at higher magnifications (see Figure 5-36).

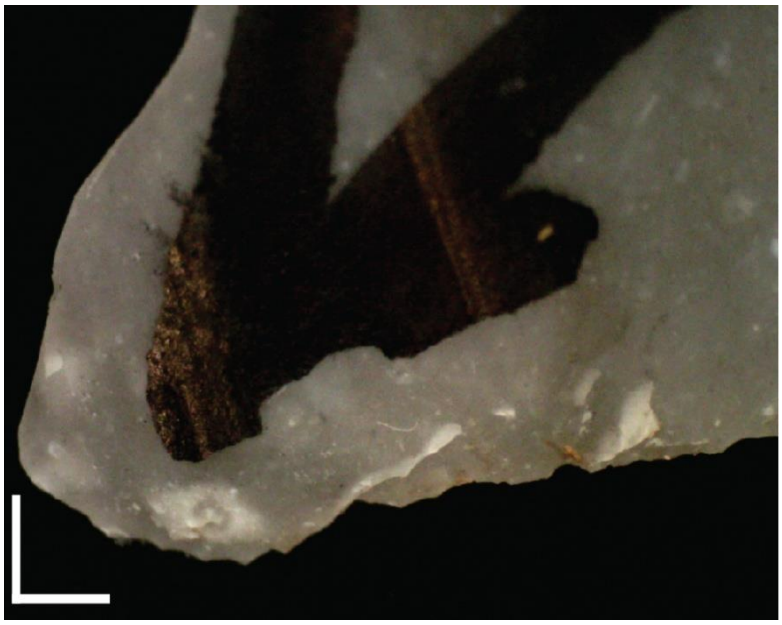


Figure 5-32: *Experimental lithic used to cut dry antler for 20 minutes, 50x, 1mm. Large hinge and step fractures can be seen along the worked edge.*

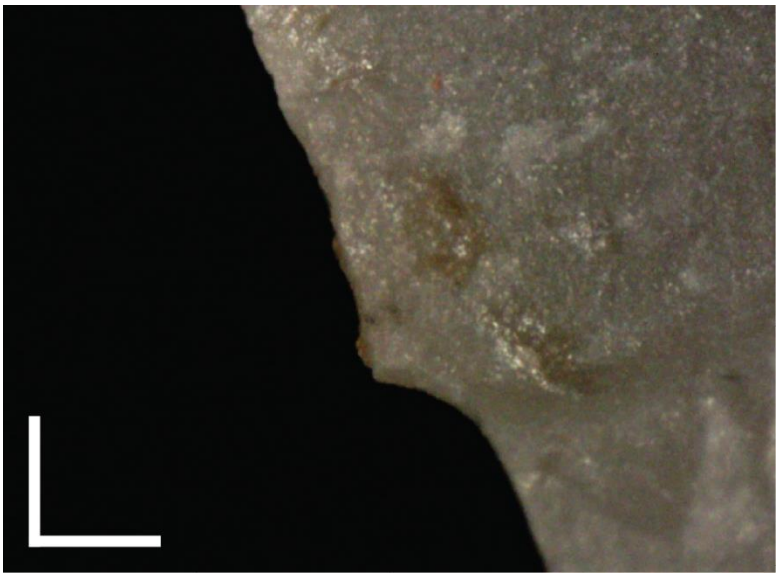


Figure 5-33*: Experimental lithic used to cut dry antler for 20 minutes, 230x magnification, scale 200 µm. Dull, pitted polish*

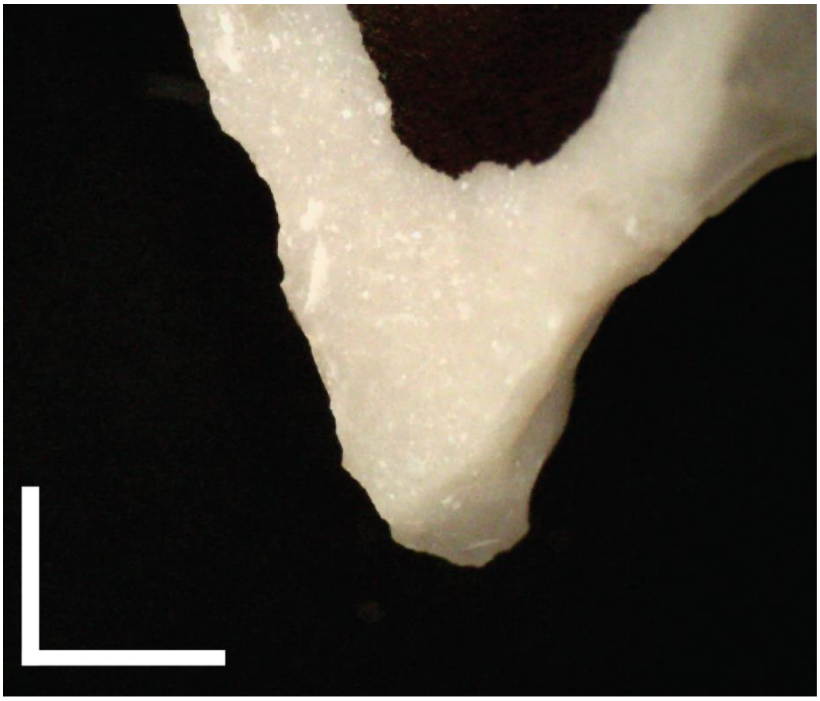


***Figure 5-34**: Experimental lithic used to drill into dry antler for 20 minutes, 25x magnification, 2mm scale. Large step scars along tip, with a snapped termination along the end of the tip itself.*

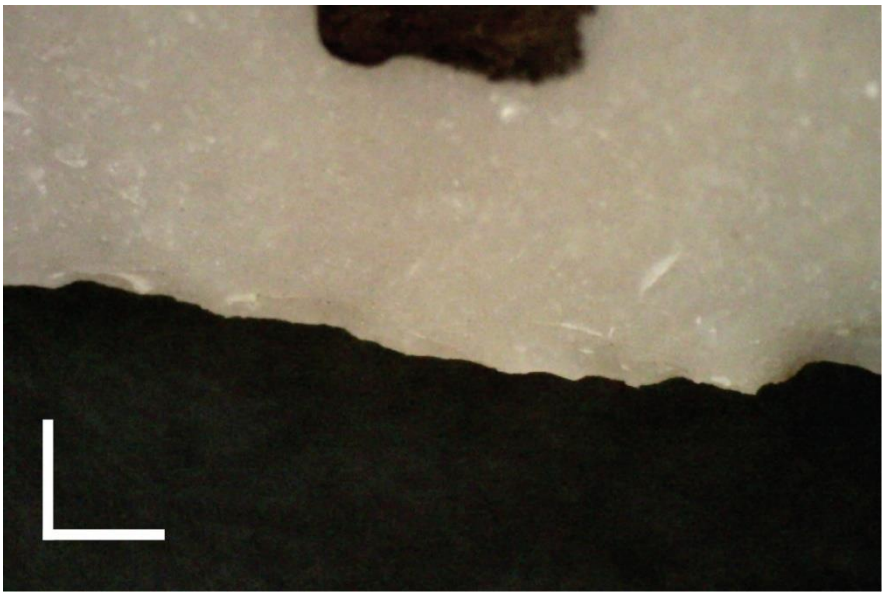


***Figure 5-35:** Experimental lithic used to scrape dry antler for 20 minutes. 30x magnification, 1mm scale. Large hinge and step scars occur along the worked edge*

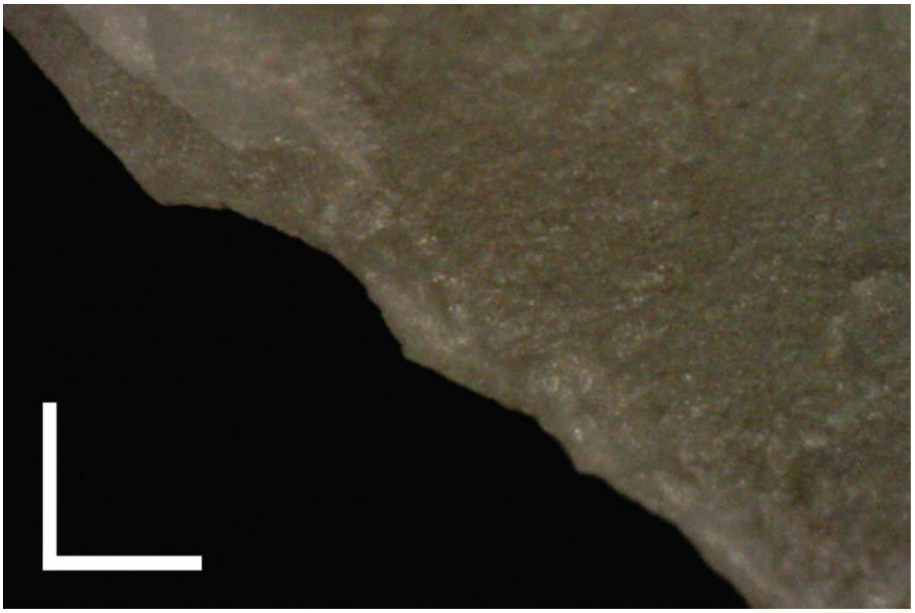


***Figure 5-36**: Experimental lithic used to scrape dry antler for 20 minutes, 230x magnification, scale 200 µm. Dull polish on ventral face of tool*

5.10.2 Wet Antler

Less wear is observable on the lithic when working wet antler compared to dry antler. Cutting wet antler produced continuous small hinge scars (see Figure 5-37). These were apparent on both faces along the worked edge. Polish formation was minimal, likely due to the reduced friction of the material being wet.

Drilling wet antler produced mostly hinge scars along the tip, with a few step scars also present (see Figure 5-38). The tip did not snap as it did with working dry antler, but it did become rounded. Dull, pitted polish was observed (see Figure 5-39).

Scraping wet antler produced small continuous hinge scars (Figure 5-40). No polish was observed.

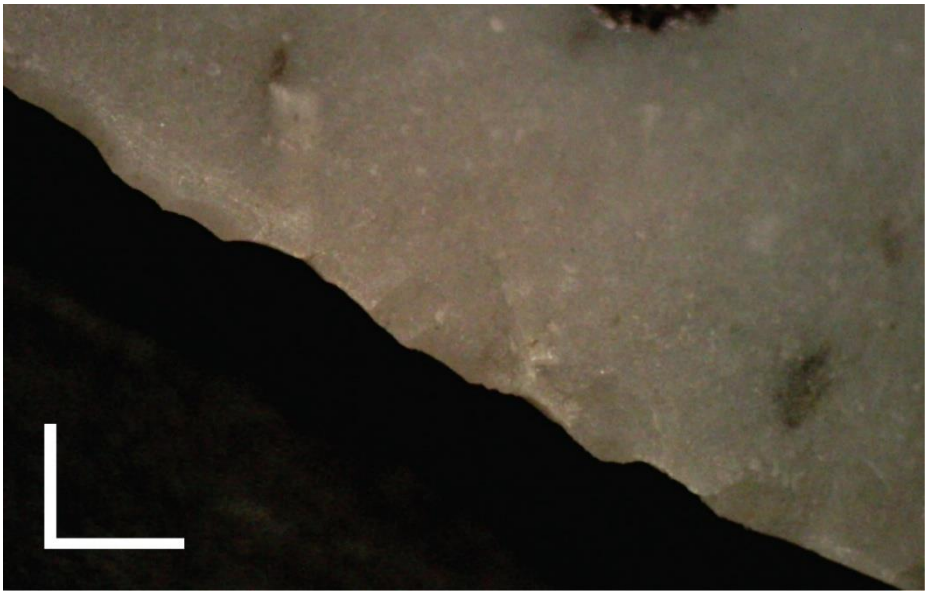


Figure 5-37: *Experimental lithic used to cut wet antler, 50x magnification, 1mm scale. Small hinge scars along worked edge.*

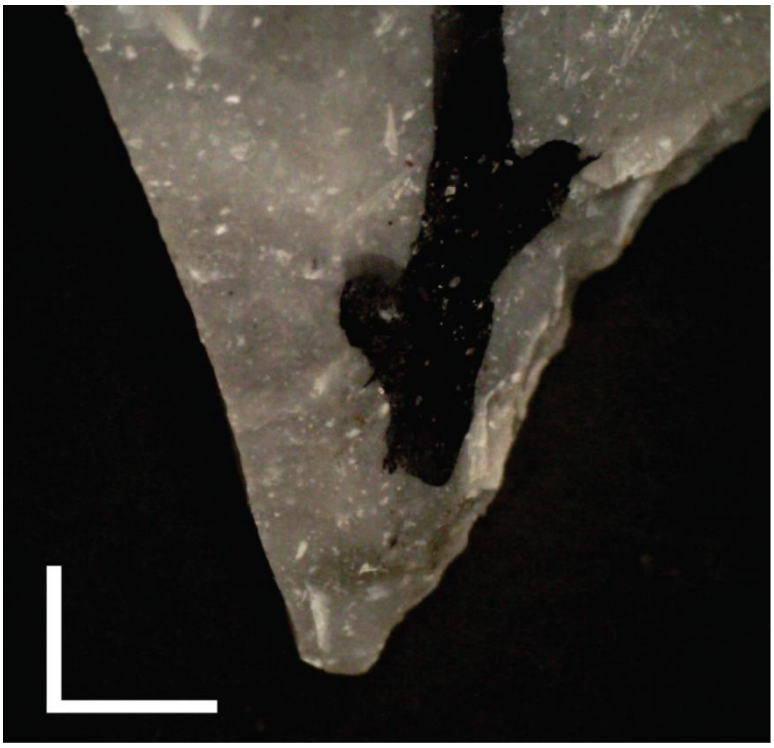


Figure 5-38*: : Experimental lithic used to drill into wet antler for 20 minutes, 25x magnification, 2mm scale. Hinge and step scars along worked edge, rounding noted at tip.*

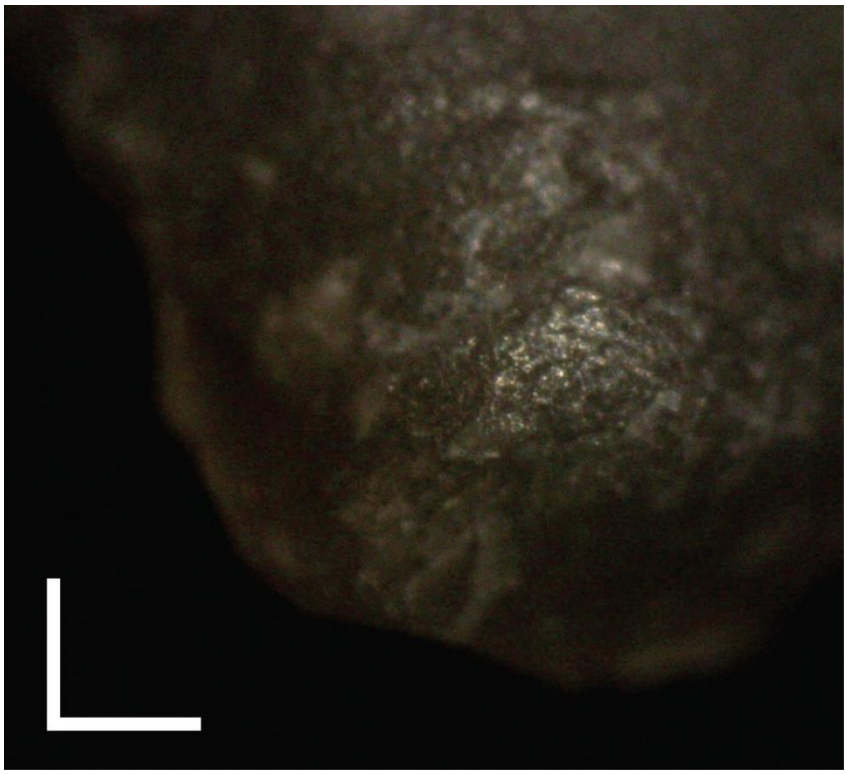


Figure 5-39: *Experimental lithic used to drill into wet antler for 20 minutes, 230x magnification, , scale 200 µm. Dull polish on worked tip associated with rounding*

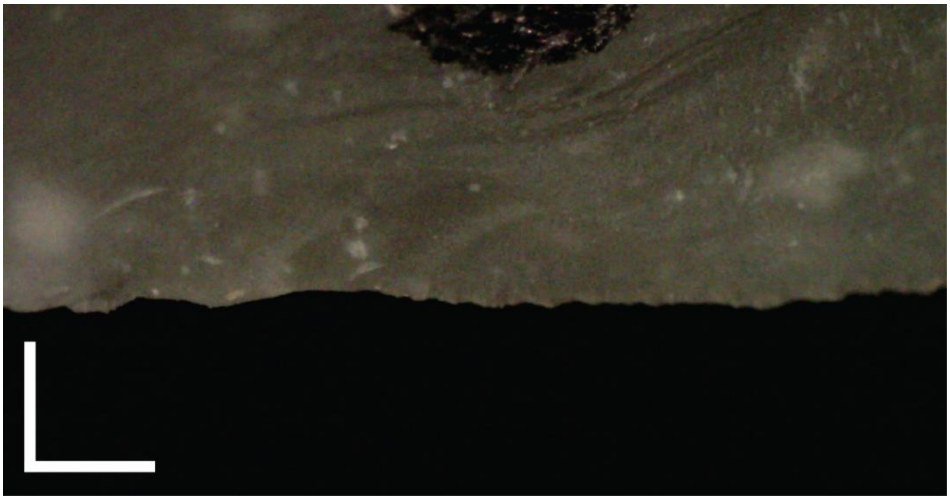


Figure 5-40*: Experimental lithic used to scrape wet antler for 20 minutes, 65x magnification, 0.5mm scale. Small continuous hinge scars.*

5.11 Horn

5.11.1 Dry Horn

Working dry horn produced a medium-hard wear pattern. Cutting dry horn caused the development of a continuous band of feather scars, with a few isolated hinge scars (see Figure 5-41). Polish was observed at higher magnifications. This was somewhat bright with limited radiation away from the worked edge (Figure 5-42).

Drilling dry horn produced a rounded tip with some hinge fractures around such (Figure 5-43). Limited striations could be seen occurring horizontal to the worked tip. Polish was not observed.

Scraping dry horn produced a number of feather and hinge scars, associated with edge rounding (see Figure 5-44). Polish was not observed.

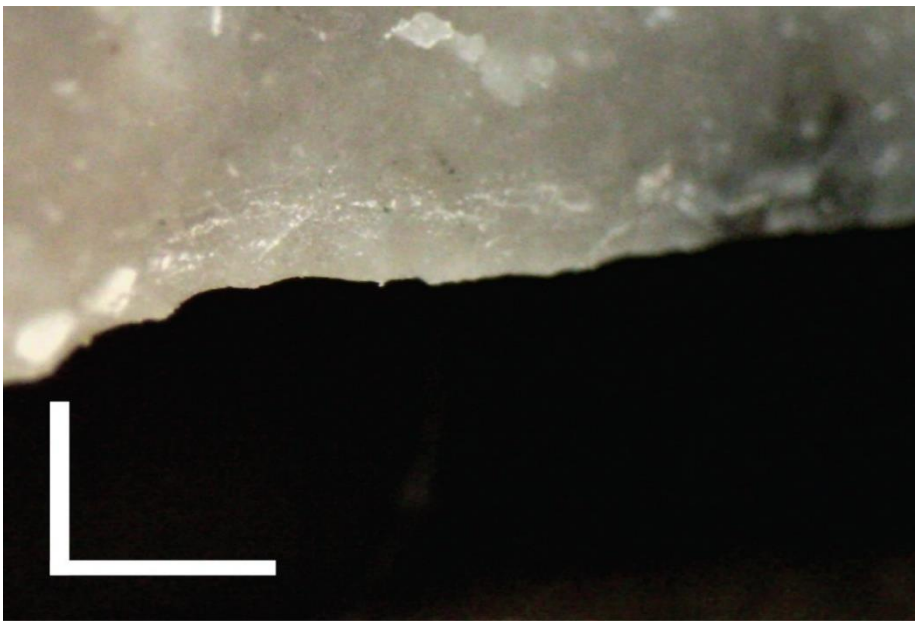


***Figure 5-41**: Experimental lithic used to cut dry horn for 20 minutes, 50x magnification, 1mm scale. Continuous feather scars with few hinge scars*

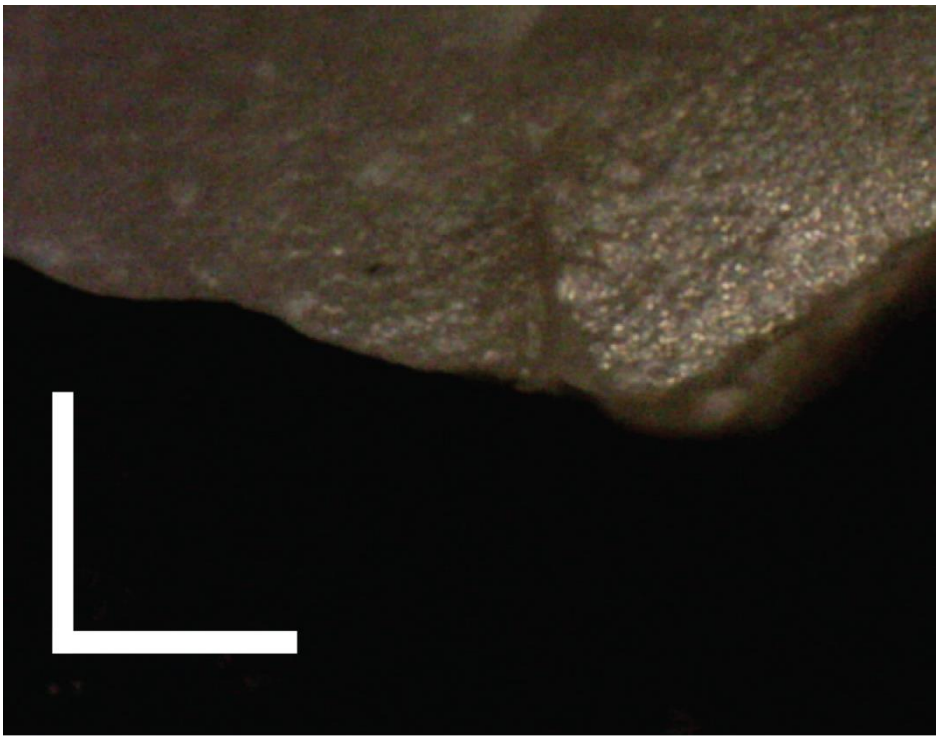


***Figure 5-42**: Experimental lithic used to cut dry horn for 20 minutes, 230x magnification. scale 200 µm. Somewhat bright polish along worked edge*

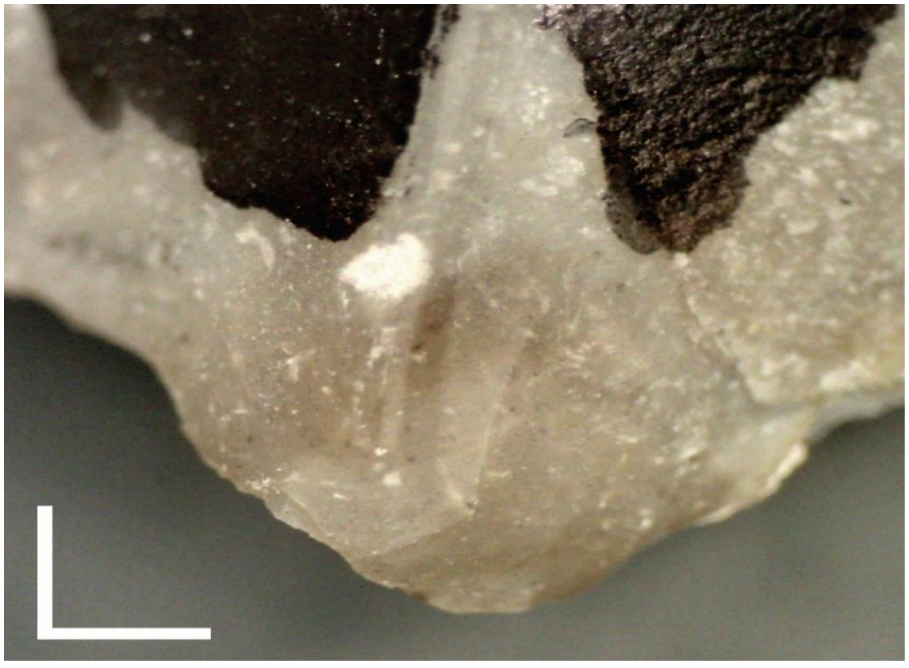


***Figure 5-43**: Experimental lithic used to drill into dry horn for 20 minutes, 50x magnification, 1mm. Rounding and limited hinge scars*

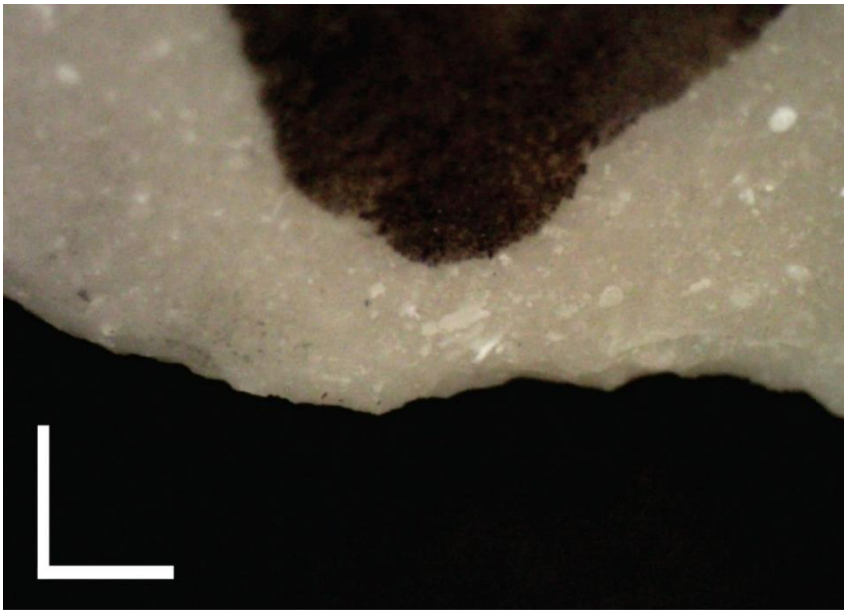


Figure 5-44: *Experimental lithic used to scrape dry horn for 20 minutes, 50x magnification, 1mm scale. Feather and hinge scars along a rounded edge*

5.11.2 Wet Horn

Working wet horn produced a softer wear pattern to that produced by working dry horn. Cutting produced a continuous band of feather scars, with smaller isolated hinge scars scattered across the edge (see Figure 5-45). Polish was visible at higher magnification (see Figure 5-46). It extended far from the worked edge and was somewhat bright and greasy.

Drilling wet horn produced small hinge scars. The tip was snapped (see Figure 5-47).

Scraping wet horn caused continuous hinge scars on the dorsal face of the working edge (see Figure 4-48). Some edge rounding was observed. There was no observable polish.

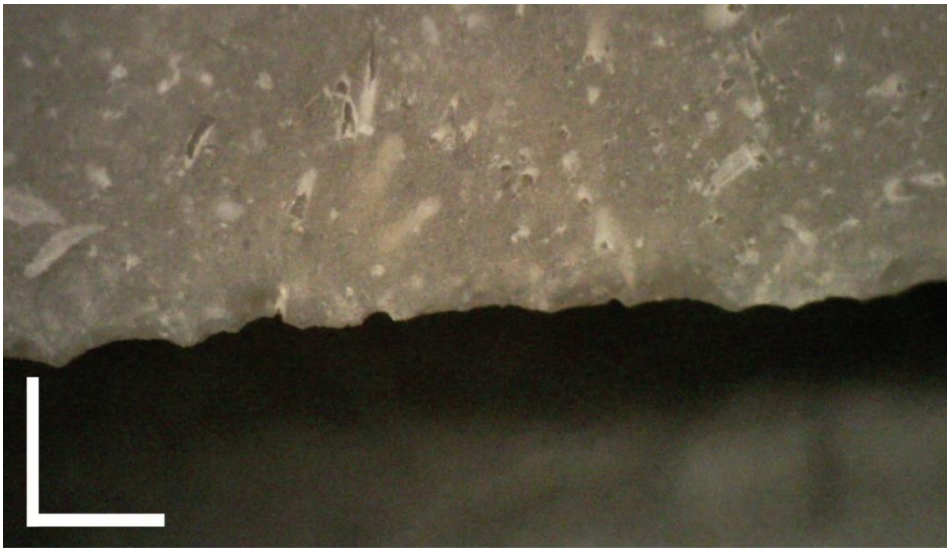


***Figure 5-45**: Experimental lithic used to cut wet horn for 20 minutes, 50x magnification, 1mm scale. Large continuous feather scars with smaller hinge scars along worked edge*

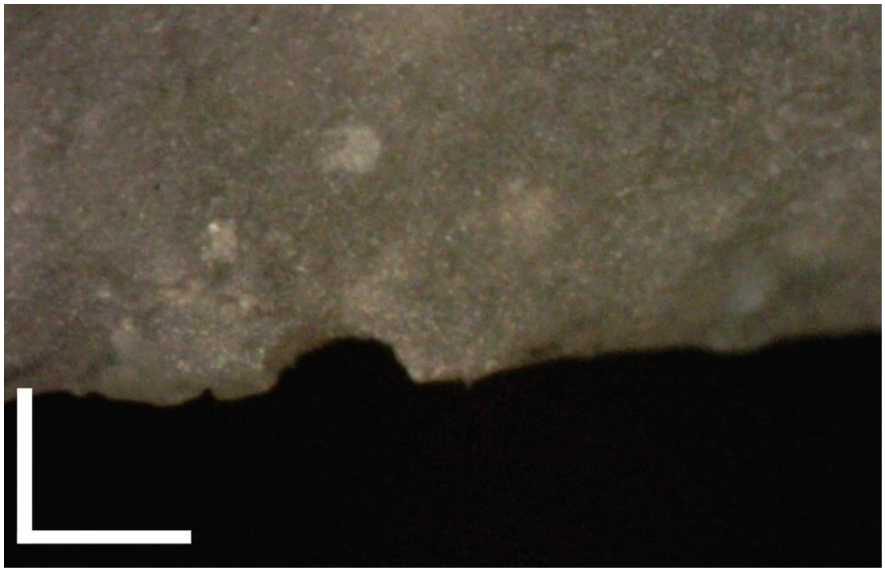


***Figure 5-46**: Experimental lithic used to cut wet horn for 20 minutes, 230x magnification, scale 200 µm. Somewhat bright polish along worked edge*

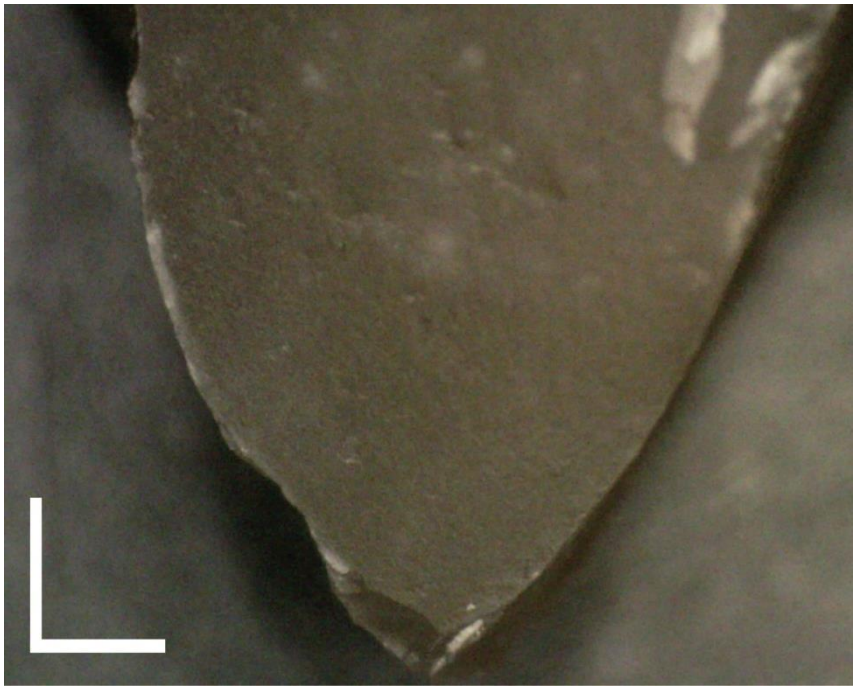


Figure 5-47: *Experimental lithic used to drill wet horn for 20 minutes, 50x magnification, 1mm scale. Large snap termination with smaller hinge scars.*

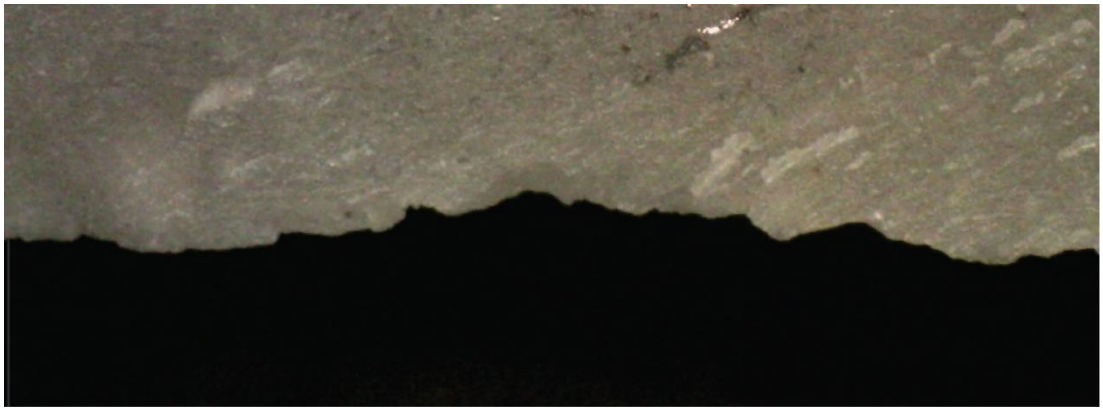


Figure 5-48*: Experimental lithic used to scrape wet horn for 20 minutes, 50x magnification, 1mm scale. Continuous hinge scars*

5.12 Experimental Discussion

As discussed in Chapter 4 the experimental series was designed with reference to established literature to inform as to the raw material chosen to create the lithics themselves, the motions used, and the materials chosen to work (Keeley, 1980; Odell, 2006; González-Urquijo and Ibáñez Esteves, 1994; Vaughan, 1981, 1985; Bamforth et al., 1990; Marreiros et al., 2014, 2020). Those materials served as a proxy for the flora and fauna known to have been exploited by or available to the Palaeolithic hominins of the Zagros (Campana and Crabtree, 2019; Hunt et al., 2023; Evins, 1982; Mata-González et al., 2022, 2023; Heydari-Guran et al., 2021).

5.12.1 Meat

Working raw meat produced very little in the way of edge alterations. This could be attributed to the softness of the material which does not offer a high enough resistance to produce significant edge alteration. Some striations formed but these were small and narrow. Polish was noticeable only above magnifications of 200x, and through the aid of the polariser attachment on the DINO-LITE microscope. Observable polish associated with processing meat was greasy and bright, extending away from the worked edge. This type of wear, though minimal, has been observed by several other researchers (Semenov, 1964; Keeley, 1980; Tringham et al.,1974; Ibáñez and Mazzucco, 2021; van Gijn, 2014; Croft, 2017; Nicolas et al., 2020; Vaughan, 1985; González-Urquijo and Ibáñez Esteves,1994).

There was little variation in the wear produced when working raw or cooked meat, however, working cooked meat produced some small, continuous feather scars after 20 minutes work which was not observed when working raw meat. This may be due to the increased toughness of the meat following the cooking process. Polish was observed (again above 200x magnification) but appeared less bright and less greasy than with raw meat. This may be due to the cooking process removing fat from the material which has been hypothesised by other researchers (Ibáñez and Mazzucco, 2021; Keeley, 1980; Odell, 2004).

As with working raw meat, working raw meat and bone produced a bright, greasy polish apparent at higher magnifications. Where the working of meat and bone differed from raw meat was in the degree of edge damage observed at the end of the working period. With the cutting experiments, edge scarring was noted with larger scars visible even at lower magnifications. These were feather and hinge in termination. Some rounding and crushing were also noted. This is again corroborated by the published literature (e.g. Keeley, 1980; Tringham et al., 1974; Semenov, 1964; Ibáñez and Mazzucco, 2021; van Gijn, 2014; Vaughan, 1985; González-Urquijo and Ibáñez Esteves, 1994). Following the sawing action, more edge damage and more polish was recorded compared to the cutting action. Additionally, the sawing motion produced large, undulating scars causing the tool edge to resemble that of a modern saw blade. This breakage pattern is repeated across all the experimental lithics used for sawing. It could be caused by

dislodged fragments of flint from the tool itself rubbing against the worked edge rather than from direct contact with the worked material (Vaughan, 1981).

Cooked meat and bone again produced only subtle differences from the raw variant. Where polish formed it was duller and less greasy. The sawing motion again produced an undulating, saw-like wear pattern on the tool.

5.12.2 Bone

Working bone caused significant alterations to the experimental lithics. The cutting or engraving of dry bone resulted in heavily scarred edges with striations and polish. The polish differed from that of meat by its duller appearance and the presence of pitting. Some crushing and rounding of the edge was also noted.

Drilling dried bone resulted in significant damage to the working tip after just 10 minutes making the scar pattern difficult to identify and rendering the tool ineffectual. No polish was noted, likely due to the dry bone having lost some grease or fats during the cooking process.

The working of fresh bone did not differ greatly from the working of dried bone. Following engraving, large scars could be seen as well as a significant number of striations occurring at oblique angles to the tool's edge, and dull, pitted polish formed. Again, the drilling of fresh bone resulted in catastrophic damage to the tip which became unusable after just 10 minutes.

The working of bone (fresh or dried) caused heavy edge alteration in the form of scarring and striation formation and in the case of drilling, catastrophic edge damage. Polish was bright and pitted and appeared similar to meat polish. These findings are supported by the works of other analysts (Semenov, 1964; Keeley, 1980; Tringham et al., 1974; Ibáñez and Mazzucco, 2021; Vaughan, 1985; González-Urquijo y Ibáñez Esteves, 1994; van Gijn, 2014; Croft, 2017; Nicolás et al., 2020; Chen et al., 2017; Zupancich et al., 2016).

5.12.3 Fish

The experimental working of fish produced limited edge alterations throughout all experiments. Like in the raw meat experiments this could be attributed to softness of the material being worked. Scarring and striations were noted but were minimal, occurring in a lower quantity than usual meat working. Where the working of fish differed from that of other materials was in the production of a very bright, greasy polish occurring in linear bands, which did not occur in the working of meat products. Whilst this was noted following one of the cooked fish experiments, it was much more apparent in those using the raw fish.

Scraping/descaling fish resulted in a more unilateral formation of wear on the dorsal face of the tool with limited formation on the ventral face. Cutting caused wear on both faces equally, with striations and polish occurring

parallel to the worked material. These results support those of previous research, although this field is limited (Van Gijin, 1984).

5.12.4 Hide

Cutting hide produced rounded edges and limited polish which was duller than that of meat. Dried hide produced a duller polish in than fresh hide. This is likely due to the lack of fat and moisture on the dried hide which would act as a natural lubricant during motion. The polish was also pitted, unlike that of meat polish (Keeley, 1980; González-Urquijo and Ibáñez Esteves, 1994).

Scraping dry and fresh hide also produced polish on the edge of the tool, with more greasy polish forming on the ventral face of the worked edge than on the dorsal face.

In the case of piercing/awling, the wear created by the working of fresh and dried hide varied. The awling of fresh hide resulted in a rounded tip with limited striations. In the case of dried hide, the same was true, in addition to several smaller scars forming. This could be attributed to the increased friction caused by a lack of moisture in the dried hide.

Again, the results of working hide support those of other researchers (Keeley, 1980; Tringham et al.,1974; Semenov, 1964; Ibáñez and Mazzucco, 2021; van Gijn, 2014; Vaughan, 1985; González-Urquijo y Ibáñez Esteves, 1994).

5.12.4.1 Effect of Tanning

Tanning is a chemical process whereby animal skins are treated so as to prevent rot. Archaeological and ethnographic evidence shows that methods of such differ across space and time, and different agents produce different leathers, which might in turn produce different wear traces on lithics. The leather working experiments carried out for this study were conducted on modern, factory treated leather. This is a limitation of the study as there is no way to know what agent was used to treat the leather, and modern techniques almost certainly differ from those used in the past (Thomson, 2011). Skinning is evidenced at Shanidar Cave by a number of cut-marked ibex (*Capra aegagrus*) phalanges (Campana and Crabtree, 2019), and it is likely that those skins were treated, but the method(s) are currently unknown. A discussion of different tanning processes and how they might affect wear patterns on lithics is presented below.

5.12.4.1.1 Brain Tanning

Brain tanning is a form of oil tanning. It is believed to be one of the oldest methods for tanning, being utilised since at least the late Palaeolithic (Gilligan, 2010). Fresh hide would be scraped to remove any adherents and possibly dehaired before being soaked in water to make it malleable. Brain (perhaps from the same animal) would be worked into the hide forming a paste allowing phospholipids to saturate the skin. These natural oils would make it water resistant (Covington, 2005; Davis et al., 2024). Brain tanning therefore might produce a greasier hide than that produced using another

method meaning that one might expect to see a greasier polish on the edge of the relevant lithic.

5.12.4.1.2 Smoke Tanning

The smoking of hides is often paired with brain tanning (Riggs, 2017; Hayden, 2022). A skin is prepared through defleshing and soaking before being allowed to dry. The skin may then be treated with a brain paste or not. The skin is stretched using a frame, over a smoking fire. The smoke then bonds to the amine groups within the collagen of the hide, waterproofing the skin and protecting it from degradation (Covington, 2006). Wear from smoked hide might produce a duller polish to a lithic due to the drying of the hide. However, if brain matter were introduced one might expect to see grease transfer to the lithic as suggested above.

5.12.4.1.3 Ochre Tanning

The use of ochre as a tanning agent has been argued for Middle Stone Age (MSA) hominins due to the sheer abundance of ochre at MSA sites including Blombos Cave, South Africa (*H. sapiens*). Modern experiments have shown that the application of ochre inhibits the breakdown of biological material. Red ochre in particular contains high levels of haematite, a mineral known to have antibacterial properties (Henshilwood et al., 2009; Mandl, 1961; Velo, 1984; Rifkin, 2011). Wear traces on a lithic used to work ochre-treated hide would arguably be dependent on the level of moisture left in

that hide. Ochre residue might adhere to the tool, but the survival of such would be dependent on the depositional environment and the choice of cleaning method employed by the researcher (see sections 4.2.3 and 4.4.4).

5.12.4.1.4 Vegetable Tanning

The use of tannins from plant matter in the production of leather is well established in the archaeological record from the Neolithic period onwards and methods of such are known from historical sources (Reed, 1972; Haslam, 1997; Goffer, 2007; Van Driel-Murray, 2009; Heth, 2015). Whilst earlier evidence for vegetable tanning is unknown, the materials have always been available to hominins meaning that the technique might have been used but that evidence has not survived (Cuyler, 1999). As with the other methods, animal skin is cleaned and washed before a plant matter e.g. oak bark (*Quercus* sp.) is applied in a process called liming. Liming impedes the breakdown of collagen and ensures that the hide does not degrade. In addition to the standard greasy polish on a lithic used to work hide, the applied plant matter might also produce a very bright, glossy polish caused by the high silica content of such. However, experimental reconstructions of vegetable tanning have shown that the amount of plant matter remaining on the hide following the process degrades within hours and as such, it may not influence wear formation on a tool (Groenman-van Waateringe et al., 1999).

5.12.5 Shell

The utilisation of shells for personal adornment or as vessels has long been argued as an indicator of behavioural modernity (Bar-Yosef, 2002). This material category was chosen due to the presence of shell ornaments in many Upper Palaeolithic contexts, including at Shanidar (Bouzouggar et al., 2007; Hunt et al., 2017). More recently, worked shells have been recovered from sites associated with Neanderthals (Douka and Spinapolice, 2012; Villa et al., 2020).

Working shell resulted in a damage pattern similar to that produced by working bone, which was expected given that both materials are categorised as 'hard' on Odell's scale (1979, 2006). Like cutting/engraving bone, cutting/engraving shell resulted in large, deep flake scars occurring at 90 degrees to the worked edge. Thus, lithics which retain evidence of shell working may be mistaken for bone working, especially when analysing at lower magnification where polish cannot be discerned. The difference between working shell and bone was apparent in the formation of polish following engraving experiments, which in the shell appeared matt, dull, and lacked the characteristic pitting of bone polish, presumably due to a lack of natural grease within the shell. This polish was also observable only at the highest magnifications.

Drilling shells caused significant alterations to the working tip of the tool. After 15 minutes the tool became ineffectual. The drilling experiments nevertheless lasted 20 minutes, during which time, only one large perforation could be

made. Given the time and effort and that this action would render the tool unusable it could be argued that perforated shells were of some value to ancient humans.

5.12.6 Wood

Wood working created large, deep scars like those produced by bone working. Cutting and sawing led to the development of scars along the worked edge of the tool. These scars were larger and more apparent when working hard wood, otherwise, there were no significant differences in the wear produced by working soft or hard wood. Working wood produced a widespread polish which appeared smooth and bright, with occasional doming noted throughout the composition of the polish. The doming effect was not observed for any other worked material. This effect is also observed by other researchers (Keeley, 1980; Ibáñez and Mazzucco, 2021; González-Urquijo and Ibáñez Esteves, 1994).

Sawing wood produced continuous, large semi-circular scars and larger isolated scars along the worked edge. More scars and striations were formed by sawing wood than by cutting wood. Tool edge rounding was also observed following the cutting action but not with the sawing.

Debarking/scraping the wood produced little in the way of edge alteration. Some isolated scars were noted but these were few in number. The diagnostic smooth and domed polish was again noted but with lesser coverage than in the cutting and sawing motions.

5.12.7 Plant Fibres

Working hard wood fibres produced an edge with limited rounding and small to medium hinge fractures. Polish was not observed. The working of soft wood fibres resulted in very little edge alteration, but very bright, glossy polish formed. Two studies evidence Neanderthal use of plant fibres (Hardy et al., 2020; Prince, 2000) though studies evidencing the peeling of wood to reveal fibres in the Palaeolithic are limited (Liu et al., 2026), The action is inferred from evidence dating to the Mesolithic/Epipaleolithic or later (Adovaiso et al., 1996; Nadel et al., 1994; Hardy, 2008, 2016). The wear patterns described in this study are noted by other authors (Keeley, 1980; González-Urquijo and Ibáñez Esteves, 1994; Liu et al., 2026).

5.12.8 Antler

Working antler produces a wear pattern similar to that of bone working, especially when the antler is dry. Large step and hinge scars form and polish is generally dull with limited pitting. The working of dry antler was difficult, but the material became much more workable when soaked in water for 24 hours. Scars formed when working the wet antler were smaller and fewer in number. These were also hinge in their termination, however. Given the difficulty in working dry antler versus wet antler, it is possible that past populations would also have soaked antlers prior to working them. The results of working antler in this experiment are consistent with the findings of other

studies (Keeley, 1980; Ibáñez and Mazzucco, 2021; González-Urquijo and Ibáñez Esteves, 1994; Tringham, 1974; LeMoine, 1994).

5.12.9 Horn

Horn working produced a medium-hard wear pattern with hinge terminations being the most common form of edge alteration. Again, soaking the horn in water overnight resulted in a material that was much easier to work. Fewer edge alterations were observed after working wet horn. Horn is a relatively underrepresented material in archaeological and experimental use-wear studies; however, these results are consistent with the available data (Pawlik, 1993).

5.12.10 Experimental Conclusion

Harder materials such as bone, antler, shell, and wood produce heavy scar patterns which vary dependant on the motion taking place. Softer materials, such as meat, fish, and hide, do not typically alter the worked edge to the same degree. The most apparent difference between working hard and soft materials is in the morphology and formation of polish, as well as in the size and termination of any scars.

5.13 Conclusion

This chapter has provided the results from the experimental portion of this thesis. Lithic flakes produced from flint were used to work several materials serving as allegories for materials which would have been utilised at Shanidar Cave based upon the available evidence. An overview of results is presented in Table 5-1.

The following chapter will cover the results of the examination of the archaeological stone tools from Shanidar Cave. In addition to the published literature, the results of Chapter 5 are used to inform as to the use of the recovered lithics.

Table 5-1: *Summary of results of experimental work*

Material	***Action***	***Striations***	***Polish***	***Edge alterations***
Raw meat	*Cutting*	*Limited, narrow and shallow*	*Very bright, greasy, widespread*	*Few, small, isolated feather scars*
Raw meat + bone	*Cutting*	*Few, narrow and shallow*	*Very bright, greasy, widespread*	*Small – medium feather and hinge scars*
Raw meat + bone	*Sawing*	*Few, narrow and shallow*	*Very bright, greasy, widespread*	*Large undulating hinge and step scars*
Cooked meat	*Cutting*	*Limited, narrow and shallow*	*Very bright, greasy, less widespread than raw*	*Few, small, isolated feather scars*
Cooked meat + bone	*Cutting*	*Few, narrow and shallow*	*Very bright, greasy, less widespread than raw*	*Large hinge and step scars*
Cooked meat + bone	*Sawing*	*Few, narrow and shallow*	*Very bright, greasy, less widespread than raw*	*Large undulating hinge and step scars*
Dry bone	*Cutting /Engraving*	*Significant number of striations*	*Bright, pitted and grainy*	*Large, deep step and hinge scars*
Dry bone	*Drilling*	*N/A*	*N/A*	*Large step scar and snap scar across tip*
Fresh bone	*Cutting /Engraving*	*Significant number of striations*	*Very bright, greasy, widespread*	*Large, deep step and hinge scars*
Fresh bone	*Drilling*	*N/A*	*N/A*	*Large step scar and snap scar across tip*

Fresh fish	*Scraping/ Descaling*	*N/A*	*Very bright greasy polish, linear streaks within polish*	*Limited number of small, discontinuous feather scars*
Fresh fish	*Cutting*	*N/A*	*Very bright greasy polish, linear streaks within polish*	*Limited number of small, discontinuous feather scars*
Cooked fish	*Cutting*	*N/A*	*Very bright greasy polish, linear streaks within polish*	*Limited number of small, discontinuous micro scars*
Fresh hide	*Scraping*	*N/A*	*Bright, greasy. Slow forming and less widespread than meat polish*	*Significant edge rounding*
Fresh hide	*Cutting*	*N/A*	*Bright, greasy. Slow forming and less widespread than meat polish*	*Significant edge rounding, feather scars*
Fresh hide	*Awling*	*Few, narrow and shallow*	*Bright, greasy. Slow forming and less widespread than meat polish. More polish formation than the other actions.*	*Significant edge rounding*
Dry hide	*Scraping*	*N/A*	*Dull, pitted. Slow forming, less widespread than fresh hide*	*Significant edge rounding*
Dry hide	*Cutting*	*N/A*	*Dull, pitted. Slow forming, less widespread than fresh hide*	*Significant edge rounding, feather scars*
Dry hide	*Awling*	*N/A*	*Limited amount if polish formed. Dull, pitted. Slow forming, less widespread than fresh hide*	*Large discontinuous hinge scars, significant rounding*
Shell	*Cutting/ Engraving*	*N/A*	*Limited polish formation. Matt, non-greasy, dull*	*Large, deep, continuous step and hinge scars*
Shell	*Drilling*	*Limited, horizontal to tip*	*N/A*	*Step and snap along tip, rounded unworkable edge*
Hard wood	*Sawing*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Large, deep, continuous hinge and isolated larger step scarring*
Hard wood	*Cutting*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Limited scar formation, rounding*
Hard wood	*Scraping/ Debarking*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Limited edge alteration, some hinge scarring on ventral face. Some rounding*
Soft wood	*Sawing*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Hinge scars, undulating pattern*
Soft wood	*Cutting*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Limited scar formation, rounding*
Soft wood	*Scraping/ Debarking*	*Small limited striations*	*Smooth, bright, domed polish. Extensive*	*Limited edge alteration, some step scarring on ventral face. Some rounding*
Oak bast fibres	*Scraping/ Peeling*	*Small faint striations at 9-degrees to worked edge*	*N/A*	*Medium hinge scars, some rounding*

Pine bast fibres	*Scraping/ Peeling*	*Very small, faint striations at 90 degrees to worked edge*	*Very bright, glossy polish*	*Limited alteration, few feather scars*
Antler – Dry	*Cutting*	*Small faint striations at 9-degrees to worked edge*	*Dull, limited amount of pitting*	*Continuous step and hinge scars*
Antler – Dry	*Drilling*	*N/A*	*N/A*	*Large step scars, snapped tip*
Antler– Dry	*Scraping*	*Small faint striations at 9-degrees to worked edge*	*Dull polish, very limited pitting*	*Large hinge and step scars*
Antler-Wet	*Cutting*	*N/A*	*Minimal, dull polish*	*Small continuous hinge scars*
Antler-Wet	*Drilling*	*N/A*	*Dull polish, very limited pitting*	*Hinge scars, few step scars, tip became rounded*
Antler-Wet	*Scraping*	*N/A*	*N/A*	*Small continuous hinge scars*
Horn – Dry	*Cutting*	*N/A*	*Bright polish radiating away from worked edge*	*Continuous feather scars, few isolated hinge scars*
Horn – Dry	*Drilling*	*Limited, faint striations occurring horizontal to worked tip*	*Dull polish, very limited pitting*	*Tip became rounded but did not snap. Limited hinge scars*
Horn – Dry	*Scraping*	*N/A*	*N/A*	*Feather and hinge scars, limited edge rounding*
Horn - Wet	*Cutting*	*N/A*	*Limited polish formation, bright and greasy extending away from worked edge*	*Continuous feather scars, isolated hinge scars*
Horn - Wet	*Drilling*	*N/A*	*N/A*	*Small hinge scars along with one large snap scar along the worked tip*
Horn - Wet	*Scraping*	*N/A*	*N/A*	*Continuous hinge scars along dorsal face, limited edge rounding*

Chapter 6 : Results II – Archaeological

The previous chapter covered the results of the experimental series produced for this project. Flint obtained along the coast of Norfolk, UK, was knapped into flakes and used to work a selection of materials which served as proxies for those known to have been used by, or available to the Palaeolithic hominins of Shanidar Cave. The results of experimental work show that there are variations in the wear produced by different materials which can be observed microscopically. The results from this experimental series are applied to the archaeological material recovered from Shanidar Cave below. This chapter aims to answer research questions 1 and 2, which are concerned with the typology of the Shanidar lithic assemblage, and how tools were used.

The long temporal sequence of the cave allows for analysis of the lithic material from the Middle Palaeolithic into the Upper Palaeolithic. All raw data from the archaeological analyses are provided in Appendices 2 and 3. An overview of the stratified assemblage is presented in Table 6-1, and a breakdown of the number of lithics by type is provided in Figure 6-1.

Table 6-1: *Shanidar Cave lithic assemblage by tool type – Mous. = Mousterian*

	Tool Type	Total	% of assemblage	Use-wear	% of total worked tools	% of tool type	Residue	% of total residue	% of tool type
Mous.	Mousterian point	43	10.7	14	13.1	32.5	5	14.7	11.7
	Elongated Mousterian point	12	3.0	8	7.5	66.7	4	11.7	33.3
	Side scraper	31	7.8	19	18.5	64.5	5	14.7	16.1
Baradostian	Unretouched blade	18	4.5	2	1.9	11	1	2.9	5.5
	Retouched blade	27	6.8	12	11.2	44	4	11.7	14.8
	Unretouched bladelet	9	2.3	1	0.9	11	1	2.9	11.1
	Retouched bladelet	66	16.5	11	10.3	17	1	2.9	1.5
	Dufour bladelet	2	0.5	0	0	0	0	0	0
	Unretouched point	5	1.3	3	2.8	60	1	2.9	20
	Retouched point	6	1.5	3	2.8	50	2	5.8	33.3
	El Wad point	1	0.3	0	0	0	0	0	0
	End scraper	8	2.0	6	5.6	75	4	11.7	50
	Bladelet core	15	3.8	0	0	0	0	0	0
	Crested blade	7	1.8	4	3.7	57	0	0	0
Indeterminate	Unretouched flake	34	8.6	4	3.7	11.7	0	0	0
	Retouched flake	16	4.0	2	1.9	12.5	1	2.9	6.25
	Cortical flake	35	8.8	5	4.7	14.2	1	2.9	2.9
	Flake core	18	4.5	0	0	0	0	0	0
	Notch	4	1.0	0	0	0	0	0	0
	Denticulate	5	1.3	3	2.8	60	0	0	0
	Informal tool	18	4.5	2	1.9	11	1	2.9	5.6
	Awl	11	2.8	0	0	0	0	0	0
	Burin	8	2.0	7	6.5	87.5	2	5.8	25
	Fragment <2cm	289	N/A	0	0	0	0	0	0
		688	**100**	**106**	**100**	**N/A**	**34**	**100**	**N/A**

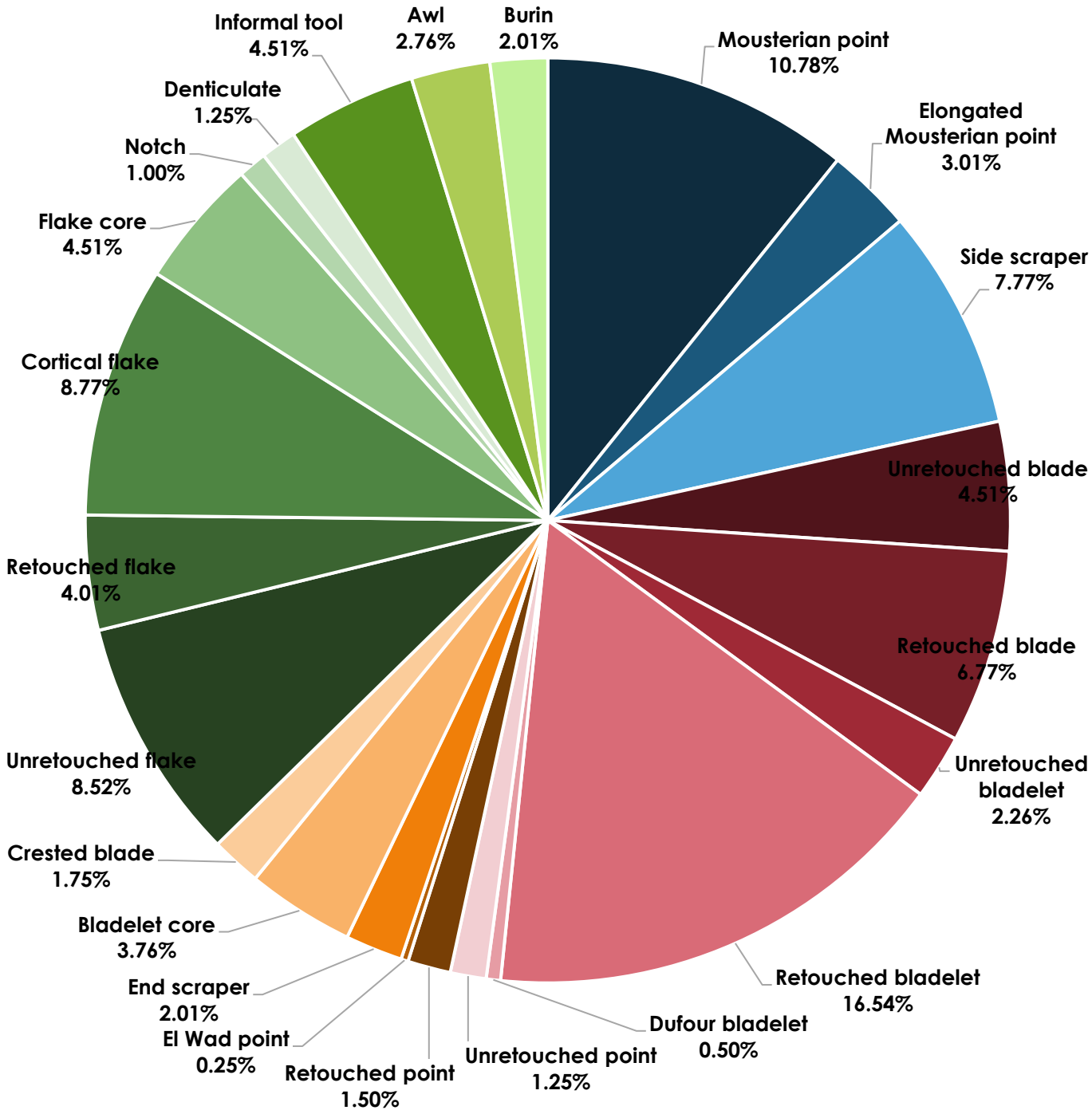


Figure 6-1: *Pie chart showing the breakdown of the Shanidar Cave lithic assemblage by type. Mousterian type tools are presented in shades of blue, Baradostian in shades of red, and tools indeterminate to industry in greens*

6.1 Typology of the Shanidar Assemblage

A total of 977 lithics excavated from Shanidar Cave were assessed. After blind laboratory analysis lithics that were unstratified or recovered from cleaning contexts were rejected from further study, leaving a total of 688, of which 289 (44%) were fragments less than 1cm so too small to identify to type. Of the larger lithics, 402 lithics were assigned typology. The tool types are listed below by their traditionally associated industry: Mousterian, considered Middle Palaeolithic, Baradostian, considered Upper Palaeolithic, and Indeterminate, i.e. lithics that were typologically distinct but are found in both Middle Palaeolithic and Upper Palaeolithic industries.

6.1.1 Mousterian Tool Types

The typical Mousterian tools identified from the Shanidar assemblage are Mousterian points and side scrapers. Mousterian points are separated into classic Mousterian points and elongated Mousterian points.

6.1.1.1 Mousterian Points

There are 43 classic Mousterian points in the assemblage (10.7% of total assemblage). Mousterian points are large (typically retouched) flakes fashioned into a large point which is usually hafted. As such they are usually interpreted as hunting tools (Solecki, 1963; Bordes, 1961a; Shea, 1990). An example tool is presented in Figure 6-2. The Shanidar raw material is predominantly chert with five examples of jasper. Mousterian points are

noted throughout the sequence from Harris matrix Phases 12 to 3, associated with MIS 5c (c. 75,000 – 100,000 years before present) to MIS 3 (c. 30,000 – 36,000 years BP) (Figure 6-3). They are most numerous in Phase 12 (n=15).



***Figure 6-2**: Chert Mousterian point from phase 4 (context 1653, ID: 299). Scale 5 mm*

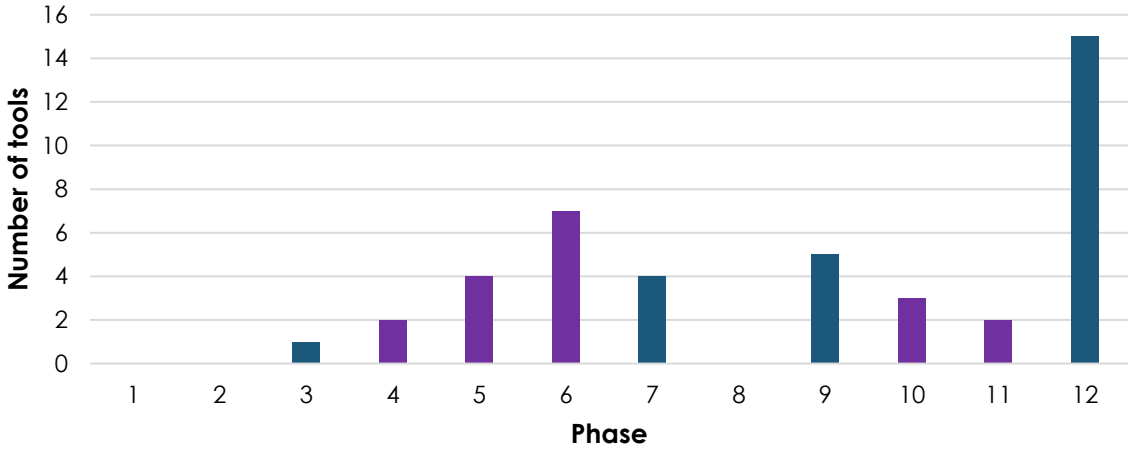


Figure 6-3: *Number of Mousterian points by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered, The largest number of lithics (n=15) is found in Phase 12*

Measurements of Mousterian points are presented in Table 6-2. The average measurements for Mousterian points from Shanidar Cave are 31.0 mm in length, 18.0 mm in width, and 5.0 mm in thickness. The average dimensions of Mousterian points by phase is presented in Table 6-3 and plotted in Figure 6-4. The size of Mousterian points from Shanidar Cave remains consistent through time.

Table 6-2: *Mousterian points and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
323	1628	**3**	31	18	5	Chert
299	1653	**4**	35	21	4	Chert
855	2558	**4**	40	27	4	Chert
132	1125	**5**	38	19	5	Chert
316	1648	**5**	42	36	6	Chert
428	1834	**5**	37	20	3	Jasper
317	1638	**5**	41	21	6	Chert
411	1852	**6**	36	22	4	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
424	1852	**6**	46	26	6	Chert
452	1867	**6**	32	18	2	Chert
457A	1863	**6**	34	21	3	Chert
467A	1845	**6**	30	16	5	Chert
479	1876	**6**	48	36	7	Jasper
520	2018	**6**	45	31	5	Chert
555	2263	**7**	42	19	9	Jasper
372	1919	**7**	38	26	6	Chert
423	1922	**7**	37	22	4	Jasper
701	2257	**7**	35	22	3	Chert
560	2278	**9**	31	19	5	Chert
565	2281	**9**	35	16	4	Chert
566	2283	**9**	31	28	11	Chert
569	2283	**9**	31	17	5	Chert
222	1507	**9**	31	18	4	Chert
421	1924	**10**	36	20	4	Chert
585	2312	**10**	32	21	2	Chert
601	2401	**10**	32	24	3	Jasper
600	2333	**11**	38	21	4	Chert
595	2331	**11**	38	22	4	Chert
609	2347	**12**	41	22	3	Chert
810	2503	**12**	38	22	4	Chert
780	2539	**12**	28	18	5	Chert
820D	2555	**12**	22	11	3	Chert
602	2340	**12**	31	28	5	Chert
603	2344	**12**	30	20	5	Chert
614	2349	**12**	41	32	5	Chert
628	2550	**12**	32	28	7	Chert
820G	2555	**12**	47	26	2	Chert
870	2518	**12**	32	31	7	Chert
875	2539	**12**	38	20	2	Chert
878	2512	**12**	50	22	5	Chert
881	2560	**12**	42	38	7	Chert
899	2604	**12**	49	28	3	Chert
916	2539	**12**	39	22	3	Chert

Table 6-3: *Average dimensions of Mousterian points by archaeological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
3	MIS 3	1	31	18	5
4	MIS 3	2	37.5	24	4
5	MIS 3	4	39.5	24	4
6	MIS 3 early	7	38.7	24.3	4.5
7	MIS 4	4	38	22.5	5.5
9	MIS 5a	5	31.8	19.6	5.8
10	MIS 5a	3	33.3	21.7	3
11	MIS 5a	2	38	21.5	4
12	MIS 5c	15	37.3	24.5	4.4
Total	-	43	36.1	22.2	4.6

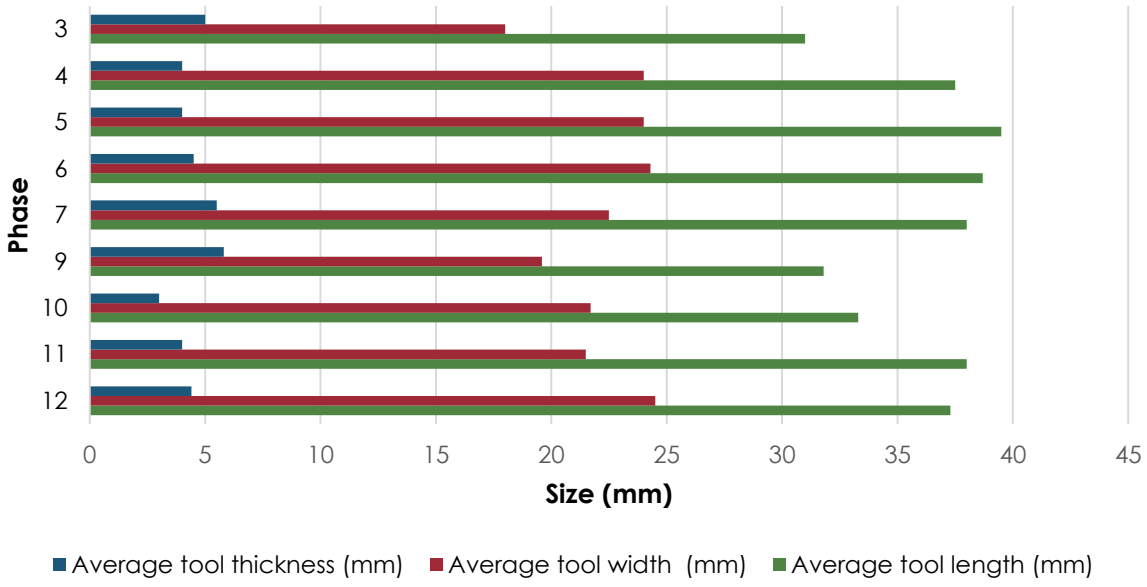


Figure 6-4*: Average dimensions of Mousterian points by chronological phase*

6.1.1.2 Elongated Mousterian Points

There are 12 elongated Mousterian points in the assemblage (3%). Again, the Shanidar raw material is typically chert with two examples of jasper. An example elongated Mousterian point is presented in Figure 6-5. Elongated Mousterian points are recovered from Phase 11 which is associated with MIS 5a (c. 71,000 – 75,000 years BP) to Phase 4 which is associated with MIS 3 (c. 36,000 – 60,000 years BP) (Figure 6-6).

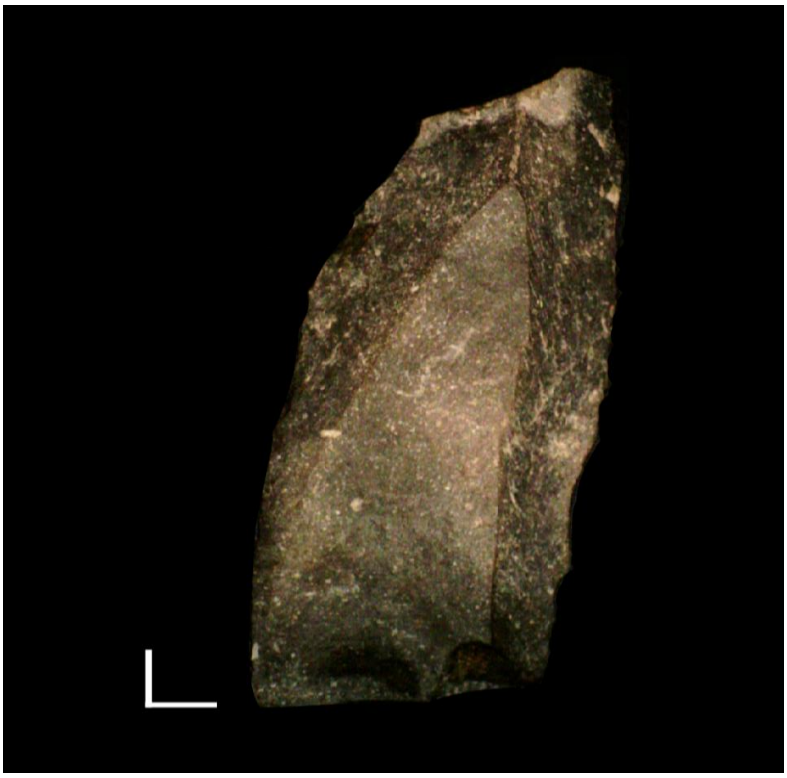


Figure 6-5: *Chert elongated Mousterian point from Phase 4 (context 1156, ID: 313). Scale 5 mm*

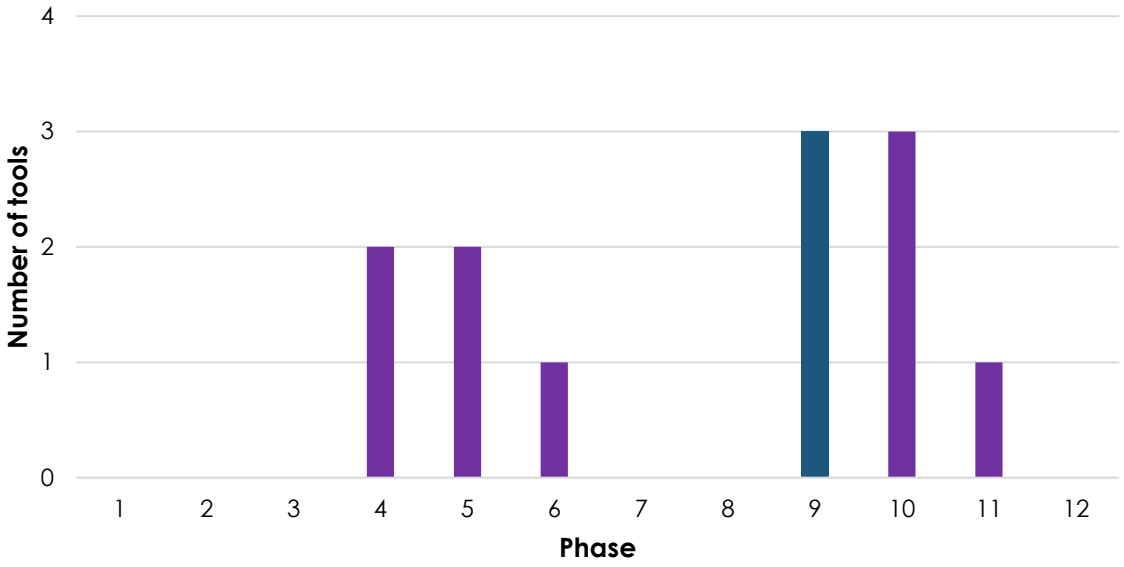


***Figure 6-6**: Number of Elongated Mousterian points by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of elongated Mousterian points are presented in Table 6-4. The average measurements for elongated Mousterian points identified from Shanidar Cave are 40.8 mm in length, 17.3 mm in width, and 4.0 mm in thickness. The average dimensions of elongated Mousterian points by phase is presented in Table 6-5 and plotted in Figure 6-7. Like Mousterian points, the size of elongated Mousterian points remains relatively consistent through time.

***Table 6-4:** Elongated Mousterian points and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
214	1322	**4**	34	13	3	Chert
313	1156	**4**	42	18	6	Chert
165	1369	**5**	50	20	6	Chert
167	1410	**5**	42	20	3	Chert
481	2043	**6**	40	19	2	Chert
567	2283	**9**	44	18	6	Jasper

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
580	2303	**9**	60	26	10	Jasper
687	2284	**9**	31	13	6	Chert
589	2314	**10**	41	19	4	Chert
653	2312	**10**	43	19	7	Chert
879	2517	**10**	31	11	4	Chert
593	2326	**11**	32	12	4	Chert

Table 6-5: *Average dimensions of Elongated Mousterian points by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
4	MIS 3	2	38	15.5	4.5
5	MIS 3	2	46	20	4.5
6	MIS 3 early	1	40	19	2
9	MIS 5a	3	45	19	7.3
10	MIS 5a	3	38.3	16.3	5
11	MIS 5c	1	32	12	4
Total	-	12	40.8	17.3	5.1

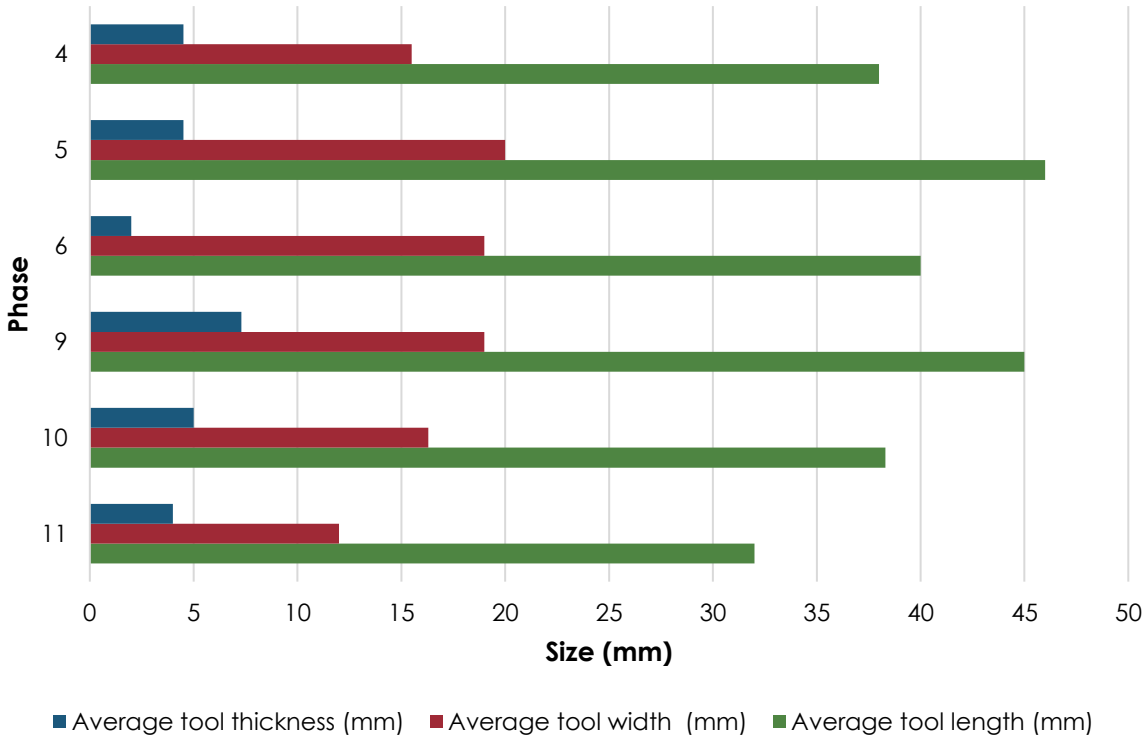


***Figure 6-7**: Average dimensions of elongated Mousterian points by chronological phase*

6.1.1.3 Side Scrapers

There are 31 side scrapers in the assemblage (7.8%). Side scrapers are ordinarily associated with secondary survival activities such as the working of hides, wood, and plant products rather than the direct act of procuring food (Dibble, 1987b, 1995; Shea, 2013). All of these lithics are typified by at least one retouched "scraping" edge, which is usually steeply retouched to become flat. There are four sub-categories: single-edge, double-edge, convergent, and transverse (Bordes, 1961a; see section 4.4.2, Table 4-7). At Shanidar Cave the most common type is the double-edge side scraper

which is represented by 18 lithics (Figure 6-8). There are 11 single-edge scrapers and two convergent scrapers. There were no transverse side scrapers. The Shanidar raw material is predominantly chert with four examples of jasper. Side scrapers are found throughout the sequence from Phases 12 to 1, representing MIS 5c (c. 75,000 – 100,000 years BP) to MIS 3 – 2 (c. <30,000 years BP). Side scrapers by chronological phase and type are presented in Figures 6-9 and 6-10.



Figure 6-8: *Chert double-edge side scraper from Phase 12 (context 2560, ID: 906). Scale 10 mm*

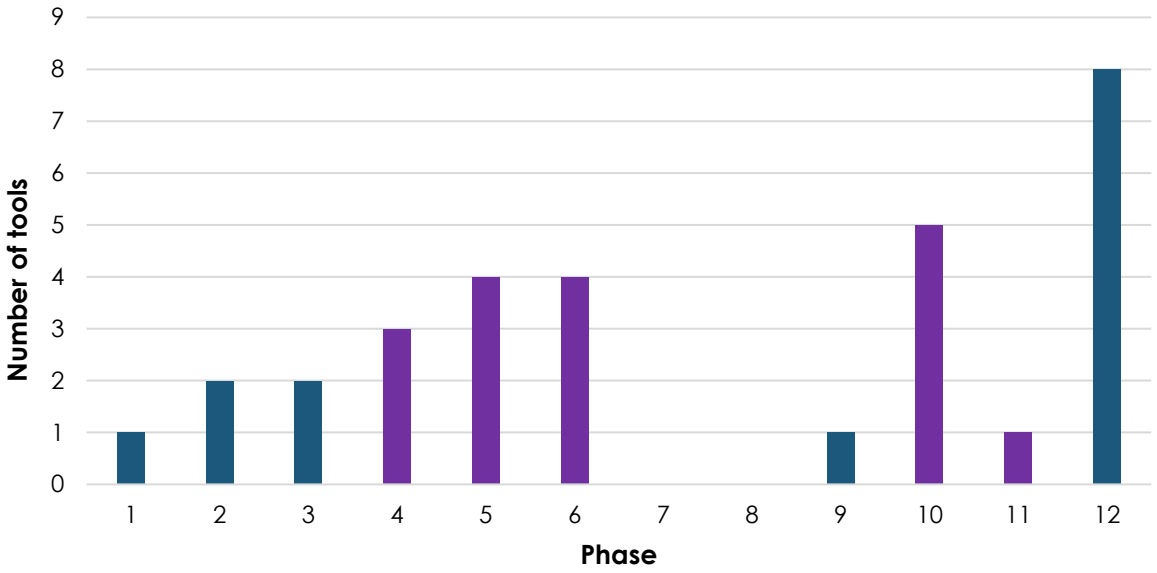


Figure 6-9: *Number of side scrapers by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

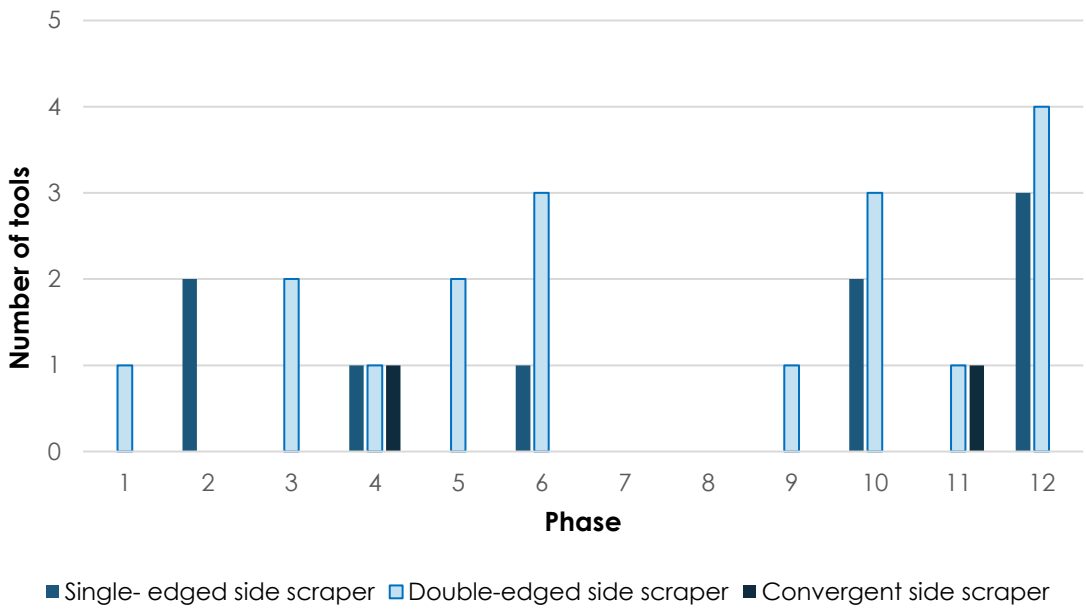


Figure 6-10: *Types of side scrapers by chronological phase*

Measurements of side scrapers are presented in Table 6-6. Side scrapers are formed by a reduction process (see 4.4.2), therefore, different sizes of individual scrapers might represent different stages of such.

Table 6-6: *Side scrapers and associated measurements by chronological phase*

Specimen ID	Context	Phase	Type	Length (mm)	Width (mm)	Thickness (mm)	Material
488	-	**1**	Double-edge	52	30	11	Chert
134	1037	**2**	Single-edge	22	17	2	Chert
28	512	**2**	Single-edge	21	12	3	Chert
106	1037	**3**	Double-edge	41	20	7	Chert
405	1862	**3**	Double-edge	36	35	11	Chert
330	1609	**4**	Single-edge	42	34	7	Chert
151	1433	**4**	Double-edge	31	19	4	Chert
218	1392	**4**	Convergent	40	20	3	Chert
43	752	**5**	Double-edge	30	29	9	Chert

Specimen ID	Context	Phase	Type	Length (mm)	Width (mm)	Thickness (mm)	Material
480	2125	**5**	Double-edge	51	31	6	Chert
55	802	**5**	Single-edge	52	31	9	Chert
228	1310	**5**	Single-edge	35	19	3	Chert
420	1852	**6**	Double-edge	57	26	6	Chert
404	1860	**6**	Double-edge	36	31	11	Chert
407	1868	**6**	Double-edge	47	25	9	Chert
470	1861	**6**	Single-edge	40	11	6	Chert
573	2284	**9**	Double-edge	42	30	4	Jasper
584	2312	**10**	Double-edge	35	32	6	Chert
583	2307	**10**	Double-edge	44	31	9	Jasper
408	1933	**10**	Double-edge	35	29	5	Chert
582	2307	**10**	Single-edge	32	28	4	Chert
590	2312	**10**	Single-edge	32	28	6	Jasper
674	2337	**11**	Double-edge	32	22	4	Chert
906	2560	**12**	Double-edge	40	19	5	Chert
296	1752	**12**	Double-edge	31	19	4	Chert
857	2560	**12**	Double-edge	42	32	6	Jasper
613	2349	**12**	Double-edge	22	21	5	Chert
820A	2555	**12**	Single-edge	42	25	6	Chert
901	2560	**12**	Convergent	39	22	6	Chert
793	2540	**12**	Single-edge	19	18	4	Chert
895	2604	**12**	Single-edge	32	13	5	Chert

6.1.2 Baradostian Tools

The Baradostian/Zagros Aurignacian tools identified from Shanidar Cave include blades (retouched, non-retouched, and crested), bladelets (retouched, unretouched, and Dufour), points (retouched, unretouched, and El Wad), end scrapers, and bladelet cores (Solecki, 1955, 1979; Reynolds et al., 2016).

6.1.2.1 Unretouched Blades

There are 17 unretouched blades in the assemblage (4.3%). Blades are long narrow flakes which are typically associated with the Upper Palaeolithic (Barkai et al., 2017) as well as some Mousterian sites in the Zagros (Skinner, 1965; Lindly, 1997). The unretouched blades from Shanidar Cave are not complete, and as such are better classified as blade butts, i.e. the inferior portion of the blade containing the striking platform (n=14) and snapped blades i.e. the superior portion of the tool (n=3) (;De Mortillet, 1869; Shea, 2013). An example of an unretouched blade butt is presented in Figure 6-11. The raw material used at Shanidar Cave is mostly chert but there are also two examples of jasper and one of limestone. Blades are found between Phases 12 and 3, associated with MIS 5c (c. 75,000 – 100,000 years BP) to MIS 3 (c. 36,000 – 60,000 years BP) (Figure 6-12). Measurements of these pieces are provided in Table 6-7. As the complete size of these blades is unknown it is impossible to provide average dimensions and to analyse size trends through time.



***Figure 6-11**: Chert unretouched blade (blade butt) from Phase 10 (context 1924, ID: 406). Scale 5 mm*

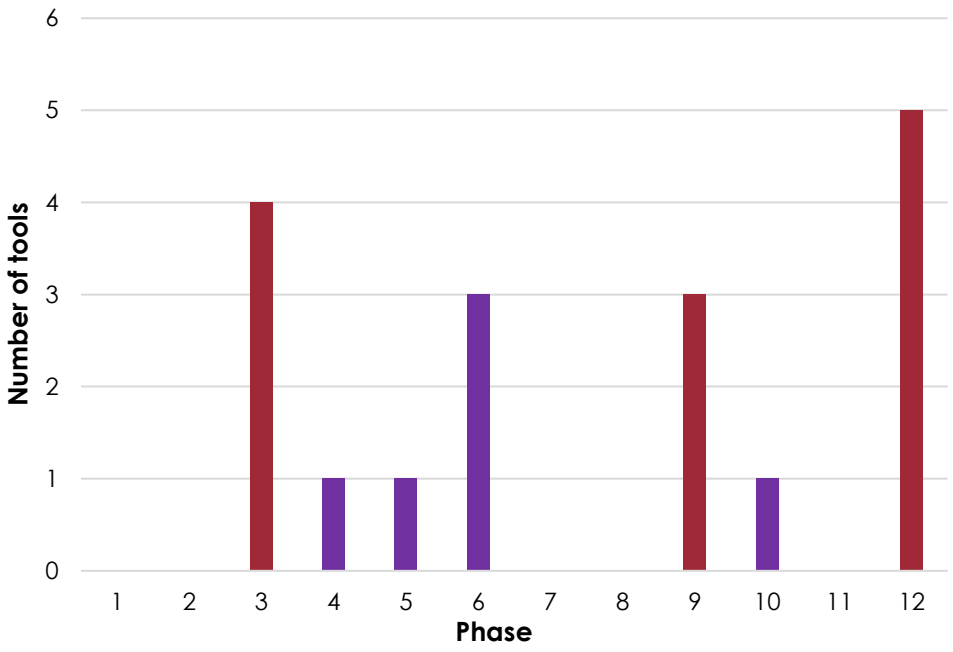


***Figure 6-12:** Number of unretouched blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Table 6-7: *Unretouched blades and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Type	Material
380	1832	**3**	42	17	4	Butt	Chert
427	1856	**3**	33	16	4	Butt	Jasper
891	2538	**3**	27	8	4	Butt	Chert
401	1835	**4**	25	19	3	Butt	Chert
496	2118	**5**	51	28	11	Snapped	Chert
490	2017	**6**	51	29	11	Snapped	Chert
409	1852	**6**	29	11	4	Butt	Chert
467	1845	**6**	31	30	7	Butt	Chert
570	2284	**9**	24	20	5	Butt	Chert
572	2284	**9**	27	9	8	Butt	Chert
577	2286	**9**	22	18	5	Butt	Chert
406	1924	**10**	55	21	9	Snapped	Chert
607	2346	**12**	27	14	6	Butt	Chert
616	2351	**12**	27	22	3	Butt	Chert
611	2348	**12**	16	11	4	Butt	Chert
624	2342	**12**	34	22	8	Butt	Chert
625	2343	**12**	27	25	6	Butt	Jasper

6.1.2.2 Retouched Blades

There are 27 retouched blades in the assemblage (7.3%). As above, blades are elongated narrow flakes typically associated with the Upper Palaeolithic. The typical raw material from Shanidar Cave is chert with three examples of jasper. An example of a chert retouched (truncated) blade is presented in Figure 6-13. Retouched blades are found throughout the Shanidar Cave sequence from Phase 12 (MIS 5c, c. 75,000 – 100,000 years BP) to Phase 2 (MIS 3, c. 30,000 – 36,000 years BP) (Figure 6-14).



***Figure 6-13**: Chert truncated blade from Phase 3 (context 1107, ID: 111). The blade is truncated at both the top and bottom. Scale 10 mm*

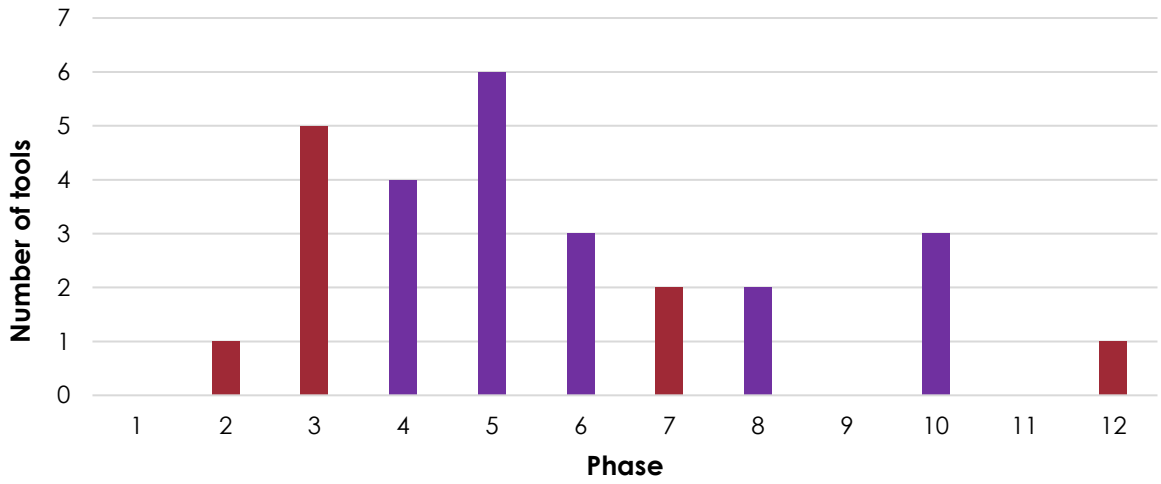


***Figure 6-14:** Number of retouched blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of retouched blades are presented in Table 6-8. Only three blades were complete: one whole blade from Phase 10, and two truncated blades, i.e. blades that have been retouched so as to deliberately shorten them, from Phases 5 and 3. The majority of retouched blades from Shanidar Cave are incomplete and as such might be better classified as blade butts and snapped blades, as defined above (section 6.1.2.1). Again, as the complete size of the majority of blades is unknown it is impossible to analyse size trends through time. That the majority of blades are incomplete is reflective of continuous activity at the site whether human, animal, or natural.

Table 6-8: *Retouched blades and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Type	Material
319	629	**2**	37	11	5	Butt	Chert
890	2536	**3**	29	19	5	Butt	Chert
62	748	**3**	62	22	7	Snapped	Chert
111	1107	**3**	80	19	4	Truncated	Chert
229	1418	**3**	41	18	5	Snapped	Chert
250	-	**3**	32	18	5	Snapped	Chert
335	581	**4**	31	19	3	Butt	Chert
149	1438	**4**	28	21	3	Butt	Chert
334	634	**4**	27	18	4	Snapped	Chert
387	1836	**4**	53	20	7	Snapped	Chert
40	723	**5**	29	12	4	Butt	Chert
52	545	**5**	31	12	3	Snapped	Chert
60	711	**5**	32	19	4	Snapped	Chert
63	748	**5**	50	10	4	Snapped	Chert
162	1448	**5**	103	35	11	Truncated	Chert
331	1636	**5**	29	20	4	Snapped	Chert
419	1816	**6**	31	13	6	Butt	Chert
482	2041	**6**	32	21	3	Snapped	Chert
483	2039	**6**	22	12	2	Snapped	Chert
74	1535	**7**	36	22	6	Snapped	Jasper
556	2268	**7**	38	26	4	Snapped	Jasper
75	1503	**8**	21	11	3	Butt	Chert
238	1506	**8**	24	12	3	Butt	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Type	Material
442	1924	**10**	34	22	5	Butt	Chert
416	1924	**10**	26	20	4	Butt	Chert
588	2314	**10**	68	22	4	Whole	Jasper
808	2560	**12**	21	5	2	Butt	Chert

6.1.2.3 Unretouched Bladelets

There are eight unretouched bladelets in the assemblage (1.1%). There is no unequivocal definition of what constitutes a bladelet. Generally, it is meant as a smaller blade less than 50 mm in length (Gennai et al., 2021). An example of a retouched bladelet is presented in Figure 6-15. Given their small-size bladelets are typically interpreted as part of a composite tool, suggesting that the use of perishable materials should also be assumed in contexts in which bladelets are recovered (Binneman and Mitchell, 1997; Normand et al., 2009; Shea, 2013; Gennai et al., 2021). The raw material utilised at Shanidar Cave is exclusively chert. Bladelets are found between Phases 5 to 2 (MIS 3, c. 60,000 years BP – 30,000 years BP) (Figure 6-16).



***Figure 6-15**: Chert unretouched bladelet from Phase 6 (context 1823, ID: 410). Scale 2 mm*

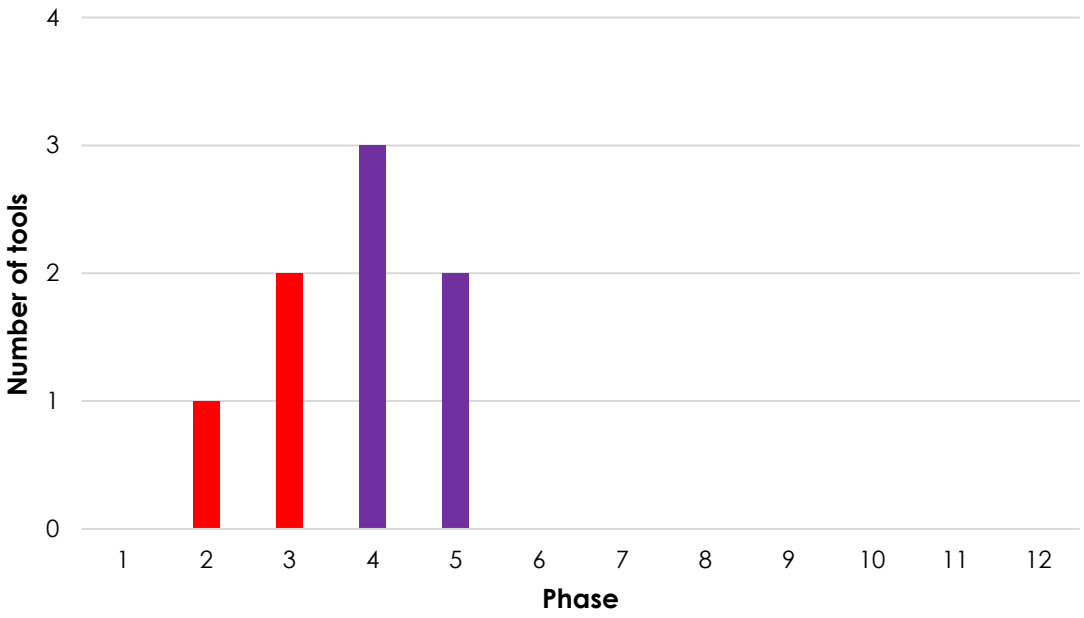


***Figure 6-16:** Number of unretouched bladelets by phase. Purple bars represent phases from which Neanderthal remains have been recovered. Five lithics are directly associated with Neanderthal phases. As demonstrated, unretouched bladelets are only found in the upper sequence of the cave (MIS 3 – 2)*

Measurements of unretouched bladelets are provided in Table 6-9. The average measurements for unretouched bladelets from Shanidar Cave are 13.1 mm in length, 4.1 mm in width, and 2.1 mm in thickness. Average measurements are presented by Phase in Table 6-10 and Figure 6-17. Whilst one tool from Phase 5 (ID: 312) is slightly longer than the rest (+3 to +5 mm), there is no obvious trend in the size of unretouched bladelets size across the occupational sequence of Shanidar Cave.

Table 6-9: *Unretouched bladelets and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
302	609. 4524	**2**	12	4	2	Chert
301	629, 4533	**3**	11	3	2	Chert
328	1037	**3**	13	3	2	Chert
321	1388	**4**	12	3	2	Chert
338	560	**4**	12	4	3	Chert
817	2558	**4**	11	6	2	Chert
293	1624, 4604	**5**	13	4	2	Chert
312	16,114,560	**5**	16	5	2	Chert

Table 6-10: *Average dimensions of unretouched bladelets by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	1	12	4	2
3	MIS 3	2	12	3	2
4	MIS 3	3	11.6	4.4	2.3
5	MIS 3	2	14.5	4.5	2
Total	-	8	12.5	3.9	2.1

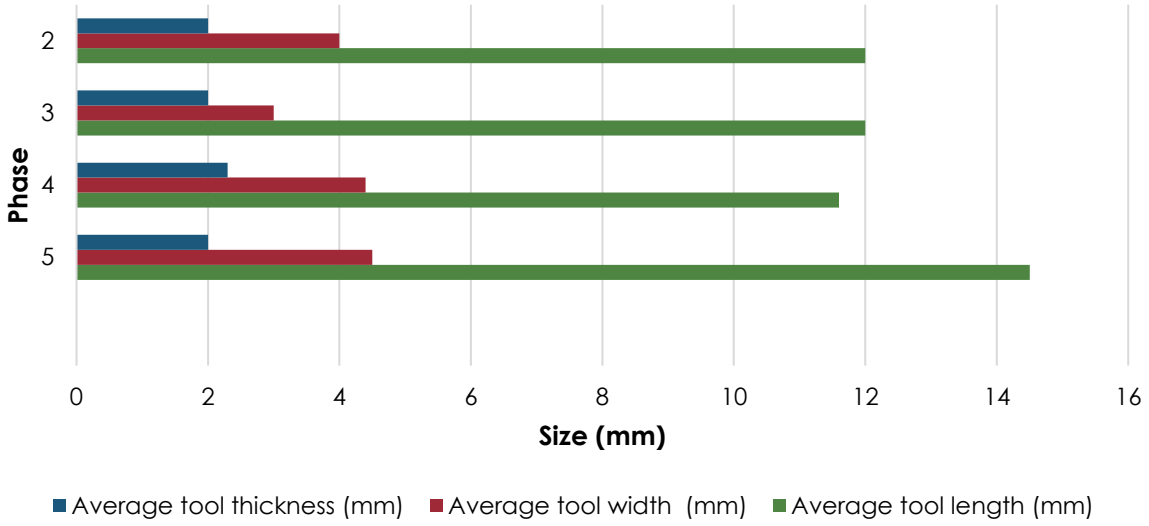


Figure 6-17: *Average dimensions of unretouched bladelets by chronological phase*

6.1.2.4 Retouched Bladelets

There are 66 retouched bladelets in the assemblage (14.1%). Retouched bladelets are smaller blades (less than 50mm) with deliberate retouch (Gennai et al., 2023). An example of a retouched blade is presented in Figure 6-18. The majority of retouched bladelets from Shanidar Cave are made from chert (n=62), four are made from jasper. Retouched bladelets are noted throughout the sequence from Phase 12 (MIS 5c, c. 75,000 – 100,000 years BP) to Phase 2 (MIS 3, c. 30,000 – 36,000 years BP) but are most numerous in Phase 3 (MIS 3, c. 30,000 – 36,000 years BP) (n=17) and Phase 12 (n= 14) (Figure 6-19).



***Figure 6-18**: Chert retouched bladelet from Phase 5 (context 748, ID: 64). Scale 1 mm*

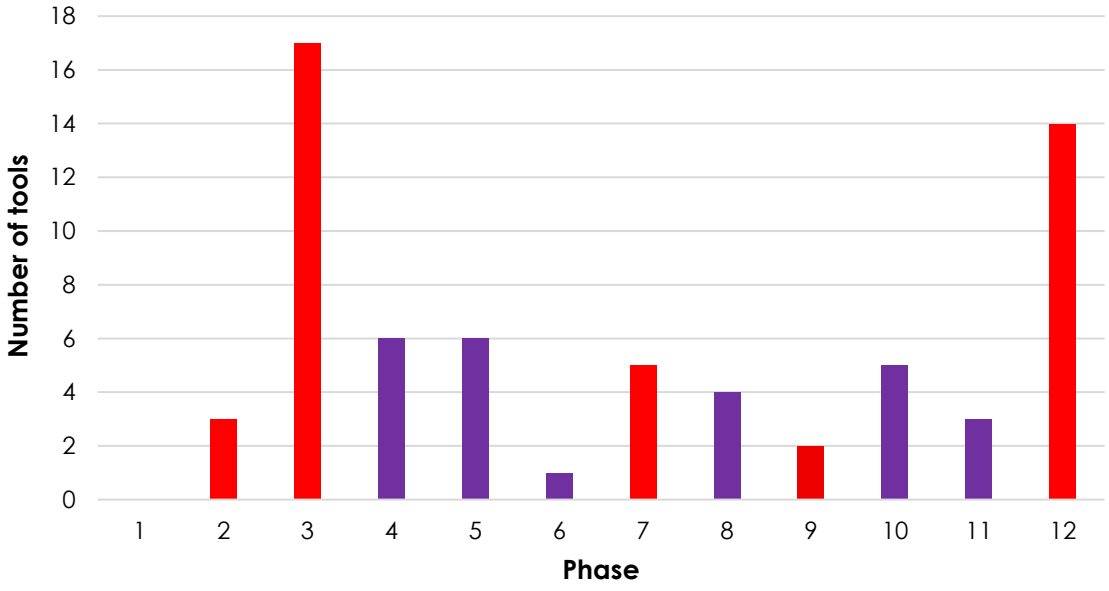


Figure 6-19: *Number of retouched bladelets by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Though 25 retouched bladelets are associated with Neanderthal phases the majority are not (n=41). The highest numbers of these tools are found in the Upper Palaeolithic Phase 3 (n=17 and the Middle Palaeolithic Phase 12 (n=14). Retouched bladelets can be associated therefore with both Neanderthals and* Homo sapiens *at Shanidar Cave*

Measurements of retouched bladelets from Shanidar Cave are provided in Table 6-11. The average dimensions of retouched bladelets is 21.2 mm in length, 6.5 mm in width, and 2.7 mm in thickness. Average measurements by chronological phase are presented in Table 6-12 and Figure 6-20. There is no apparent trend in the size of retouched bladelets across the occupational sequence nor in the types of retouch.

Table 6-11: *Retouched bladelets and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
885	2531	**2**	17	5	3	Chert
896	2589	**2**	13	4	2	Chert
913	2593	**2**	31	4	2	Chert
108	1049	**3**	39	9	4	Chert
119	1213-1216	**3**	11	4	2	Chert
121	1048	**3**	19	4	2	Chert
122	1034	**3**	19	8	3	Chert
140	568	**3**	22	9	4	Chert
164	1418	**3**	32	4	2	Chert
230	1418	**3**	19	5	2	Chert
314	1627	**3**	27	5	2	Chert
337	630(A)	**3**	9	6	2	Chert
374	1862	**3**	18	11	2	Jasper
375	1858	**3**	30	6	2	Chert
462	1856	**3**	21	9	4	Chert
877	2536	**3**	9	7	4	Chert
889	2537	**3**	11	6	4	Chert
898	2538	**3**	22	5	4	Chert
917	2538	**3**	21	6	3	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
19b	537	**4**	29	6	3	Chert
147	1458	**4**	26	12	4	Jasper
325	1609	**4**	12	6	3	Chert
882	2530	**4**	18	4	2	Chert
884	2530	**4**	21	4	2	Chert
908	2530	**4**	20	6	2	Chert
873	2530	**4**	28	7	2	Chert
298	632	**5**	21	5	2	Chert
39	750	**5**	20	7	2	Chert
64	748	**5**	39	8	4	Chert
115	1118	**5**	26	9	3	Chert
116	1213	**5**	19	5	2	Chert
341	1652	**5**	26	8	3	Chert
433	1823	**6**	25	16	3	Jasper
234A	1535	**7**	22	9	2	Jasper
378	1916	**7**	28	11	4	Jasper
686	2270	**7**	9	6	2	Chert
686A	2270	**7**	8	5	2	Chert
695	2253	**7**	30	10	5	Chert
205	1505	**8**	31	6	4	Chert
557	2273	**8**	16	5	2	Chert
666	2273	**8**	9	5	2	Chert
672	2276	**8**	12	19	3	Chert
574	2284	**9**	22	9	4	Chert
576	2284	**9**	16	11	2	Chert
511	2000	**10**	32	4	3	Chert
511A	2000	**10**	19	6	2	Chert
430	1924	**10**	19	5	3	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
511B	2000	**10**	27	2	2	Chert
667	2300	**10**	11	3	2	Chert
592	2326	**11**	11	8	3	Chert
597	2332	**11**	11	5	3	Chert
697	2339	**11**	9	2	2	Chert
820H	2555	**12**	27	5	4	Chert
820I	2555	**12**	17	6	2	Chert
820J	2555	**12**	13	2	2	Chert
820K	2555	**12**	12	4	2	Chert
820L	2555	**12**	17	4	2	Chert
856A	2555	**12**	41	11	4	Chert
856B	2555	**12**	15	6	2	Chert
856C	2555	**12**	31	5	2	Chert
856D	2555	**12**	47	12	4	Chert
856E	2555	**12**	5	2	2	Chert
856F	2555	**12**	21	5	2	Chert
856G	2555	**12**	21	4	2	Chert
880	2430	**12**	18	6	2	Chert
698	2349	**12**	26	5	2	Chert

Table 6-12: *Average dimensions of retouched bladelets by phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	3	20.3	4.3	2.3
3	MIS 3	17	21.7	6.5	2.8
4	MIS 3	6	21	6.3	2.6
5	MIS 3	6	26.7	7.6	3
6	MIS 3 early	1	25	16	3
7	MIS 4	5	19.4	8.2	3
8	MIS 5a	4	17	8.8	2.75

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
9	MIS 5a	2	19	10	3
10	MIS 5a	5	21.6	4	2.4
11	MIS 5a	3	10.3	5	2.6
12	MIS 5c	14	22.2	5.5	2.4
Total	-	66	21.1	6.5	2.7

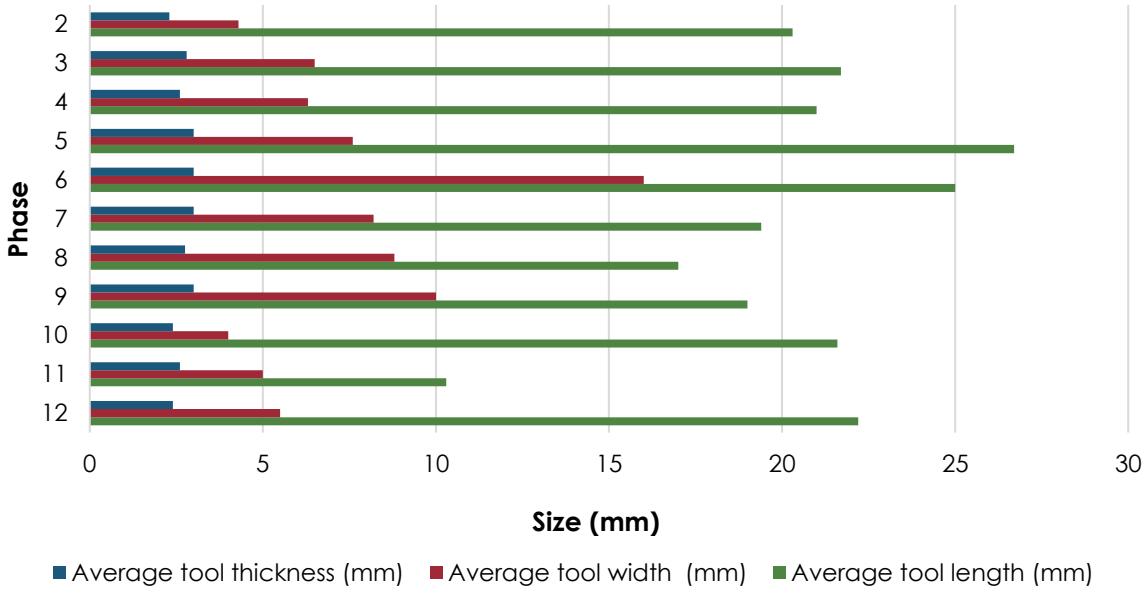


Figure 6-20: *Average dimensions of unretouched bladelets by phase*

6.1.2.5 Dufour Bladelets

There are two Dufour bladelets in the assemblage (0.5%). Dufour bladelets are twisted bladelets with fine and abrupt retouch. They are associated with the Levantine Aurignacian (Derevianko, 2016; Zaidner et al., 2025). Both of the Shanidar examples are made from chert (e.g. Figure 6-21)

and were recovered from Phase 3, which is associated with MIS 3 (c. 30,000 – 36,000 years BP) (Figure 6-22).



***Figure 6-21**: Chert Dufour bladelet from Phase 3 (context 1037, ID: 141G). Scale 2mm*

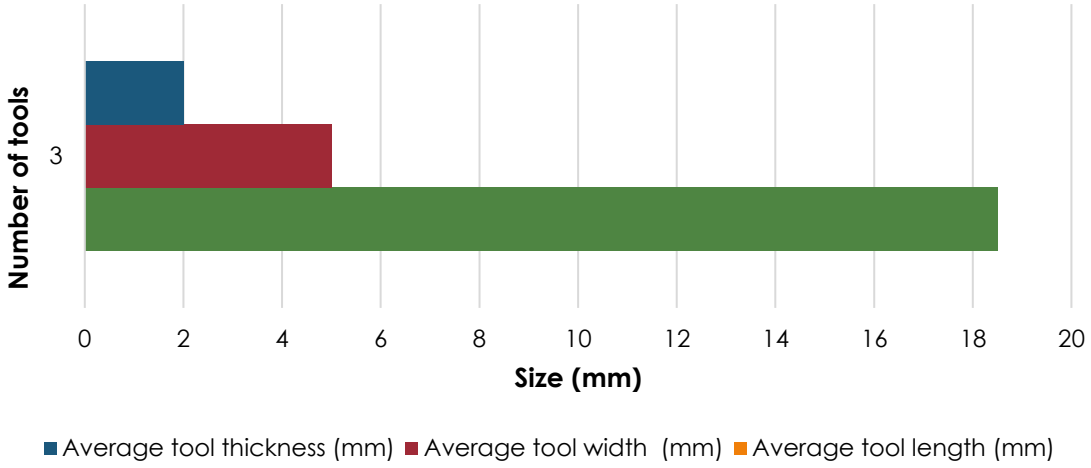


***Figure 6-22:** Average dimensions of Dufour bladelets*

Measurements are presented in 6-13. The average dimensions for Dufour bladelets at Shanidar Cave is 18.5 mm in length, 5.0 mm in width and 2.0 mm in thickness.

Table 6-13: *Dufour bladelets and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
903	2599	**3**	18	4	2	Chert
141G	1037	**3**	19	6	2	Chert

6.1.2.6 Unretouched Points

There are five unretouched points in the assemblage (0.8%). These are points which are typically narrower than the Mousterian points covered above but do not show deliberate retouch. There are three examples in chert and one in jasper. An example of an unretouched point is presented in Figure 6-23. Unretouched points were recovered from Phases 6 to 3 at Shanidar Cave and are therefore associated with MIS 3 (c. 30,000 – 60,000 years BP) (Figure 6-24).



Figure 6-23: *Chert unretouched point from Phase 4 (context 1433, ID: 170). Scale 5 mm*

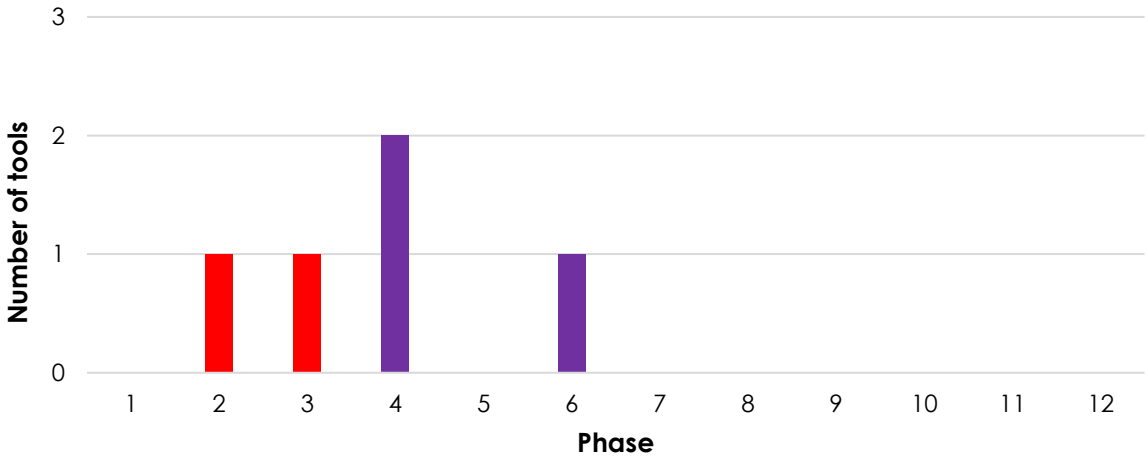


Figure 6-24: *Number of unretouched points by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of unretouched points are presented in Table 6-14. The average measurements for unretouched points from Shanidar Cave are 30.8 mm in length, 10.4 mm in width and 4.0 mm in thickness. Average measurements are presented by phase in Table 6-15 and Figure 6-25. There is no obvious trend in the size of unretouched points across the occupational sequence of Shanidar Cave

Table 6-14: *Unretouched points and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
332	567	**2**	32	9	3	Chert
1411	568	**3**	21	10	4	Chert
163	1400	**4**	42	10	6	Chert
170	1433	**4**	38	12	4	Chert
457	1863	**6**	21	11	3	Chert

Table 6-15*: Average dimensions of unretouched point by archaeological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	1	32	9	3
3	MIS 3	1	21	10	4
4	MIS 3	2	40	11	5
6	MIS 3 early	1	21	11	3
Total	-	5	30.8	10.4	4

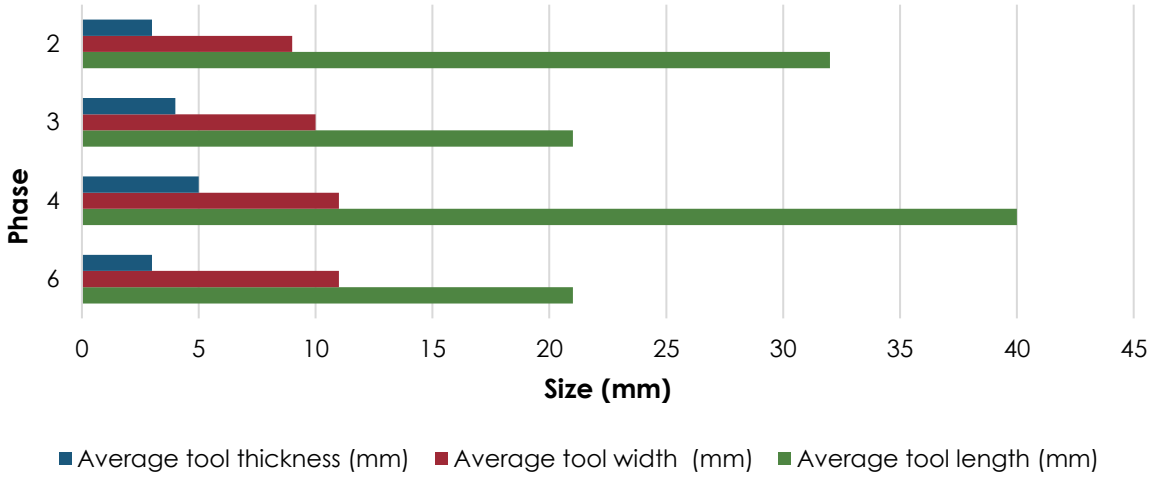


Figure 6-25: *Average dimensions of unretouched point by chronological phase*

6.1.2.7 Retouched Points

There are six retouched points in the assemblage (1.2%). Retouched points are thin, narrow tools which are typically interpreted as projectile points. The development of sophisticated points is a hallmark of the Levantine Upper Palaeolithic (Tostevin, 2000; Shea, 2006). An example of a retouched point is presented in Figure 6-26. The raw material at Shanidar Cave is exclusively chert. Retouched points are found in Phases 5 to 2, representing MIS 3 (c. 30,000 – 60,000 years BP) (Figure 6-27).



Figure 6-26: *Chert retouched point from Phase 3 (context 1049, ID: 108). Scale 5 mm*

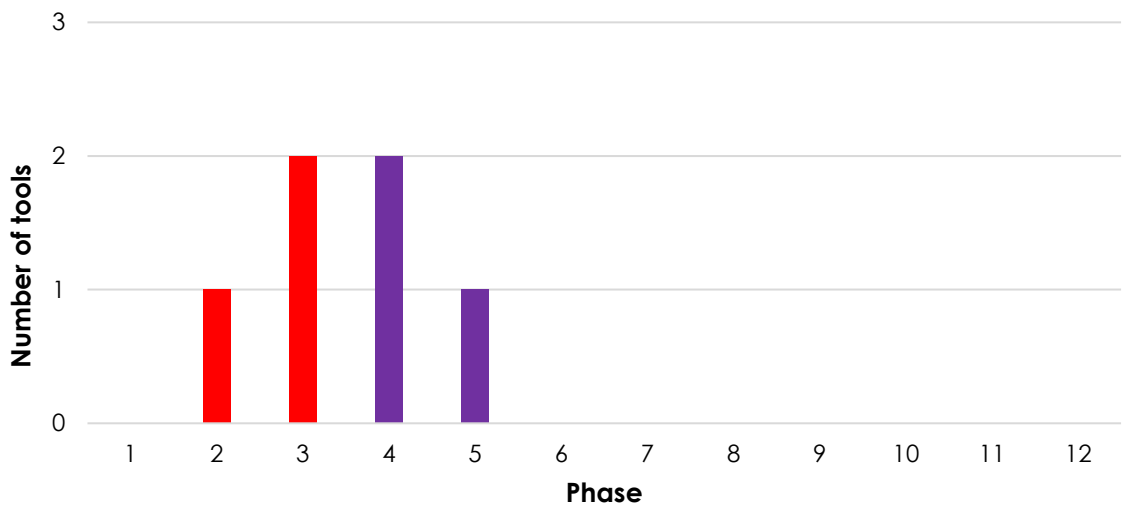


Figure 6-27*: Number of retouched points by archaeological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Retouched points are only found in the upper sequence of the cave (MIS 3 – 2)*

Measurements of retouched points are provided in Table 6-16. The average measurements for retouched points from Shanidar Cave are 28 mm in length, 9.8 mm in width and 3.6 mm in thickness. Average measurements are

presented in Table 6-17 and Figure 6-28. While there is an apparent increase in average length (up to +8 mm) and width (up to +17 mm) between Phases 5 and 2, the sample sizes for each phase are limited to one or two lithics and thus may not be conclusive.

Table 6-16: *Retouched points and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
315	1502-1505,4349	**2**	30	21	6	Chert
874	2538	**3**	36	12	5	Chert
107	1043	**3**	24	4	3	Chert
340	1609	**4**	28	11	3	Chert
117	1151	**5**	22	4	3	Chert
46	708	**5**	30	9	4	Chert

.

Table 6-17: *Average dimensions of retouched points by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	1	30	21	6
3	MIS 3	2	30	8	4
4	MIS 3	2	28	9	2.5
5	MIS 3	1	22	4	3
Total	-	6	28	9.8	3.6

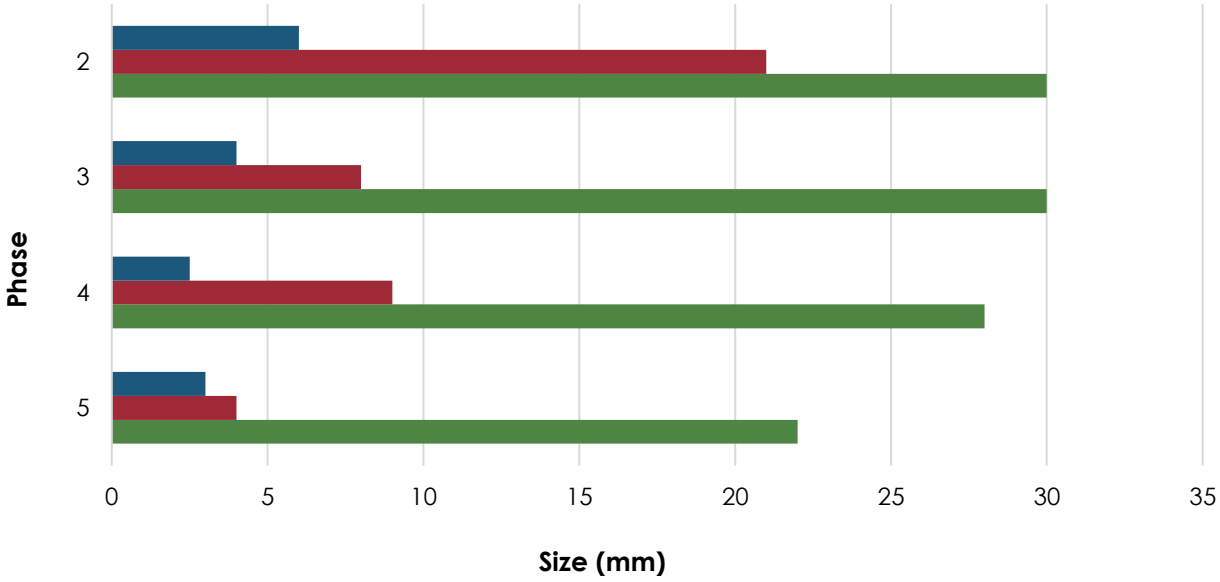


Figure 6-28: *Average dimensions of retouched points by chronological phase*

6.1.2.8 El Wad Points

There is one El Wad point (0.3%), which is made of chert. El Wad points are highly retouched and are produced from bladelet blanks. They are interpreted as projectiles and are associated with the Levantine Ahmarian industry (Gennai et al., 2023; Shea, 2006). The Shanidar example was found in Phase 3 (MIS 3, c. 30,000 – 36,000 years BP). It is presented in Figure 6-29. The point measures 20 mm in length, 11 mm in width, and 2 mm in thickness (Table 6-18, Figure 6-30).



***Figure 6-29**: Chert El Wad point from Phase 3 (context 1043, ID: 128). Scale 5 mm*

***Table 6-18**: Measurements of the El Wad point from Shanidar Cave*

Specimen ID	Context	Phase	Type	Length (mm)	Width (mm)	Thickness (mm)	Material
128	1043	**3**	El Wad point	20.0	11.0	2.0	Chert

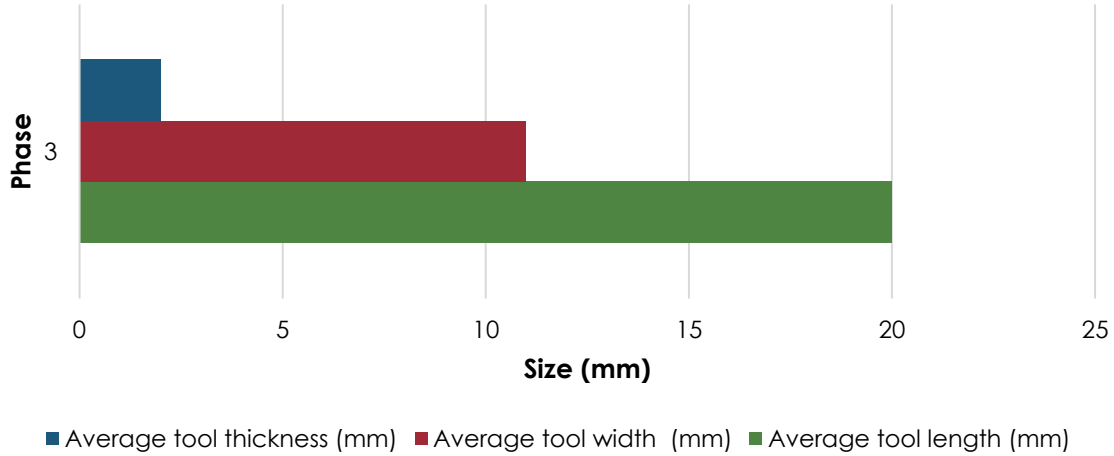


***Figure 6-30:** Measurements of the El Wad point from Shanidar Cave*

6.1.2.9 End Scrapers

There are eight end scrapers in the assemblage (2.2%). End scrapers are tools with at least one steeply retouched edge, distal to the striking platform (Ray, 1937). As with side scrapers, this tool form is assumed to be a hide working tool (Aleo, 2021; Loebel, 2013). An example of an end scraper from Shanidar Cave is presented in Figure 6-31. The raw material used Shanidar Cave is predominantly chert with one example of jasper. End scrapers are found from Phases 7 to 3, representing MIS 4 (c. 60,000 – 71,000 years BP) to MIS 3 (c. 30,000 – 36,000 years BP) (Figure 6-32).

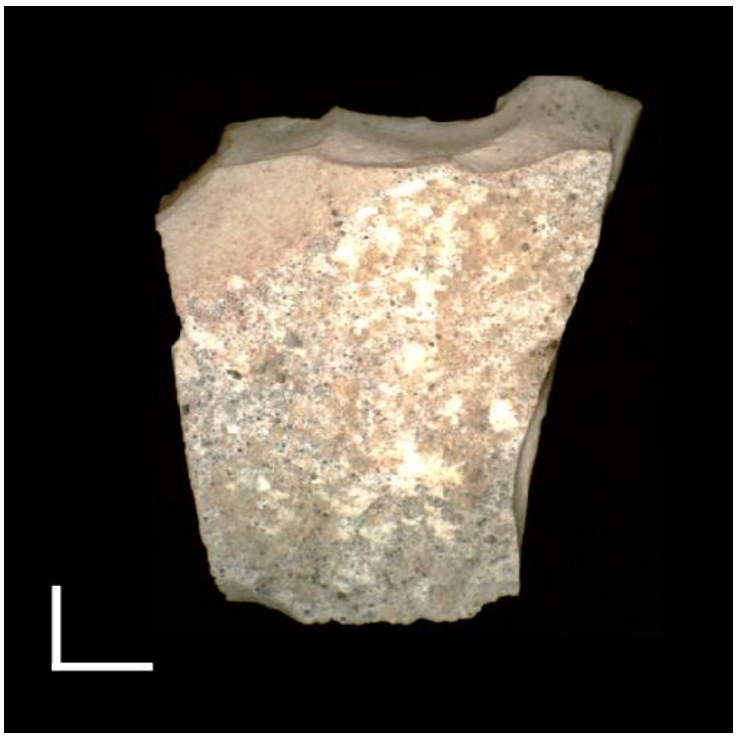


Figure 6-31: *Chert end scraper from Phase 3 (context 518, ID: 58). Scale 10 mm*

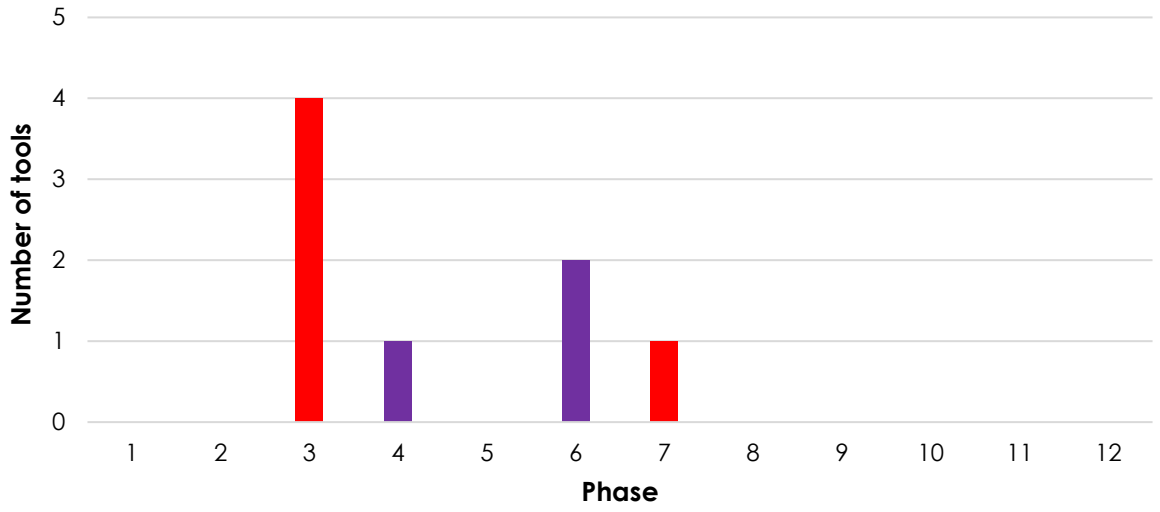


***Figure 6-32**: Number of end scrapers by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of end scrapers are provided in Table 6-19. The average measurements for end scrapers from Shanidar Cave were 40.0 mm in length, 21.8 mm in width and 7.4 mm in thickness. Average measurements are presented in Table 6-20 and Figure 6-33. Per the average dimensions data, end scrapers from Phase 3 appear larger than those from underlying phases. However, the Phase 3 average is impacted by the very large end scraper (ID: 172) which measures 71 mm in length and 31 mm in width.

***Table 6-19**: End scrapers and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
58	518	**3**	40	29	11	Chert
112	1037	**3**	32	13	5	Chert
141b	568	**3**	42	20	11	Chert
172	1418	**3**	71	32	9	Chert
297	560	**4**	34	18	6	Chert
399	1852	**6**	28	21	5	Jasper
403	1845	**6**	41	19	4	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
381	1922	**7**	32	22	8	Chert

Table 6-20: *Average dimensions of End scrapers by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
3	MIS 3	4	46.3	23.5	9
4	MIS 3	1	34	18	6
6	MIS 3	2	34.5	20	4.5
7	MIS 4	1	32	22	8
Total	-	8	40	21.8	7.4

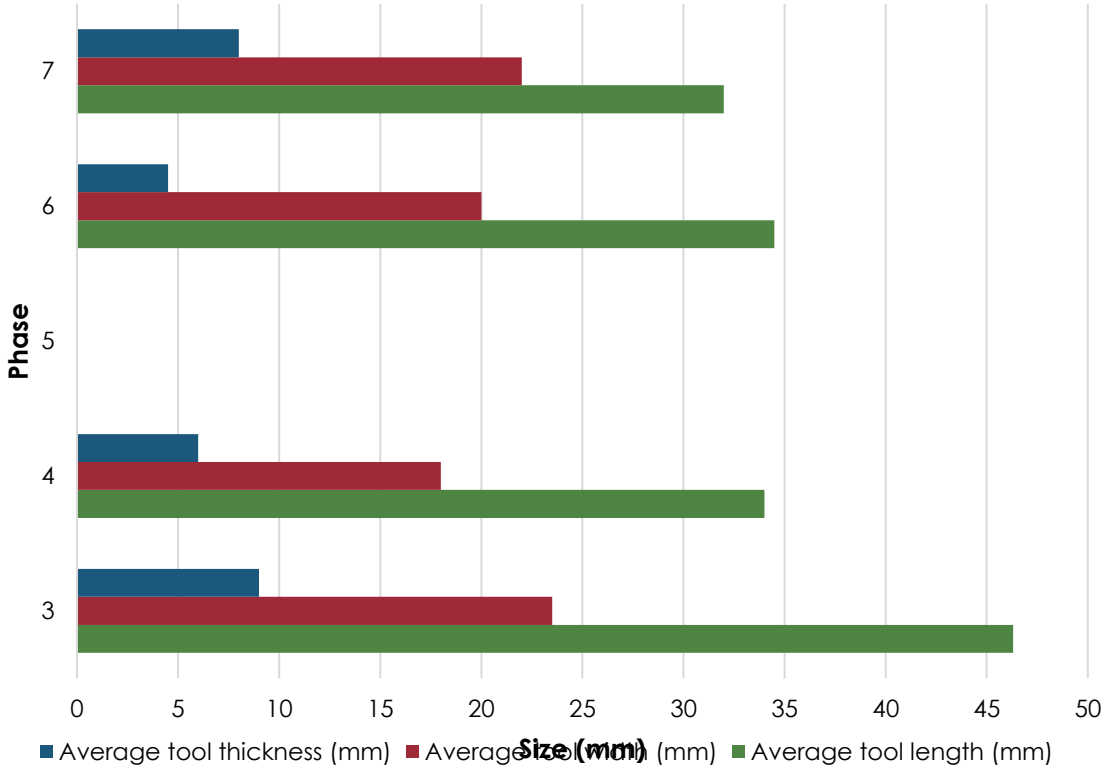


Figure 6-33*: Average dimensions of end scrapers by archaeological phase*

6.1.2.10 Bladelet Cores

There are 15 bladelet cores in the assemblage (4.1%). Bladelet cores refer to cores with small, thin, parallel removals. They are associated with Upper Palaeolithic industries (Shea, 2006, 2013; Gennai et al., 2021, 2023). An example of a bladelet core is presented in Figure 6-34. All examples from Shanidar are made of chert. They are found from Phases 6 to 2, representing MIS 3 (c. 30,000 – 60,00 BP) (Figure 6.35).



Figure 6-34: *Chert bladelet core from Phase 3 (context 714, ID: 42). Scale 10 mm*

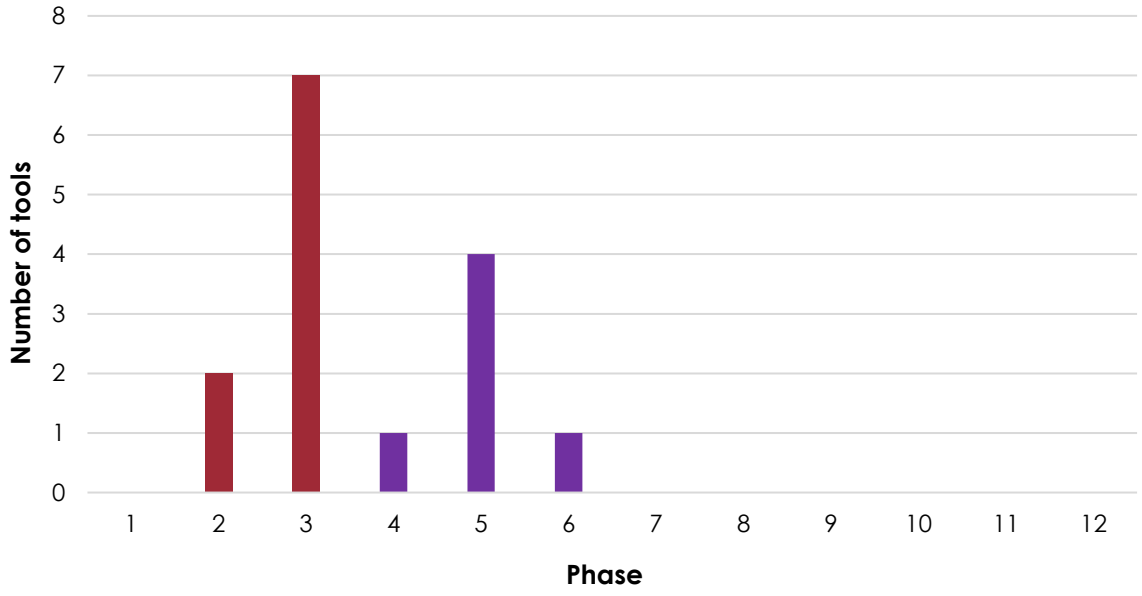


Figure 6-35: *Number of bladelet cores by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Bladelet cores are only found in the upper sequence of the cave (MIS 3 – 2)*

Measurements of bladelet cores are provided in Table 6-21. The average measurements for bladelet cores from Shanidar Cave were 32.2 mm in length 21.3 mm in width and 13.8 mm in thickness. Average measurements are presented by phase in Table 6-22 and Figure 6-36. Given the nature of this artefact type i.e. it forms the basis of other tools, the size and shape can be highly variable even within sites. It is difficult therefore to assess size trends through time.

Table 6-21: *Bladelet cores and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
307	567	**2**	39	29	19	Chert
439	1803	**2**	29	21	20	Chert
42	714	**3**	24	18	9	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
118	1046	**3**	28	9	7	Chert
308	1622	**3**	39	29	12	Chert
805	2536	**3**	25	19	14	Chert
805A	2536	**3**	39	11	7	Chert
805B	2536	**3**	31	21	11	Chert
805C	2536	**3**	37	19	18	Chert
432	1835	**4**	28	20	18	Chert
450	1834	**5**	39	22	16	Chert
11	546	**5**	40	39	25	Chert
44	752	**5**	22	19	7	Chert
227	1367	**5**	28	19	5	Chert
434	1852	**6**	35	25	18	Chert

Table 6-22: *Average dimensions of Bladelet Cores by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	Top MIS 3	2	34	25	19.5
3	MIS 3	7	31.8	18	11.1
4	MIS 3	1	28	20	18
5	MIS 3	4	32.3	24.5	13.3
6	MIS 3 early	1	35	25	18
Total	-	15	32.2	21.3	13.8

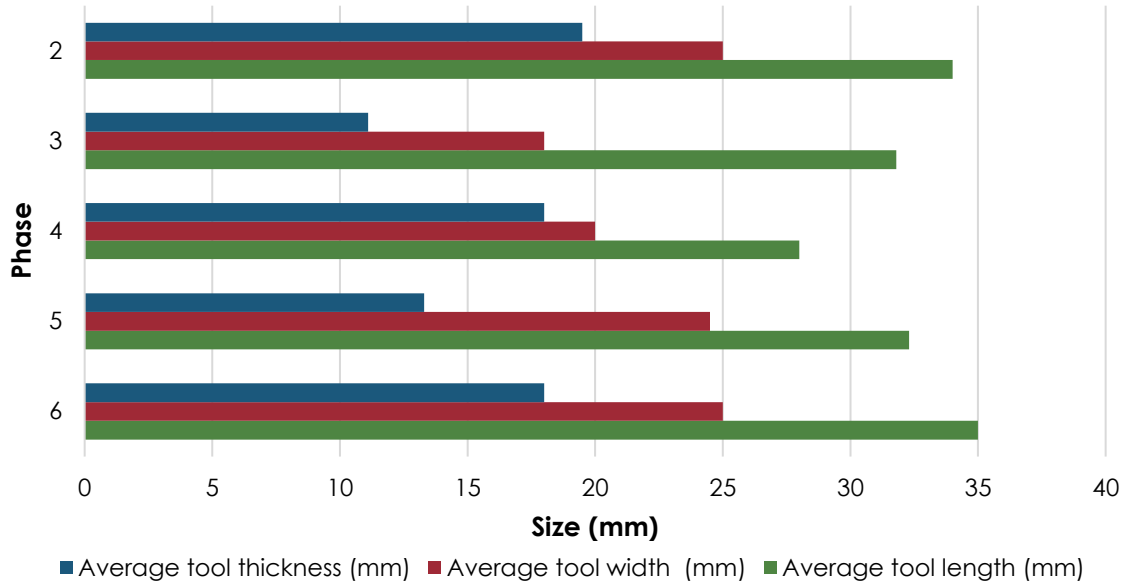


Figure 6-36: *Average dimensions of bladelet cores by chronological phase*

6.1.2.11 Crested Blades

There are seven crested blades in the assemblage (1.9%). Crested blades are elongated flakes with a prominent ridge (crest) along one edge either created intentionally or naturally occurring (Gennai et al., 2021). An example of a crested blade is presented in Figure 6-37. The raw material from Shanidar Cave is chert with one exception of jasper. Crested blades are found between Phases 5 and 2, associated with MIS 3 (c. 30,000 – 60,000 years BP) (Figure 6-38).



Figure 6-37: *Chert crested blade recovered from Phase 2 (context 2531, ID: 909). Scale 5 mm*

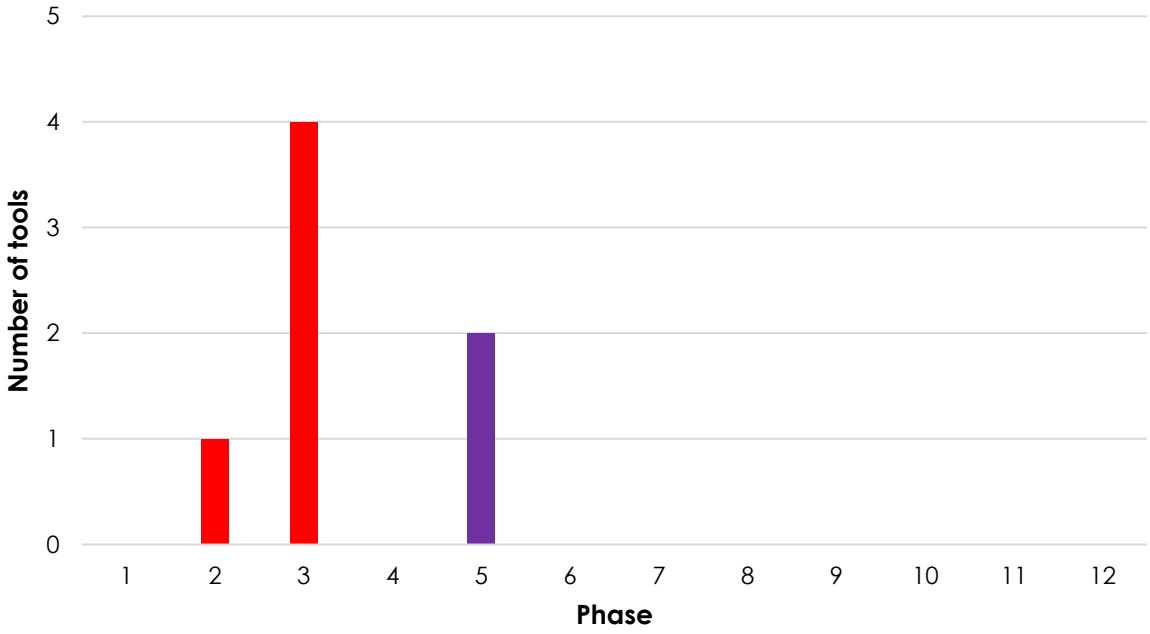


Figure 6-38*: Number of crested blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. These tools are only found in the upper sequence of the cave (MIS 3 -2)*

Measurements of crested blades are provided in Table 6-23. The average measurements for crested blades at Shanidar Cave were 36.7 mm in length, 9.1 mm in width and 5.2 mm in thickness. Average measurements are presented by phase in Table 6-24 and Figure 6-39. There is no obvious trend in crested blade size across Shanidar's occupational sequence.

***Table 6-23**; Crested blades and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
909	2531	**2**	41	12	4	Chert
49	526	**3**	12	2	2	Chert
139	1107	**3**	41	7	5	Chert
166	1418	**3**	41	18	8	Chert
171	1418	**3**	32	5	4	Chert
212	1327	**5**	49	9	7	Jasper
412	1914	**5**	41	11	7	Chert

***Table 6-24**: Average dimensions of crested blades by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	1	41	12	4
3	MIS 3	4	31.5	8	4.75
5	MIS 3	2	45	10	7
Total	-	7	36.7	9.1	5.2

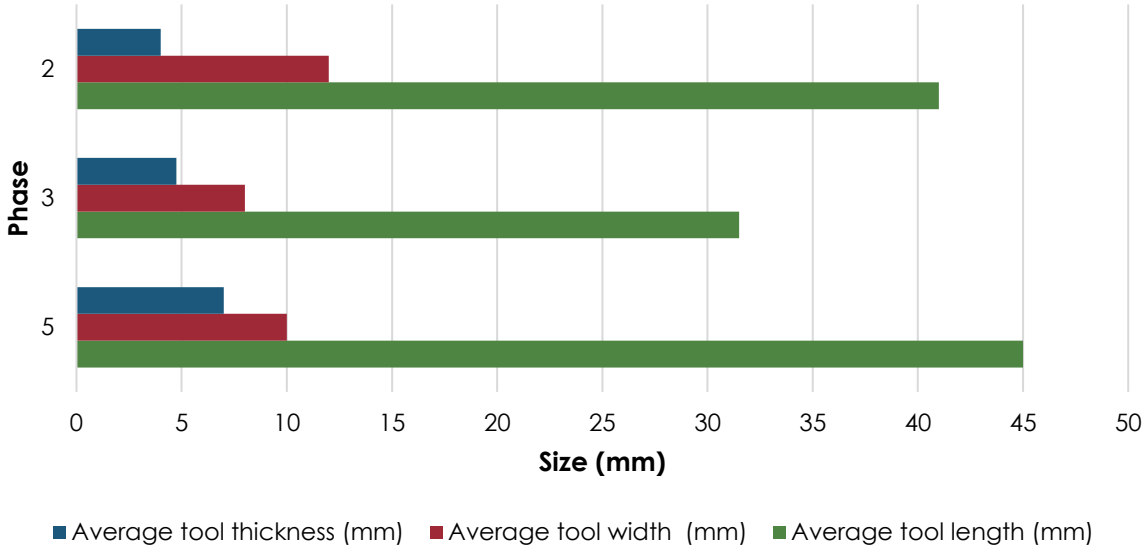


***Figure 6-39**: Average dimensions of crested blade by chronological phase*

6.1.3 Indeterminate

Certain tool forms are found in both Middle Palaeolithic and Upper Palaeolithic assemblages, making it difficult to assign them to a particular hominin group or tool industry (Bordes, 1964a; Shea, 2013). Examples of such from Shanidar Cave are provided below. These forms include flakes (generic flakes, retouched flakes, and cortical flakes), flake cores, awls, burins, notches, denticulates, and informal tools.

6.1.3.1 Unretouched Flakes

There are 3 unretouched flakes indeterminate to industry (8.4%). Flakes are traditionally associated with Neanderthals and earlier hominins whilst

blade-based knapping is associated with *Homo sapiens,* however, flakes are produced in the preparation of a blade core, as well as serving as a functional tool, meaning that flakes cannot easily be attributed to either tool industry (Andrefsky, 2007; Odell, 2004). An example of an unretouched flake is presented in Figure 6-40. Most flakes from Shanidar Cave are made of chert but there is one example in agate from Phase 7 (MIS 4, c. 60,000 – 70,000 years BP). Flakes are noted throughout almost the entirety of the sequence, from MIS 5c (c. 75,000 – 100,000 years BP) to MIS 3 (c. 30,000 – 36,000 years BP) (Figure 6-41).

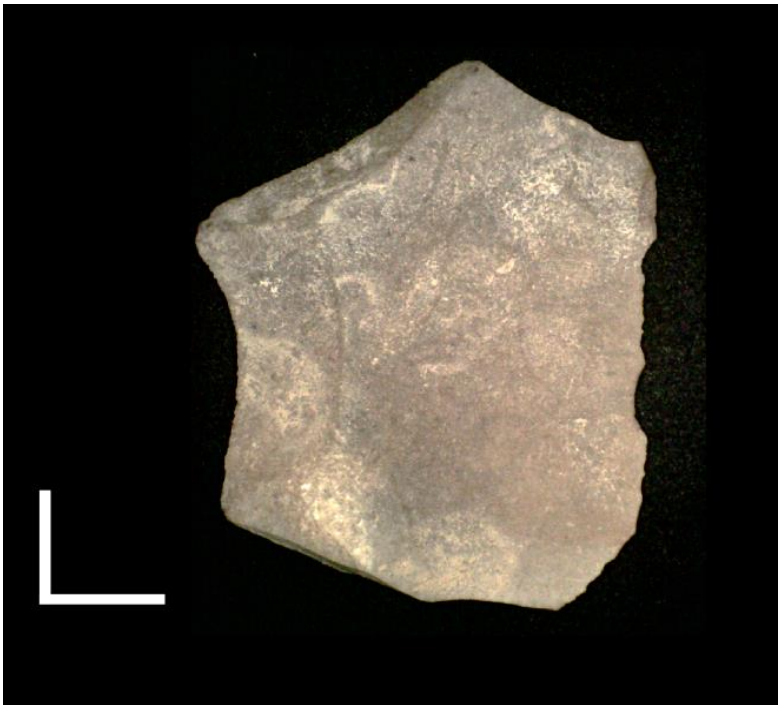


Figure 6-40: *Chert flake recovered from Phase 10 (context 1935, ID: 459). Scale 5 mm*

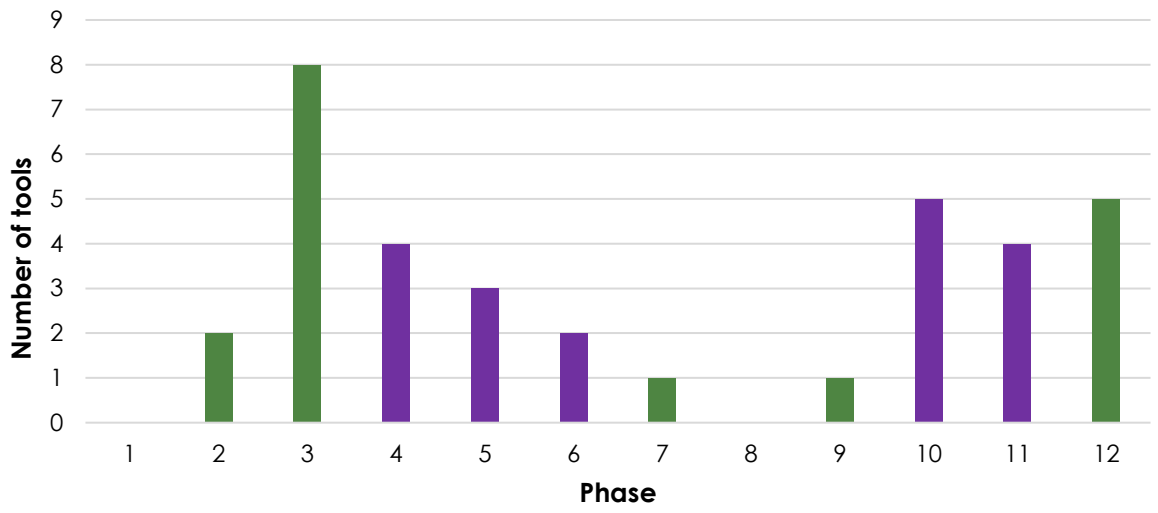


***Figure 6-41**: Number of unretouched flakes by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Flakes are found throughout the cave's occupational sequence*

Measurements of unretouched flakes are provided in Table 6-25. The average measurements for unretouched flakes from Shanidar Cave were 22 mm in length, 15.5 mm in width, and 4.1 mm in thickness. Average measurements are presented in Table 6-26 and Figure 6-42. The average length of tools from Phase 6 appears larger than the average length of tools from any other phase but the sample size for this phase is just two. There is no obvious trend in the size of unretouched flakes across time.

***Table 6-25:** Unretouched flakes and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
336	567	**2**	21	19	5	Chert
887	2593	**2**	25	24	6	Chert
12	519	**3**	21	11	5	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
143	1418	**3**	11	6	2	Chert
303	629, 4533	**3**	25	24	6	Chert
304	629, 4522	**3**	21	11	5	Chert
417	1809	**3**	22	12	2	Chert
787	2536-2538	**3**	22	18	3	Chert
802	2537	**3**	21	16	3	Chert
893	2536	**3**	16	8	2	Chert
19a	537	**4**	19	8	3	Chert
144	1458	**4**	12	8	3	Chert
326	561	**4**	21	11	4	Chert
339	560	**4**	22	15	2	Chert
57	708	**5**	31	26	7	Chert
145	1306	**5**	15	9	2	Chert
305	1611, 4560	**5**	19	16	4	Chert
402	1852	**6**	35	22	4	Chert
438	1859	**6**	29	23	5	Chert
656	2261	**7**	27	20	4	Agate
774	2278- 2281	**9**	22	16	2	Chert
213	1514	**10**	29	19	2	Chert
459	1935	**10**	21	21	4	Chert
474	2101	**10**	20	18	4	Chert
475	2101	**10**	25	14	3	Chert
655	2305	**10**	32	21	5	Chert
493	2125	**11**	14	8	2	Chert
591	2315	**11**	34	13	3	Chert
596	2331	**11**	18	16	2	Chert
657	2321	**11**	32	19	3	Chert
783	2518	**12**	21	19	5	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
789	2512	**12**	24	18	6	Chert
804	2503	**12**	22	20	4	Chert
820	2555	**12**	25	19	14	Chert
892	2500	**12**	32	29	3	Chert

Table 6-26: *Average dimensions of unretouched flakes by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	2	23	21.5	5.5
3	MIS 3	8	18.8	11.8	2.8
4	MIS 3	4	16	7.7	3.3
5	MIS 3	3	23	17	4.5
6	MIS 3 early	2	32	22.5	4.5
7	MIS 4	1	27	20	4
9	MIS 5a	1	22	19	5
10	MIS 5a	5	24.5	18.5	4
11	MIS 5a	4	24.5	14	2.5
12	MIS 5c	5	19.6	16	6.4
Total	-	35	22	15.5	4.1

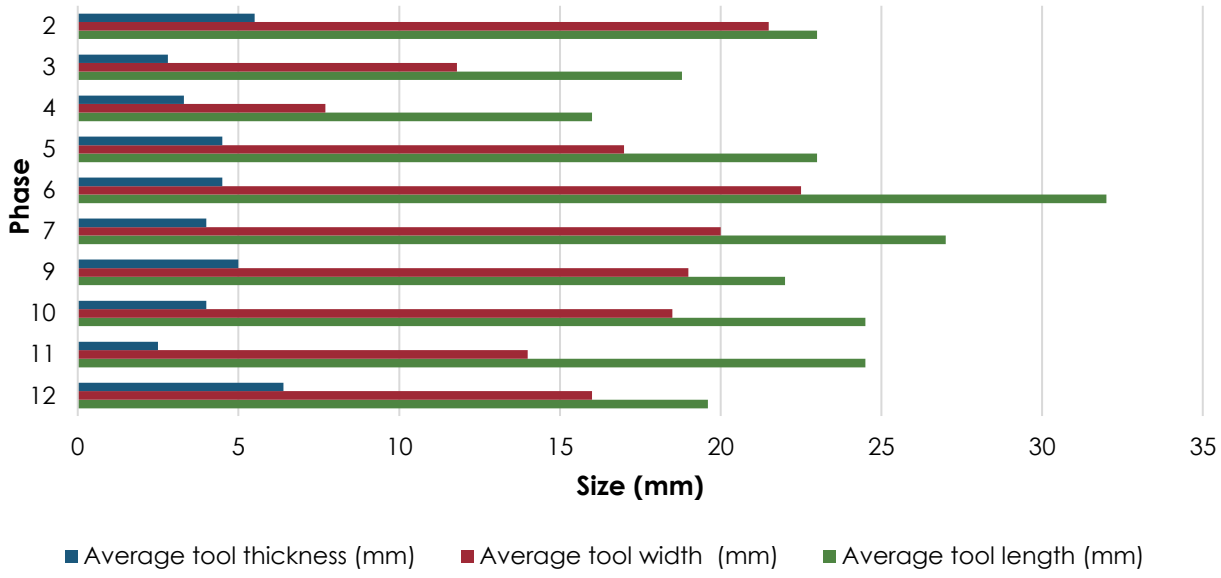


Figure 6-42: *Average dimensions of unretouched flakes by chronological phase*

6.1.3.2 Retouched Flakes

There are 16 retouched flakes in the assemblage (4.3%), all of which are made of chert. An example of a retouched flake is presented in Figure 6-43. Retouched flakes are found from Phase 12 (MIS 5c, c. 75,000 – 100,000 years BP) to Phase 3 (MIS 3, c. 30,000 – 36,000 years BP) (Figure 6-44).

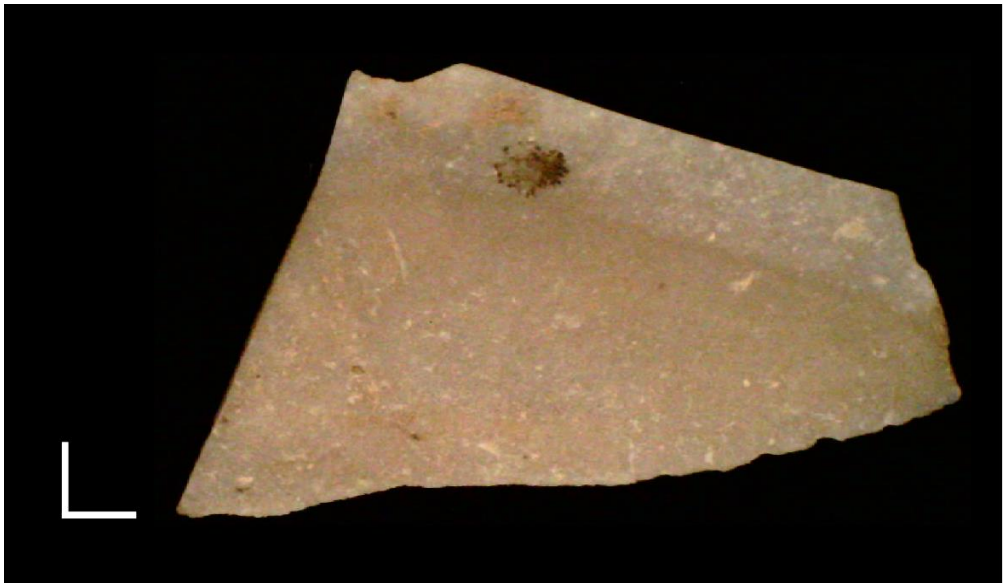


***Figure 6-43**: Chert retouched flake from Phase 5 (context 723, ID: 255). Scale 5 mm*

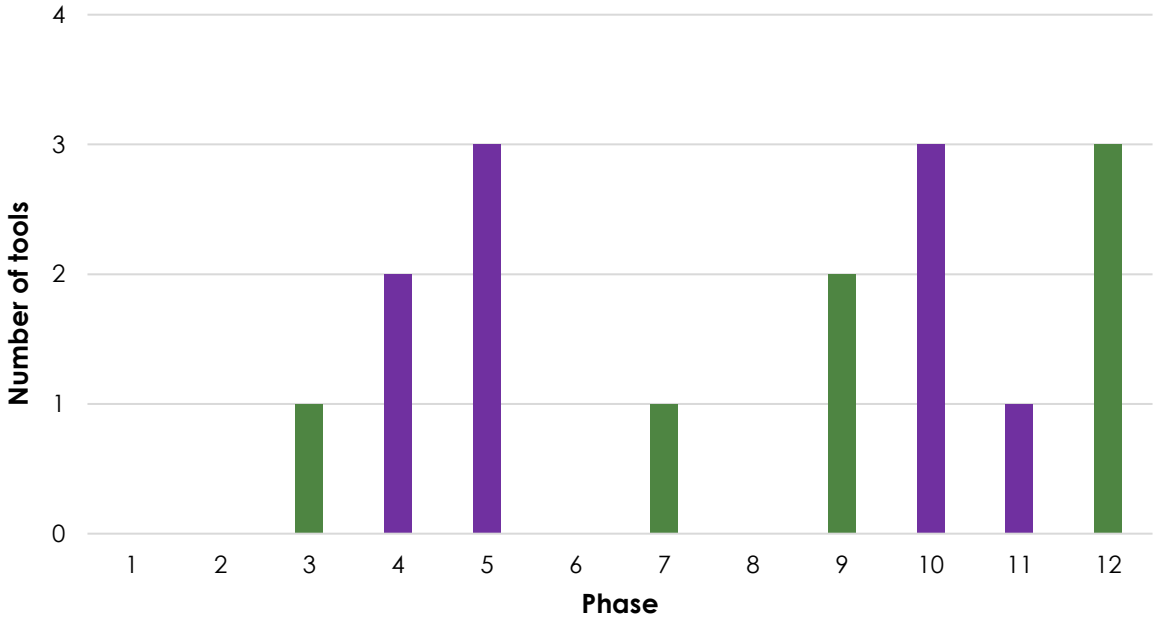


***Figure 6-44**: Number of retouched flakes by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Retouched flakes are found throughout the sequence*

Measurements of retouched flakes are provided in Figure 6-27. The average measurements for retouched flakes at Shanidar Cave were 25.3 mm in length, 16.3 mm in width and 3.4 mm in thickness. Average measurements are presented by phase in Table 6-28 and Figure 6-45. There is no obvious trend in the size of retouched flakes across the occupational sequence of the site.

Table 6-27: *Retouched flakes and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
876	2536	**3**	12	9	3	Chert
13	529	**4**	19	17	3	Chert
454	1838	**4**	42	31	9	Chert
33	723	**5**	21	8	3	Chert
255	723	**5**	22	17	2	Chert
216	1435	**7**	28	10	5	Chert
691	2265	**7**	27	22	4	Chert
76	1508	**9**	33	28	4	Chert
571	2284	**9**	32	11	5	Chert
429	1931	**10**	34	14	4	Chert
587	2312	**10**	17	11	3	Chert
634	2313	**10**	18	9	4	Chert
594	2330	**11**	27	12	3	Chert
324	1747	**12**	31	22	3	Chert
610	2347	**12**	26	18	2	Chert
615	2350	**12**	22	15	2	Chert

Table 6-28: *Average dimensions of retouched flake by archaeological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
3	MIS 3	1	12	9	2
4	MIS 3	2	30.5	24	6
5	MIS 3	3	21.7	14	2.3
7	MIS 4	1	27	22	4
9	MIS 5a	2	32.5	19.5	4.5
10	MIS 5a	3	23	11.3	3.6
11	MIS 5a	1	27	12	3
12	MIS 5c	3	26.3	18.3	2.3
Total	-	16	25.3	16.3	3.4

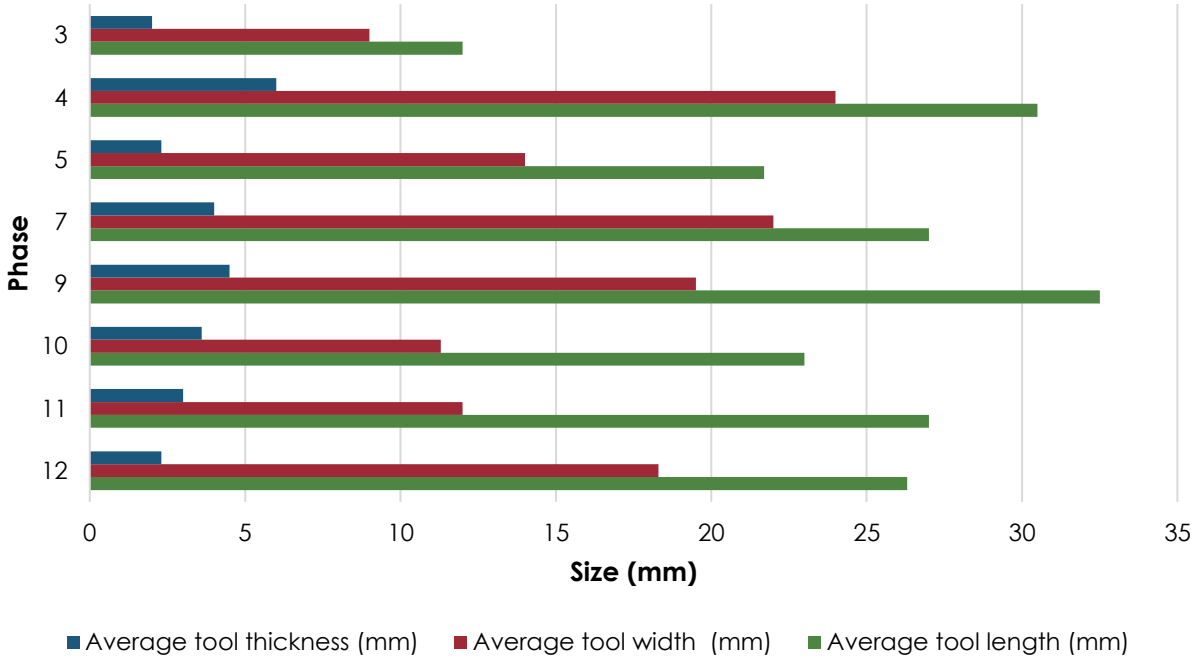


Figure 6-45: *Average dimensions of retouched flakes by chronological phase*

6.1.3.3 Cortical Flakes

There are 35 cortical flakes in the assemblage (9.0%) made exclusively of chert. Cortical flakes are removed from a flake core early in the knapping process and as such they still retain cortex (Debénath and Dibble,1994*; Shea*, 2013). An example of a cortical flake is presented in Figure 6-46. Cortical flakes are found throughout the entire sequence from Phase 12 to Phase 1, MIS 5c to MIS 3 – 2 (c. 75,000 – 100,000 years BP to <30,000 years BP) (Figure 6-47).



Figure 6-46*: Chert cortical flake recovered from Phase 6 (context 1852, ID: 425). Scale 10 mm*

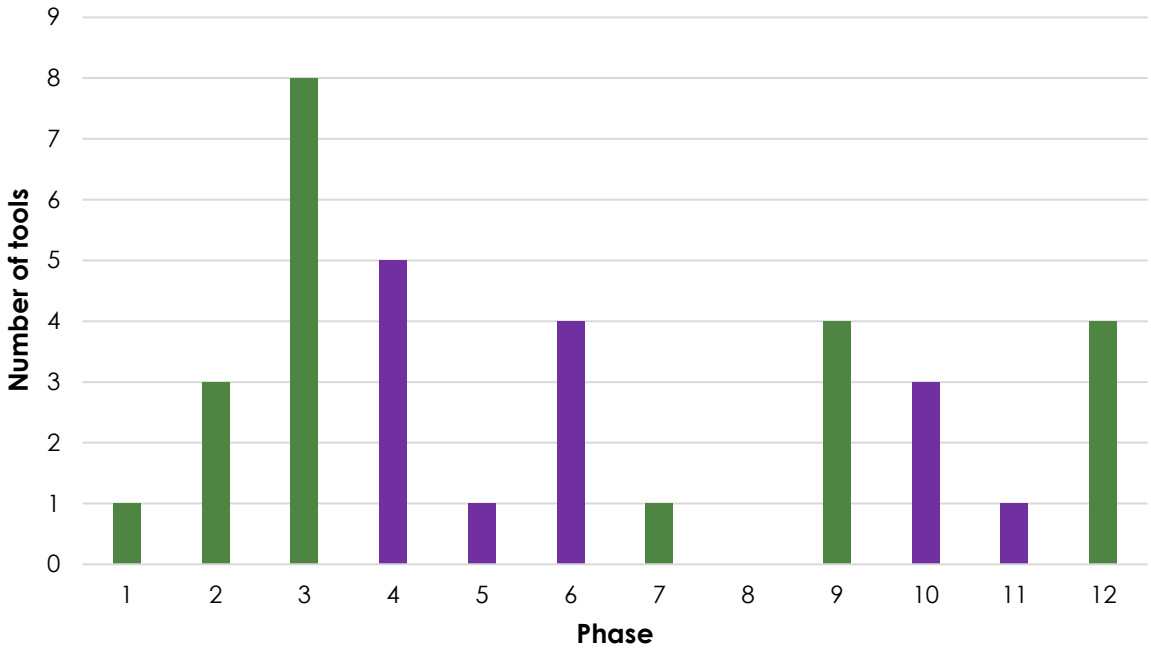


Figure 6-47: *Number of cortical flakes by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Cortical flakes are found throughout the occupational sequence of the cave.*

Measurements of cortical flakes are provided in Table 6-29. The average measurements for cortical flakes from Shanidar Cave were 30.3 mm in length, 15.4 mm in width and 5.3 mm in thickness. Average measurements are presented by phase in Table 6-30 and Figure 6-48. On the whole, the lithics from the lower sequence (Phases 12 to 6, MIS 4 - 5) are longer and wider than those from the upper sequence (Phases 5 and up, MIS 3).

Table 6-29: *Cortical flakes and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
489	Outcrop G	**1**	32	21	9	Chert
322	567	**2**	35	7	6	Chert
126	1050	**2**	9	8	2	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
872	2563	**2**	25	11	7	Chert
47	524	**3**	21	8	3	Chert
61	508	**3**	21	18	3	Chert
127	1045	**3**	31	19	6	Chert
129	1049	**3**	19	11	2	Chert
133	1046	**3**	17	11	4	Chert
142	1418	**3**	22	10	2	Chert
150	1418	**3**	41	24	11	Chert
309	1655	**3**	22	17	4	Chert
1	-	**4**	32	11	9	Chert
3	-	**4**	30	12	9	Chert
327	1660	**4**	29	6	4	Chert
426	1835	**4**	24	11	3	Chert
883	2530	**4**	30	12	3	Chert
105	1056	**5**	21	11	8	Chert
413	1823	**6**	33	17	6	Chert
425	1852	**6**	29	18	3	Chert
437	1913	**6**	41	25	9	Chert
452A	1867	**6**	21	14	3	Chert
422	1904	**7**	41	19	5	Chert
385	1519	**9**	41	32	11	Chert
562	2279	**9**	23	17	3	Chert
564	2280	**9**	31	19	10	Chert
568	2284	**9**	50	12	4	Chert
310	1519	**10**	31	19	3	Chert
586	2312	**10**	42	30	4	Chert
599	2401	**10**	51	21	4	Chert
494	2138	**11**	37	12	2	Chert
612	2348	**12**	37	20	6	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
786	2522	**12**	31	11	8	Chert
809	2560	**12**	22	19	2	Chert
820C	2555	**12**	39	12	5	Chert

***Table 6-30**: Average dimensions of cortical flakes by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
1	Holocene	1	32	21	9
2	Top MIS 3	3	23	8.6	5
3	MIS 3	8	24.3	14.8	4.4
4	MIS 3	5	29	10.4	5.6
5	MIS 3	1	21	11	8
6	MIS 3 early	4	30.5	17.5	5.8
7	MIS 4	1	41	19	5
9	MIS 5a	4	36.3	20	7
10	MIS 5a	3	41.3	23.3	3.7
11	MIS 5a	1	37	12	2
12	MIS 5c	4	32.25	15.5	5.3
Total	-	35	30.3	15.4	5.3

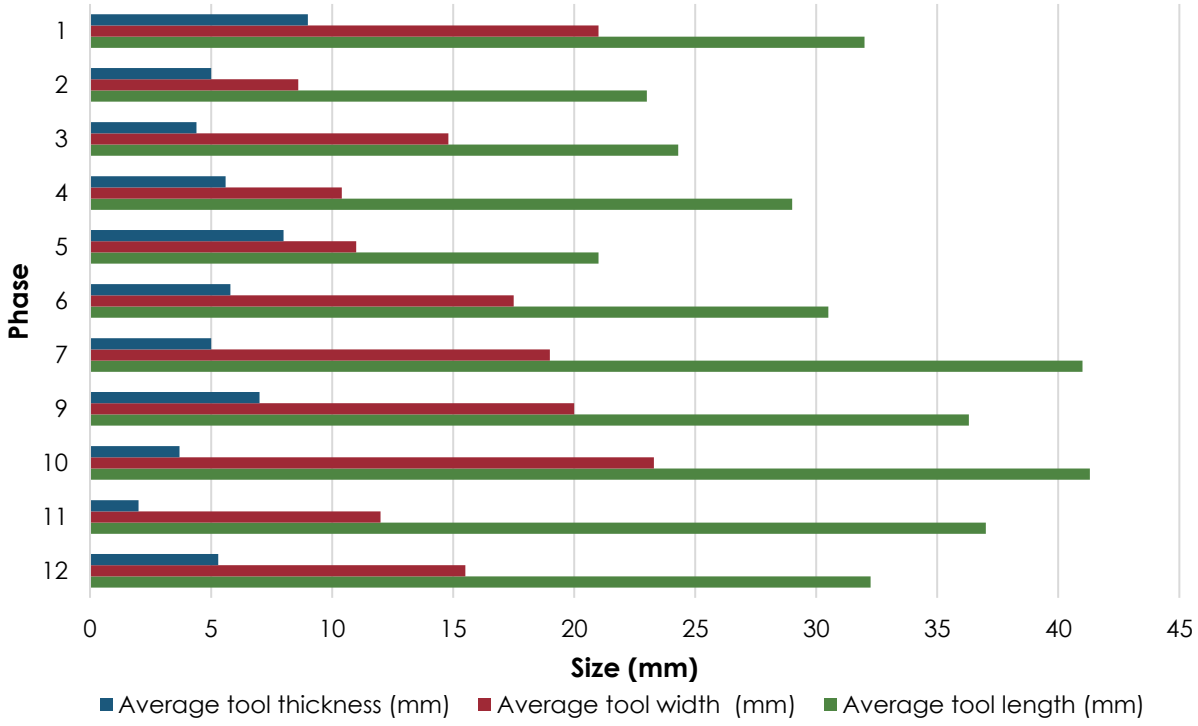


Figure 6-48: *Average dimensions of cortical flake by chronological phase*

6.1.3.4 Flake Cores

There are 18 flake cores (4.9%). Flake cores are nodules/cobbles which have been deliberately knapped to remove flakes. As is noted at other Neanderthal sites in the Zagros, evidence for the typical Levallois method associated with the Neanderthals is limited (Lindley, 1997; Skinner, 1965; see section 2.4.2). Solecki found some Levallois cores in Layer D at Shanidar Cave, but these had been reworked into other forms (Solecki, 1963). An example flake core is presented in Figure 6-49. The raw material is chert or jasper. Flake cores are noted throughout the sequence (MIS 5c to MIS 3, c. 75,000 – 100,000 years BP to 30,000 – 36,000 years BP) (Figure 6-50).



Figure 6-49: *Chert flake core from Phase 6 (context 733, ID: 54). Scale 5 mm*

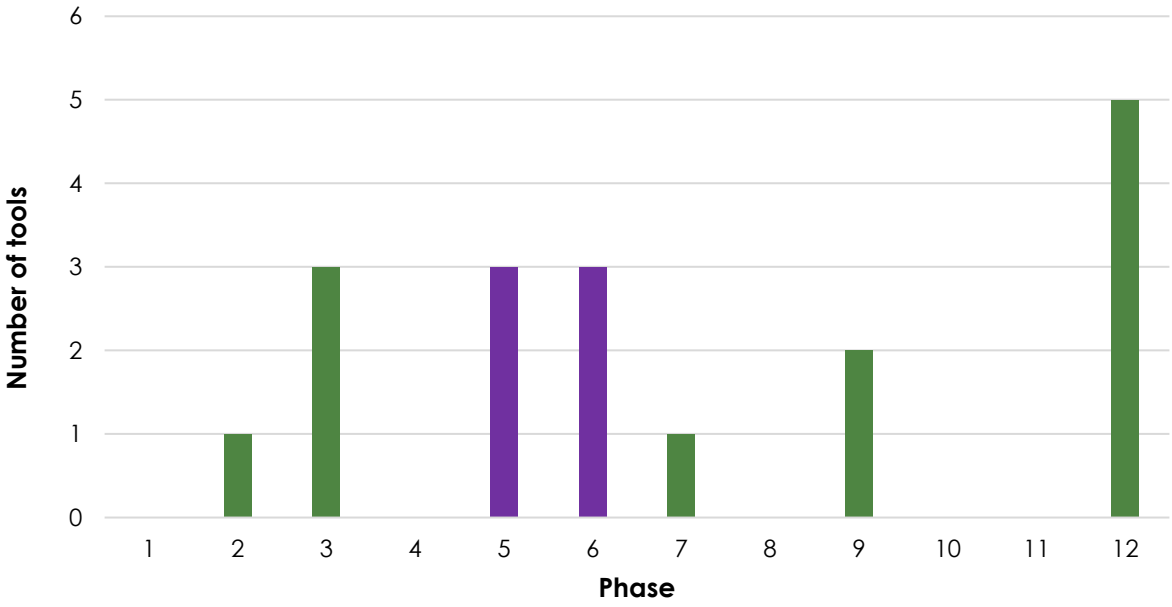


Figure 6-50: *Number of flake cores by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Flake cores are found throughout the sequence of the cave, with the highest concentration of tools coming from Phase 12 (n=5)*

Measurements of flake cores are provided in Table 6-31. The average measurements for flake cores from Shanidar Cave were 35.6 mm in length, 27 mm in width and 13.3 mm in thickness. Average measurements are presented by phase in Table 6-32 and Figure 6-51. The single flake core from Phase 7 is larger than the remainder of the lithics. The average measurements from Phases 2 and 3 are fairly similar and may suggest some sort of continuity of knapping techniques in MIS 3, however, the measurements are also similar to those from Phase 12 (MIS 5c).

Table 6-31: *Flake cores and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
311	1502-1505,4349	**2**	28	21	14	Jasper
141	1046	**3**	26	19	11	Chert
141A	1037	**3**	38	27	20	Chert
141M	1036	**3**	29	21	12	Chert
161	1459	**5**	42	31	11	Chert
209	1340	**5**	42	26	19	Chert
306	1613, 4585	**5**	32	28	27	Chert
478	2037	**6**	57	41	13	Jasper
487	2039	**6**	36	29	4	Jasper
54	733	**6**	24	18	9	Chert
73	1534	**7**	55	42	21	Chert
418	1925	**9**	38	29	13	Chert
561	2278	**9**	42	39	22	Jasper
200	2516	**12**	29	21	13	Chert
622	2350	**12**	39	28	11	Jasper

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
902	2539	**12**	38	37	19	Jasper
910	2604	**12**	22	12	6	Chert
856	2555	**12**	21	18	8	Chert

***Table 6-32**: Average dimensions of flake cores by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	1	28	21	14
3	MIS 3	3	31	22.3	14.3
5	MIS 3	3	42	28.5	15
6	MIS 3 early	3	39	29.3	8.7
7	MIS 4	1	55	42	21
9	MIS 5a	2	40	34	17.5
12	MIS 5c	5	29.8	23.2	11.4
Total	-	18	35.6	27	13.3

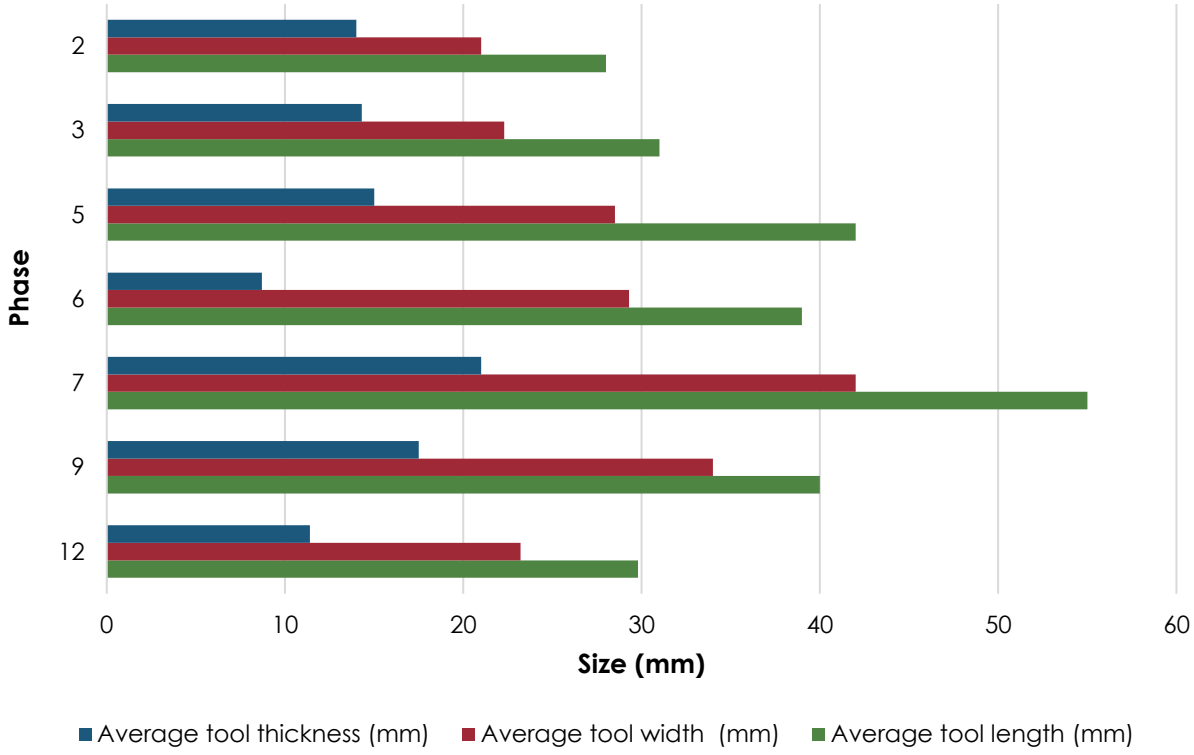


Figure 6-51: *Average dimensions of flake cores by archaeological phase*

6.1.3.5 Notches

There are four notches in the assemblage (1.1%). Notches are flakes which have been deliberately retouched to produce a semi-circular hole or 'notch' along one worked edge (Bordes, 1961a; Debénath and Dibble, 1994). An example is presented in Figure 6-52. The raw material is exclusively chert. Notches are found in Phases 12, 9, and 2 (MIS 5c, MIS 5a, MIS 3) (Figure 6-53).



Figure 6-52: *Chert notch from Phase 12 (context 2355, ID: 617). Scale 5 mm*

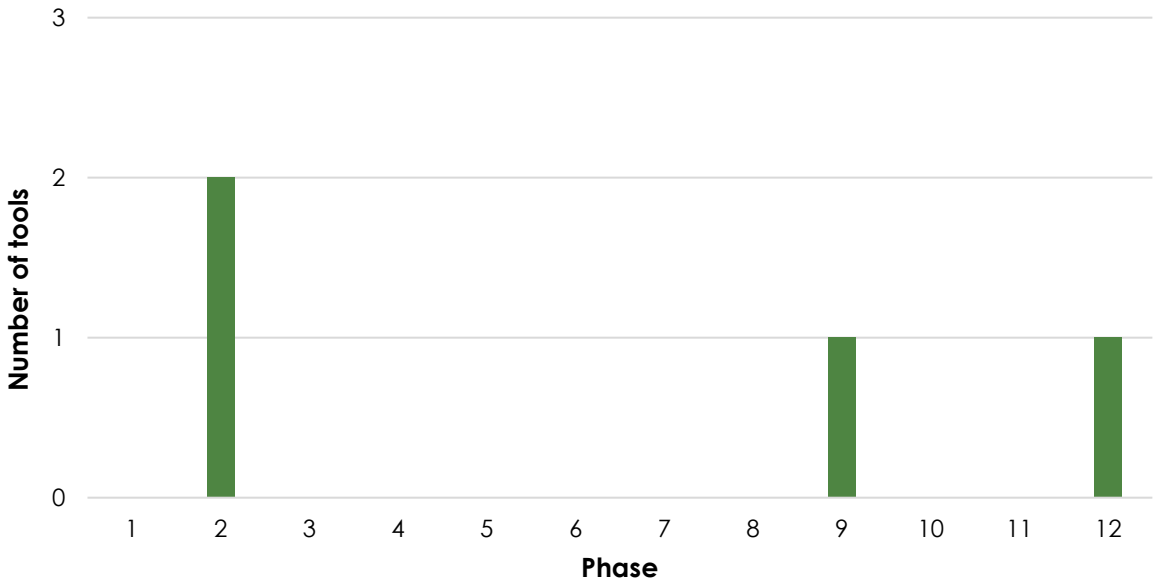


Figure 6-53: *Number of notches by chronological phase. Notches have not been recovered from phases associated with Neanderthal remains*

Measurements of notches are provided in Table 6-33. The average measurements for notches from Shanidar Cave were 27.4 mm in length, 12.4 mm in width and 4.4 mm in thickness. Average measurements are presented by phase in Table 6-34 and Figure 6-54. There is no obvious trend in the size of notches across the occupational sequence of Shanidar Cave.

Table 6-33: *Notches and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
897	2593	**2**	32	12	6	Chert
141E	567	**2**	22	12	4	Chert
575	2278	**9**	21	14	3	Chert
617	2355	**12**	35	12	4	Chert

Table 6-34: *Average dimensions of notches by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
2	MIS 3	2	27	12	5
9	MIS 5a	1	21	14	3
12	MIS 5c	1	35	12	4
Total	-	4	27.4	12.4	4.4

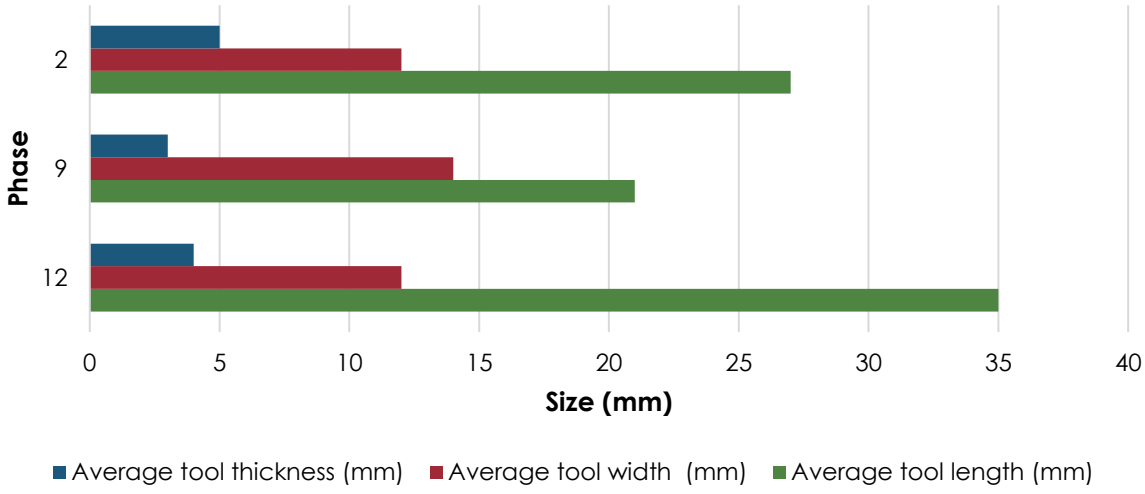


Figure 6-54: *Average dimensions of notches by chronological phase*

6.1.3.6 Denticulates

There are five denticulates in the assemblage (1.4%). Denticulates are retouched flakes which have undulating edges giving the appearance of a "saw-like" working edge (Bordes, 1961a; Debénath and Dibble, 1994). The raw material from Shanidar Cave is exclusively chert. Lithic 400 (Figure 6-55) was made from onyx, a form of banded chert. Denticulates were recovered from Phases 12 (MIS 5c, c. 75,000 – 100,000 years BP), 10 (MIS 5a, c. 71,000 – 75,000 years BP), 5 (MIS 3, c. 36,000 – 60,000 years BP), and 1 (<30,000 years BP) (Figure 6-56).

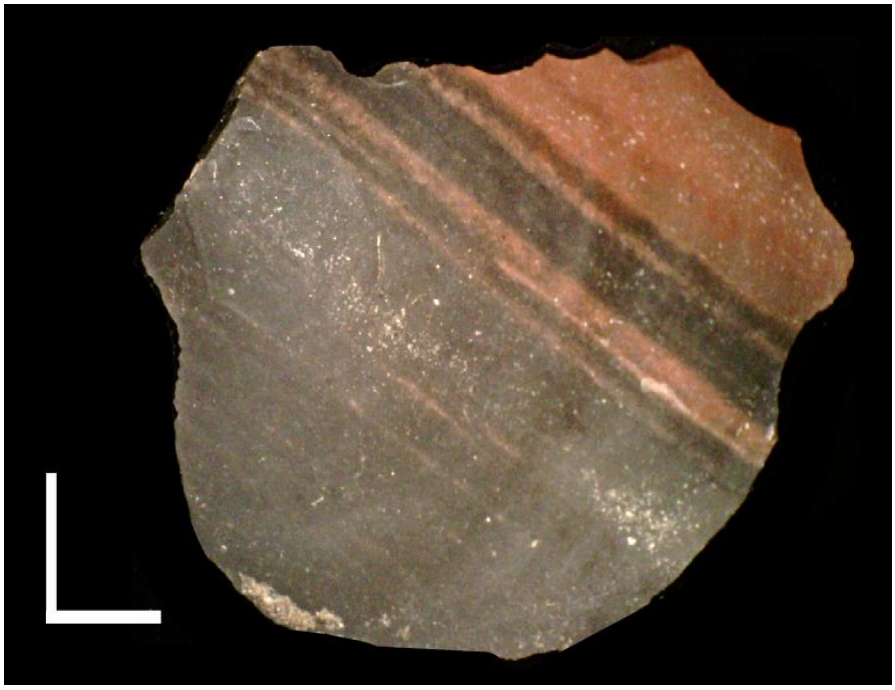


Figure 6-55: *Onyx (banded chert) denticulate from Phase 5 (context 1836, ID: 400). Scale 2 mm*

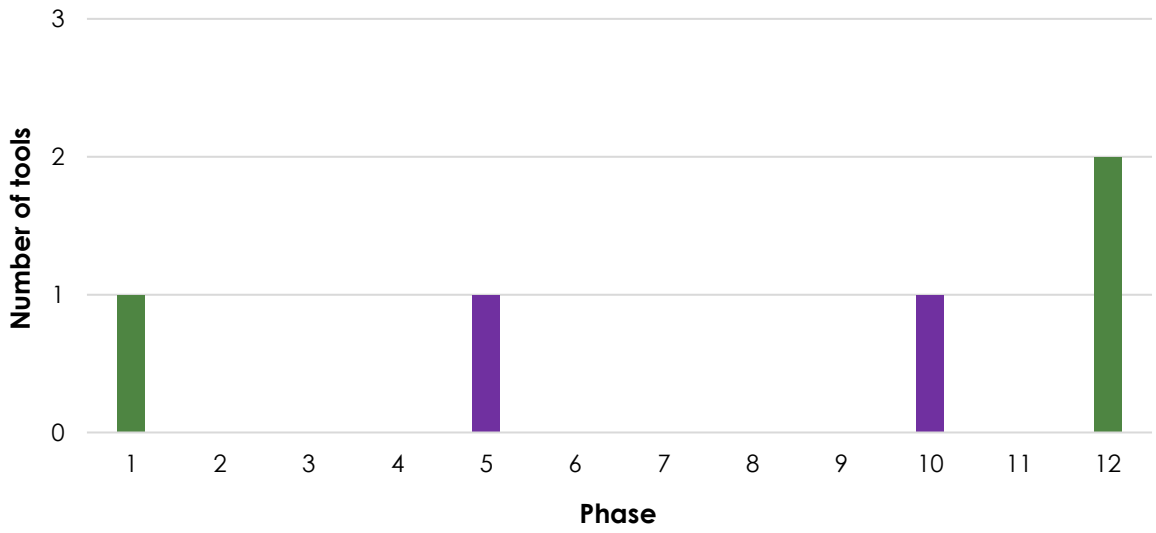


Figure 6-56*: Number of denticulates by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered.*

Measurements of denticulates are provided in Table 6-35. The average measurements for denticulates from Shanidar Cave were 29 mm in length,

18.8 mm in width and 3.8 mm in thickness. Average measurements are presented in Table 6-36 and Figure 6-57. The denticulate from Phase 10 is nearly double the width of all others, however, given the small sample size (n=5) it is not possible to assess trends through time.

***Table 6-35**: Denticulates and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
498	-	**1**	21	19	2	Chert
400	1836	**5**	35	13	6	Chert
203	1523	**10**	32	29	4	Chert
608	2346	**12**	36	15	5	Chert
790	2512	**12**	21	18	2	Chert

***Table 6-36**: Average dimensions of denticulates by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
1	Holocene	1	21	19	2
5	MIS 3	1	35	13	6
10	MIS 5a	1	32	29	4
12	MIS 5c	2	28.5	16.5	3.5
Total	-	5	29	18.8	3.8

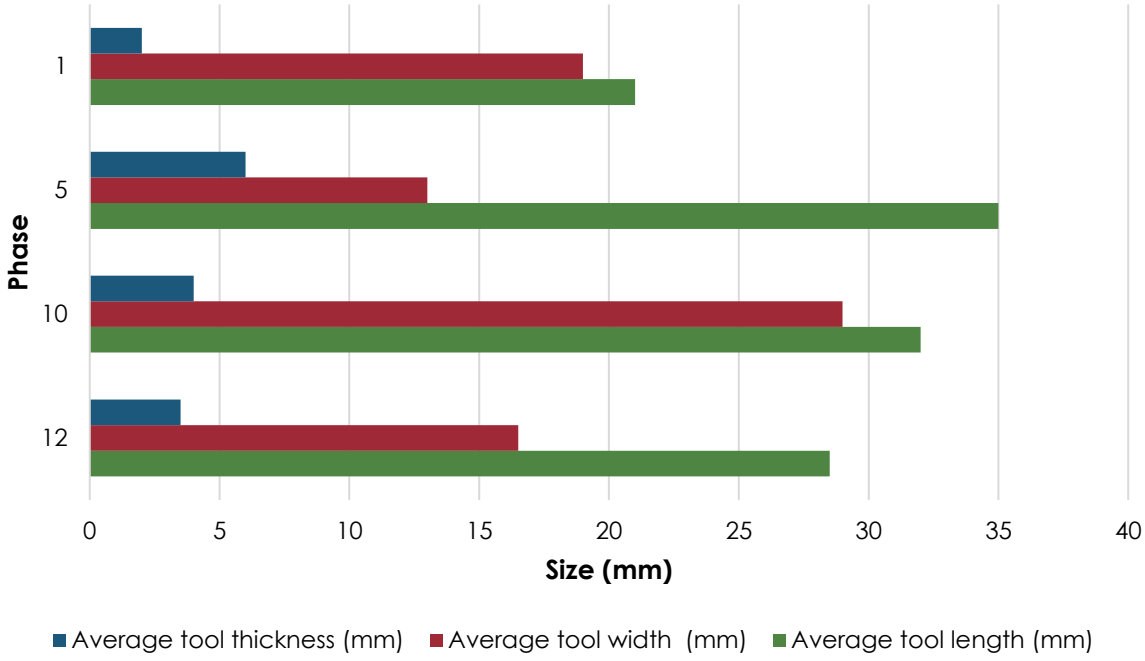


Figure 6-57: *Average dimensions of denticulates by archaeological phase*

6.1.3.7 Informal Tools

There are 18 informal tools in the assemblage (4.9%). Informal tools are flakes which do not comfortably fit into an established tool typology. Tools such as these are sometimes referred to as 'blanks' because they were never fully knapped into their final form (Shea, 2013; Debénath and Dibble, 1994). An example informal tool is presented in Figure 6-58. The raw material from Shanidar Cave is typically chert with two tools formed of jasper. Informal tools are found throughout the sequence (MIS 5c to MIS 3) (Figure 6-59).



Figure 6-58: *Chert informal tool from Phase 3 (context 1043, ID: 131). Scale 5 mm*

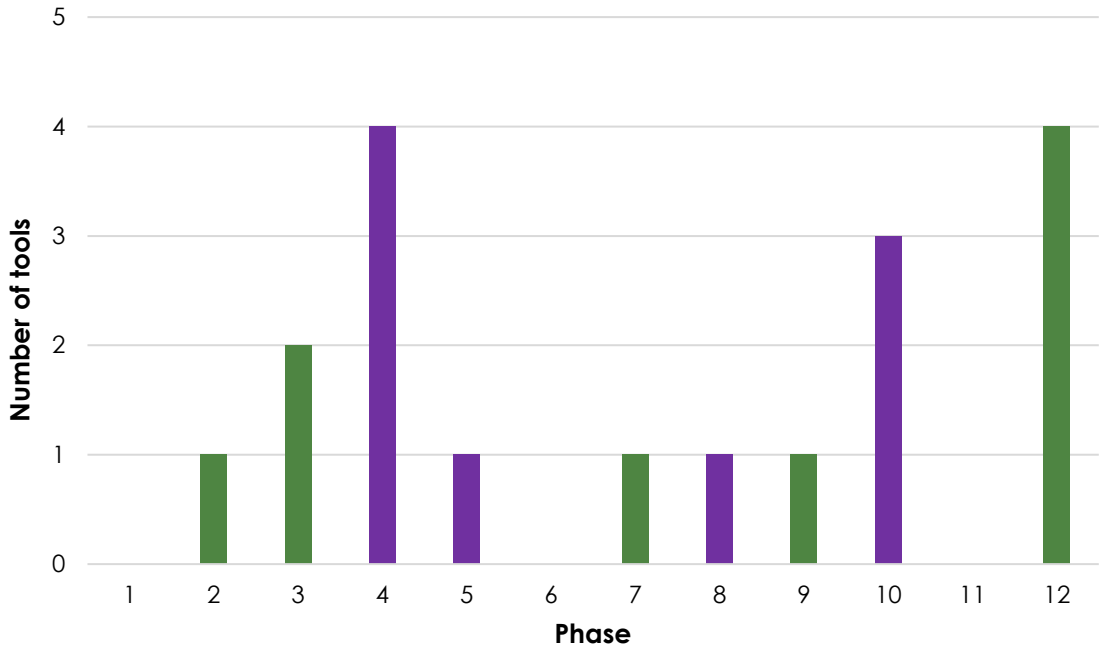


Figure 6-59: *Number of informal tools by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. Informal tools are found throughout the sequence of the site.*

Measurements of informal tools are provided in Table 6-37. The average measurements of informal tools from Shanidar Cave are 30.4 mm in length, 16.3 mm in width and 5 mm in thickness.

***Table 6-37**: Informal tools and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
907	2563	**2**	41	19	8	Chert
131	1043	**3**	39	20	6	Chert
915	2537	**3**	28	14	5	Chert
38	735	**4**	42	28	4	Chert
138	1062	**4**	22	13	2	Chert
886	2530	**4**	20	9	4	Chert
894	2530	**4**	12	9	8	Chert
318	1634	**5**	12	6	3	Chert
234	1535	**7**	28	21	7	Jasper
558	2272	**8**	28	20	5	Chert
581	2303	**9**	21	18	4	Chert
486	2000	**10**	45	22	4	Chert
579	2300	**10**	31	28	3	Chert
598	2401	**10**	50	15	3	Chert
681	2351	**12**	-	-	-	Chert
807	2610	**12**	29	12	6	Chert
900	2545	**12**	56	17	4	Chert
904	2562	**12**	22	11	6	Jasper

6.1.3.8 Awls

There are 11 awls total in the assemblage (1.9%). Awls are elongated flakes with a thin, pointed edge, interpreted as sewing or drilling implements (Debénath and Dibble, 1994). An example is presented in Figure 6-60. Awls are found between Phases 12 (MIS 5c) and 3 (MIS 3) at Shanidar Cave (Figure 6-61).



***Figure 6-60**: Chert awl recovered from Phase 5 (context 718, ID: 53). Scale 10 mm*

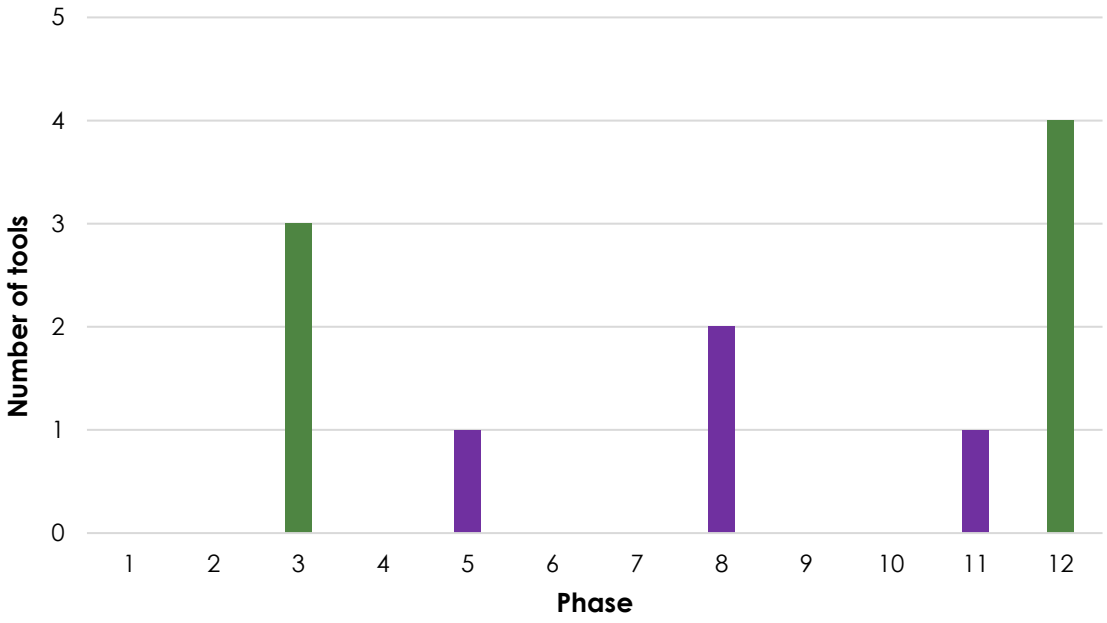


***Figure 6-61**: Number of awls by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of awls are provided in Table 6-38. The average measurements for awls from Shanidar Cave are 33.4 mm in length, 15.6 mm in width and 3.9 mm in thickness. Average measurements are presented by phase in Table 6-39 and Figure 6-62. These vary by phase and no trend can be discerned.

***Table 6-38**: Awls and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
292	638. 639.580. 581.	**3**	21	7	2	Chert
135	1033	**3**	21	8	2	Chert
169	1418	**3**	42	19	6	Jasper
53	718	**5**	39	29	5	Chert
168	1503	**8**	35	22	5	Chert
700	2270	**8**	50	21	4	Chert

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
703	2339	**11**	20	11	3	Chert
820B	2555	**12**	39	20	4	Jasper
820E	2555	**12**	31	10	4	Chert
820F	2555	**12**	41	18	5	Chert
888	2539	**12**	29	6	3	Chert

***Table 6-39**: Average dimensions of awls by chronological phase*

Phase	Marine Isotope Stage	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
3	Top MIS 3	3	28	11.3	3.3
5	MIS 3	1	39	29	5
8	MIS 5a	2	42.5	21.5	4.5
11	MIS 5c	1	20	11	3
12	MIS 5a	4	35	13.5	4
Total	-	11	33.4	17.3	3.9

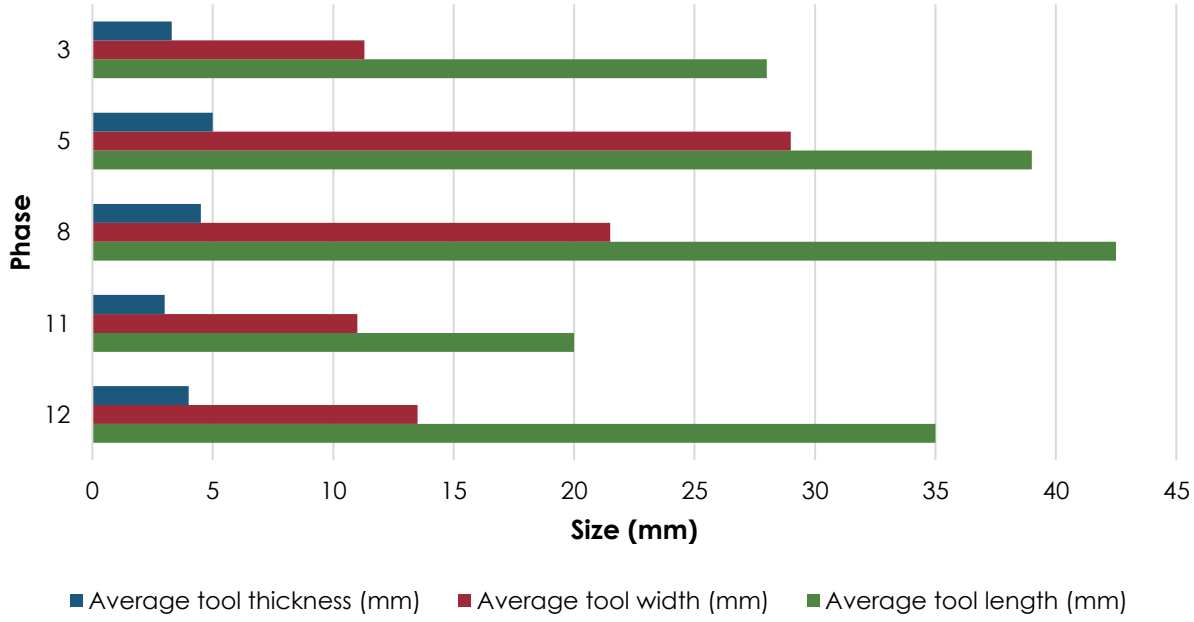


***Figure 6-62:** Average dimensions of awls by chronological phase*

6.1.3.9 Burins

There are eight burins in the assemblage (2.2%). Burins are flakes with a sharp bevelled edge and one or more "burin spall" removals (Debénath and Dibble, 1994). An example of a burin is presented in Figure 6-63. The raw material from Shanidar Cave is mostly chert, with two examples of jasper. Burins are noted between Phases 10 (MIS 5a, c. 71,000 – 75,000 years BP) and 3 (MIS 3, c. 30,000 – 35,000 years BP (Figure 6-64).



***Figure 6-63**: Chert burin from Phase 3 (context 1034, ID: 109). Scale 5 mm*

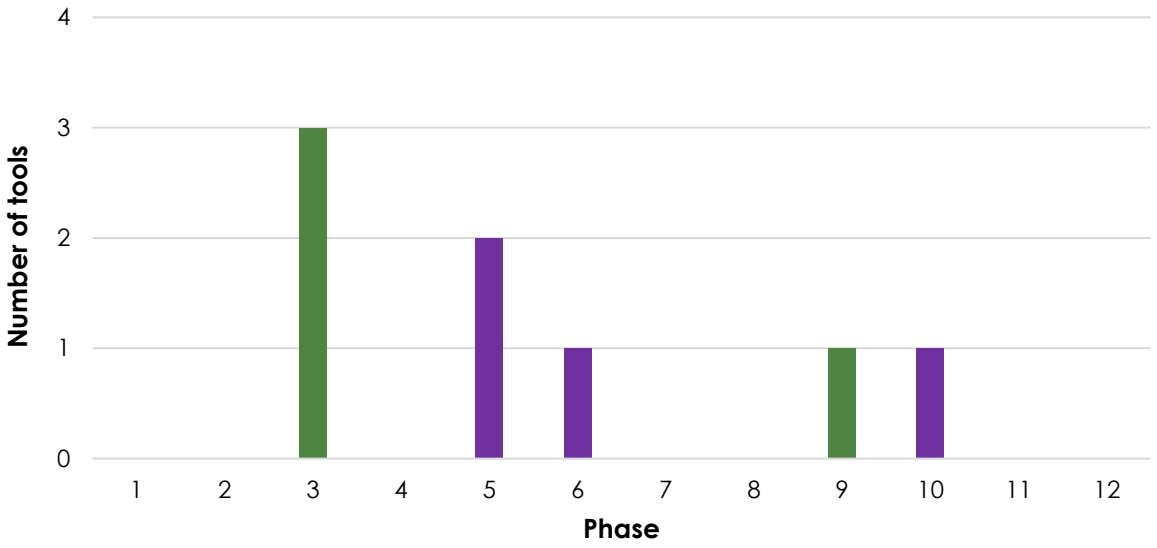


***Figure 6-64**: Number of burins by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

Measurements of burins are provided in Table 6-40. The average dimensions for burins from Shanidar Cave are 33.25 mm in length, 16.2 mm in width and 5.6 mm in thickness. Average measurements are presented by phase in Table 6-41 and Figure 6-65. Burins from Shanidar Cave appear to become larger (in length, width and thickness) by MIS 3, however, this data has been generated from a very small sample.

***Table 6-40:** Burins and associated measurements by chronological phase*

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
109	1034	**3**	30	10	4	Chert
110	1043	**3**	31	19	4	Chert
141k	1037	**3**	-	-	-	Chert
51	721	**5**	44	31	11	Chert
114	1013	**5**	32	12	5	Jasper

Specimen ID	Context	Phase	Length (mm)	Width (mm)	Thickness (mm)	Material
389	1845	**6**	56	22	8	Jasper
383	1925	**9**	23	11	5	Chert
379	1924	**10**	22	7	4	Chert

***Table 6-41**: Average dimensions of burins by chronological phase*

Phase	MIS Phase	Number of specimens	Average tool length (mm)	Average tool width (mm)	Average tool thickness (mm)
3	MIS 3	3	29.7	15.4	4
5	MIS 3	2	38	21.5	8
6	MIS 3 early	1	56	22	8
9	MIS 5a	1	23	11	5
10	MIS 5a	1	22	7	4
Total	-	8	33.25	16.2	5.6

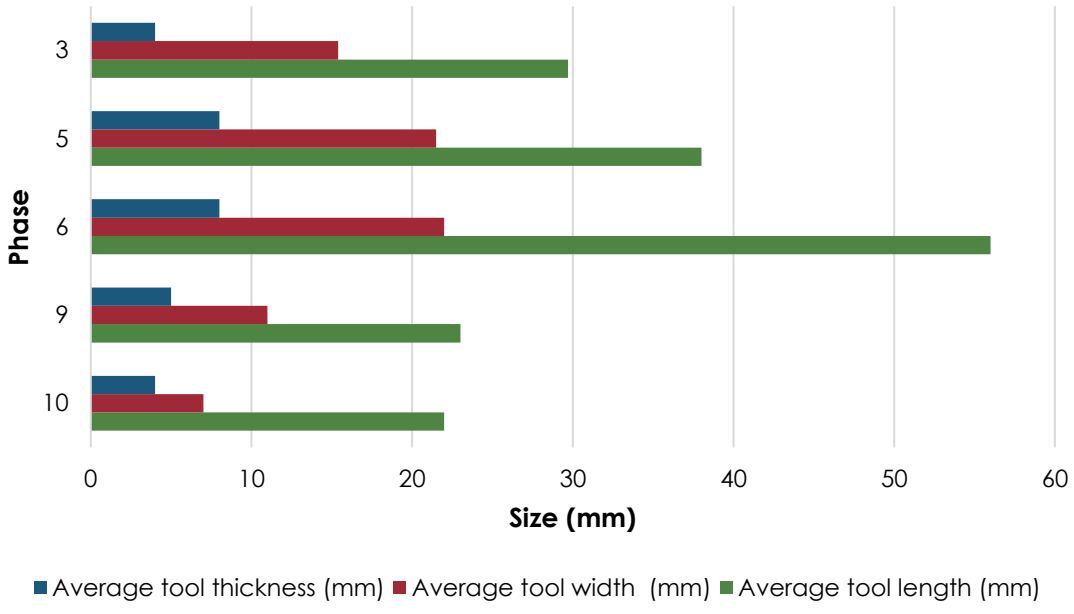


***Figure 6-65:** Average dimensions of burins by chronological phase*

6.1.4 Summary of Lithic Typology by Phase

The chronological sequence of Shanidar Cave sequence stretches from c. 100,000 years BP to <30,000 years BP. The excavated contexts were broken down into 12 broad chronological phases to allow for generalisations (see section 2.5). Skeletal material of *Homo neanderthalensis* has been recovered from between Phases 11 (MIS 5a, c. 70,000 – 75,000 years BP) to 4 (MIS 3, c. 55,000-58,000 years BP). The highest concentration of lithics typically attributed to the Mousterian industry (ordinarily associated with Neanderthals) is in phase 12 (n=23), which is associated with MIS 5c, dating around 75,000 to 100,000 years BP. However, there is also a relatively high density of stylistically Mousterian tools in phase 6 (n=12), which is an early part of MIS 3, approximately 60,000-55,000 years before present (Table 2-3).

Lithics typically attributed to the Baradostian/Aurignacian populations including bladelets, end scrapers, and crested blades have traditionally considered as marking the arrival of *Homo sapiens* at any given site during the later to final Middle Palaeolithic (Breuil, 1907; Kozlowski and Otte, 2000; Otte and Kozlowski, 2011; Shea, 2013). Lithic artefacts typically associated with the Baradostian and Aurignacian are however, as demonstrated above, found as far back as the base of the re-exposed sequence (excavated 2015 – present), c. 100,000 years ago. There is a larger proportion of stylistically Baradostian material from phase 6 onwards (60,000 – 55,000 years BP) with the largest density occurring in phase 3 (36,000 – 30,000 years BP). A summary is presented in Table 6-42.

Table 6-42: *Number of specimens by chronological phase*

		MIS 1	MIS 3					MIS 4	MIS 5a				MIS 5c	
	Tool Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Mousterian	*Mousterian point*	*0*	*89i*	*1*	*2*	*4*	*7*	*4*	*0*	*5*	*3*	*2*	*15*	***43***
	Elongated Mousterian point	*0*	*0*	*0*	*2*	*2*	*1*	*0*	*0*	*3*	*3*	*1*	*0*	***12***
	Side scraper	*1*	*2*	*2*	*3*	*4*	*4*	*0*	*0*	*1*	*5*	*1*	*8*	***31***
Baradostian	*Unretouched blade*	*0*	*0*	*3*	*1*	*1*	*3*	*0*	*0*	*3*	*1*	*0*	*5*	***18***
	Retouched blade	*0*	*1*	*5*	*4*	*6*	*3*	*2*	*2*	*0*	*3*	*0*	*1*	***27***
	Unretouched bladelet	*0*	*1*	*2*	*4*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	***8***
	Retouched bladelet	*0*	*3*	*17*	*6*	*6*	*1*	*5*	*4*	*2*	*5*	*3*	*14*	***66***
	Dufour bladelet	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***2***
	Unretouched point	*0*	*1*	*1*	*2*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	***5***
	Retouched point	*0*	*1*	*2*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***6***
	El Wad point	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***1***
	End scraper	*0*	*0*	*4*	*1*	*0*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	***8***
	Bladelet core	*0*	*2*	*7*	*1*	*4*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	***15***
	Crested blade	*0*	*1*	*4*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***7***
Indeterminate	*Unretouched flake*	*0*	*2*	*8*	*4*	*3*	*2*	*1*	*0*	*1*	*5*	*4*	*5*	***34***
	Retouched flake	*0*	*0*	*1*	*2*	*2*	*0*	*2*	*0*	*2*	*3*	*1*	*3*	***16***
	Cortical flake	*1*	*3*	*8*	*5*	*1*	*4*	*1*	*0*	*4*	*3*	*1*	*4*	***35***
	Flake core	*0*	*1*	*5*	*0*	*3*	*3*	*1*	*0*	*2*	*0*	*0*	*5*	***18***
	Notch	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	***4***
	Denticulate	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*0*	*2*	***5***
	Informal tool	*0*	*1*	*2*	*4*	*1*	*0*	*1*	*1*	*1*	*3*	*0*	*4*	***18***
	Awl	*0*	*0*	*3*	*0*	*1*	*0*	*0*	*2*	*0*	*0*	*1*	*4*	***11***
	Burin	*0*	*0*	*3*	*0*	*2*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	***8***
	Total	**3**	**21**	**81**	**43**	**46**	**34**	**18**	**9**	**26**	**36**	**14**	**71**	**402**

6.2 Use-Wear by Tool Type

A total of 657 lithics were analysed microscopically. 106 lithics had evidence of wear. Of the 23 total identified tool types, 18 were represented in the use-wear results (Figure 6-66). Traces of wear were not found on Dufour bladelets, El Wad points, bladelet cores, notches, and awls.

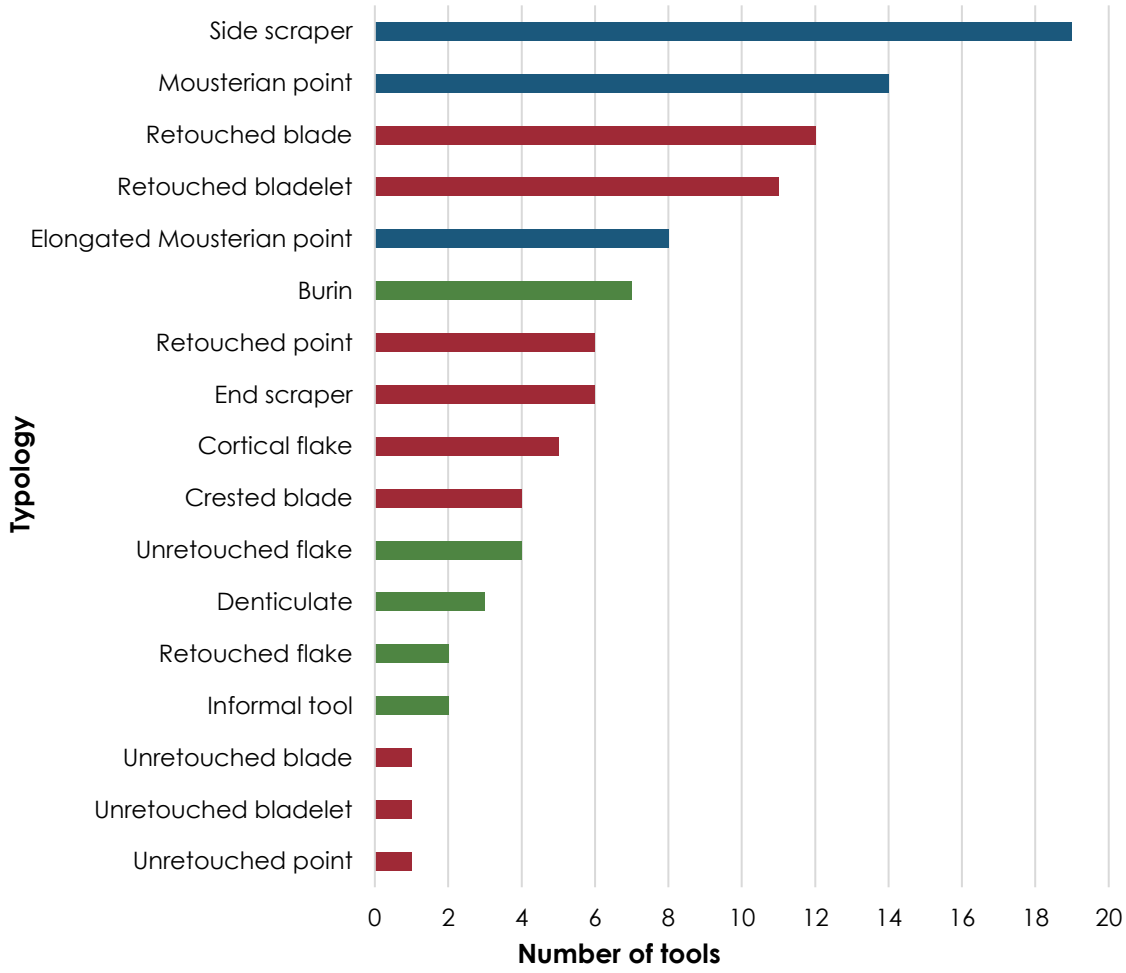


***Figure 6-66**: Number of worked lithics by typology*

6.2.1 Worked Mousterian Points

Wear traces were found on 14 of the 41 Mousterian points (34.2% of Mousterian points, 13.1% of total worked assemblage). These were recovered from Phases 12, 10, 9, 7, 6, 5, and 4 (MIS 5c – MIS 3) (Figure 6-67). Five tools were interpreted as butchery tools (MIS 5 – MIS 3), five as wood working tools (MIS 5 – MIS 4), two tools as bone working tools (both MIS 5), one as a hide working tool (MIS 3), and one as a horn working tool (MIS 3) (Figures 6-68 and 6-69).

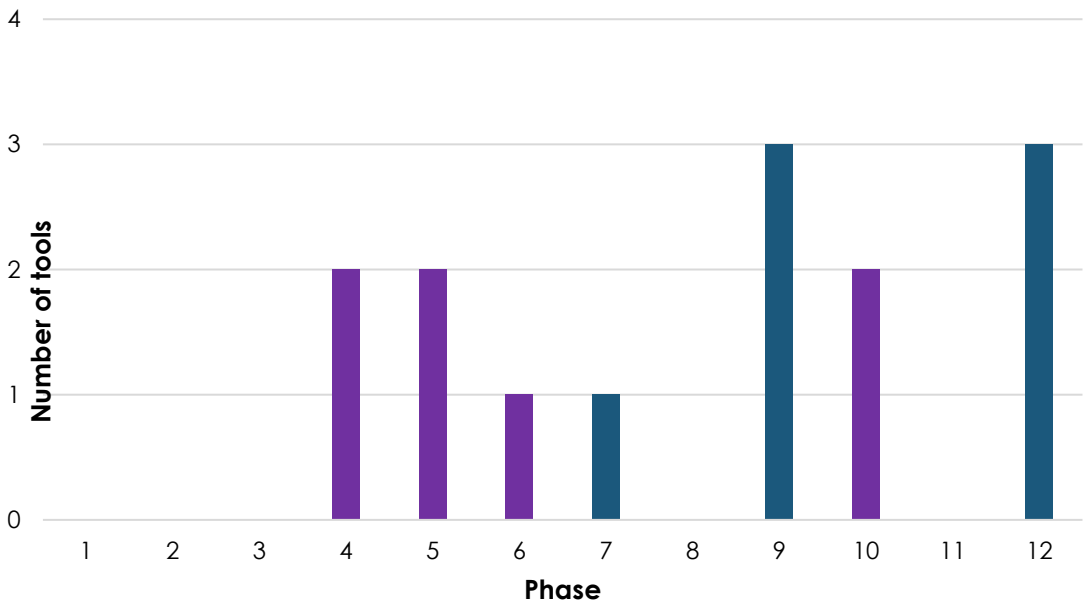


Figure 6-67: *Number of worked Mousterian tools by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

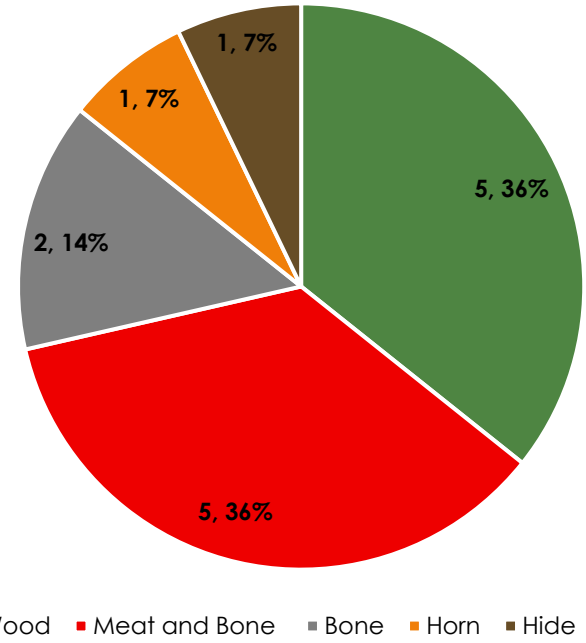


Figure 6-68: *Breakdown of Mousterian point use by worked material*



Figure 6-69*: Number of Mousterian points by chronological phase and by worked material*

Butchery tools were identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish, which is characteristic of working meat (see section 5.2 and 5.3, Figure 6-70). Wood working tools were identified because of the characteristics of the edge damage, mainly the presence of hinge and step fractures, in addition to limited edge rounding. Further, where polish occurred it was domed, which is characteristic of working wood (see section 5.8). Bone working tools were identified on the basis of significant edge damage (large step fractures) and the presence of pitted polish (see section 5.4). The tool interpreted as having worked hide had minimal edge scarring, significant edge rounding, and a grainy polish that could be differentiated from polish typical of working meat (section 5.6). The horn working tool had initially been interpreted as a wood working tool, but after washing in hydrochloric acid (HCl) a very greasy polish became apparent alongside the hinge scars typical of working medium material (section 5.11, Figure 6-71). This was the only interpretation that changed following acid cleaning (described in section 4.4.1). A summary of worked Mousterian points from Shanidar Cave is presented in Table 6-43.

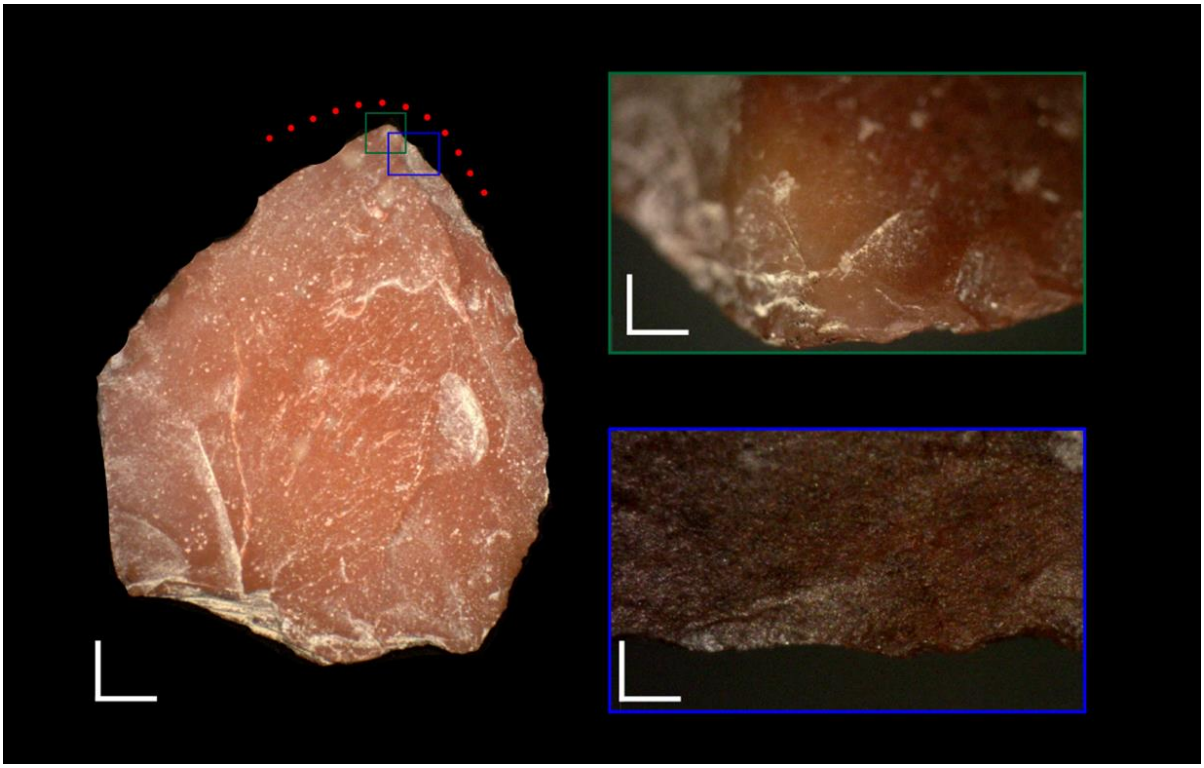


Figure 6-70: *Mousterian point from Phase 6 (context 1876, ID: 479). Macro scale 5 mm. Red dotted line shows location of worked edge. Green square (50x magnification, scale 0.5 mm) shows a crushed and rounded tip with manganese oxide. Blue square (230x magnification, scale 0.2mm) shows a bright greasy polish associated with the worked edge. The polish extends away from the edge. Interpretation: butchery tool, potentially hafted projectile or thrusting weapon (suggested by crushed tip)*

Table 6-43: Summary of worked Mousterian points

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
299	1653	**4**	Small continuous feather scars, edge rounding	Bright, greasy, grainy	Cutting	Soft-medium	Hide
855	2558	**4**	Limited small hinge scar formation	Limited, bright, greasy	Cutting	Medium	Meat and bone
132	1125	**5**	Small hinge scars, Limited small striations	Bright, greasy	Cutting	Medium	Meat and bone
317	1638	**5**	Striations in circular pattern around tip.	Dull, greasy	Drilling	Medium	**Horn***

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
			Hinge scars, rounding				
479	1876	**6**	Limited hinge scar formation	Greasy, bright	Cutting	Medium	Meat and bone
555	2263	**7**	Heavy, continuous hinge and step scarring.	Limited spread, isolated brighter domes	Cutting	Hard	Wood, hard
222	1507	**9**	Small hinge scars, Limited small striations	Very bright greasy	Cutting	Soft	Meat and bone
560	2278	**9**	Hinge and step Scars with limited rounding	Bright, pitted	Cutting	Hard	Bone
566	2283	**9**	Small hinge scars, Limited small striations	Very greasy, bright	Cutting	Medium	Meat and bone
421	1924	**10**	Striations running parallel to edge, continuous hinge and step scars some edge rounding.	Bright, widespread domed	Cutting	Medium	Wood, soft
585	2312	**10**	Limited striations parallel to tip, some small step scars, rounding.	Bright domed polish	Scraping	Medium	Wood, soft
602	2340	**12**	Larg hinge and step Scars with limited rounding	Bright greasy polish, pitted	Drilling	Hard	Bone
870	2518	**12**	Continuous scarring with smaller hinge and step terminations, slight rounding	Bright domed polish	Scraping	Medium	Wood, soft
878	2512	**12**	Striations at 90 degrees to edge, deep hinge and step scars	N/A	Scraping	Hard	Wood, hard

**Following cleaning protocols discussed in section 4.4.1, interpretation of lithic 317 was changed from a wood working tool to a horn working tool.*

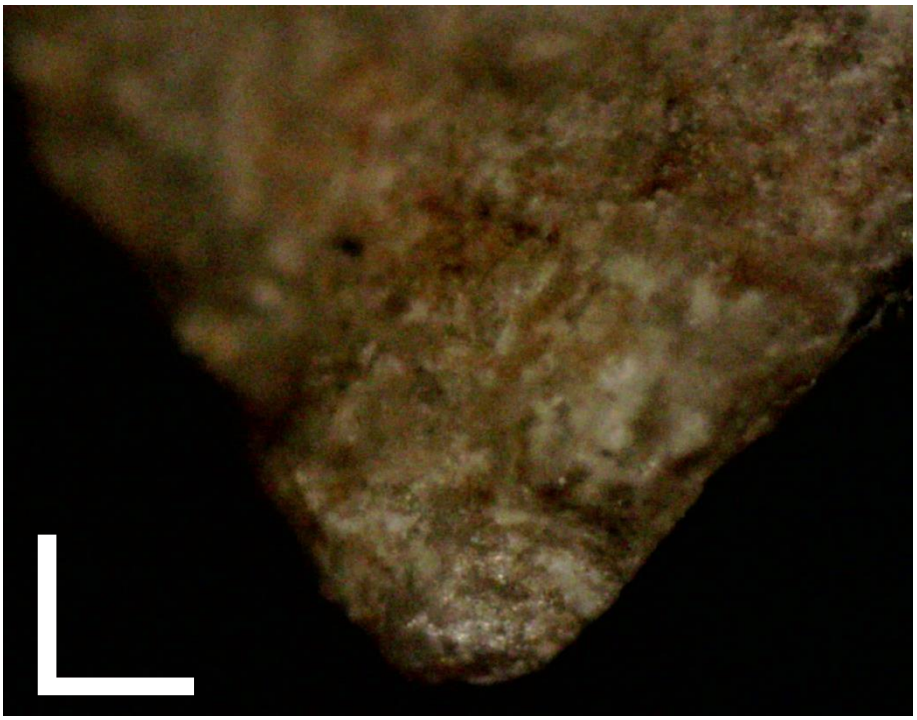


Figure 6-71: *Mousterian point 317 from Phase 5, interpreted as a horn working tool. Small hinge scars are seen around the tip which has become rounded through use suggesting the working of a material of medium hardness. Further, the dull, greasy polish is similar to that produced in the horn working experiments (section 5.10). Striations occurring horizontal to the worked tip and in a circular pattern suggest the tool was used in a drilling motion. 230x magnification, scale 0.2mm*

6.2.2 Worked Elongated Mousterian Points

Wear traces were found on eight elongated Mousterian points (67% of elongated Mousterian points, 7.5% of total worked assemblage). These were recovered from Phases 11, 9, 6, 5, and 4 (MIS 5a – MIS 3) (Figure 6-72). Three examples were interpreted as bone working tools, two as hide working tools, two as having worked meat and bone, and one as having worked wood (Figure 6-73 and 6-74).

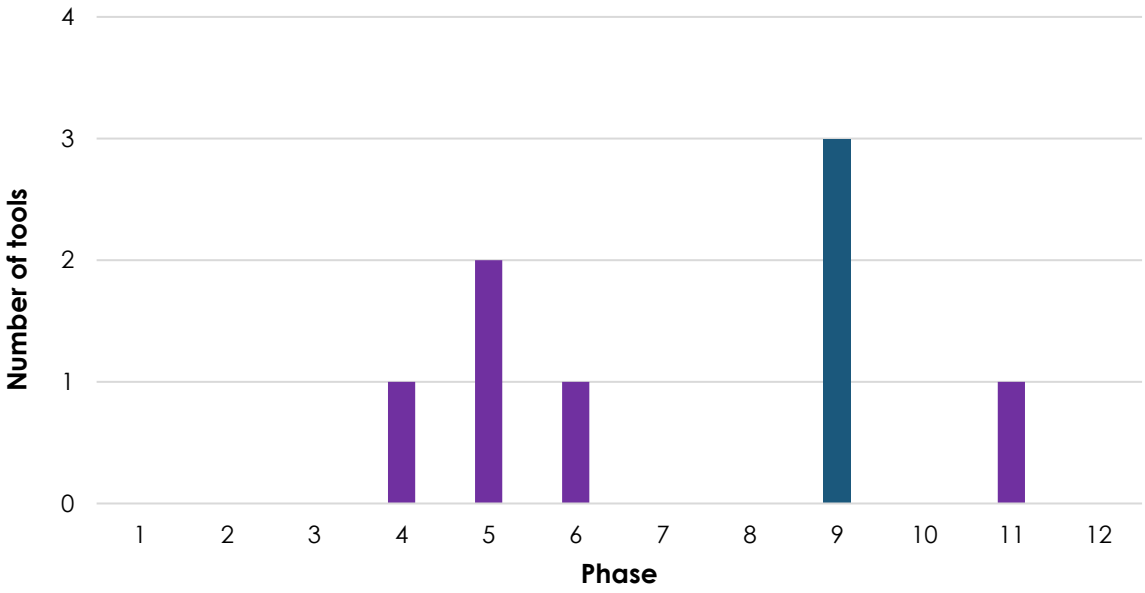


Figure 6-72: *Number of worked elongated Mousterian points by archaeological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

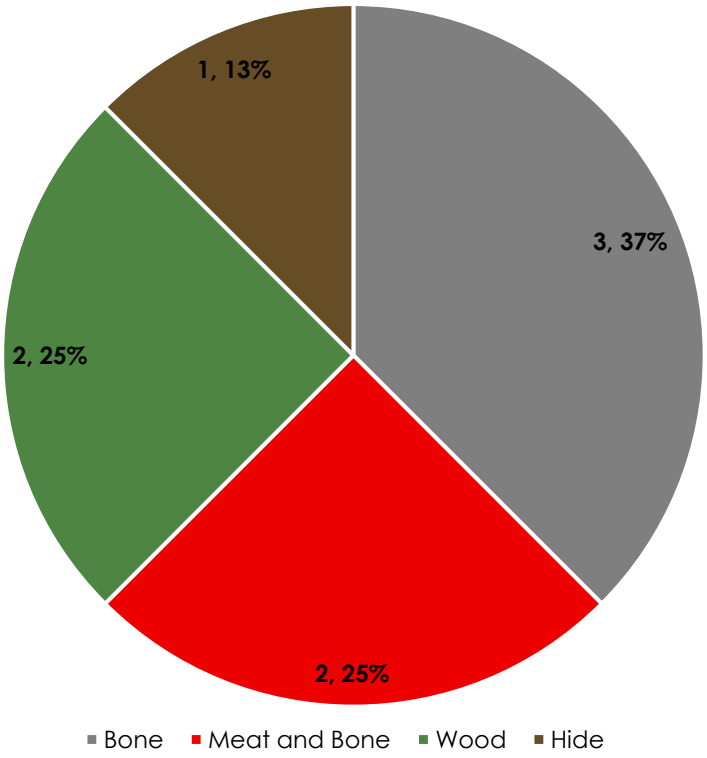


***Figure 6-73**: Breakdown of elongated Mousterian point use by worked material*

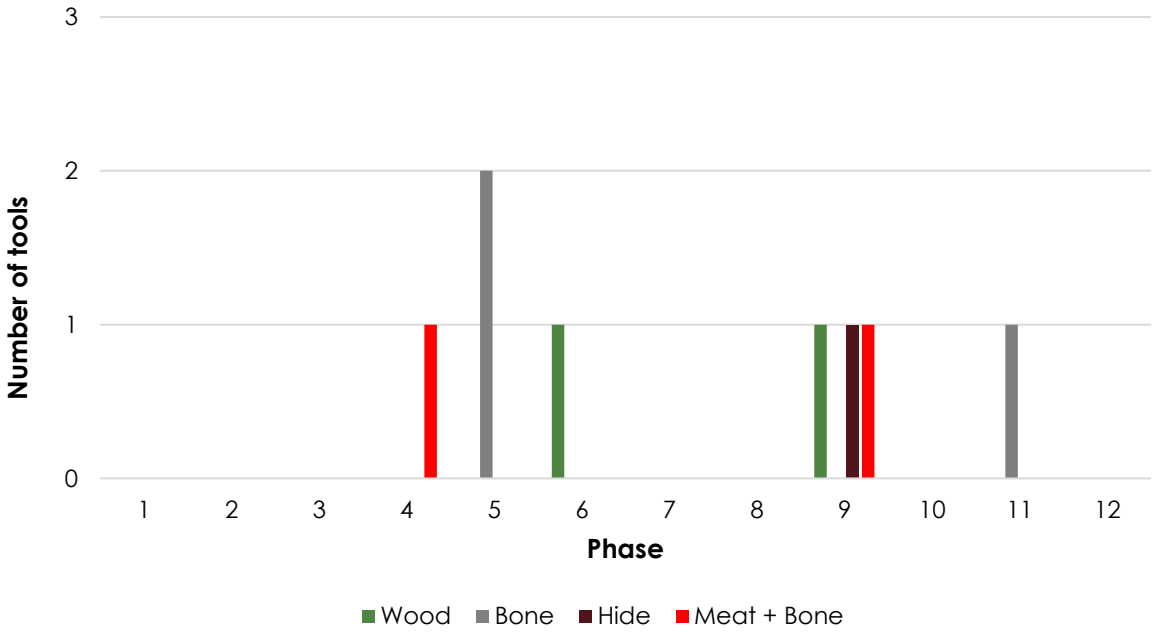


***Figure 6-74:** Number of elongated Mousterian points by chronological phase and worked material*

The three bone working tools were identified based on the presence of a dull, pitted polish and of significant edge damage (large step fractures) (see section 5.4, Figure 6-75). Butchery tools were identified based on the occurrence of the characteristic bright, greasy polish and the presence of feather and hinge scars (see section 5.2 and 5.3). Wood working tools were identified because of characteristic domed polish, as well as the presence of hinge and step fractures in addition to limited edge rounding (see section 5.8). The tool interpreted as having worked hide had significant edge rounding, minimal edge scarring and a greasy, grainy polish (section 5.6). A summary of worked elongated Mousterian points from Shanidar Cave is presented in Table 6-44.

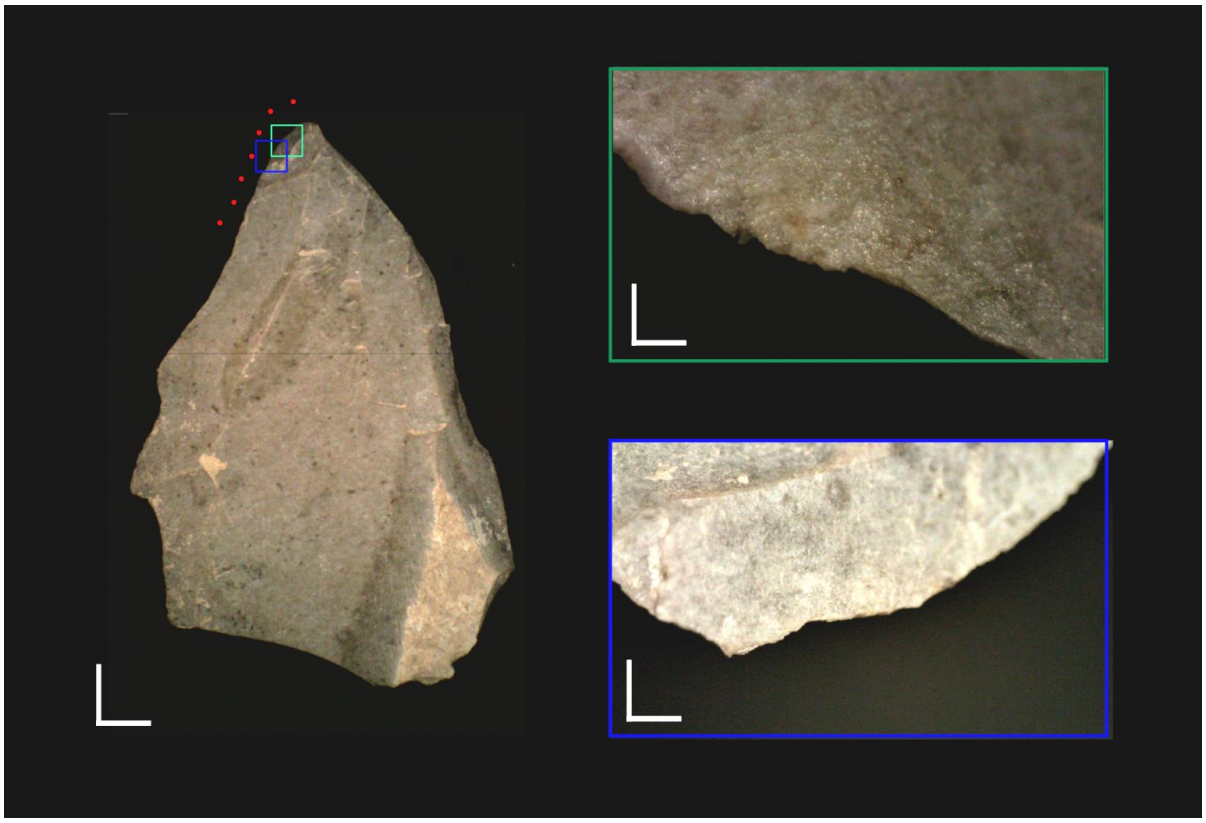


***Figure 6-75**: Worked elongated Mousterian point from Phase 5 (context 1410, ID: 167). Macro scale 5 mm. Red dotted line shows location of worked edge. Green square (230x magnification, scale 0.2mm) shows small, continuous rounded scars with a dull, pitted polish. Blue square (65x magnification, scale 0.5 mm) shows continuous scarring and striations obtuse to worked edge. Interpretation: bone working tool*

***Table 6-44:** Summary of worked elongated Mousterian points*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
165	1369	**5**	Large hinge and step scars with limited rounding, striations in a circular pattern around tip	Dull pitted polish	Drilling	Hard	Bone
167	1410	**5**	Large hinge and step scars with limited rounding	Dull pitted polish	Cutting	Hard	Bone

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
313	1156	**4**	Small continuous feather and hinge scars, some edge rounding	Bright, greasy	Cutting	Soft-Medium	Meat and bone
481	2043	**6**	Striations diagonal to edge, base rounded, hinge scars	Very bright domed polish	Cutting	Hard	Wood, hard
567	2283	**9**	Continuous scarring, step and hinge terminations,	Very bright domed polish	Cutting	Hard	Wood, hard
580	2303	**9**	Edge rounding along thin edge, very limited feather scarring.	Bright greasy, grainy	Scraping	Soft-medium	Hide, fresh
687	2284	**9**	Small continuous feather scars, larger isolated hinge scars, edge rounding.	Limited but bright and greasy	Cutting	Soft-Medium	Meat and bone
593	2326	**11**	Large hinge and step scars with limited rounding	N/A	Cutting	Hard	Bone, dry

6.2.3 Worked Side Scrapers

Wear traces were found on 19 of the 31 side scrapers (65% of side scrapers, 17.8% of total worked assemblage). These were recovered from across the entire sequence, Phases 12 to 1 (Figure 6-76). The majority were interpreted as hide working tools (n=11). A further six were used to work wood, and one each used to work meat and plant fibres (Figures 6-77 and 6-78).

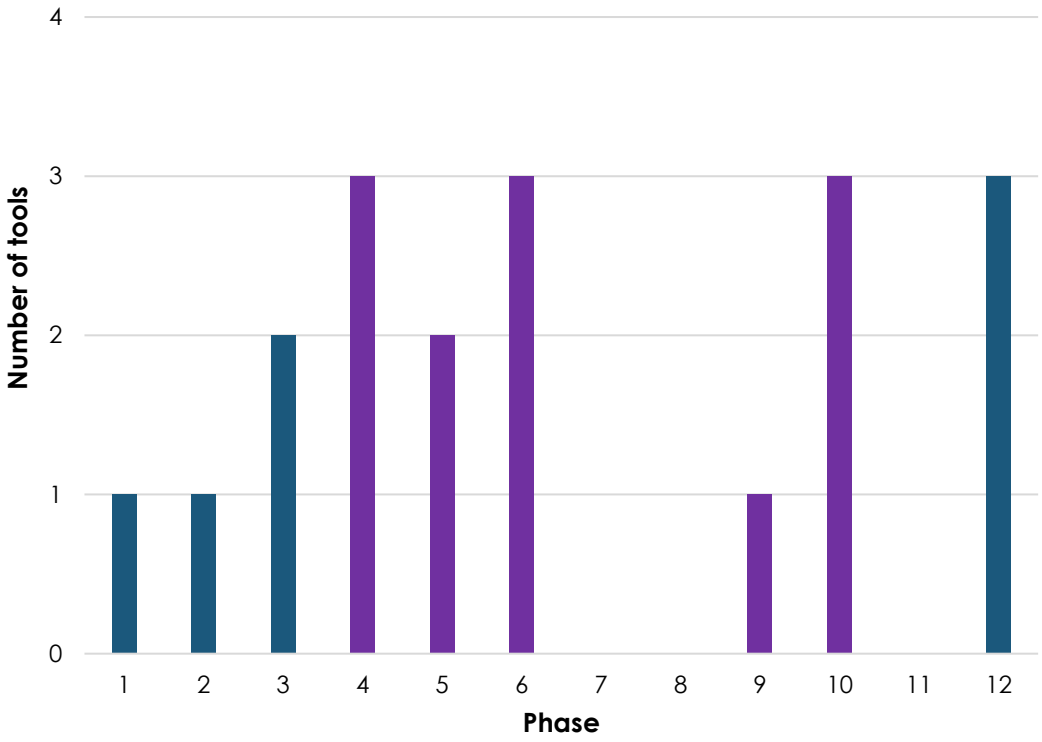


Figure 6-76: *Worked side scrapers by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

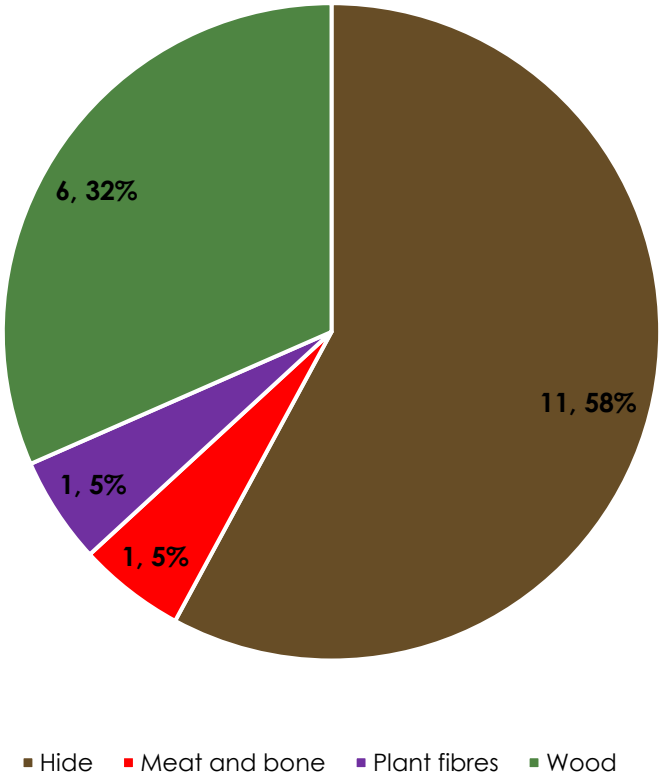


Figure 6-77: *Breakdown of side scraper use by worked material*

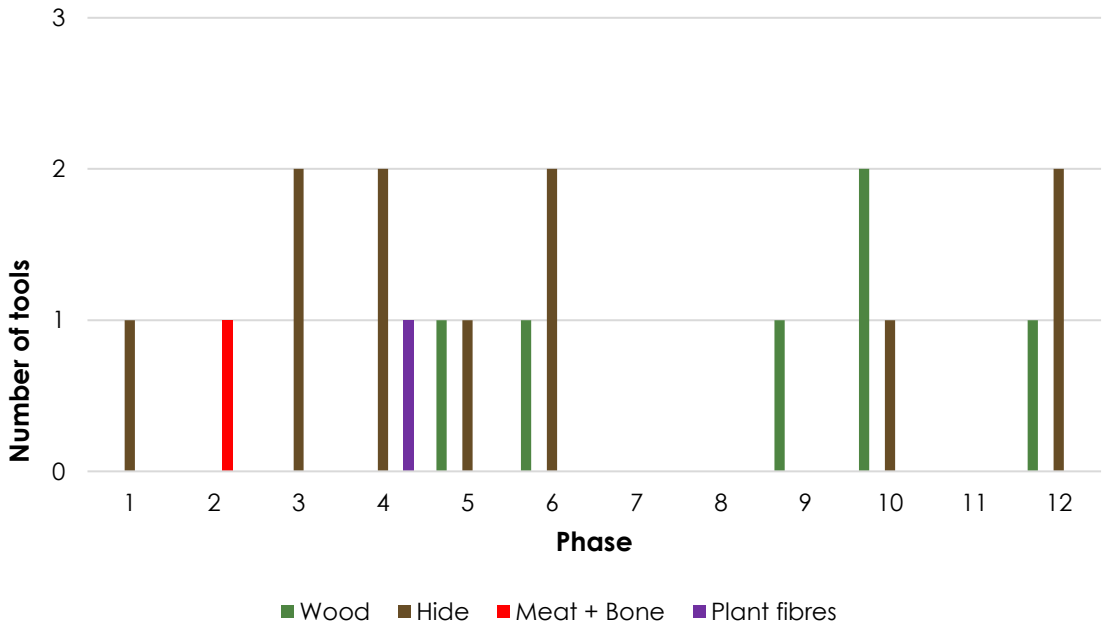


Figure 6-78: *Number of side scrapers by chronological phase and worked material*

The hide working tools had the characteristic polish associated with hide working (grainy and greasy), as well as minimal edge scarring and significant edge rounding (section 5.6, Figure 6-79). Wood working tools were identified because of the characteristics of the edge damage, mainly the presence of hinge and step fractures, in addition to limited edge rounding. Further, where polish occurred it was domed which is characteristic of working wood (see section 5.8). The butchery tool was identified based on the appearance of feather and hinge scars as well as the presence of a bright, greasy polish (see section 5.2 and 5.3). Finally, the tool which was identified as having worked plant fibres had a limited number of feather terminations, with a very bright and glossy polish, which was distinguishable from all other forms of polish (see section 5.9). A summary of worked side scrapers from Shanidar Cave is presented in Table 6-45.

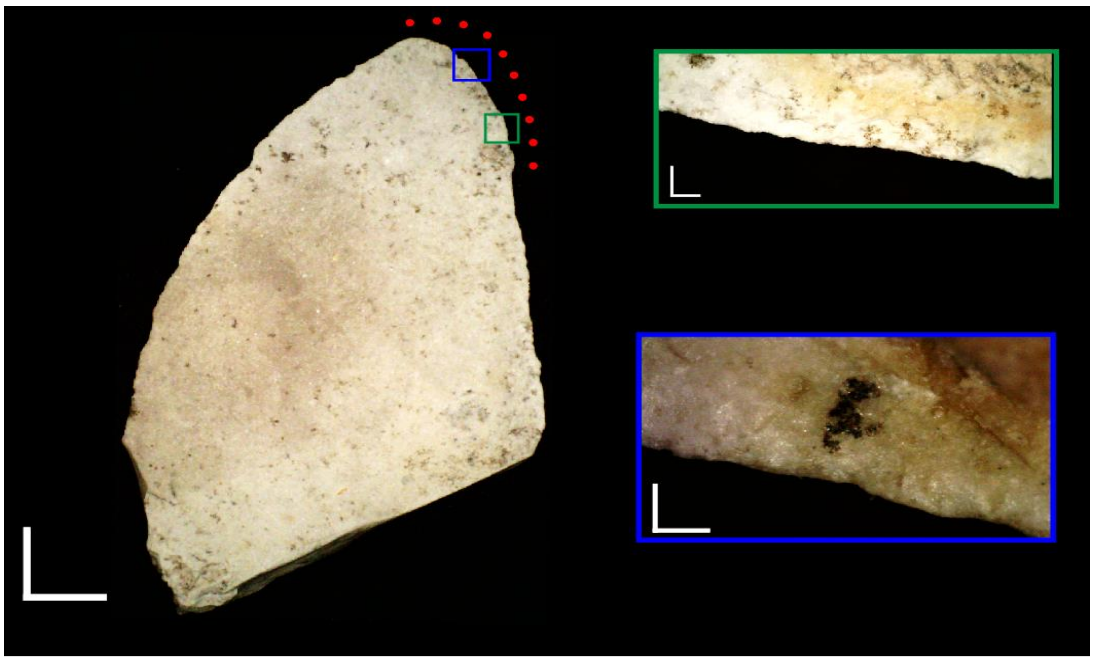


Figure 6-79: *Worked side scraper from Phase 3 (context 1037, ID: 106). Macro scale 5 m. Red dotted line shows location of worked edge. Green square (140x magnification, scale 0.5 mm) shows a heavily rounded edge and manganese. Blue square (230x magnification, scale 0.2mm) shows a heavily rounded edge with dull, pitted polish and manganese. Interpretation: dry hide working tool*

Table 6-45: *Summary of worked side scrapers*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
488	-	**1**	Rounding along all edges, occasional isolated feather scars	Bright greasy, grainy	Scraping	Soft-medium	Hide, fresh
28	512	**2**	Large semi-continuous hinge scars, rounding	Limited but bright and greasy	Cutting	Medium	Meat and bone
106	1037	**3**	Rounding, smaller isolated feather scars	Dull, matt, grainy	Scraping	Medium	Hide, dry
405	1862	**3**	Rounding, smaller isolated feather scars	Dull, matt, grainy	Scraping	Medium	Hide, dry
151	1433	**4**	Rounded edges, very limited scars, feather terminations	Bright greasy, grainy	Scraping	Soft-medium	Hide, fresh
218	1392	**4**	Rounded edges, semi-continuous hinge scars	Dull, matt, grainy	Scraping	Medium	Hide, dry
330	1609	**4**	Small feather scars,	Very thin, bright glossy	Scraping	Soft	Plant fibres
55	802	**5**	Large, deep hinge and step scars, rounding, striations at 90 degrees to edge	Bright, domed polish	Scraping	Hard	Wood, hard
480	2125	**5**	Rounding. smaller isolated feather scars	Bright greasy, grainy	Scraping	Soft-medium	Hide, fresh
407	1868	**6**	Significant edge rounding, isolated hinge scars	Bright, limited to edge, doming	Scraping	Soft-medium	Wood, soft
420	1852	**6**	Rounding, small continuous feather scars	Bright greasy, grainy	Scraping,	Soft-medium	Hide, fresh
470	1861	**6**	Rounded edges, small hinge scars	Dull, matt, grainy	Scraping	Medium	Hide, dry
573	2284	**9**	Rounding along all edges, isolated hinge scars	Very bright, domed	Scraping/ debarking	Soft-medium	Wood, soft

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
408	1933	**10**	Hinge and feather scars, significant edge rounding	Dull, matt, grainy	Scraping	Medium	Hide, dry
583	2307	**10**	Rounding along all edges, isolated hinge scars	Very bright, domed	Scraping	Soft-medium	Wood, soft
584	2312	**10**	Hinge scars with slightly rounded edges	Very bright, domed	Scraping	Soft-medium	Wood, soft
857	2560	**12**	Rounding, limited feather terminations	Bright greasy, grainy	Scraping,	Soft-medium	Hide, fresh
901	2560	**12**	Rounding, limited feather terminations	Bright greasy, grainy	Scraping,	Soft-medium	Hide, fresh
906	2560	**12**	Large, deep hinge and step scars, rounding, striations at 90 degrees to edge	Bright, domed polish	Scraping	Hard	Wood, hard

6.3.3.1 Single-Edge Side Scrapers

Four of the worked side scrapers recovered from Shanidar Cave were single-edge side scrapers. They were recovered from Phases 6 to 2. The working of wood, meat, hide and plant fibres is represented by one tool each. A summary is presented in Table 6-46 and Figure 6-80.

Table 6-46: *Summary of worked single-edge side scrapers*

Specimen ID	Context	Phase	Worked material
28	512	**2**	Meat and Bone
330	1609	**4**	Plant fibres

55	802	**5**	Wood
470	1861	**6**	Hide, dry

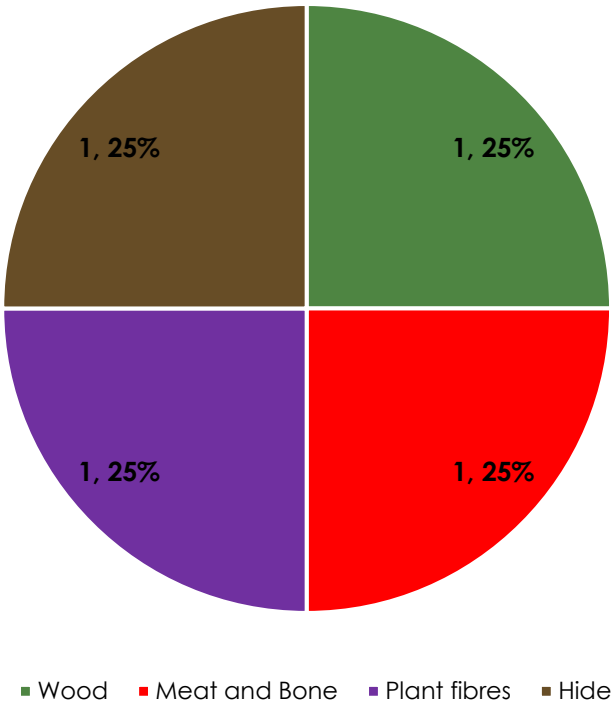


Figure 6-80: *Breakdown of single-edge side scrapers use by worked material*

6.3.3.2 Double-Edge Side Scrapers

Double-edge side scrapers account for 13 of the worked side scrapers from Shanidar Cave. They were recovered between Phases 12 and 1. These scrapers were identified as hide working (n=8) and wood working tools (n=5). A summary is presented in Table 6-47 and Figure 6-81.

Table 6-47: *Summary of worked double-edge side scrapers*

Specimen ID	Context	Phase	Worked material
488	-	**1**	Hide, fresh
106	1037	**3**	Hide, dry
405	1862	**3**	Hide, dry
151	1433	**4**	Hide, fresh
480	2125	**5**	Hide
407	1868	**6**	Wood, soft
420	1852	**6**	Hide, fresh
573	2284	**9**	Wood, soft
408	1933	**10**	Hide
583	2307	**10**	Wood
584	2312	**10**	Wood
857	2560	**12**	Hide, fresh
906	2560	**12**	Wood, soft

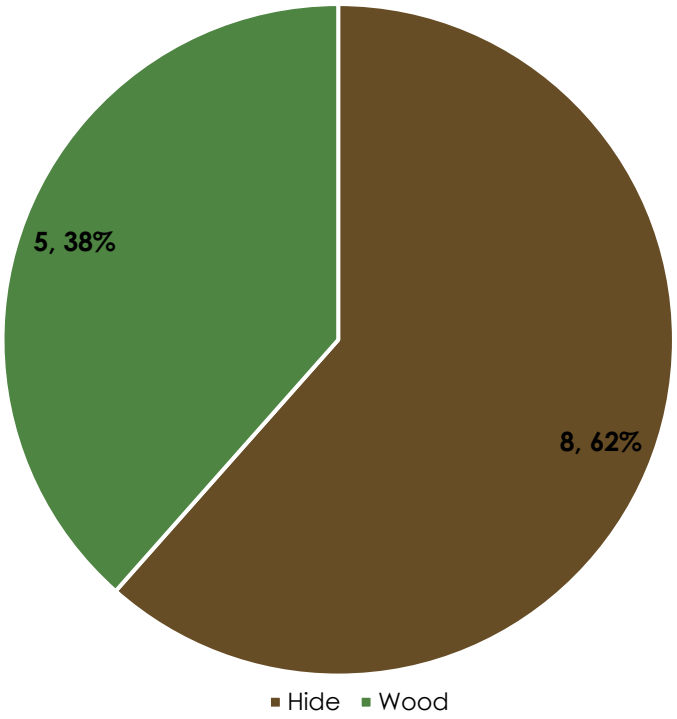


Figure 6-81: *Breakdown of double-edge side scrapers use by material*

6.3.3.3 Convergent Side Scrapers

Two of the worked side scrapers from Shanidar Cave were convergent side scrapers. These were recovered from Phase 12 and Phase 4. Both scrapers were used to work hide. A summary is presented in Table 6-48 and Figure 6-82.

Table 6-48: *Summary of worked convergent side scrapers*

Specimen ID	Context	Phase	Worked material
218	1392	**4**	Hide
901	2560	**12**	Hide

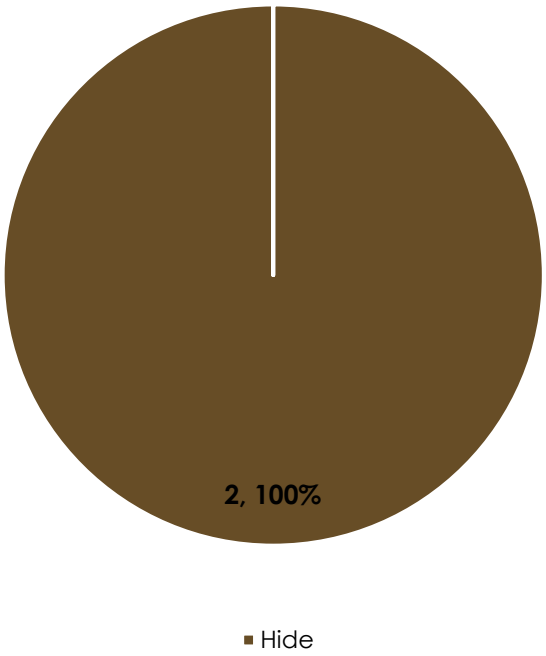


***Figure 6-82**: Breakdown of convergent side scrapers use by material*

6.2.4 Worked Unretouched Blades

Wear traces were found on two of the 16 unretouched blades (12.5% of unretouched blades, 1.9% of total worked assemblage) (Figure 6-83). The blade from Phase 3 (ID: 250) had a very bright, isolated polish and small, hinge scars. It was interpreted therefore as having worked meat and bone (see section 5.2). The blade from Phase 10 (ID: 406, Figure 6-86) was interpreted as a soft wood cutting tool due to continuous hinge scarring and bright, domed polish (see section 5.8) (Figures 6-84, 6-85 and 6-86). A summary of worked unretouched blades from Shanidar Cave is presented in Table 6-49.

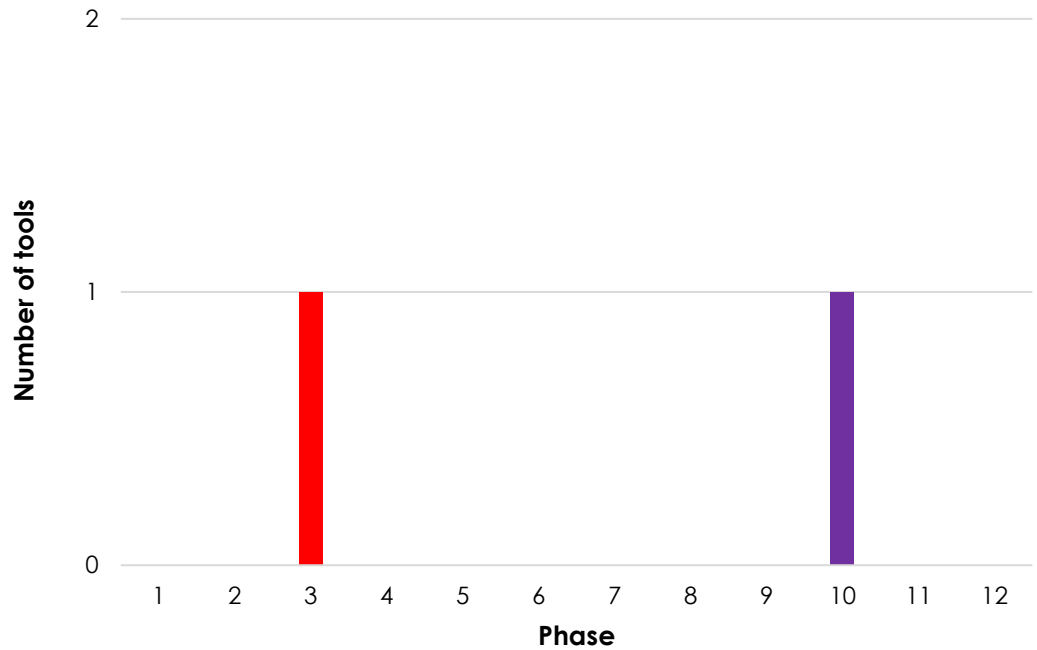


Figure 6-83: *Worked unretouched blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

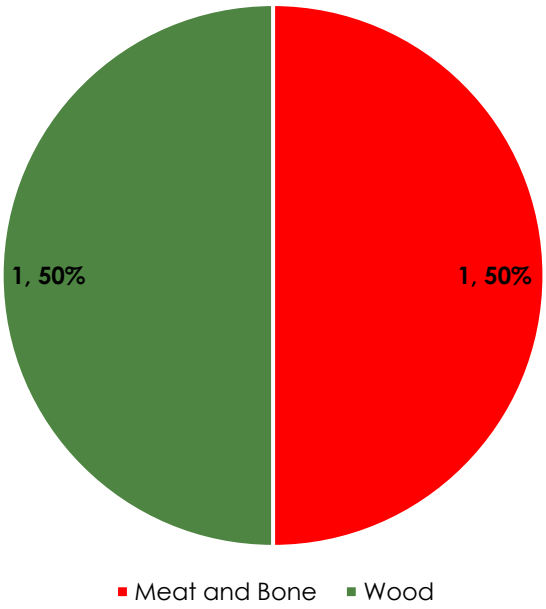


Figure 6-84: *Breakdown of unretouched blade use by worked material*



Figure 6-85: *Number of unretouched blades by chronological phase and worked material*

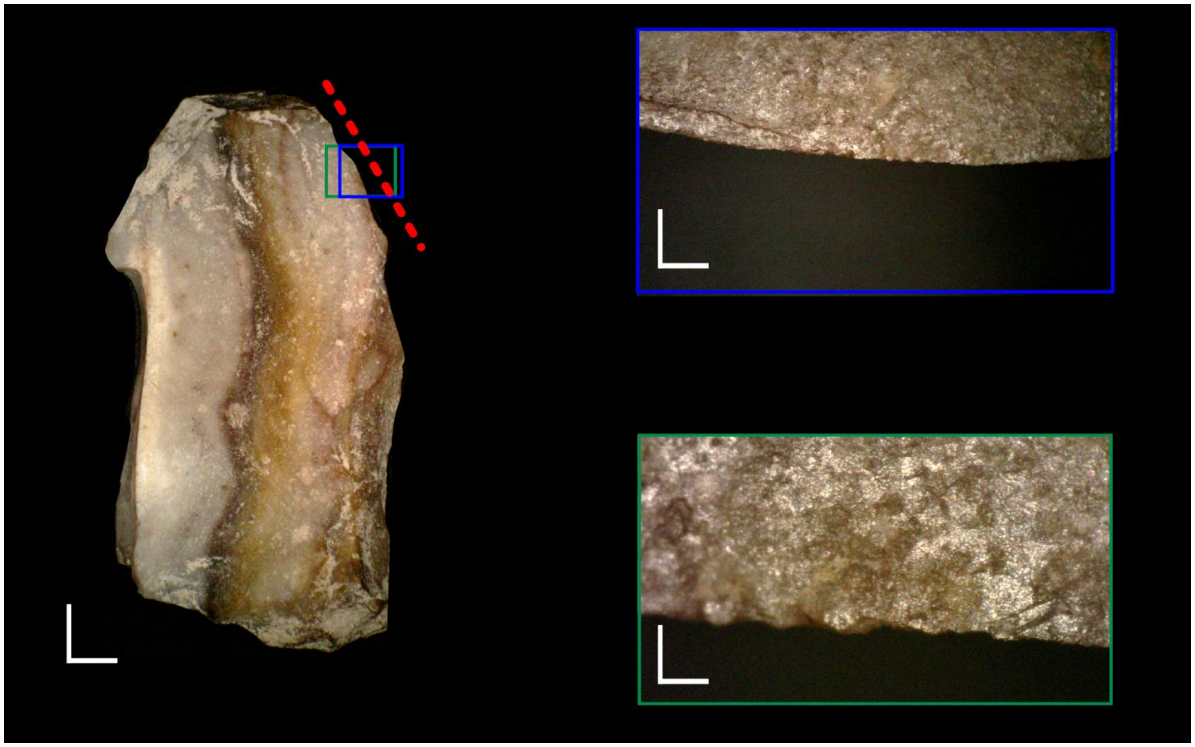


***Figure 6-86**: Worked unretouched blade from Phase 10 (context: 1924, ID: 406). Macro scale 5 mm. Red dashed line show's location of worked edge. Blue square (50x magnification, scale 1 mm) shows continuous scars with some degree of edge rounding. Green square (230x magnification, scale 0.2 mm) shows continuous scars associated with bright, domed polish. Interpretation: soft wood working tool*

***Table 6-49:** Summary of wear on unretouched blades*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
250	1406	**3**	Striations parallel to edge, small, hinge scars	Limited but bright and greasy	Cutting	Medium	Meat and bone
406	1924	**10**	Isolated feather and hinge terminations, some rounding	Very bright, domed	Cutting	Soft-medium	Wood, soft

6.2.5 Worked Retouched Blades

Wear traces were found on 12 retouched blades (44% of retouched blades, 11.2% of total worked assemblage). Worked retouched blades were recovered from Phases 10, 6, 5, 4, and 3 (Figure 6-87). Eight tools were interpreted as wood working tools, two as having worked meat and bone, one as having worked bone, and one as having worked hide (Figures 6-88 and 6-89).

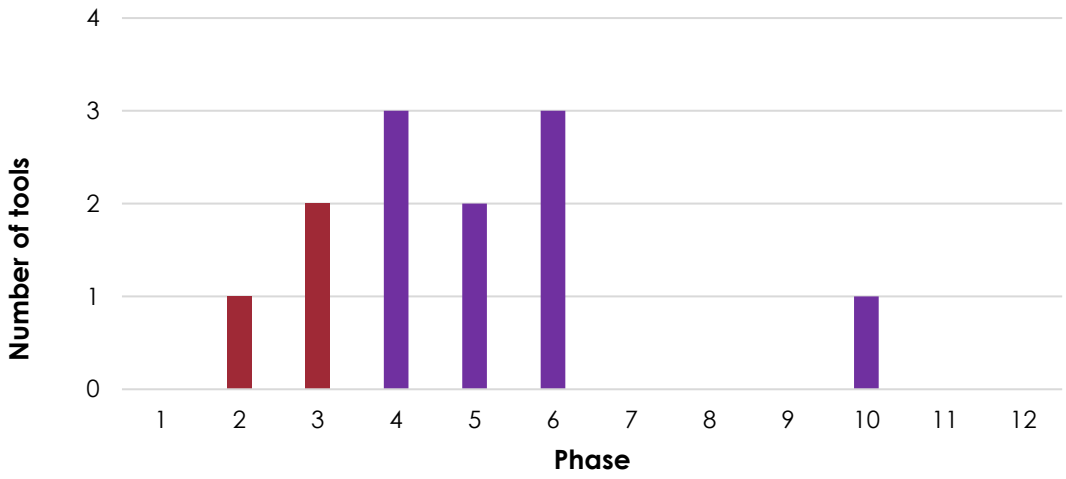


Figure 6-87: *Worked retouched blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

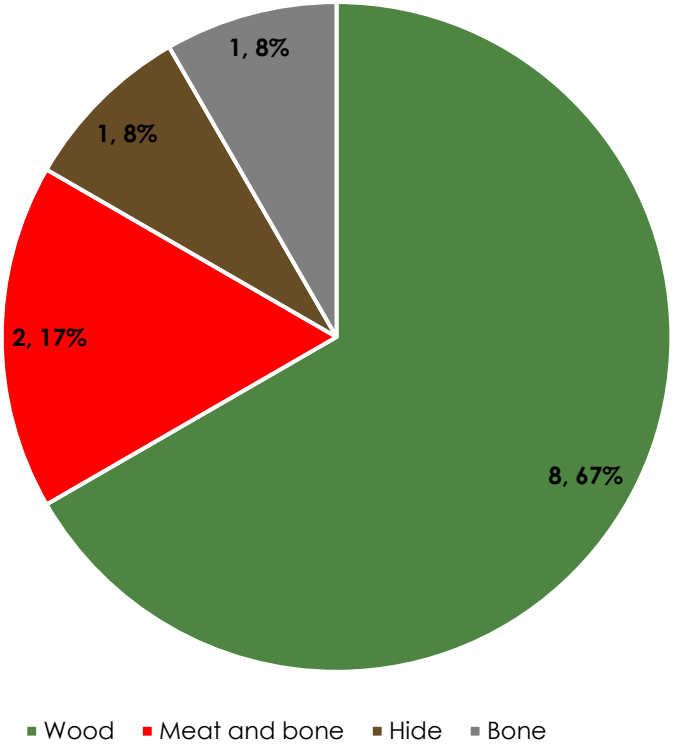


***Figure 6-88**: Breakdown of retouched blade use by worked material*

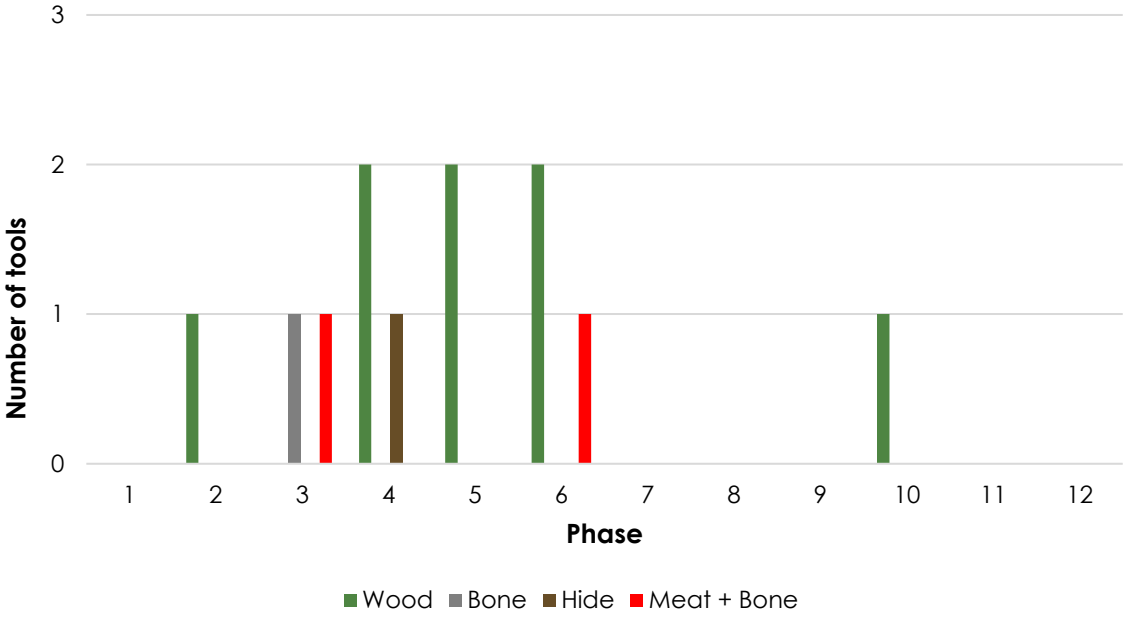


***Figure 6-89**: Number of retouched blades by chronological phase and worked material*

The tools used to work wood were identified because of the characteristics of the edge damage, mainly the presence of hinge and step fractures, in addition to limited edge rounding. Further, where polish occurred it was domed which is characteristic of working wood (see section 5.8). The two butchery tools were identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3). The single bone working tool was identified on the basis of significant edge damage (large step and hinge fractures) and the presence of a dull, pitted polish (see section 5.4). Finally, the hide working tool was identified due to presence of a bright, greasy, grainy polish and a heavily rounded worked edge (see section 5.6, Figure 6-90). A summary of the worked retouched blades from Shanidar Cave is presented in Table 6-50.

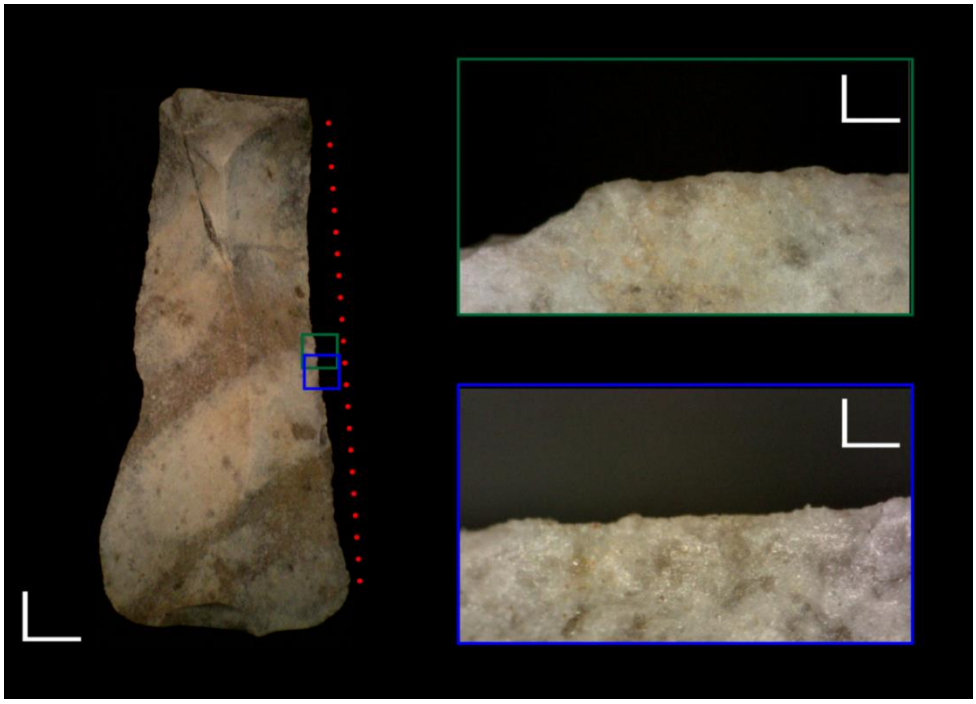


Figure 6-90: *Retouched blade from Phase 4 (context 1836, ID: 387). Macro scale 5 mm. Green square (230x magnification, scale 0.2 mm) shows significant edge rounding with limited greasy polish. Blue square (230x magnification, scale 0.2 mm) shows bright greasy and polish. Interpretation: hide working tool*

Table 6-50: *Summary of worked retouched blades*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
319	629	**2**	Rounded edges, feather and hinge terminations	Bright, domed	Scraping	Soft-medium	Wood, soft
62	748	**3**	Small continuous hinge scars	Bright and greasy	Cutting	Medium	Meat and bone
111	1107	**3**	Step and hinge Scarring, striations parallel to edge	Dull, Pitted	Cutting	Hard	Bone
149	1438	**4**	Hinge terminations, rounded edges, Faint striations parallel to worked edge	Bright, domed	Cutting	Soft-medium	Wood, soft
335	581	**4**	Small, continuous hinge terminations, rounded	Bright, thin, smooth, domed	Cutting	Soft-medium	Wood, soft

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
387	1836	**4**	Limited feather terminations, significant edge rounding	Bright greasy, grainy	Scraping	Soft-medium	Hide, fresh
52	545	**5**	Large step and hinge scars on worked edge, rounding	Limited, bright, domed	Cutting	Hard	Wood, hard
63	748	**5**	Limited hinge scar formation on dorsal face, significant edge rounding	Limited, bright, domed	Scraping	Soft-medium	Wood, soft
419	1816	**6**	Crushing, significant rounding, Limited hinge and step fractures on dorsal face	N/A	Scraping	Hard	Wood, hard
467	1845	**6**	Hinge scars, rounding	Bright, greasy	Cutting	Soft-medium	Meat and bone
482	2041	**6**	Limited hinge scar formation on dorsal face, significant edge rounding	Limited, bright, domed	Scraping	Soft-medium	Wood, soft
588	2314	**10**	Hinge and step terminations, some edge rounding	Limited, bright, domed,	Cutting	Hard	Wood, hard

6.2.6 Worked Unretouched Bladelets

Wear traces were only found on one of the four unretouched bladelets (25% of unretouched bladelets, 0.9% of total worked assemblage). Lithic 410 was recovered from Phase 6 (MIS 3) (Figure 6-91). The tool was identified as a butchery tool based on the limited number of feather scars and the presence of the very bright, greasy polish which is characteristic of working meat (see section 5.2, Figures 6-92- 6-94). A summary of the worked unretouched bladelet from Shanidar Cave is presented in Table 6-51.

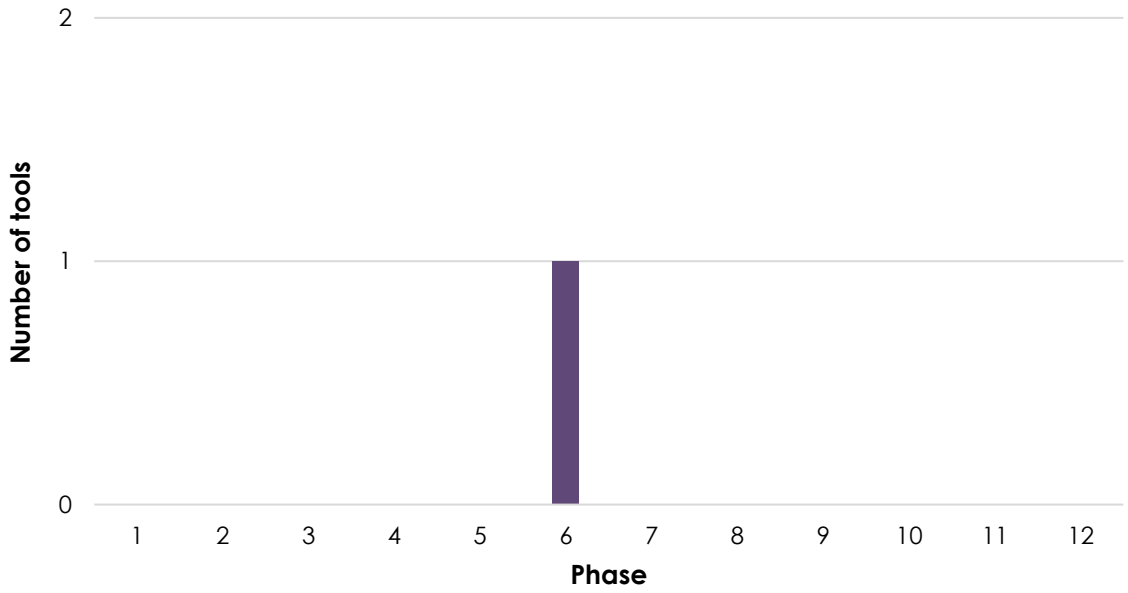


Figure 6-91: *Worked unretouched bladelets by chronological phase. The tool is associated with a Neanderthal phase*

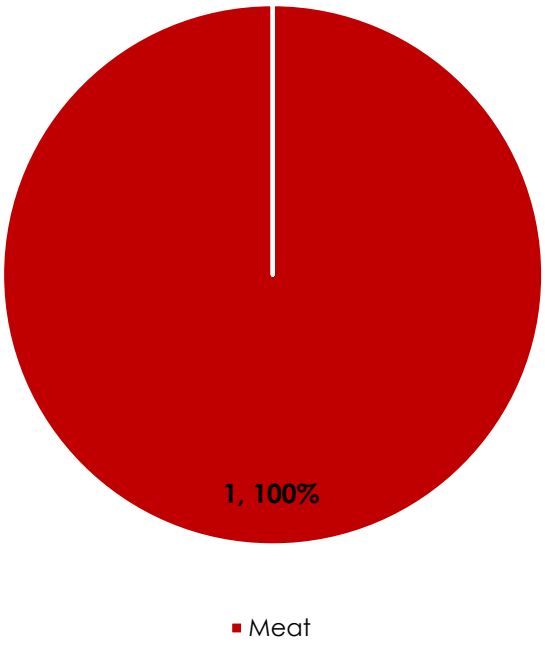


Figure 6-92: *Breakdown of unretouched bladelets use by worked material*

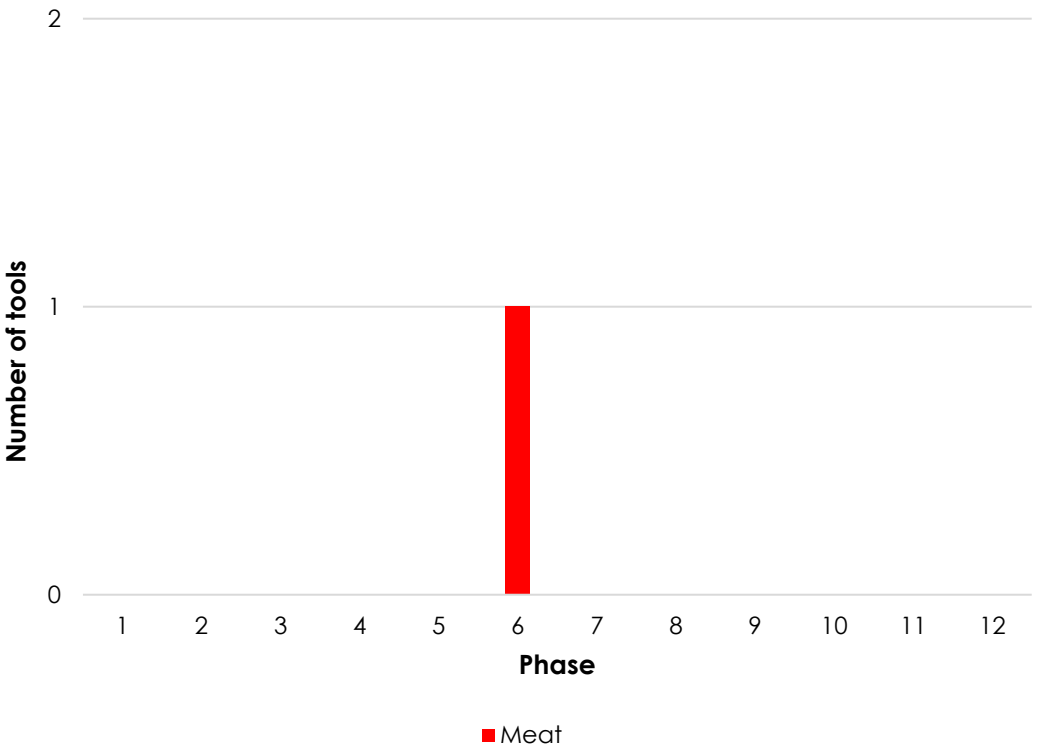


Figure 6-93*: Unretouched bladelets by chronological phase and worked material*

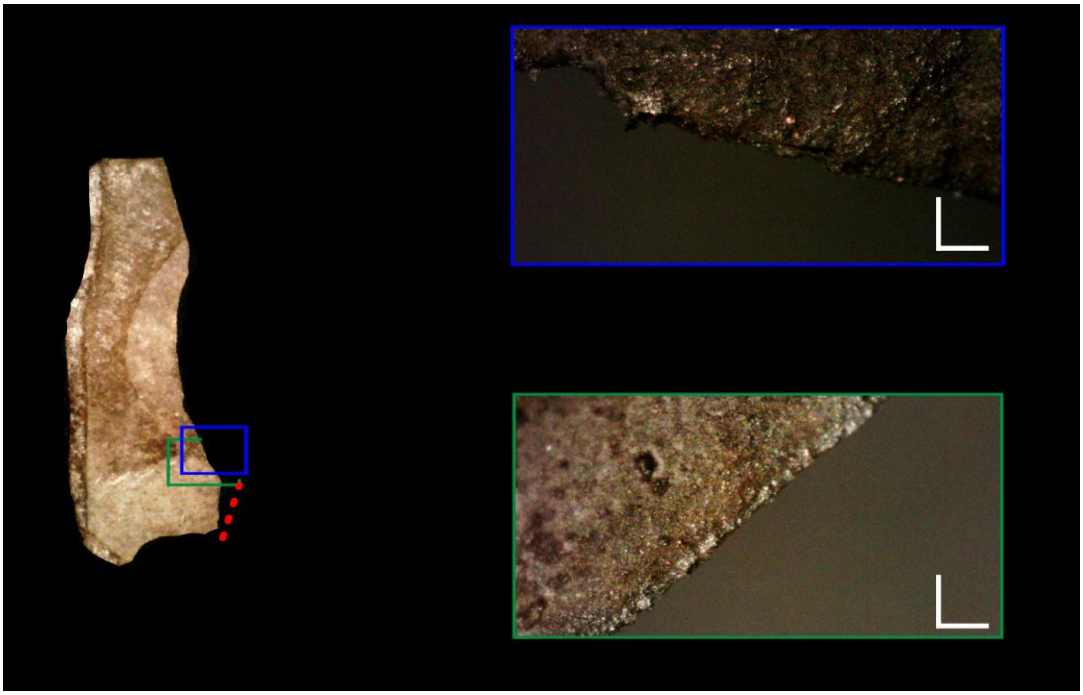


Figure 6-94: *Worked unretouched bladelet from Phase 6 (context: 1823, ID: 410). Macro scale 2 mm. Red dashed line shows location of worked edge. Blue square (230x magnification, scale 0.2 mm) shows minimal edge alteration with some bright, greasy isolated spots of polish. Green square (230x magnification, scale 0.2 mm) shows bright, greasy polish alongside multiple microscars. Interpretation: butchery tool*

Table 6-51: *Summary of worked unretouched bladelets*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
410	1823	**6**	Small feather work scars	Very bright, greasy	Cutting	Soft	Meat

6.2.7 Worked Retouched Bladelets

Wear traces were found on 11 of the 52 retouched bladelets (21.2% of retouched bladelets, 10.3% of total worked assemblage). They were recovered between Phases 5 – 3 (MIS 3) (Figure 6- 95). Four tools were associated with meat and bone, three with wood working, two with hide working, and one each with bone working and plant working (Figures 6-96 and 6-97).

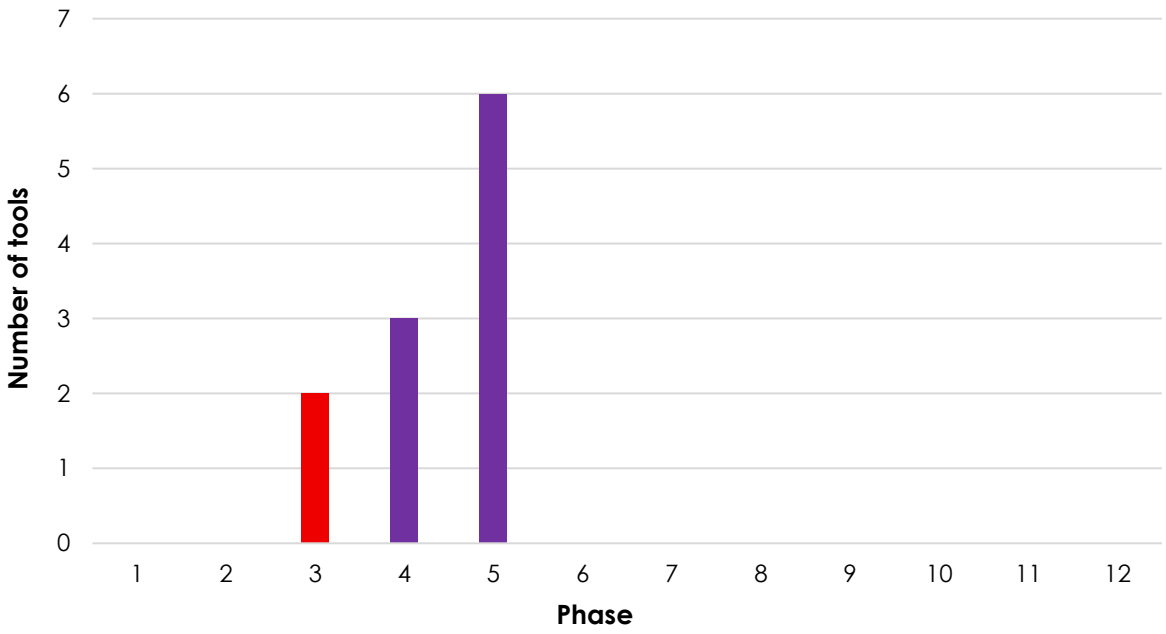


***Figure 6-95**: Worked retouched bladelets by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

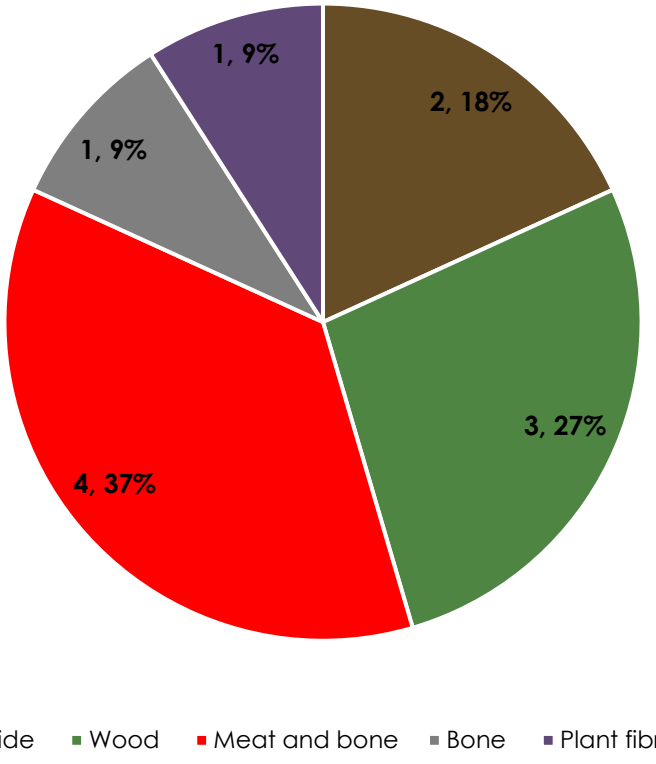


Figure 6-96: *Breakdown of retouched bladelets use by worked material*

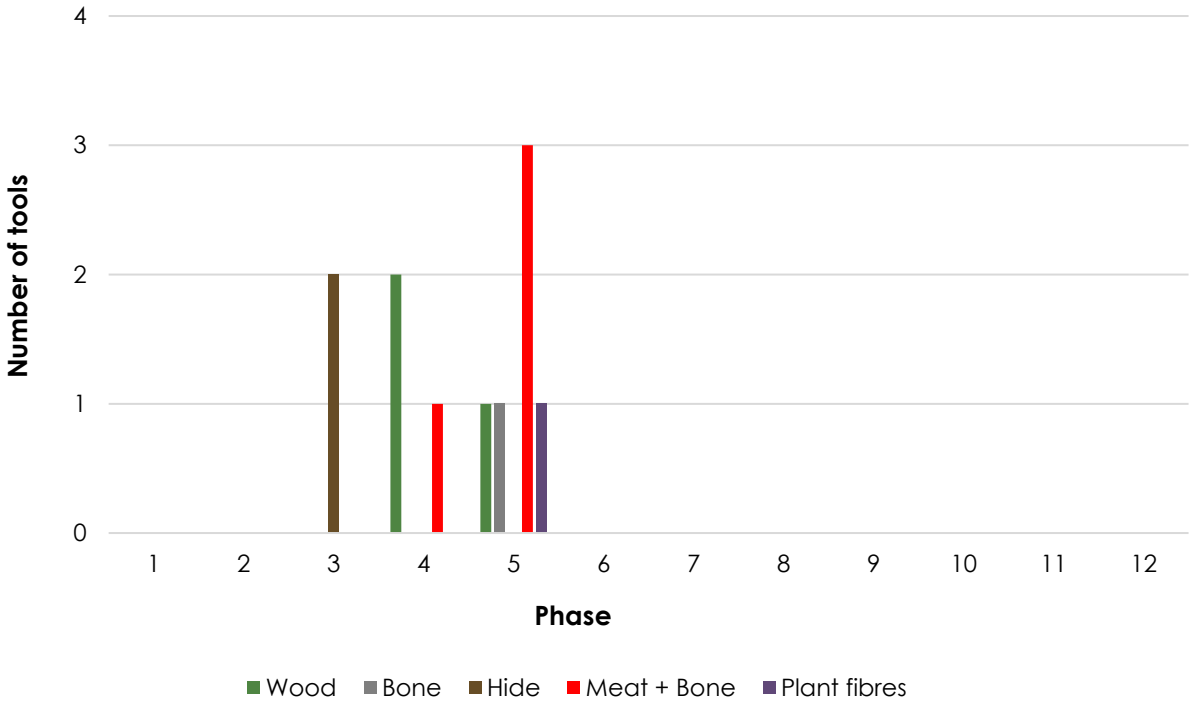


Figure 6-97: *Number of retouched bladelets by worked material and archaeological phase*

The four butchery tools were identified based on the appearance of small feather and hinge terminations and the presence of a bright and greasy polish (see section 5.2). Wood working tools were identified because of the characteristics of the edge damage, mainly the presence of hinge scars, in addition to limited edge rounding. Further, where polish occurred it was domed which is characteristic of working wood (see section 5.8). The hide working tools had a grainy polish which could be differentiated from the polish typical of working meat. In addition, these tools were heavily rounded (see section 5.6). The single bone working tool was identified based on the presence of large step scars, as well as a dull, pitted polish (see section 5.4). Finally, the tool which was identified as having worked plant fibres had a limited number of feather terminations, with a very bright and glossy polish, which was distinguishable from all other forms of polish (see section 5.9, Figure 6-98). A summary of worked retouched bladelets from Shanidar Cave is presented in Table 6-52.

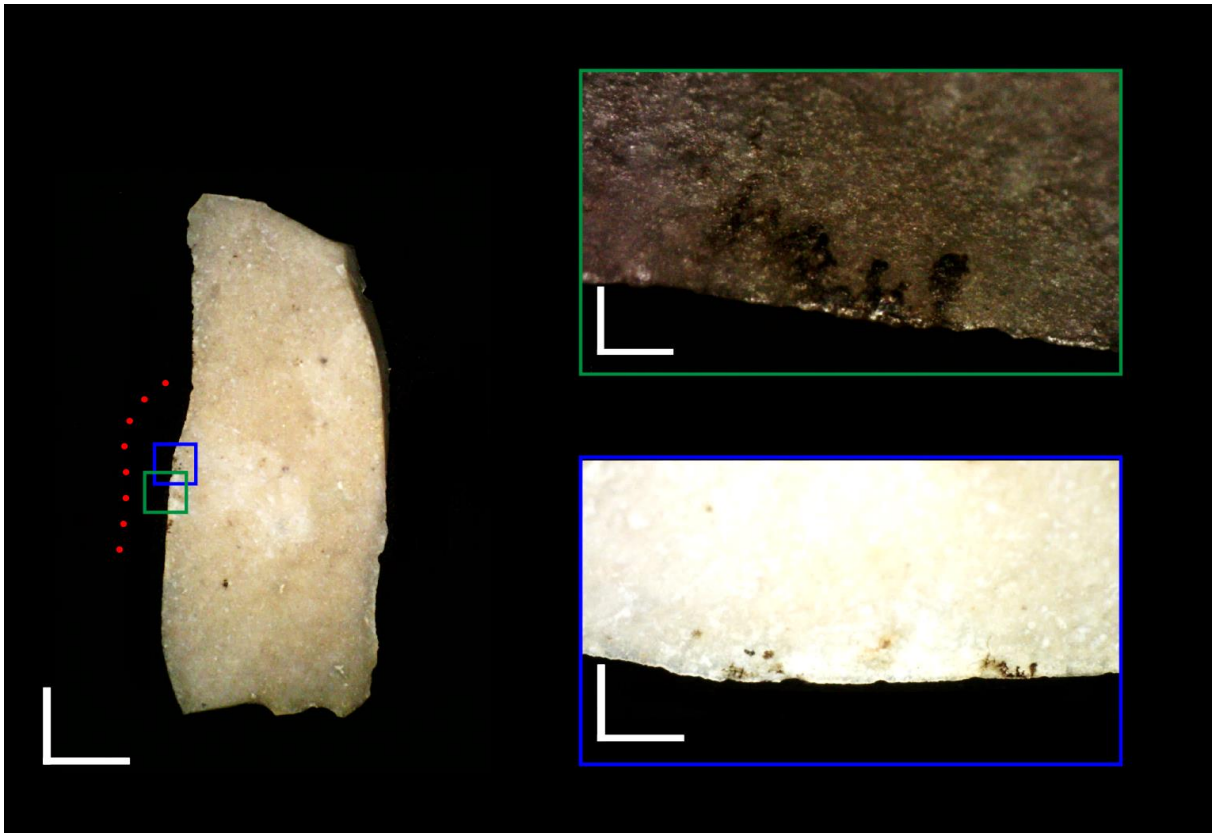


Figure 6-98: *Retouched bladelet from Phase 5 (context 1118, ID: 115), Macro scale 5 mm. Red dotted line shows location of worked edge. Green square magnification 230x, scale 0.2 mm) shows small continuous scarring, associated with bright glossy polish and manganese. Blue square (magnification 55x, scale 1.0 mm) shows manganese associated with worked edge, indicated by small feather scars. Interpretation: plant working tool*

Table 6-52*: Summary of worked retouched bladelets*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
108	1049	**3**	Snap fracture along tip, later rounded, small feather terminations	Bright greasy, grainy	Awling	Medum	Hide, dry
375	1858	**3**	Small hinge scars along tip, edge rounding	Dull, greasy, grainy	Awling	Medum	Hide, dry
148	537	**4**	Limited hinge scar formation on dorsal face	Bright, domed	Cutting	Soft-Medium	Wood, soft

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
873	2530	**4**	Continuous small hinge scars, rounding	Bright, greasy	Cutting	Soft-Medium	Meat and bone
908	2530	**4**	Snap across tip. Small, shallow hinge scars along both working edges. Slight rounding	Bright, domed	Cutting	Soft-Medium	Wood, soft
39	750	**5**	Rounding, small continuous hinge scars	Very bright, domed	Cutting	Soft-Medium	Wood, soft
46	708	**5**	Larger step scars along worked edge, some rounding	Dull, Pitted	Cutting	Hard	Bone, dry
64	748	**5**	Small feather and hinge scars, rounding	Bright, greasy	Cutting	Soft-Medium	Meat and bone
115	1118	**5**	Small, limited feather scars	Very bright, very glossy	Cutting	Soft	Plant fibres
116	1213	**5**	Small feather and hinge scars	Limited, bright, greasy	Cutting	Soft-Medium	Meat and bone
298	632	**5**	Small feather and hinge scars, some striations	Limited, bright, greasy	Cutting	Soft-Medium	Meat and bone

6.2.8 Worked Unretouched Points

Wear traces were found on three of the five unretouched points (60% of unretouched points, 2.8% of total worked assemblage). These tools were recovered from Phases 4 and 3(Figure 6-99). The two tools from phase 4 were interpreted as hide working tools and the tool from phase 3 as a bone working tool (Figures 6-100 and 6-101).

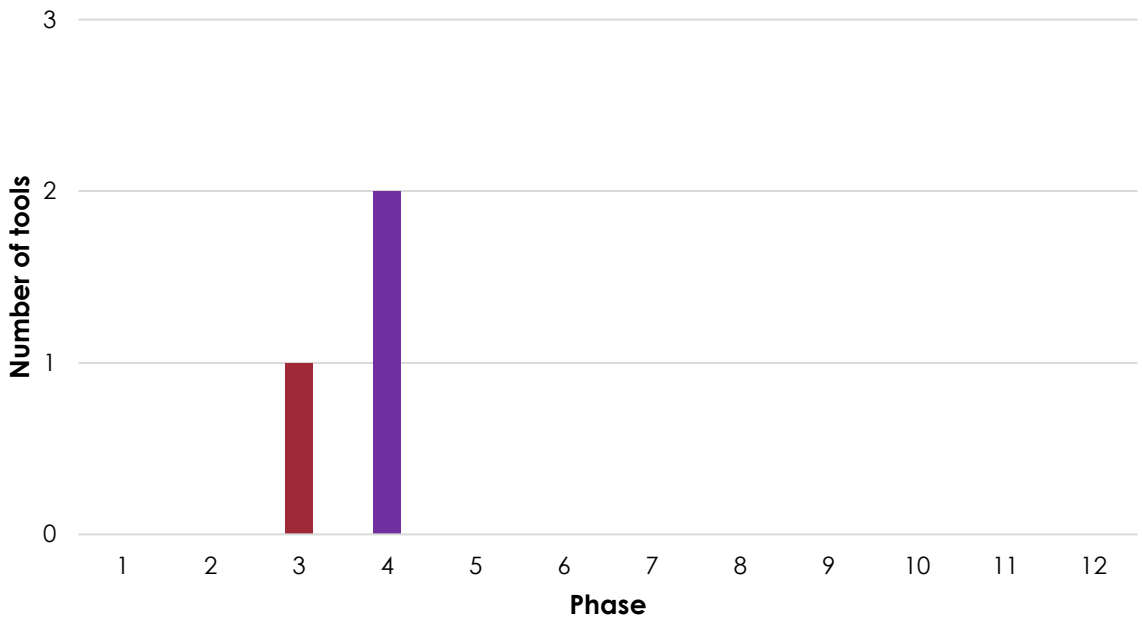


***Figure 6-99**: Worked unretouched points by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

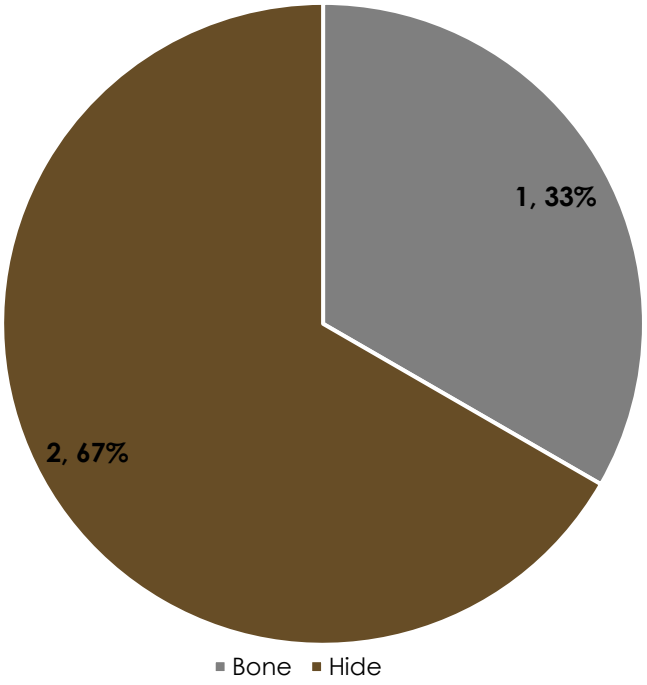


Figure 6-100: *Breakdown of unretouched point use by worked material*

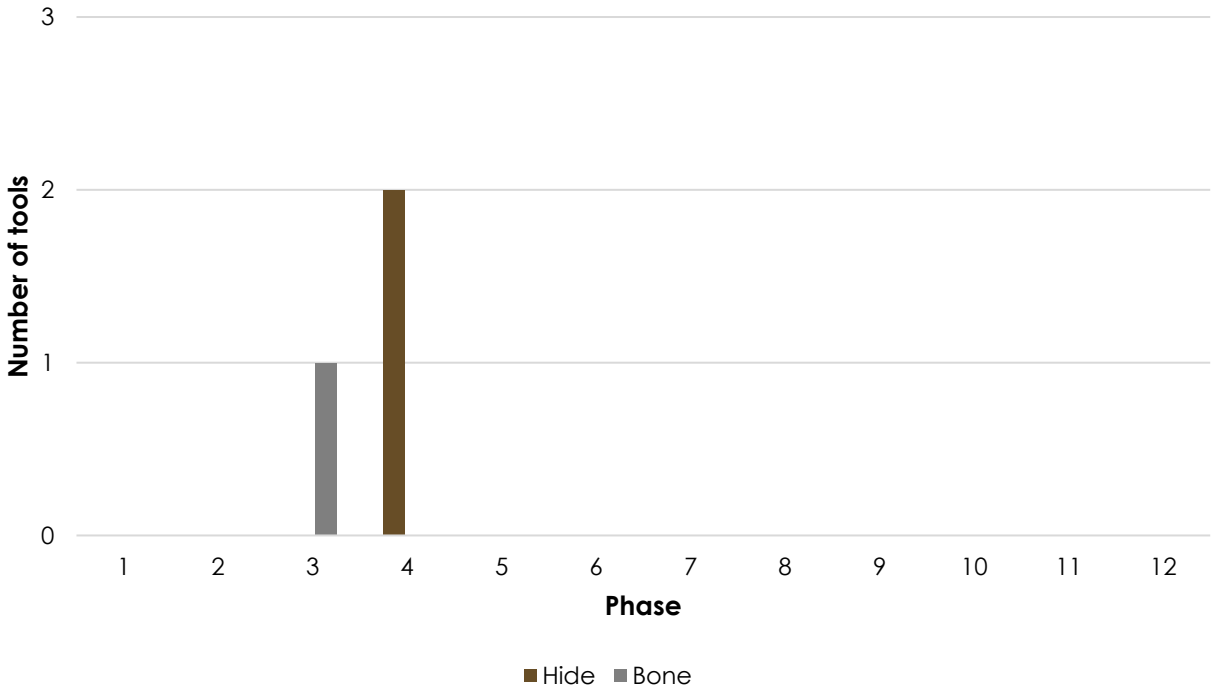


Figure 6-101: *Number of unretouched points by worked material and archaeological phase*

The hide working tools were identified due to the minimal edge scarring, edge rounding, as well as the presence of a grainy, greasy polish (section 5.6, Figure 6-102). The tool identified as a bone working tool had large step and snap terminations. The limited amount of polish on the tool was dull and pitted (see section 5.4). A summary of worked unretouched points from Shanidar Cave is presented in Table 6-53.

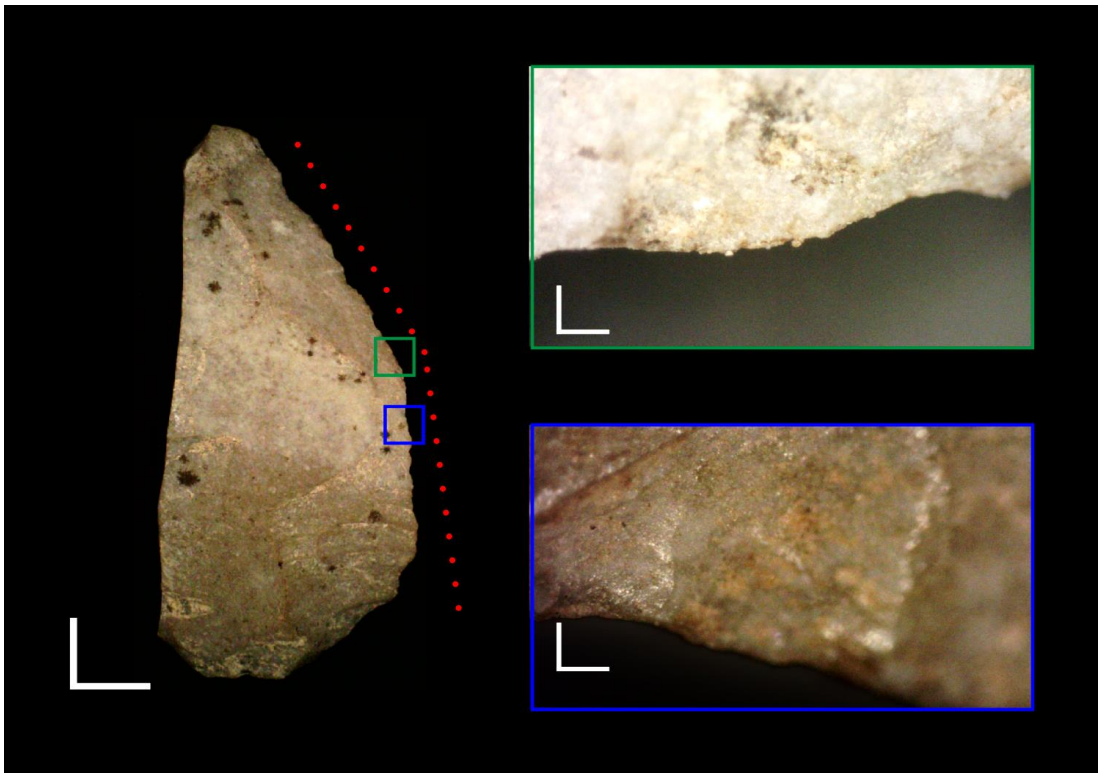


Figure 6-102: *Worked unretouched point from Phase 4 (context 1433, ID: 170). Macro scale 5 mm. Red dotted line shows location of worked edge. Green square (100x magnification, scale 0.5 mm) shows a significantly rounded edge. Blue square (230x magnification, scale 0.2mm) shows a rounded edge associated with a bright, greasy polish. Interpretation: fresh hide working tool*

***Table 6-53**: Summary of unretouched worked points*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
141i	568	**3**	Snapped and worn tip, large step fractures, Striations horizontal to tip.	Limited, dull, pitted	Drilling	Hard	Bone, dry
163	1400	**4**	Snap fracture on tip, limited feather scars, significant rounding	Bright, greasy, grainy	Awling	Soft-medium	Hide, fresh
170	1433	**4**	Small continuous feather scars, edge rounding.	Bright greasy, grainy	Cutting	Soft-medium	Hide, fresh

6.2.9 Worked Retouched Points

Wear traces were found on three of the eight retouched points (37.5% of retouched points, 2.8% of total worked assemblage) (Figure 6-103). The tools were recovered from Phases 4 and 3. Wood, hide and meat were each identified on one tool (Figures 6-104 and 6-105).

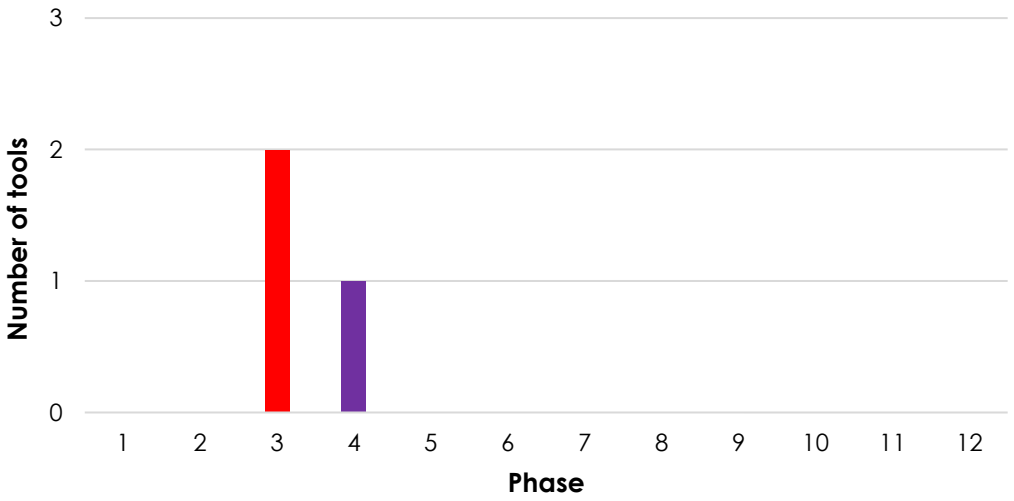


Figure 6-103: *Worked retouched points by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

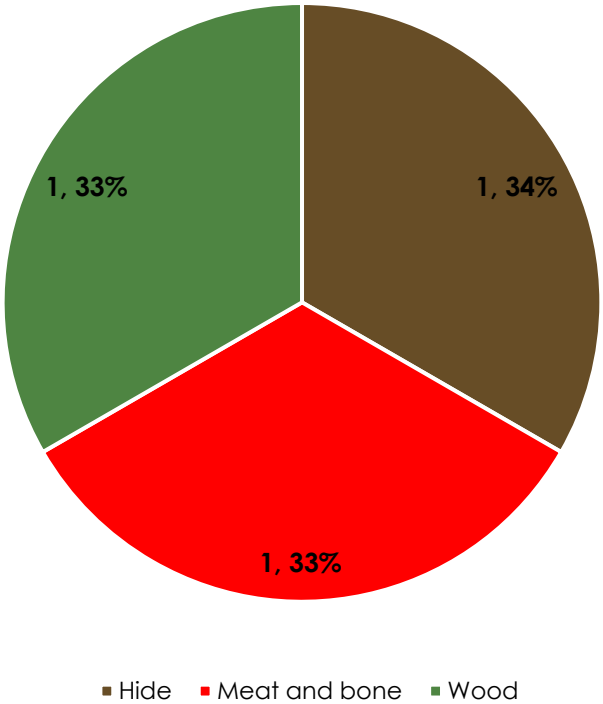


Figure 6-104: *Breakdown of retouched point use by worked material*

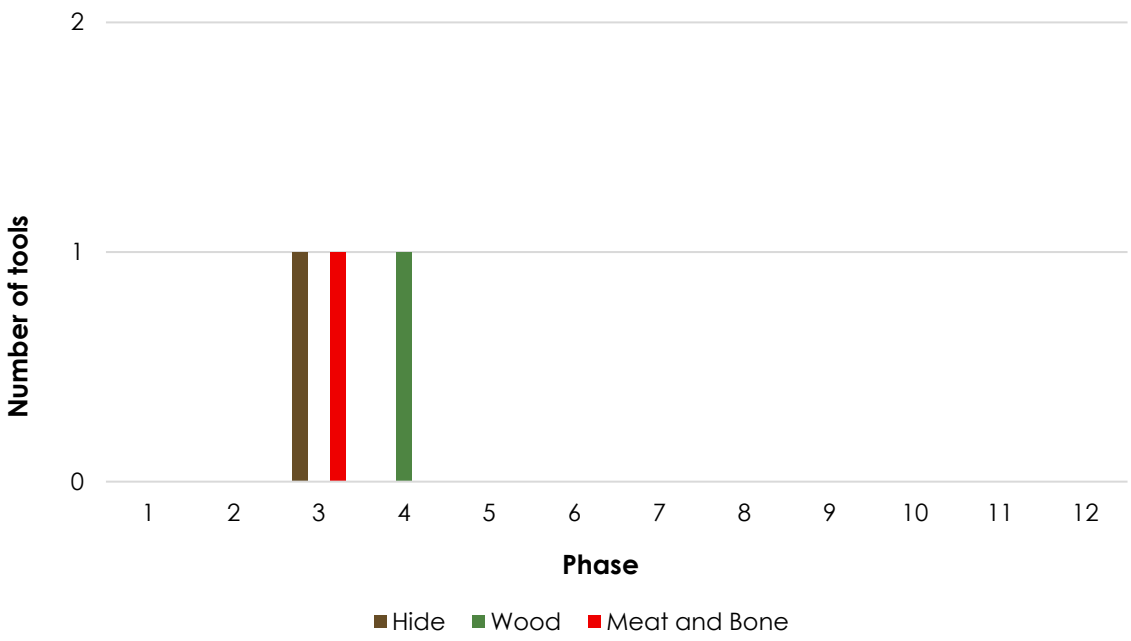


***Figure 6-105**: Number of retouched points by worked material and archaeological phase*

The tool identified as a wood working tool had limited hinge scars and some edge rounding, as well as a bright, domed polish which is characteristic of working wood (see section 5.8). The tool interpreted as having worked hide a heavily rounded tip, limited feather scars and a grainy polish (section 5.6). Finally, the butchery tool was identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3, Figure 6-106). A summary of worked retouched points from Shanidar Cave is presented in Table 6-54.

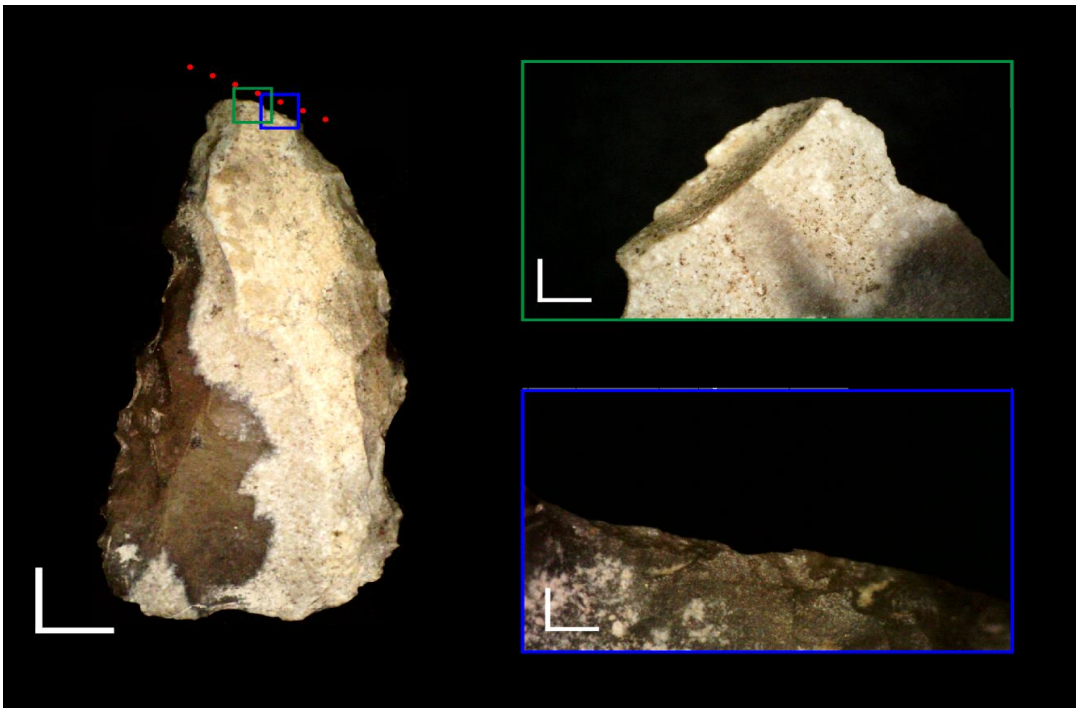


***Figure 6-106**: Worked retouched point from Phase 3 (context 2538, ID: 874). Macro cale 5 mm. Red dotted line shows location of worked edge. Green square (50x magnification, scale 0.5 mm) shows a snapped tip. Blue square (230x magnification, scale 0.2 mm) shows small hinge scars along the retouched surface associated with bright greasy polish. Interpretation: Butchery tool*

***Table 6-54:** Summary of worked retouched points*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
107	1043	**3**	Rounding on tip, limited feather scars	Bright greasy, grainy	Awling	Soft-medium	Hide, fresh
874	2538	**3**	Striations parallel to worked edge, feather and hinge scars	Limited, bright and greasy	Cutting	Soft-medium	Meat and bone
147	1458	**4**	Some hinge scars, some rounding	Bright, domed	Cutting	Soft-medium	Wood, soft

6.2.10 Worked End Scrapers

Wear traces were found on six out of eight end scrapers (75% of end scrapers, 5.6% of total worked assemblage). These were recovered from Phases 6, 4, and 3 (Figure 6-107) . Four were interpreted as hide working tools, one as a wood working tool, and one as a plant working tool (Figures 6-108 and 6-109).

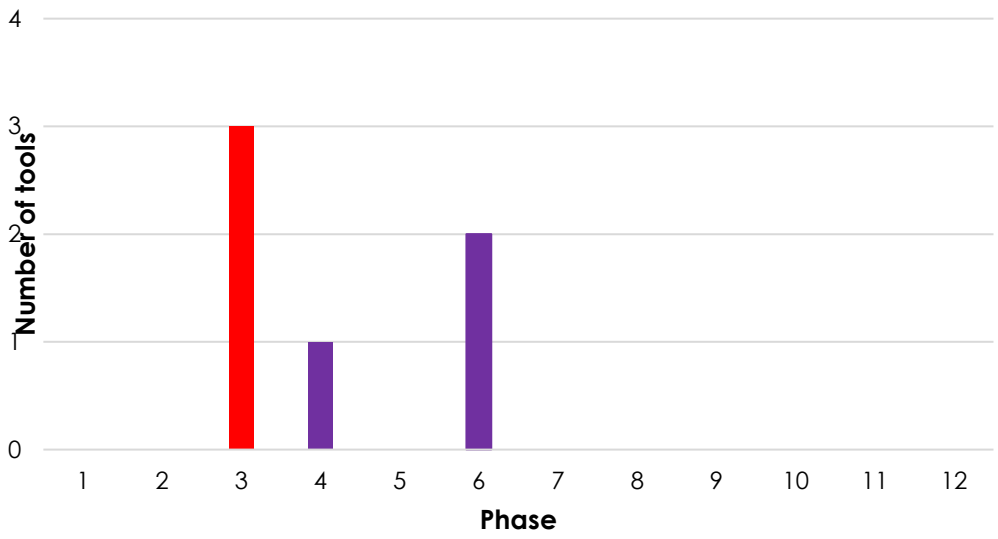


Figure 6-107: *Worked end scrapers by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

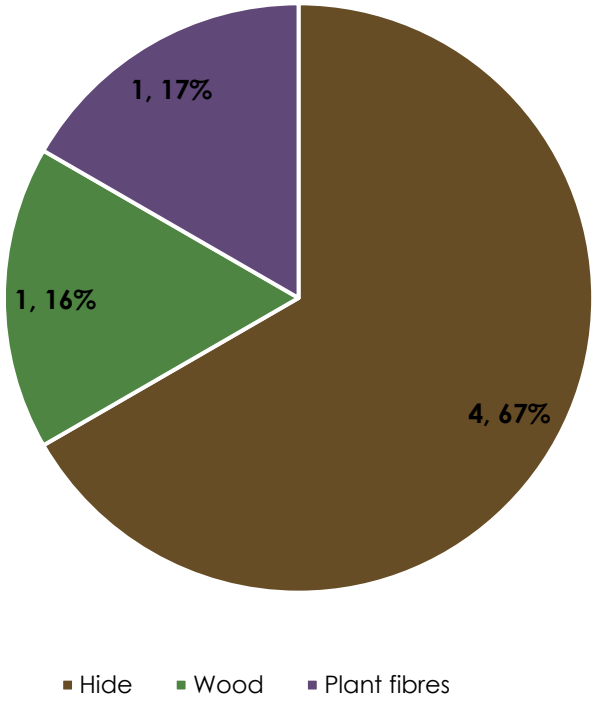


Figure 6-108: *Breakdown of retouched point use by worked material*

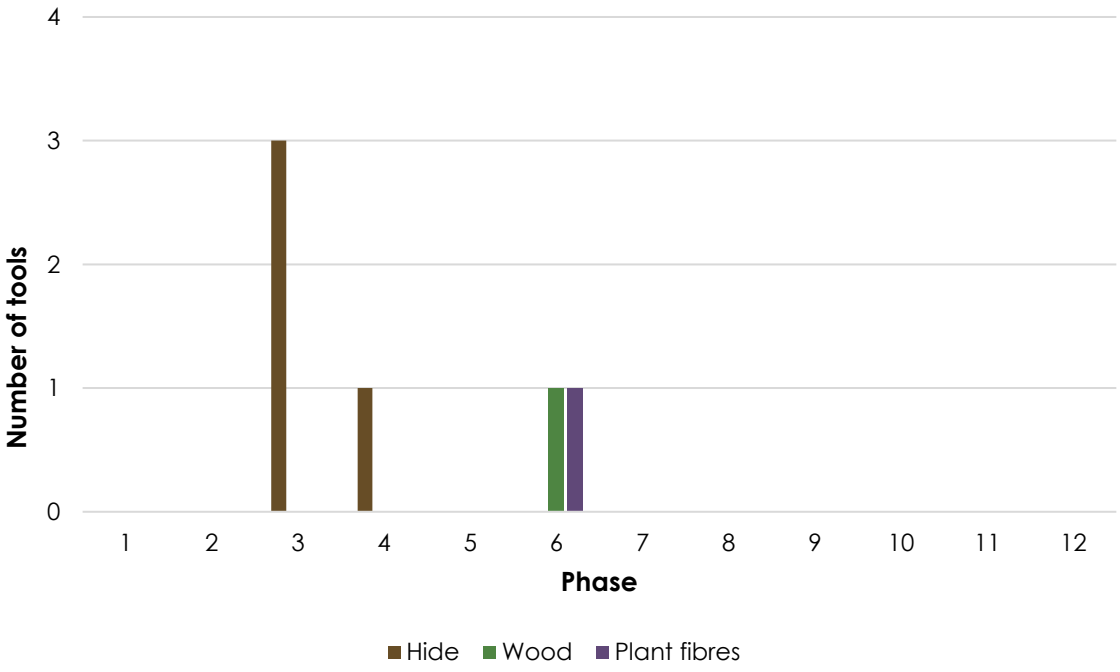


Figure 6-109: *Number of retouched points by chronological phase and worked material*

The four hide working tools were identified based on the degree of rounding, as well as the presence of a grainy and greasy polish (see section 5.6, Figure 6-110). The wood working tool was identified because of the characteristics of the edge damage (feather and hinge scars), as well as the presence of a bright, domed polish (see section 5.8). Finally, the plant working tool was identified mainly from the very bright, very glossy polish (see section 5.9). A summary of worked end scrapers from Shanidar Cave is presented in Table 6-55.

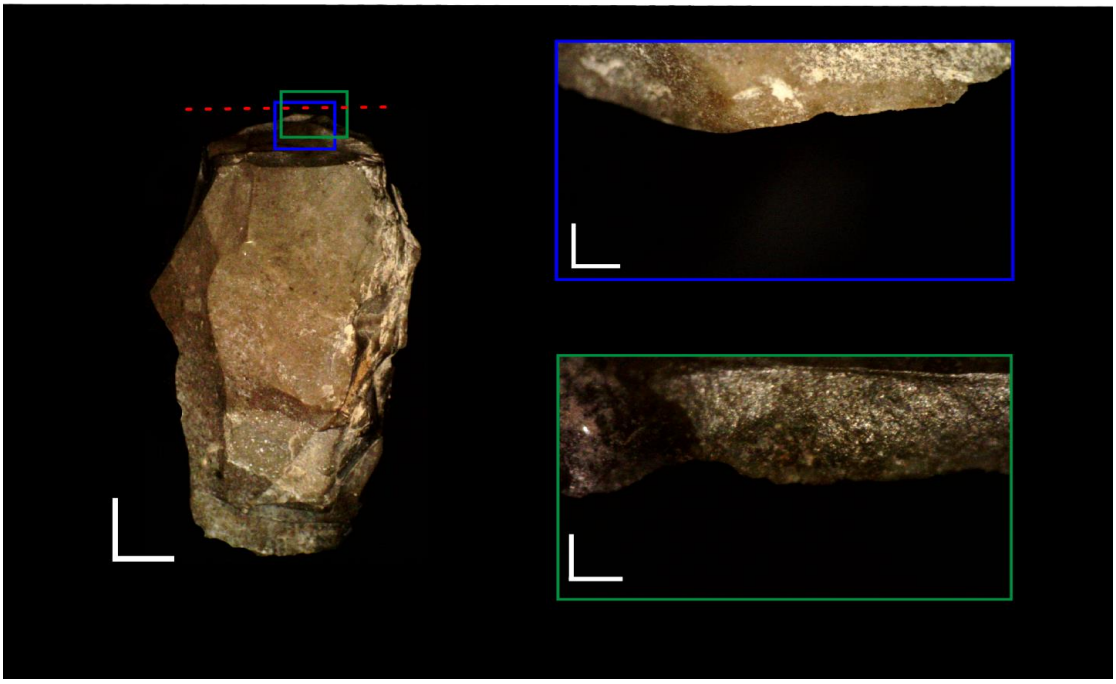


Figure 6-110: *Worked end scraper from Phase 4 (context 568, ID: 141b). Macro scale 5 mm. Red dashed line shows location of worked edge. Blue square (50x magnification, scale 1 mm) shows significant edge rounding with limited scarring. Green square (230x magnification, scale 0.2mm) shows dull pitted polish associated with a rounded edge. Interpretation: dry hide working tool*

Table 6-55: *Summary of worked end scrapers*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
58	518	**3**	Significant rounding, limited feather scars	Dull, greasy, grainy	Scraping	Medium	Hide, dry
112	1037	**3**	Rounding. Limited feather scars	Bright greasy, grainy	Scraping	Soft-Medium	Hide, fresh
141b	568	**3**	Rounding, some isolated feather scars	Bright greasy, grainy	Scraping	Soft-Medium	Hide, fresh
297	560	**4**	Rounding, some isolated feather scars	Bright greasy, grainy	Scraping	Soft-Medium	Hide, fresh
403	1845	**6**	Some edge rounding, feather and hinge scars	Bright, domed	Scraping	Soft-medium	Wood, soft
399	1852	**6**	Limited amount of edge rounding, some feather terminations	Very bright, glossy	Scraping	Soft	Plant fibres

6.2.11 Worked Crested Blades

Wear traces were found on four out of seven crested blades (57% of crested blades, 3.7% of total worked assemblage) (Figure 6-111). Two were interpreted as butchery tools, one as having worked hide and one as having worked wood (Figures 6-112 and 6-113).

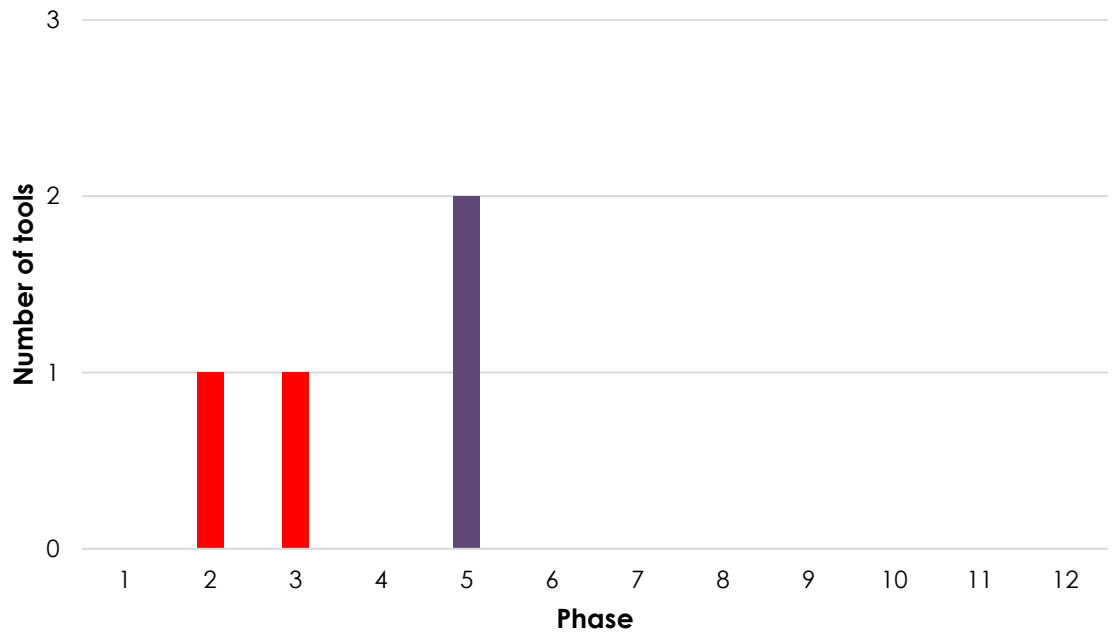


Figure 6-111: *Worked crested blades by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

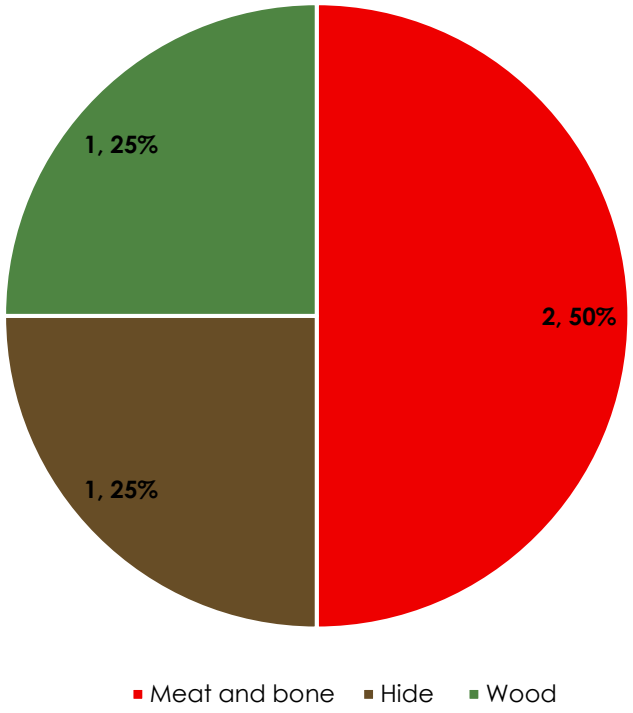


***Figure 6-112**: Breakdown of crested blade use by worked material*

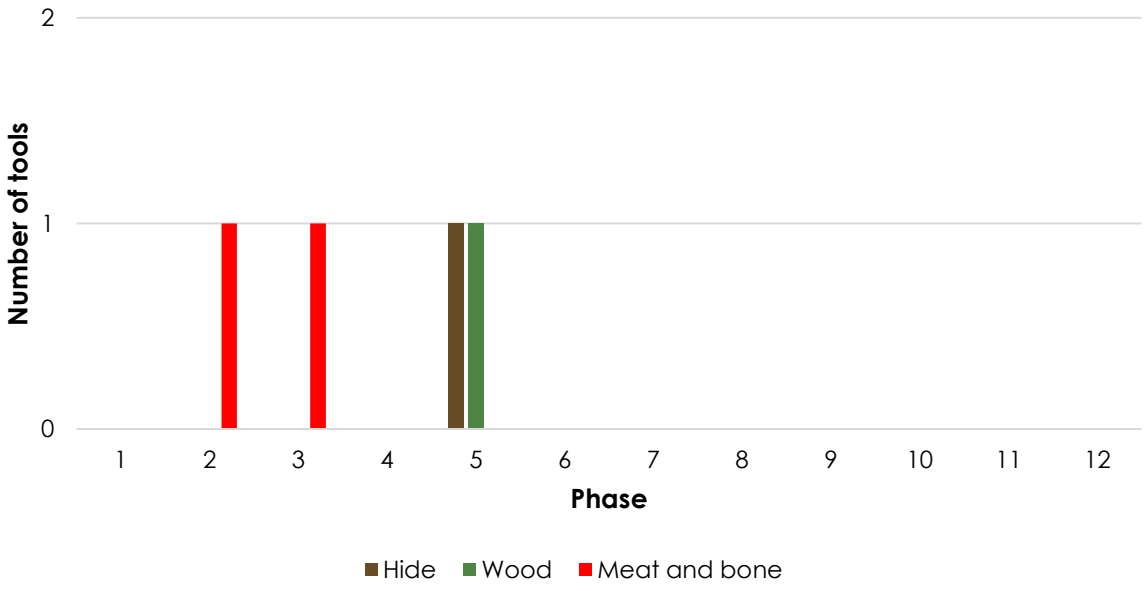


***Figure 6-113**: Number of crested blades by chronological phase and worked material*

The two butchery tools were identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3). The wood working tool was identified based on the degree of edge alteration (larger hinge and step scars), as well as a bright, domed polish (see section 5.8, Figure 6-114). Finally, the hide working tool was identified because of the minimal edge scars, edge rounding as well as the presence of a greasy polish (see section 5.6). A summary of worked crested blades from Shanidar Cave is presented in Table 6-56.

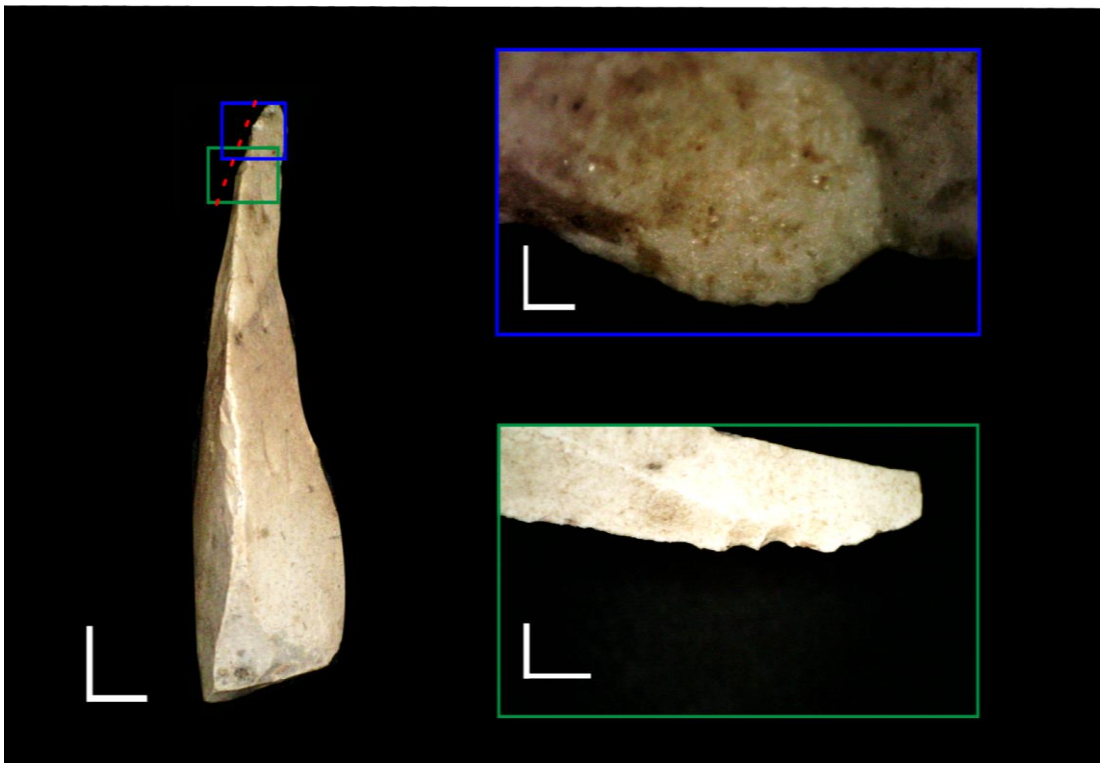


***Figure 6-114**: Worked crested blade from Phase 5 (context 1914, ID: 412). Macro scale 5 mm. Red dashed line shows location of worked edge. Blue square (230x magnification, scale 0.2 mm) shows rounded edge associated with isolated bright domed polish. Green square (30x magnification, scale 2 mm) shows large, rounded scars along the worked edge. Interpretation: wood working tool*

Table 6-56: *Summary of worked crested blades*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
909	2531	**2**	Striations parallel to worked edge, feather and hinge scars	Bright, greasy	Cutting	Soft-medium	Meat and bone
139	1107	**3**	Feather and hinge scars	Bright, greasy	Cutting	Soft-medium	Meat and bone
212	1327	***5***	Small feather scars, rounding	Dull, greasy, grainy	Scraping	Soft-medium	Hide, dry
412	1914	***5***	Rounded edge, large hinge and step scars	Bright, domed	Cutting	Hard	Wood, hard

6.2.12 Worked Unretouched Flakes

Wear traces were found on four of the 31 unretouched flakes (12.9% of unretouched flakes, 3.7% of total worked assemblage) (Figure 6-115). These were recovered from Phases 10, 6, 5, and 3. The working of wood, bone, meat and plant fibres were each evidenced by one tool (Figures 6-116 and 6-117).

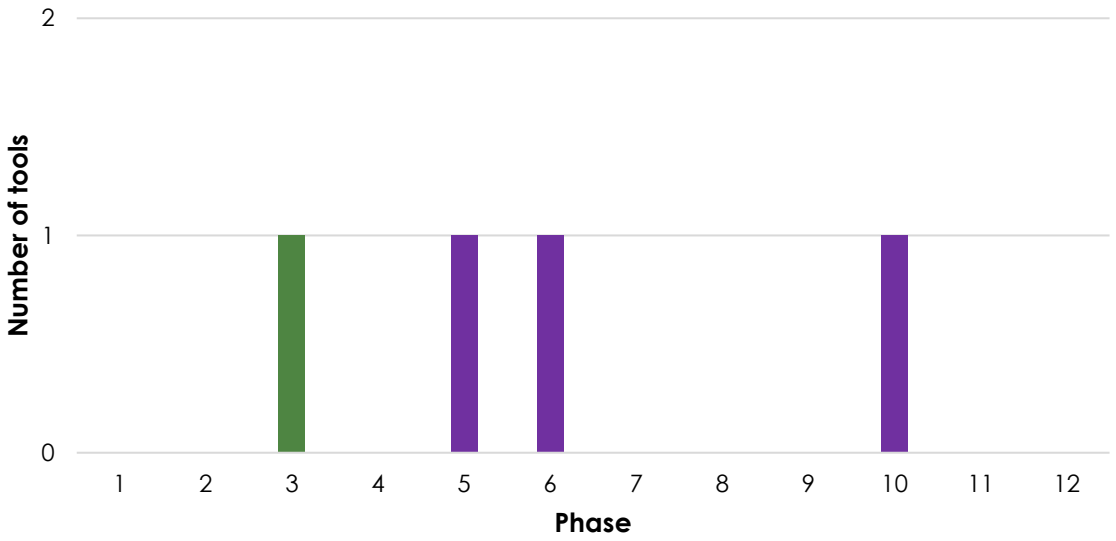


***Figure 6-115**: Worked unretouched flakes by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

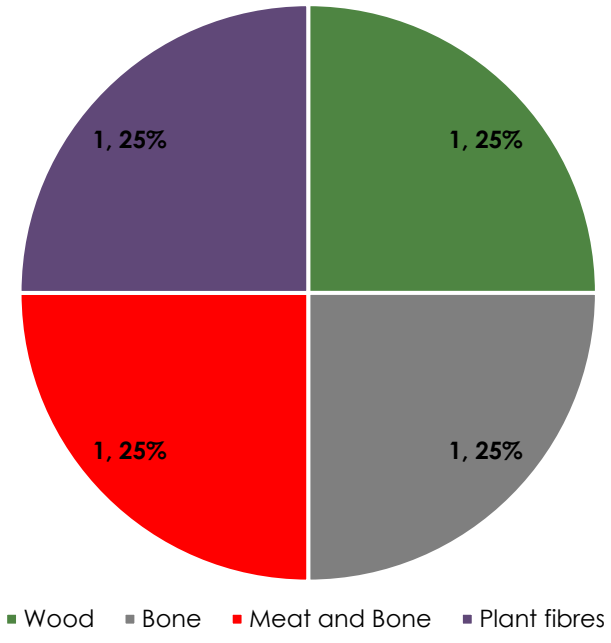


***Figure 6-116**: Breakdown of unretouched flake use by worked material*



Figure 6-117: *Number of unretouched flakes by worked material and archaeological phase*

The wood working tools was identified because of the characteristics of the edge damage, mainly the presence of larger hinge and step scars, in addition to limited edge rounding. The polish observed was bright and domed which is a characteristic of wood working (see section 5.8, Figure 6-118). The bone working tool was identified due to the significant edge damage (large step fractures) and the presence of a pitted polish (see section 5.4). The butchery tool was identified based on the presence of a bright, greasy polish as well as the degree of edge alteration (feather and hinge scars). Finally, the plant working tool was identified because of the very bright and very glossy polish (see section 5.9). A summary of worked unretouched flakes from Shanidar Cave is presented in Table 6-57.

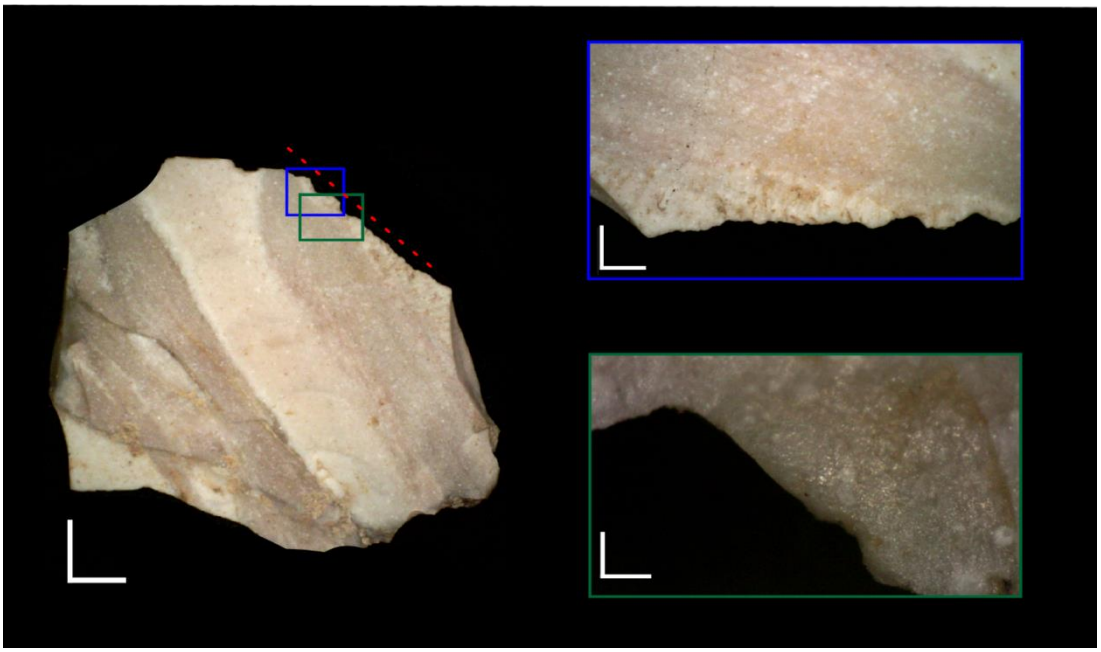


Figure 6-118: *Unretouched flake from Phase 6 (context 1852, ID: 402). Macro scale 5 mm. Red dashed line shows location of worked edge. Blue square (35x magnification, scale 2mm) shows heavy continuous scarring. Green square (230x magnification, scale 0.2mm) shows bright domed polish and a rounded edge. Interpretation: wood working tool*

Table 6-57*: Summary of worked unretouched flakes*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
787	2536-2538	**3**	Small feather scarring	Very bright, glossy	Cutting	Soft	Plant, fibres
57	708	**5**	Small feather and hinge scars	Bright, greasy	Cutting	Soft - Medium	Meat and bone
402	1852	**6**	Heavy step and hinge scars, some rounding	Bright, domed	Cutting	Hard	Wood, hard

459	1935	**10**	Striations horizontal to worked edge, large step scars	Dull, pitted	Cutting	Hard	Bone, dry

6.2.13 Worked Retouched Flakes

Wear traces were found on two out of 16 retouched flakes (12.5% of retouched flakes, 1.9% of total worked assemblage) (Figure 6-119). One tool was interpreted as working meat and the other as working wood (Figures 6-120 and 6-121).

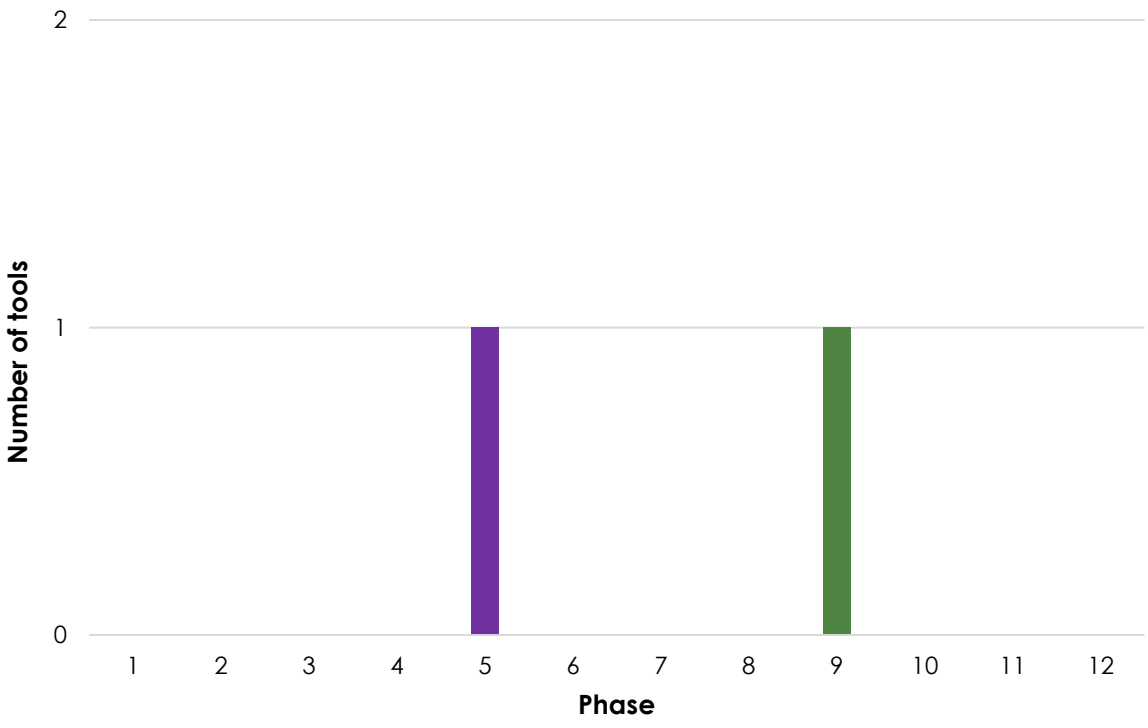


***Figure 6-119**: Worked retouched flakes by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

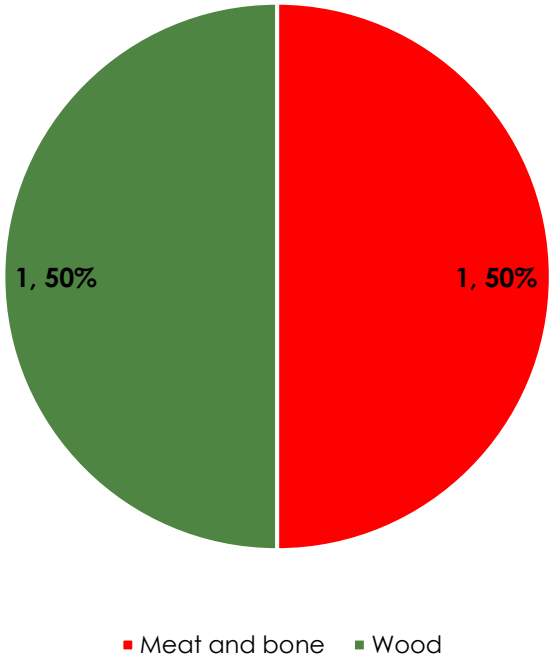


Figure 6-120: *Breakdown of retouched flake use by worked material*

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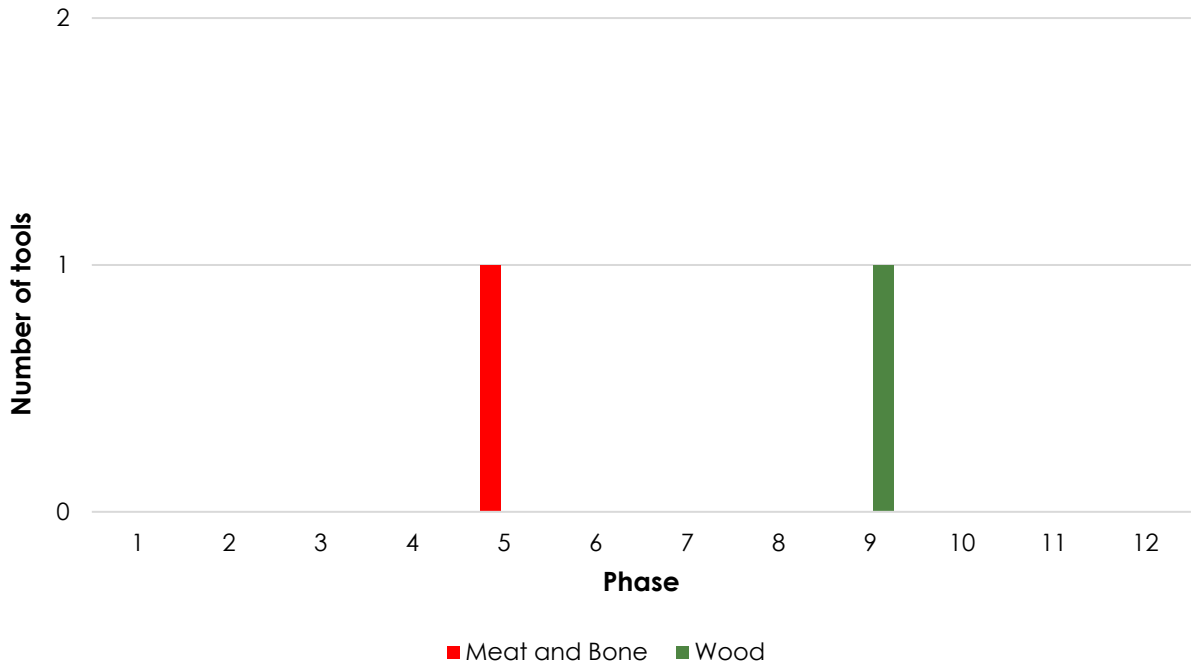


***Figure 6-121**: Number of retouched flakes by chronological phase and worked material*

The tool from phase 9 was interpreted as having been used to drill wood based on the horizontal snap fracture and circular striations around the worked tip. The polish along the worked tip was bright and domed (see section 5.8.2, Figure 6-122). The tool from phase 5 was interpreted as a butchery tool based on the degree of edge alteration (small feather and hinge scars), as well as the presence of a bright, greasy polish (see section 5.2). A summary of worked retouched flakes from Shanidar Cave is presented in Table 6-58.

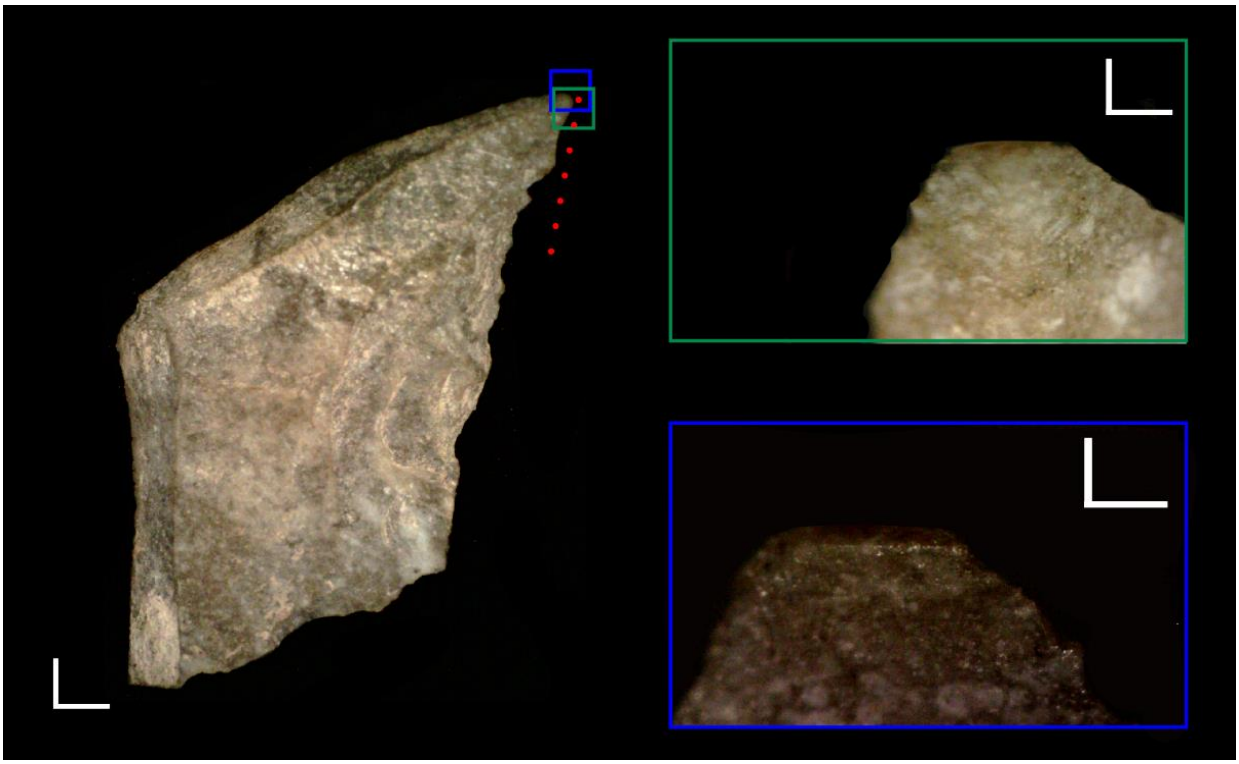


Figure 6-122: *Retouched flake from Phase 5 (context 2284, ID: 255). Macro scale 2 mm. Red dotted line shows location of worked edge. Green square (130x magnification, scale 0.2 mm) shows a crushed and rounded tip and horizontal striations. Blue square (230x magnification, scale 0.2 mm) shows same worn tip and a bright domed polish. Interpretation: wood working tool*

Table 6-58: *Summary of worked retouched flakes*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
255	1325	**5**	Small continuous feather and hinge scars, some edge rounding.	Limited, bright, greasy	Cutting	Soft-medium	Meat and bone
571	2284	**9**	Rounding on base, snapped tip and worn down, some limited hinge scars along tip, striations horizontal to tip	Bright, domed	Drilling	Soft-medium	Wood, soft

6.2.14 Worked Cortical Flakes

Wear traces were found in five of the 33 cortical flakes (15.1% of cortical flakes, 4.7% of total worked assemblage) (Figure 6-123). Two tools were identified as butchery, and one tool each were identified as working wood, bone and ochre (Figures 6-124 and 6-125).

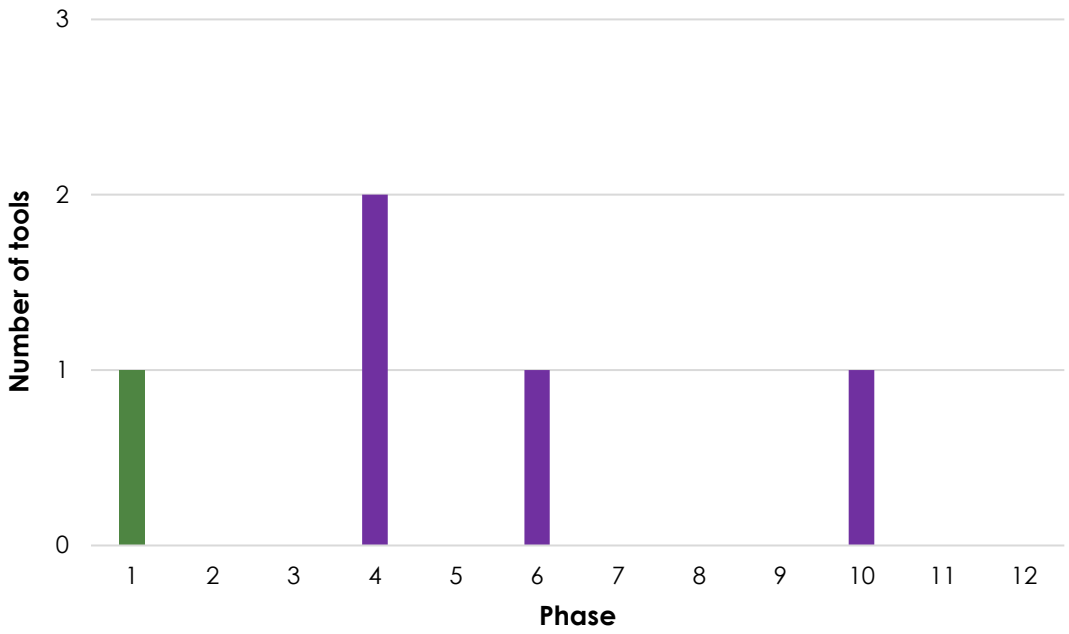


***Figure 6-123**: Worked cortical flakes by phase. Purple bars represent phases from which Neanderthal remains have been recovered*

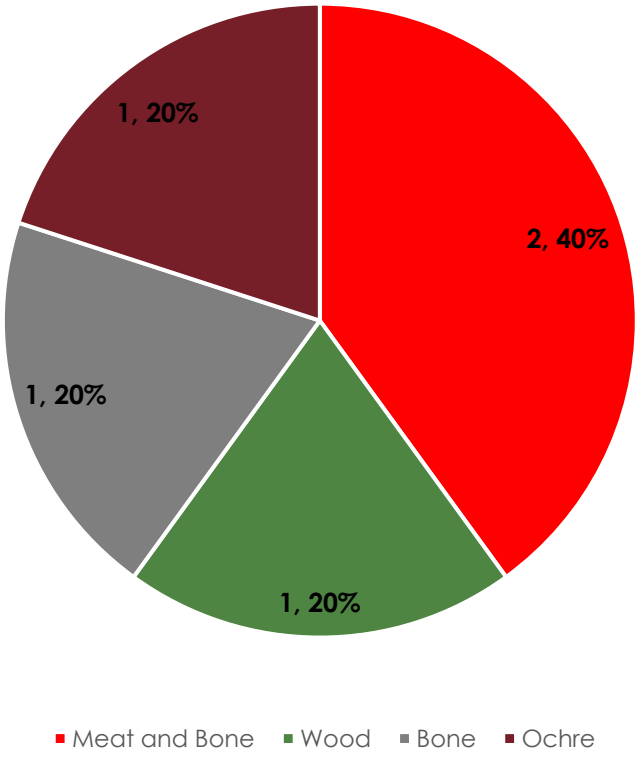


***Figure 6-124:** Breakdown of cortical flake use by worked material*

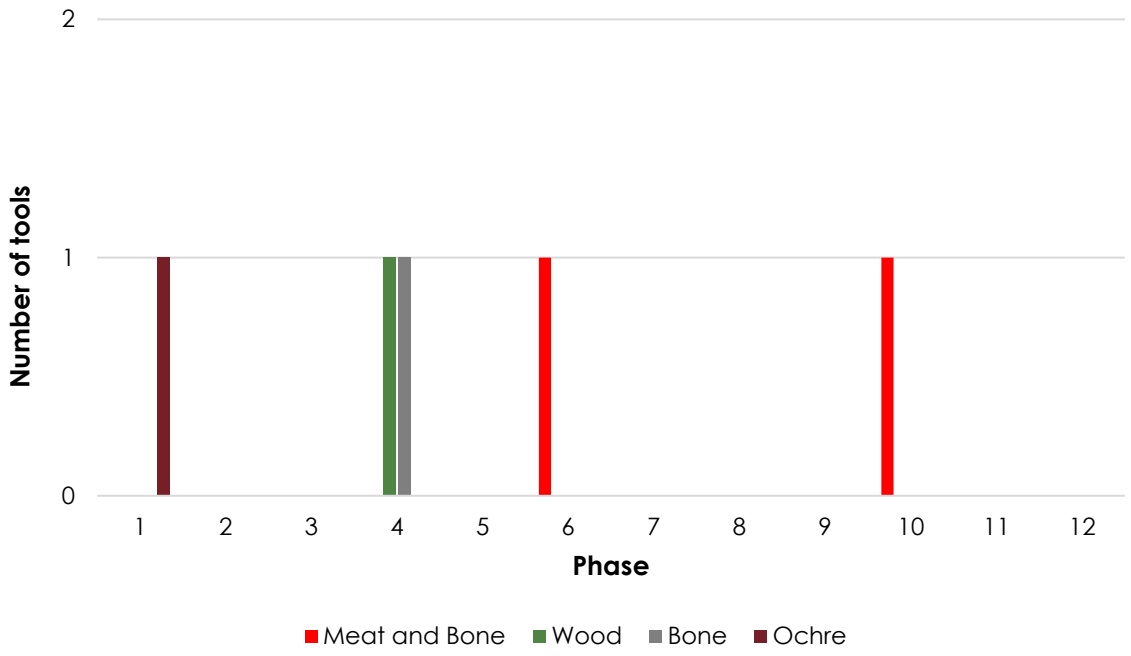


***Figure 6-125**: Number of cortical flakes by archaeological phase and worked material*

The butchery tools were identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3, Figure 6-126). The wood working tool was identified because of the characteristics of the edge damage, mainly the presence of hinge scars, in addition to limited edge rounding. Further, the polish observed was bright and domed which is characteristic of wood working (see section 5.8). The bone working tool was identified on the basis of significant edge damage (large step fractures) and the presence of pitted polish (see section 5.4). Finally, one tool was interpreted as a grinding tool.

This tool had been completely worn down on the worked surface. This tool was covered in ochre and does not match any other tool in the assemblage. It is therefore interpreted as a tool used to grind ochre. Given its location in Phase 1, it may be from an Epi-palaeolithic context rather than an Upper Palaeolithic one. A summary of worked cortical flakes is presented in Table 6-59.

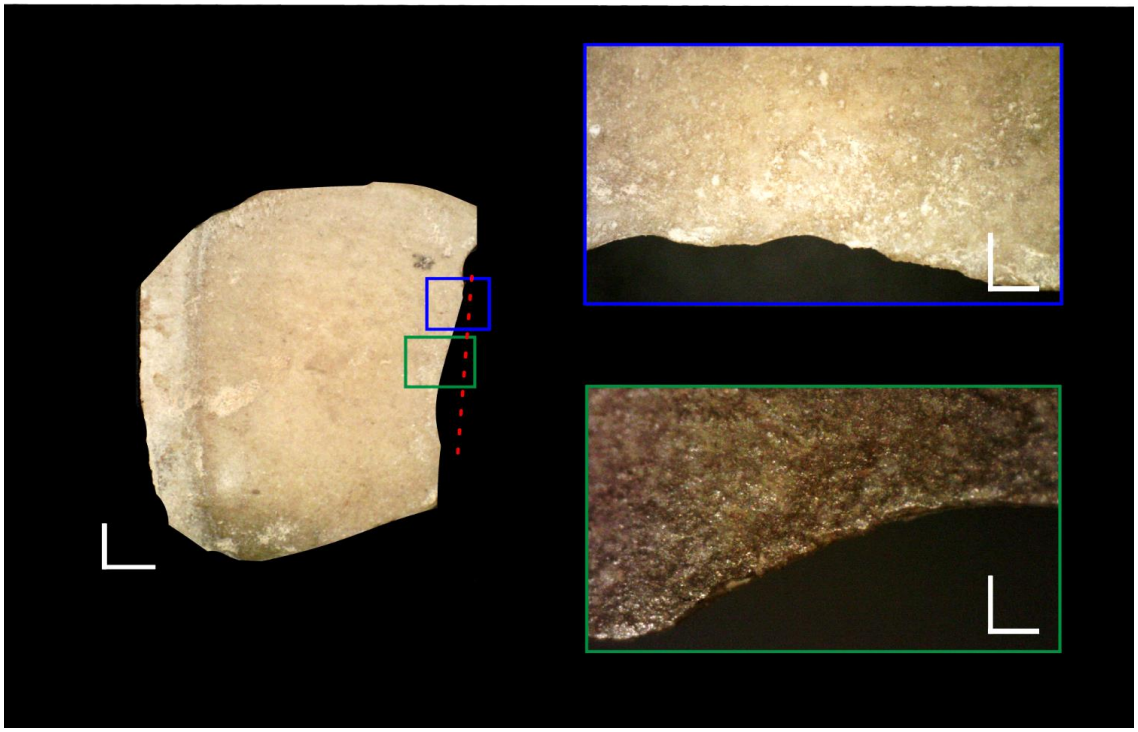


Figure 6-126: *Worked cortical flake from Phase 10 (context 2312, ID: 568). Macro scale 5 mm. Red dashed line shows location of worked edge. Blue square (50x magnification, scale 1 mm) shows small, isolated scars and limited edge rounding. Green square (230x magnification, scale 0.2 mm) shows very bright polish, which appears slightly greasy and is exclusively associated with the worked edge. Interpretation: tool used to work meat with some contact with bone*

***Table 6-59**: Summary of worked cortical flakes*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
489	-	**1**	Significant edge rounding, smoothing on one plane, heavy ochre presence associated with worn edge	N/A	Grinding	Medium	Ochre
1	-	**4**	Continuous step scarring	Limited, dull pitted	Cutting	Hard	Bone, dry
3	-	**4**	Rounding, hinge scars	Bright, domed polish	Cutting	Soft-Medium	Wood, soft
425	1852	**6**	Small, isolated feather and hinge scars	Bright, greasy	Cutting	Soft-medium	Meat and bone
586	2312	**10**	Small, isolated feather and hinge scars	Bright, greasy	Cutting	Soft-medium	Meat and bone

6.2.15 Worked Denticulates

Wear traces were found on three out of five denticulates (60% of denticulates, 2.8% of total worked assemblage) (Figure 6-127). These were recovered from Phases 10, 5 and 1. Two tools were interpreted as butchery tools and one as a bone working tool (Figures 6-128 and 6-129).

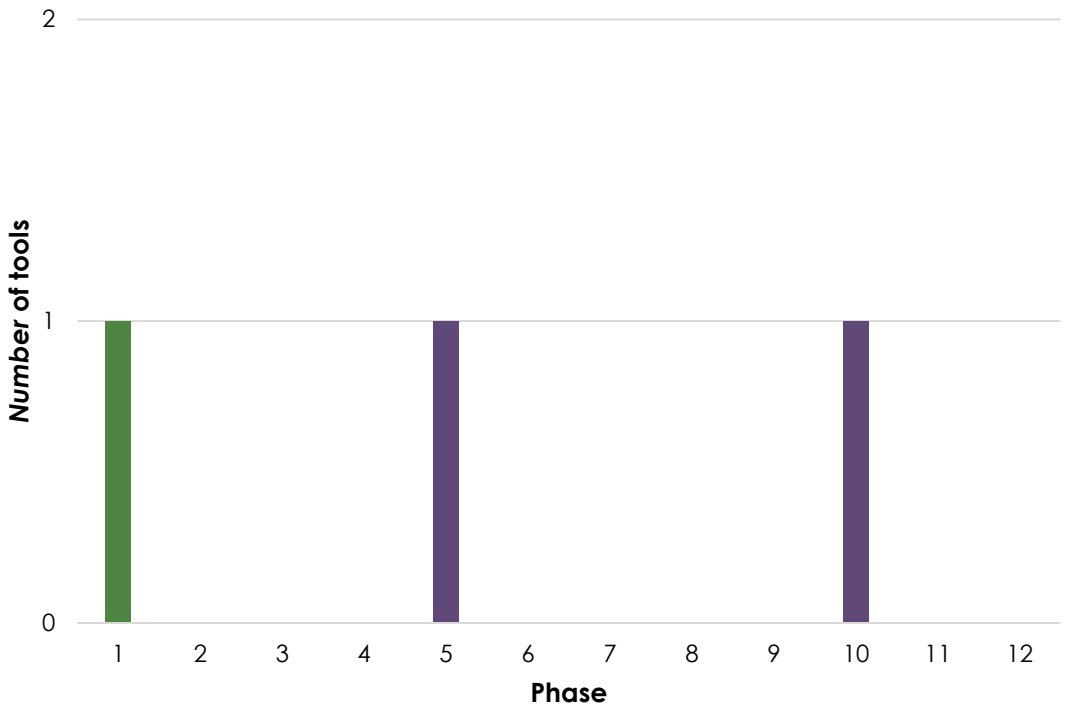


***Figure 6-127**: Worked denticulates by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

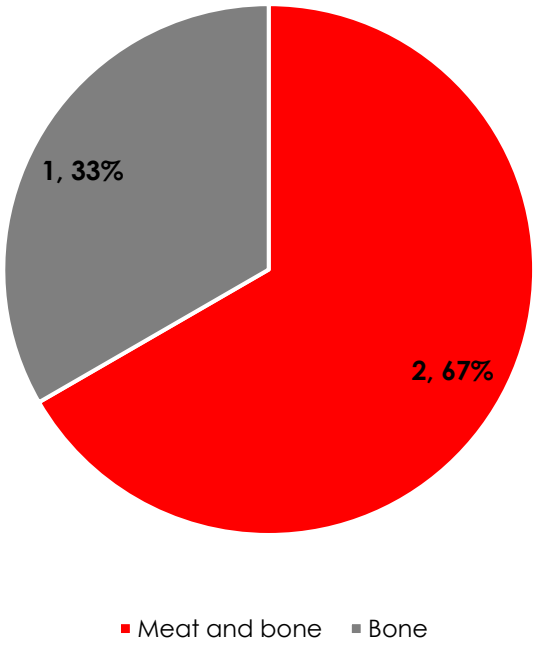


***Figure 6-128:** Breakdown of denticulate use by worked material*

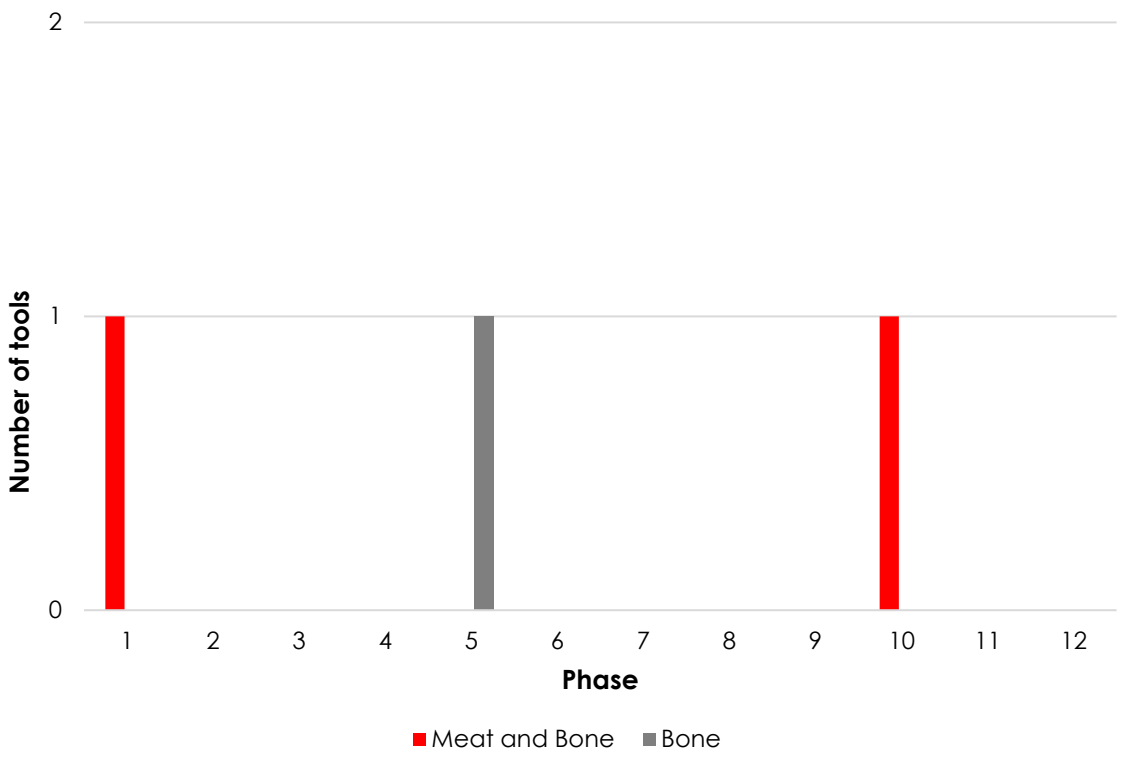


Figure 6-129: *Number of denticulates by worked material and archaeological phase*

Butchery tools were identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3, Figure 6-130). The bone working tool was identified due to significant edge damage (large step fractures) and the presence of pitted polish (see section 5.4). A summary of worked denticulates is presented in Table 6-60.

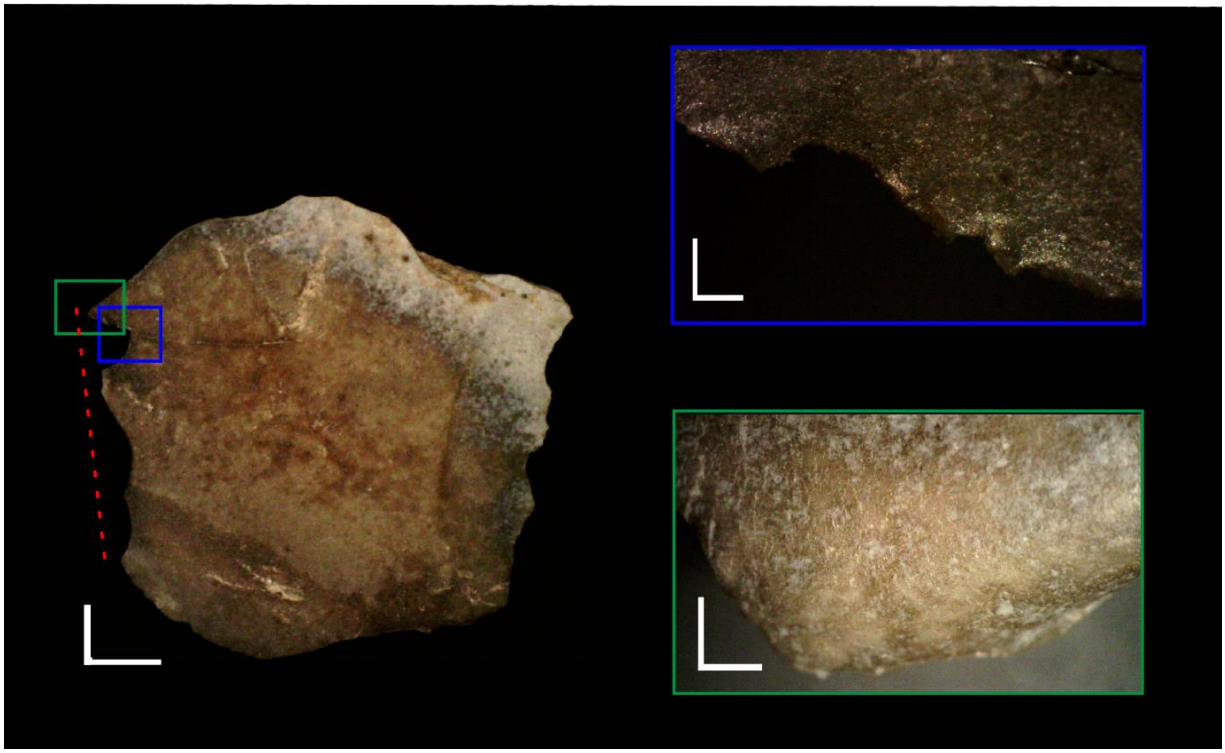


Figure 6-130: *Worked denticulate from Phase 10 (context 1523, ID: 203). Macro scale 5 mm. Red dashed line shows location of worked edge. Blue square (230x magnification, scale 0.2mm) shows very bright greasy polish associated with small scars. Green square (60x magnification, scale 0.5 mm) shows striations occurring at 90 degrees to the worked edge, and some limited edge rounding. Interpretation: butchery tool*

Table 6-60: *Summary of worked denticulates*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
498	-	**1**	Small isolated feather scars within retouched scars	Limited, bright, greasy	Cutting	Soft-Medium	Meat and bone
400	1836	**5**	Heavy, deep step scarring, rounding	Limited, dull, pitted	Cutting	Hard	Bone, dry
203	1523	**10**	Striations horizontal to worked edge, feather and hinge scars	Bright, greasy	Cutting	Soft-Medium	Meat and bone

6.2.16 Worked Informal Tools

Wear traces were found on two out of 18 informal tools (11.1% of informal tools, 1.9% of total worked assemblage) (Figure 6-131). These were recovered from Phases 12 and 3. One tool was interpreted as a butchery tool and the other as a bone working tool (Figures 6-132 and 6-133).

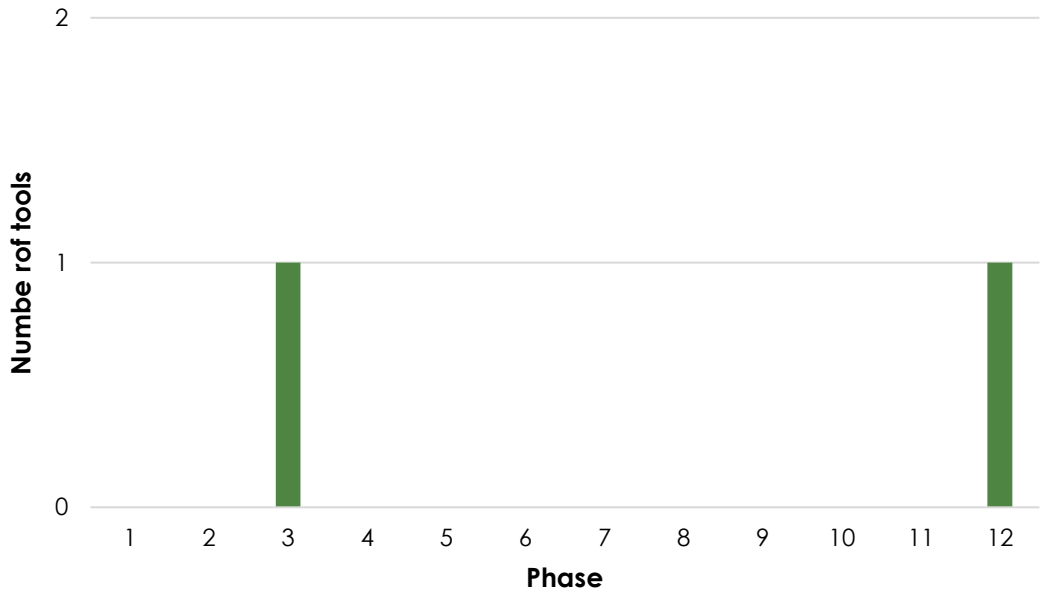


***Figure 6-131**: Worked informal tools by chronological phase. Worked informal tools are not present in phases from which Neanderthal remains have been recovered*

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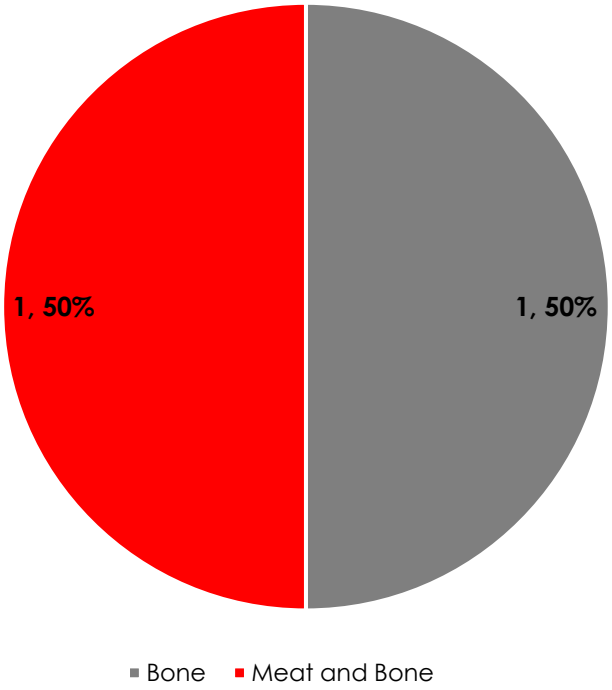


Figure 6-132: *Breakdown of informal tool use by worked material*

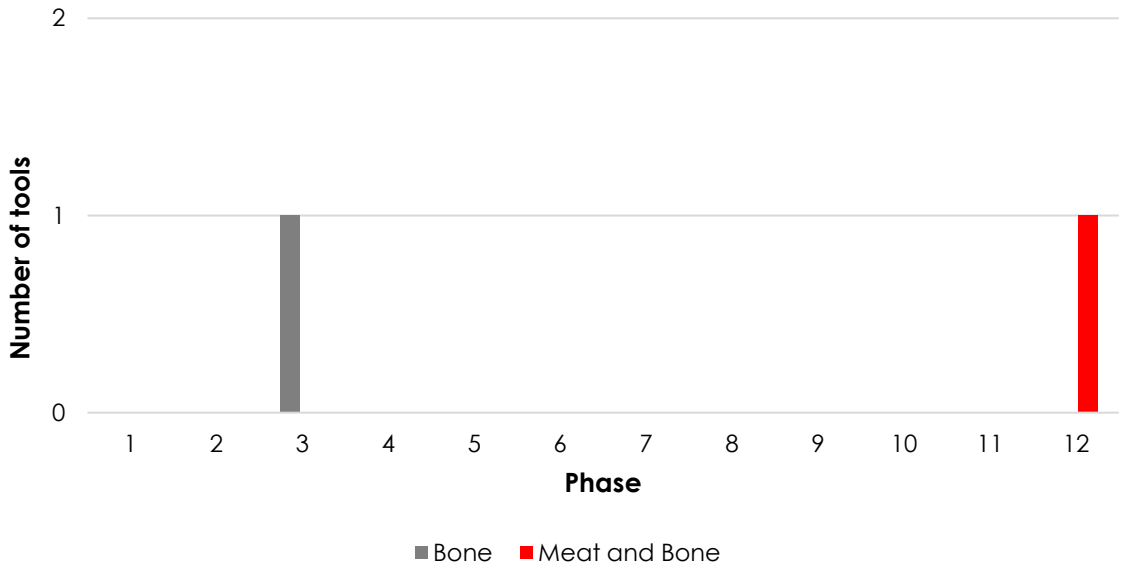


Figure 6-133: *Number of informal tools by chronological phase and worked material*

The butchery tool was identified based on the appearance of scars (feather and hinge scars) and the presence of a bright, greasy polish which is characteristic of working meat (see section 5.2 and 5.3). The bone working tool was identified on the basis of significant edge damage (large step fractures) and the presence of pitted polish (see section 5.4, Figure 6-134). A summary of the worked informal tools from Shanidar Cave is presented in Table 6-61.

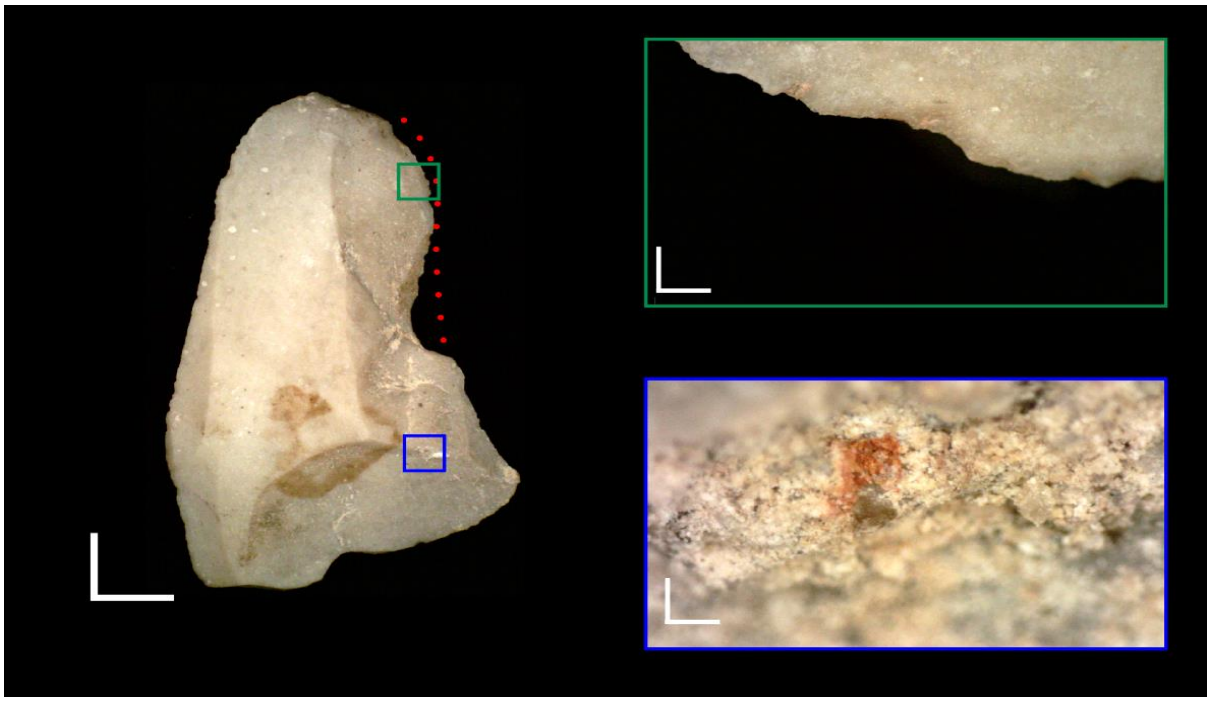


Figure 6-134: *Worked informal tool from Phase 3 (context 1043, ID: 131). Macro scale 5 mm. Red dotted line shows location of worked edge. Green square (60x magnification, scale 0.5 mm) shows scars and a crushed and rounded edge, suggesting a hard material was worked. Blue square (230x magnification, scale 0.2mm) shows ochre adhering to the base of the lithic, a possible indication of hafting. Interpretation: hafted bone working tool*

***Table 6-61**: Summary of worked informal tools*

Specimen ID	Context	Phase	Wear	Polish	Action	Hardness	Material
131	1043	**3**	Rounded edge, heavy step and hinge scaring	Limited, dull, pitting	Cutting	Hard	Bone, dry
900	2545	**12**	Feather and hinge scars. Striations horizontal to worked edge	Bright, greasy	Cutting	Soft-Medium	Meat and bone

6.2.17 Worked Burins

Wear traces were found on seven out of eight burins (87.5% of burins, 6.5% of total worked assemblage) (Figure 6-135). Two were interpreted as wood working tools. These tools had a bright, domed polish. One lithic retained evidence of hinge terminations and some rounding; whereas the other had a snap fracture across the worked tip, alongside several larger step fractures. They were interpreted as soft and hard wood respectively (see sections 5.8.1 and 5.8.2). Two lithics were interpreted as working hide, two as working wood, and one lithic each was interpreted as working meat, bone and plant fibres (Figures 6-136 and 6-137).

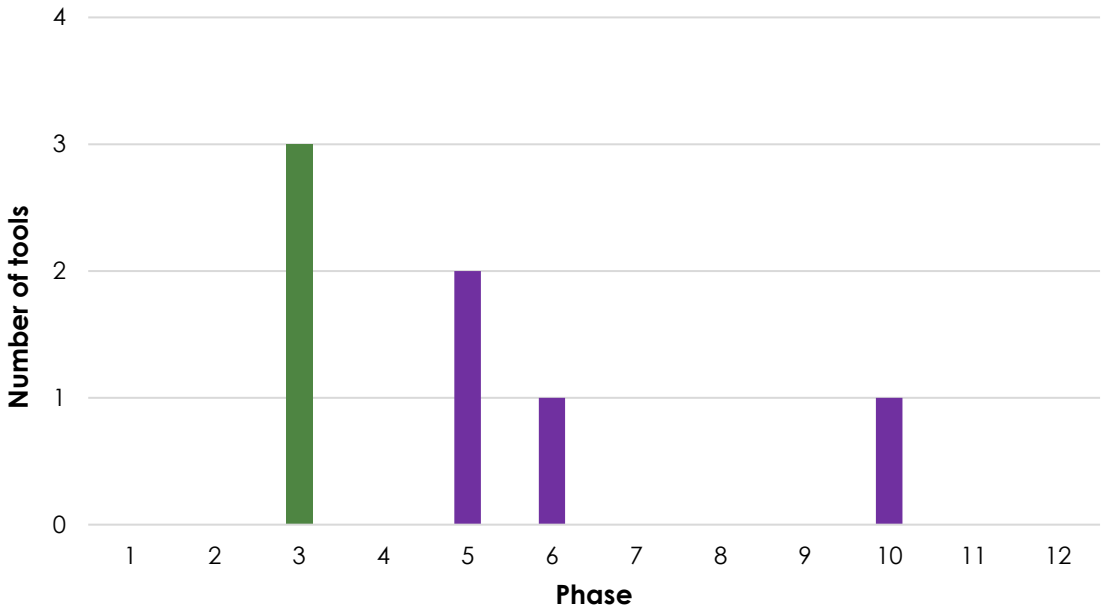


***Figure 6-135**: Worked burins by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

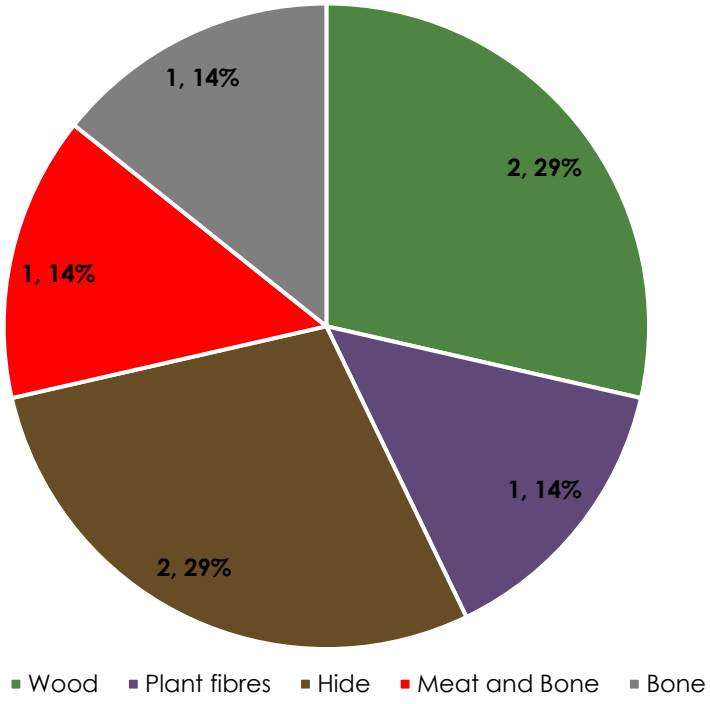


***Figure 6-136**: Breakdown of burin use by worked material*

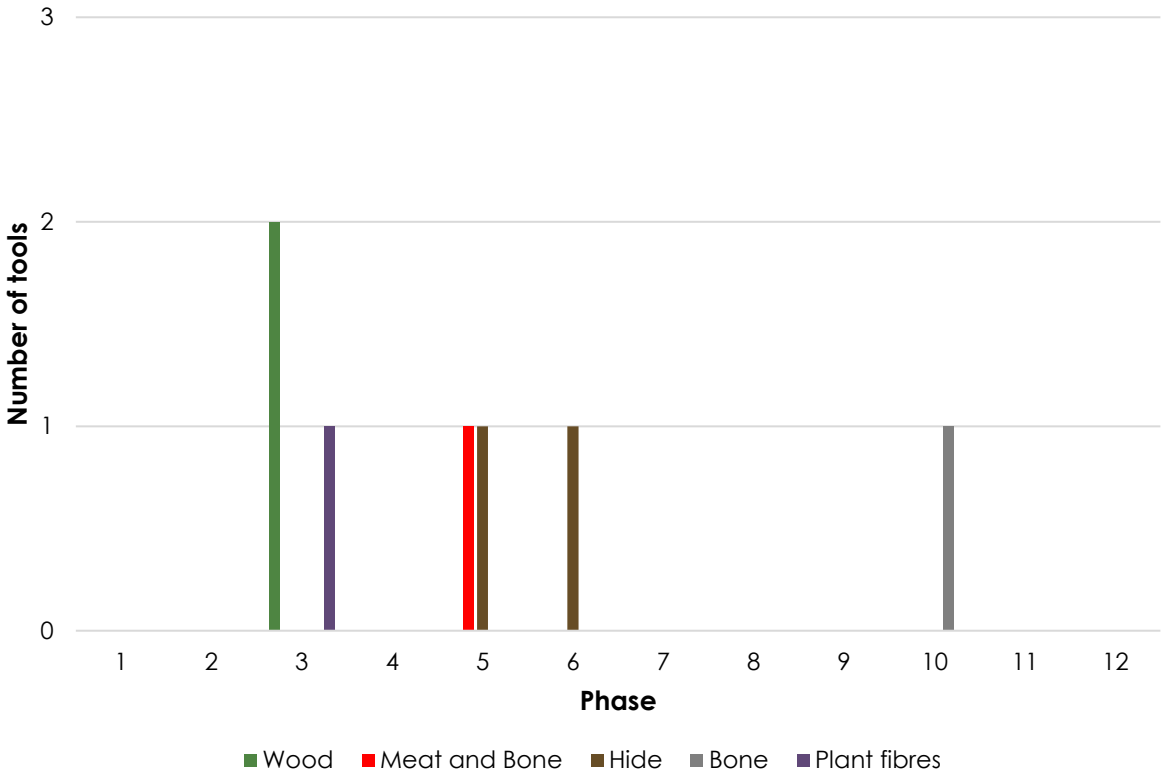


***Figure 6-137**: Number of burins by chronological phase and worked material*

Hide working tools were identified based on the minimal edge scarring, edge rounding, and the presence of a grainy polish (section 5.6, Figure 6-138). Wood working tools were identified because of the characteristics of the edge damage, mainly the presence of hinge scars, in addition to limited edge rounding. Further, where polish occurred it was domed which is characteristic of working wood (see section 5.8). The bone working tool was identified on the basis of significant edge damage (large step fractures) and the presence of pitted polish (see section 5.4). Finally, the plant working tool was identified on the basis of a very bright, very glossy polish (see section 5.9). A summary of worked burins from Shanidar Cave is presented in Table 6-62.

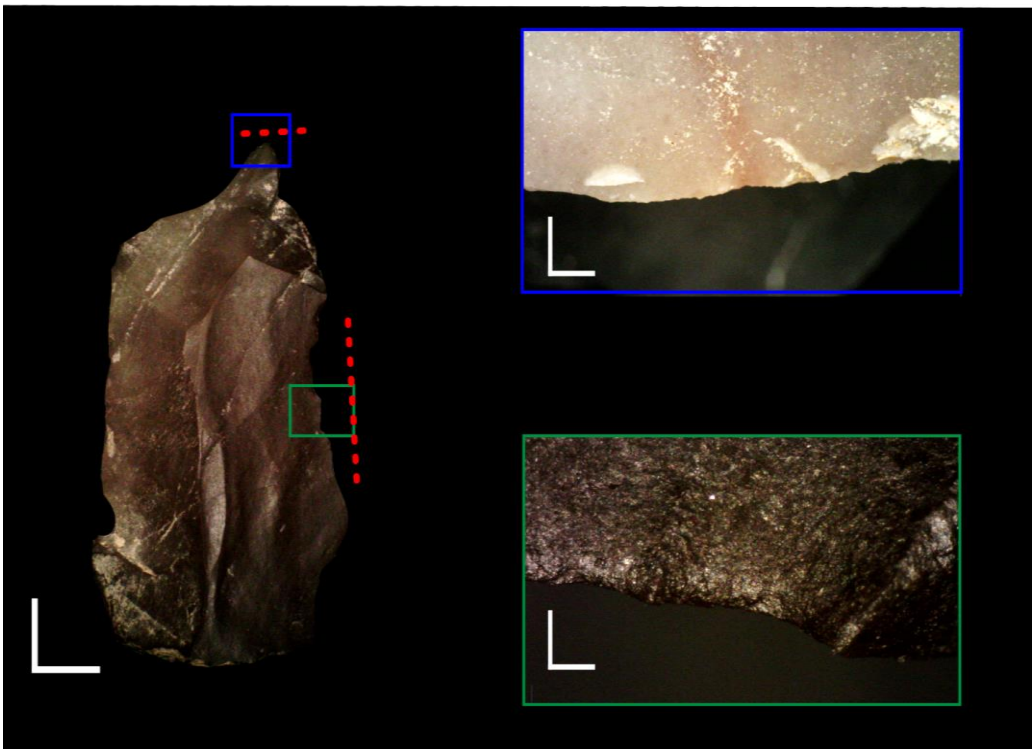


Figure 6-138: *Worked burin from Phase 6 (context 1845, ID: 389). Macro scale 1 cm. Red dashed line shows locations of worked edges. Blue square (50x magnification, scale 1 mm) shows a crushed and rounded worked tip. Striations were also apparent at 90 degrees to tip. Green square (230x magnification, scale 0.2 mm) shows a rounded, retouched edge associated with dull greasy polish. Interpretation: hide working tool*

Table 6-62*: Summary of worked burins*

Specimen ID	Context	Phase	Worked surface	Wear	Polish	Action	Hardness	Material
109	1034	**3**	Burin bit, right lateral	Hinge terminations, some rounding. Striations parallel to edge.	Limited, bright, domed	Cutting	Soft-medium	Wood, soft
110	1043	**3**	Right lateral	Small feather scars	Very bright, glossy	Cutting	Soft	Plant fibres
141k	1037	**3**	Burin bit/tip	Deep striations horizontal to worked tip, snap fracture across tip with step terminations.	Limited, bright, domed	Drilling	Hard	Wood, hard

Specimen ID	Context	Phase	Worked surface	Wear	Polish	Action	Hardness	Material
				Heavily rounded				
51	721	**5**	Burin bit/tip	Heavily rounded tip, small, rounded hinge scars	Mostly dull, greasy, grainy	Awling	Medium	Hide, dry
114	1013	**5**	Burin bit, left lateral	Small, continuous feather and hinge scars. Striations horizontal to worked edge,	Bright, smooth	Cutting	Soft-medium	Meat and bone
389	1845	**6**	Burin bit/tip and lateral edges	Tip: Heavily rounded tip, some smaller hinge scars. Edge: Heavy edge rounding, small feather scars	Bright greasy, grainy	Awling and scraping	Soft-Medium	Hide, Fresh
379	1924	**10**	Burin bit/tip	Snap fracture across tip, large step scars, heavy degree of rounding	Limited, dull, pitted	Drilling	Hard	Bone, dry

6.2.18 Use-Wear Conclusion

Table 6-63 summarises results of use-wear analyses by phase to provide an overview of behaviours and activities at Shanidar Cave through time.

Table 6-63: *Summary of lithic use at Shanidar Cave by phase/Marine Isotope Stage (MIS)*

Specimen ID	Context	Phase	MIS	Date	Type	Interpreted Action	Worked Material
488	-	**1**	1	Holocene	Side scraper	Scraping	Hide, fresh
489	-	**1**	3	Holocene	Cortical flake	Grinding	Ochre
498	-	**1**	3	Holocene	Denticulate	Cutting	Meat
28	512	**2**	3	30 – 42 kya	Side scraper	Cutting	Meat and bone
319	629	**2**	3	30 – 42 kya	Retouched blade	Scraping	Wood, soft
909	2531	**2**	3	30 – 42 kya	Crested blade	Cutting	Meat and bone
58	518	**3**	3	42 – 52 kya	End scraper	Scraping	Hide, dry
62	748	**3**	3	42 – 52 kya	Retouched blade	Cutting	Meat and bone
106	1037	**3**	3	42 – 52 kya	Side scraper	Scraping	Hide, dry
107	1043	**3**	3	42 – 52 kya	Retouched point	Awling	Hide, fresh
108	1049	**3**	3	42 – 52 kya	Retouched bladelet	Awling	Hide, dry
109	1034	**3**	3	42 – 52 kya	Burin	Cutting	Wood, soft
110	1043	**3**	3	42 – 52 kya	Burin	Cutting	Plant fibres
111	1107	**3**	3	42 – 52 kya	Retouched blade	Cutting	Bone
112	1037	**3**	3	42 – 52 kya	End scraper	Scraping	Hide, fresh
131	1043	**3**	3	42 – 52 kya	Informal tool	Cutting	Bone, dry
139	1107	**3**	3	42 – 52 kya	Crested blade	Cutting	Meat and bone
141b	568	**3**	3	42 – 52 kya	End scraper	Scraping	Hide, fresh
141i	568	**3**	3	42 – 52 kya	Unretouched point	Drilling	Bone, dry
141k	1037	**3**	3	42 – 52 kya	Burin	Drilling	Wood, hard
250	1406	**3**	3	42 – 52 kya	Retouched blade	Cutting	Meat and bone
375	1858	**3**	3	42 – 52 kya	Retouched bladelet	Awling	Hide, dry
405	1862	**3**	3	42 – 52 kya	Side scraper	Scraping	Hide, dry
787	2536-2538	**3**	3	42 – 52 kya	Unretouched flake	Cutting	Plant fibres
874	2538	**3**	3	42 – 52 kya	Retouched point	Cutting	Meat and bone

Specimen ID	Context	Phase	MIS	Date	Type	Interpreted Action	Worked Material
1	-	**4**	3	52 – 56 kya	Cortical flake	Cutting	Bone, dry
3	-	**4**	3	52 – 56 kya	Cortical flake	Cutting	Wood, soft
147	1458	**4**	3	52 – 56 kya	Retouched point	Cutting	Wood, soft
148	537	**4**	3	52 – 56 kya	Retouched bladelet	Cutting	Wood, soft
149	1438	**4**	3	52 – 56 kya	Retouched blade	Cutting	Wood, soft
151	1433	**4**	3	52 – 56 kya	Side scraper	Scraping	Hide, fresh
163	1400	**4**	3	52 – 56 kya	Retouched point	Awling	Hide, fresh
170	1433	**4**	3	52 – 56 kya	Retouched point	Cutting	Hide, dry
218	1392	**4**	3	52 – 56 kya	Side scraper	Scraping	Hide, dry
297	560	**4**	3	52 – 56 kya	End scraper	Scraping	Hide, fresh
299	1653	**4**	3	52 – 56 kya	Mousterian point	Cutting	Hide
313	1156	**4**	3	52 – 56 kya	Elongated Mousterian point	Cutting	Meat and bone
330	1609	**4**	3	52 – 56 kya	Side scraper	Scraping	Plant fibres
335	581	**4**	3	52 – 56 kya	Retouched blade	Cutting	Wood, soft
387	1836	**4**	3	52 – 56 kya	Retouched blade	Scraping	Hide, fresh
855	2558	**4**	3	52 – 56 kya	Mousterian point	Cutting	Meat and bone
873	2530	**4**	3	52 – 56 kya	Retouched bladelet	Cutting	Meat and bone
908	2530	**4**	3	52 – 56 kya	Retouched bladelet	Cutting	Wood, soft
39	750	**5**	3	56 –58 kya	Retouched bladelet	Cutting	Wood, soft
46	708	**5**	3	56 –58 kya	Retouched point	Cutting	Bone, dry
51	721	**5**	3	56 –58 kya	Burin	Awling	Hide, dry
52	545	**5**	3	56 –58 kya	Retouched blade	Cutting	Wood, hard
55	802	**5**	3	56 –58 kya	Side scraper	Scraping	Wood, hard
57	708	**5**	3	56 –58 kya	Unretouched flake	Cutting	Meat and bone

Specimen ID	Context	Phase	MIS	Date	Type	Interpreted Action	Worked Material
63	748	**5**	3	56 –58 kya	Retouched blade	Scraping	Wood, soft
64	748	**5**	3	56 –58 kya	Retouched bladelet	Cutting	Meat and bone
114	1013	**5**	3	56 –58 kya	Burin	Cutting	Meat and bone
115	1118	**5**	3	56 –58 kya	Retouched bladelet	Cutting	Plant fibres
116	1213	**5**	3	56 –58 kya	Retouched bladelet	Cutting	Meat and bone
132	1125	**5**	3	56 –58 kya	Mousterian point	Cutting	Meat and bone
165	1369	**5**	3	56 –58 kya	Elongated Mousterian point	Drilling	Bone
167	1410	**5**	3	56 –58 kya	Elongated Mousterian point	Cutting	Bone, dry
212	1327	**5**	3	56 –58 kya	Crested blade	Scraping	Hide, dry
255	1325	**5**	3	56 –58 kya	Retouched flake	Cutting	Meat and bone
298	632	**5**	3	56 –58 kya	Retouched bladelet	Cutting	Meat and bone
317	1638	**5**	3	56 –58 kya	Mousterian point	Drilling	Horn
400	1836	**5**	3	56 –58 kya	Denticulate	Cutting	Bone, dry
412	1914	**5**	3	56 –58 kya	Crested blade	Scraping	Wood, hard
480	2125	**5**	3	56 –58 kya	Side scraper	Scraping	Hide, fresh
389	1845	**6**	3	58 – 61 kya	Burin	Awling and scraping	Hide, fresh
399	1852	**6**	3	58 – 61 kya	End scraper	Scraping	Plant fibres
402	1852	**6**	3	58 – 61 kya	Unretouched flake	Cutting	Wood, hard
403	1845	**6**	3	58 – 61 kya	End scraper	Scraping	Wood, soft
407	1868	**6**	3	58 – 61 kya	Side scraper	Scraping	Wood, soft
410	1823	**6**	3	58 – 61 kya	Unretouched bladelet	Cutting	Meat
419	1816	**6**	3	58 – 61 kya	Retouched blade	Scraping	Wood, hard
420	1852	**6**	3	58 – 61 kya	Side scraper	Scraping	Hide, fresh
425	1852	**6**	3	58 – 61 kya	Cortical flake	Cutting	Meat and bone

Specimen ID	Context	Phase	MIS	Date	Type	Interpreted Action	Worked Material
467	1845	**6**	3	58 – 61 kya	Retouched blade	Cutting	Meat and bone
470	1861	**6**	3	58 – 61 kya	Side scraper	Scraping	Hide, dry
479	1876	**6**	3	58 – 61 kya	Mousterian point	Cutting	Meat and bone
481	2043	**6**	3	58 – 61 kya	Elongated Mousterian point	Cutting	Wood, hard
482	2041	**6**	3	58 – 61 kya	Retouched blade	Scraping	Wood, soft
555	2263	**7**	4	61 – 71 kya	Mousterian point	Cutting	Wood, hard
222	1507	**9**	5a	71 – 75 kya	Mousterian point	Cutting	Meat and bone
560	2278	**9**	5a	71 – 75 kya	Mousterian point	Cutting	Bone
566	2283	**9**	5a	71 – 75 kya	Mousterian point	Cutting	Meat and bone
567	2283	**9**	5a	71 – 75 kya	Elongated Mousterian point	Cutting	Wood, hard
571	2284	**9**	5a	71 – 75 kya	Retouched flake	Drilling	Wood soft
573	2284	**9**	5a	71 – 75 kya	Side scraper	Scraping	Wood, soft
580	2303	**9**	5a	71 – 75 kya	Elongated Mousterian point	Scraping	Hide, fresh
687	2284	**9**	5a	71 – 75 kya	Elongated Mousterian point	Cutting	Meat and bone
203	1523	**10**	5a	71 – 75 kya	Denticulate	Cutting	Meat and bone
379	1924	**10**	5a	71 – 75 kya	Burin	Drilling	Bone, dry
406	1924	**10**	5a	71 – 75 kya	Unretouched blade	Cutting	Wood, soft
408	1933	**10**	5a	71 – 75 kya	Side scraper	Scraping	Hide, dry
421	1924	**10**	5a	71 – 75 kya	Mousterian point	Cutting	Wood, soft
459	1935	**10**	5a	71 – 75 kya	Unretouched flake	Cutting	Bone, dry
583	2307	**10**	5a	71 – 75 kya	Side scraper	Scraping	Wood, soft
584	2312	**10**	5a	71 – 75 kya	Side scraper	Scraping	Wood, soft
585	2312	**10**	5a	71 – 75 kya	Mousterian point	Scraping	Wood, soft

Specimen ID	Context	Phase	MIS	Date	Type	Interpreted Action	Worked Material
586	2312	**10**	5a	71 – 75 kya	Cortical flake	Cutting	Meat and bone
588	2314	**10**	5a	71 – 75 kya	Retouched blade	Cutting	Wood, hard
593	2326	**11**	5a	71 – 75 kya	Elongated Mousterian point	Cutting	Bone, dry
602	2340	**12**	5c	75 – 100 kya	Mousterian point	Drilling	Bone
857	2560	**12**	5c	75 – 100 kya	Side scraper	Scraping	Hide, fresh
870	2518	**12**	5c	75 – 100 kya	Mousterian point	Scraping	Wood, soft
878	2512	**12**	5c	75 – 100 kya	Mousterian point	Scraping	Wood, hard
900	2545	**12**	5c	75 – 100 kya	Informal tool	Cutting	Meat and bone
901	2560	**12**	5c	75 – 100 kya	Side scraper	Scraping	Hide, fresh
906	2560	**12**	5c	75 – 100 kya	Side scraper	Scraping	Wood, hard

The most common worked material represented at Shanidar Cave is wood, accounting for 33 out of 106 used lithics (32% of the worked assemblage) (Figure 6-139). The next most common material is meat and bone (representing butchery), the working of which is apparent on 27 lithics (28% of the worked assemblage). Hide working is evident from 26 lithics (24% of the worked assemblage). Bone working is represented by 13 lithics (12% of the worked assemblage). The working of plant matter is apparent from five lithics (5% of the worked assemblage). Finally, ochre and horn working were represented by one lithic apiece (1% of the worked assemblage respectively). The results of use-wear analysis suggest that no tool was used for more than one activity. The tools most commonly preserving evidence of

wear were Mousterian tools, specifically side scrapers (n=19) and Mousterian points (n=15) (Figure 6-140). The majority of worked tools (n=79) were excavated from the upper sequence of Shanidar Cave (Phases 5 to 1, MIS 3). The majority of these tools came from Phase 5 (n=22). 65 of the lithics retaining wear (61.3%) were recovered from phases associated with Neanderthal remains (Phases 4-6, 10, 11) compared to 41 recovered from phases with no Neanderthal skeletal materials. A summary of worked tools by phase is presented in Table 6-64 and Figure 6-141.

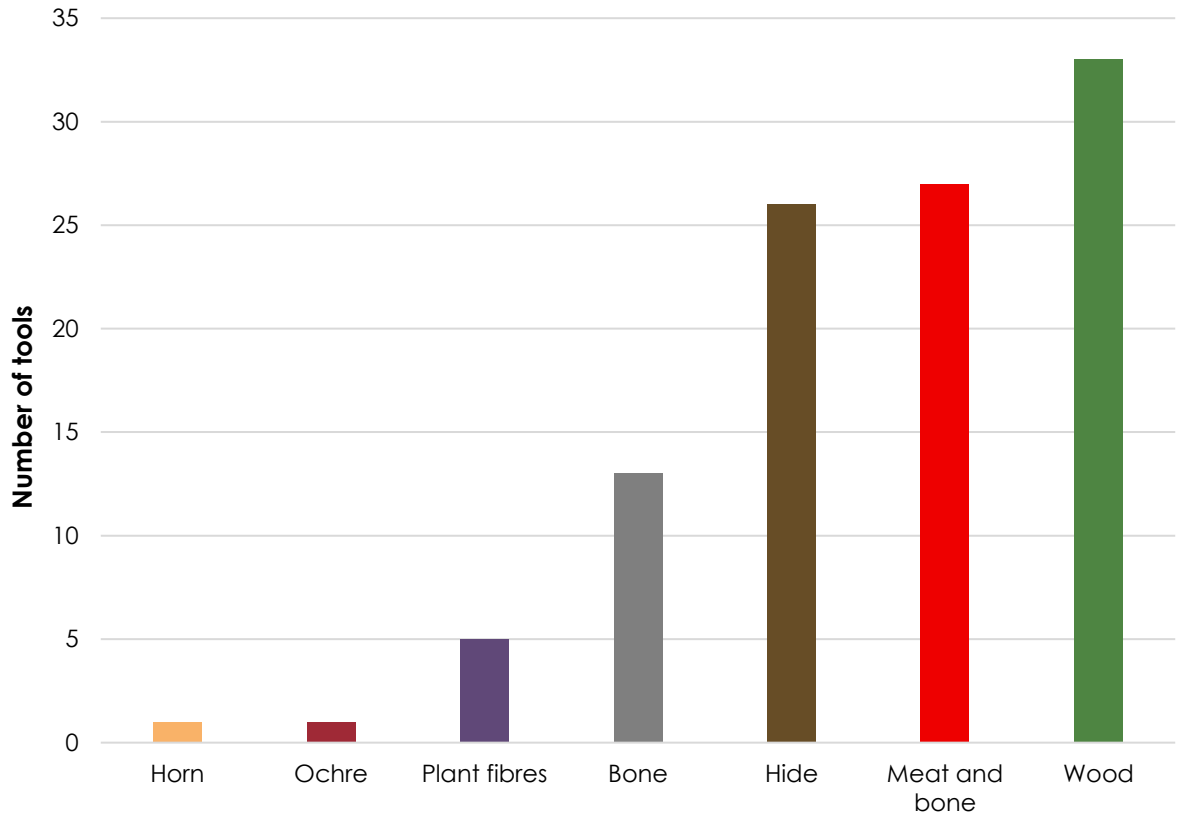


Figure 6-139: *Total worked materials from the Shanidar Cave assemblage*

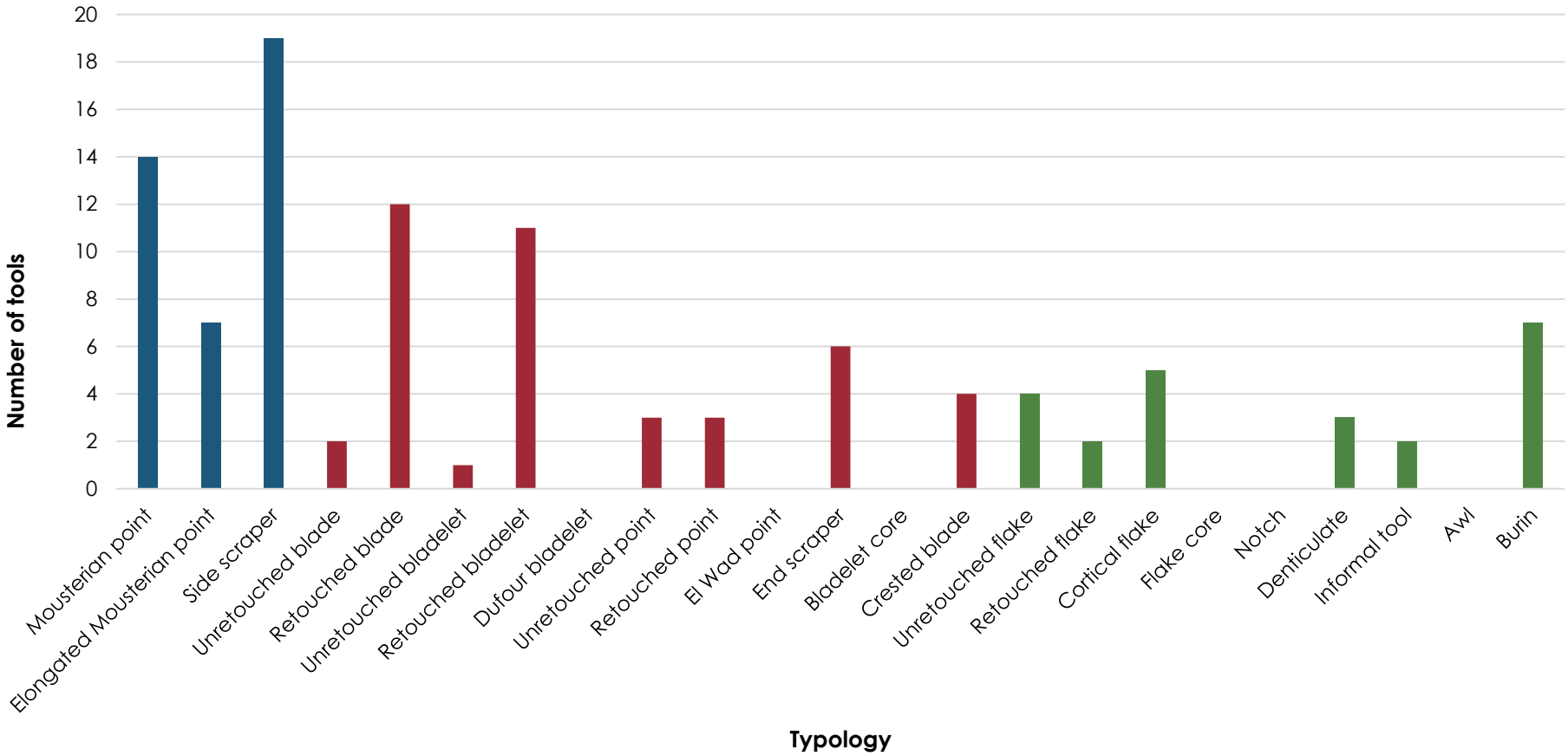


***Figure 6-140**: Number of worked tools by industry and archaeological phase. Mousterian tools are coloured blue, Baradostian red and lithics indeterminate to industry are green*

		MIS 1	MIS 3					MIS 4	MIS 5a				MIS 5c	
	Tool Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Mousterian	*Mousterian point*	*0*	*0*	*0*	*2*	*2*	*1*	*1*	*0*	*3*	*2*	*0*	*3*	***14***
	Elongated Mousterian point	*0*	*0*	*0*	*0*	*2*	*1*	*0*	*0*	*3*	*0*	*1*	*0*	***8***
	Side scraper	*1*	*1*	*2*	*3*	*2*	*3*	*0*	*0*	*1*	*3*	*0*	*3*	***19***
Baradostian	*Unretouched blade*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	***2***
	Retouched blade	*0*	*1*	*2*	*3*	*2*	*3*	*0*	*0*	*0*	*1*	*0*	*0*	***12***
	Unretouched bladelet	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	***1***
	Retouched bladelet	*0*	*0*	*2*	*3*	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***11***
	Dufour bladelet	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	Unretouched point	*0*	*0*	*1*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***3***
	Retouched point	*0*	*0*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***3***
	El Wad point	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	End scraper	*0*	*0*	*3*	*1*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	***6***
	Bladelet core	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	Crested blade	*0*	*1*	*1*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***4***
Indeterminate	*Unretouched flake*	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	***4***
	Retouched flake	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	***2***
	Cortical flake	*1*	*0*	*0*	*2*	*0*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	***5***
	Flake core	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	Notch	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	Denticulate	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	***3***
	Informal tool	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	***2***
	Awl	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***0***
	Burin	*0*	*0*	*3*	*0*	*2*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	***7***
	Total	***3***	***3***	***19***	***17***	***22***	***14***	***1***	***0***	***8***	***11***	***1***	***7***	***106***

Table 6-64: *Number of worked tools by phase*

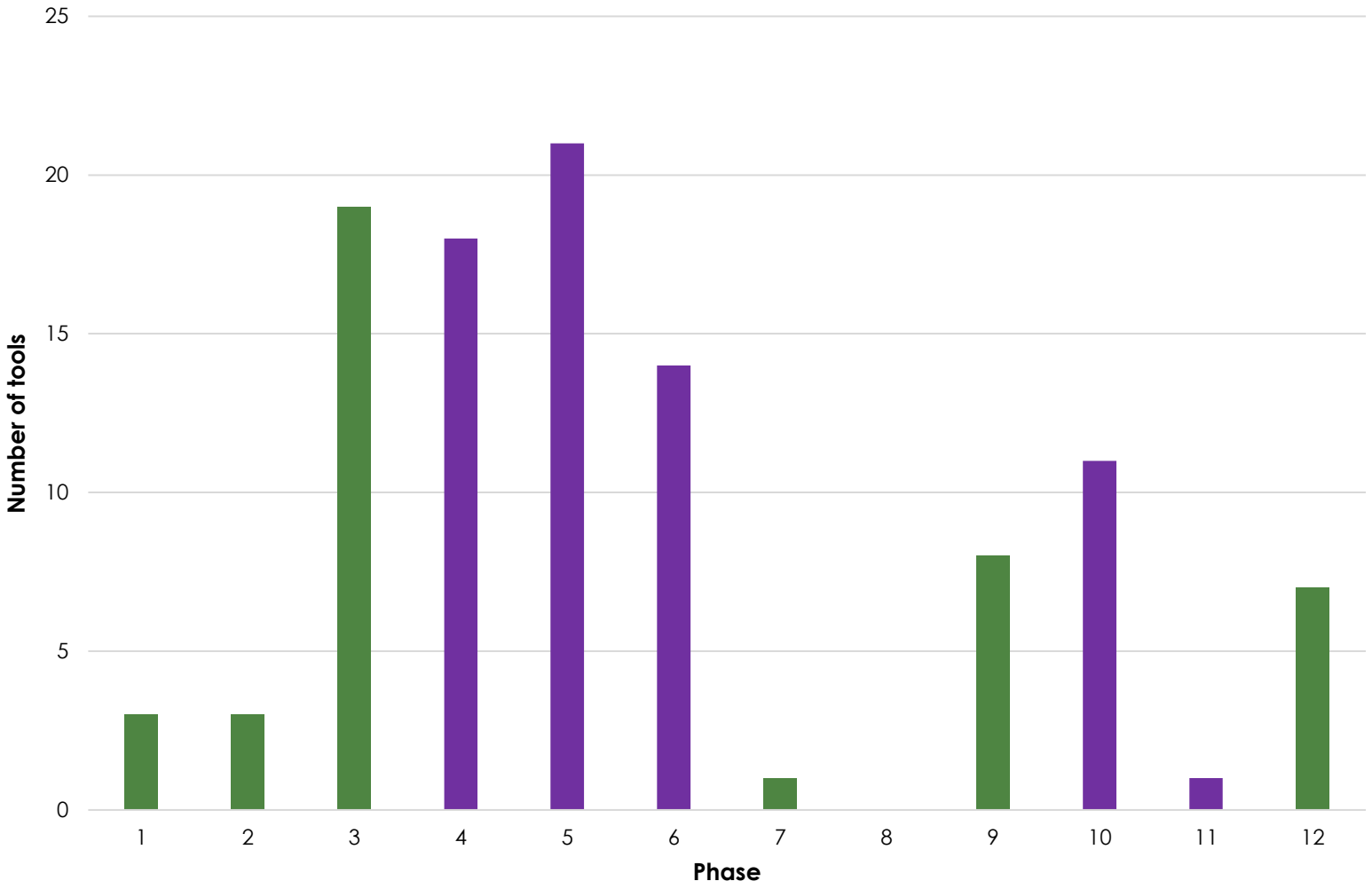


***Figure 6-141**: Number of worked tools by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered. 65 worked tools are associated with Neanderthal phases*

Figure 6-142 presents the wear categories by phase. More tools retaining wear were recovered from the upper sequence of Shanidar Cave (associated with MIS 3) than in the lower sequence (MIS 4 and 5). The only phase not represented in the use-wear results is Phase 8 which is the location of the Shanidar 4 burial cluster. This phase produced the lowest number of lithics overall (n=9). The working of ochre or horn is not evident in the lower sequence (Phases 12 – 6, MIS 4 – 5c) (Figures 6-143 and 6-144). This may be due to issues of preservation or density of activity at the site. The working of plant fibres is only represented in the lower sequence by one instance in Phase 6. No traces of working plant fibres, horn or ochre are evident in MIS 5. There appears to be an increase in bone working in MIS 3 compared to MIS 5, this may suggest a change in crafting materials. Wood working remains constant throughout the entirety of the sequence.

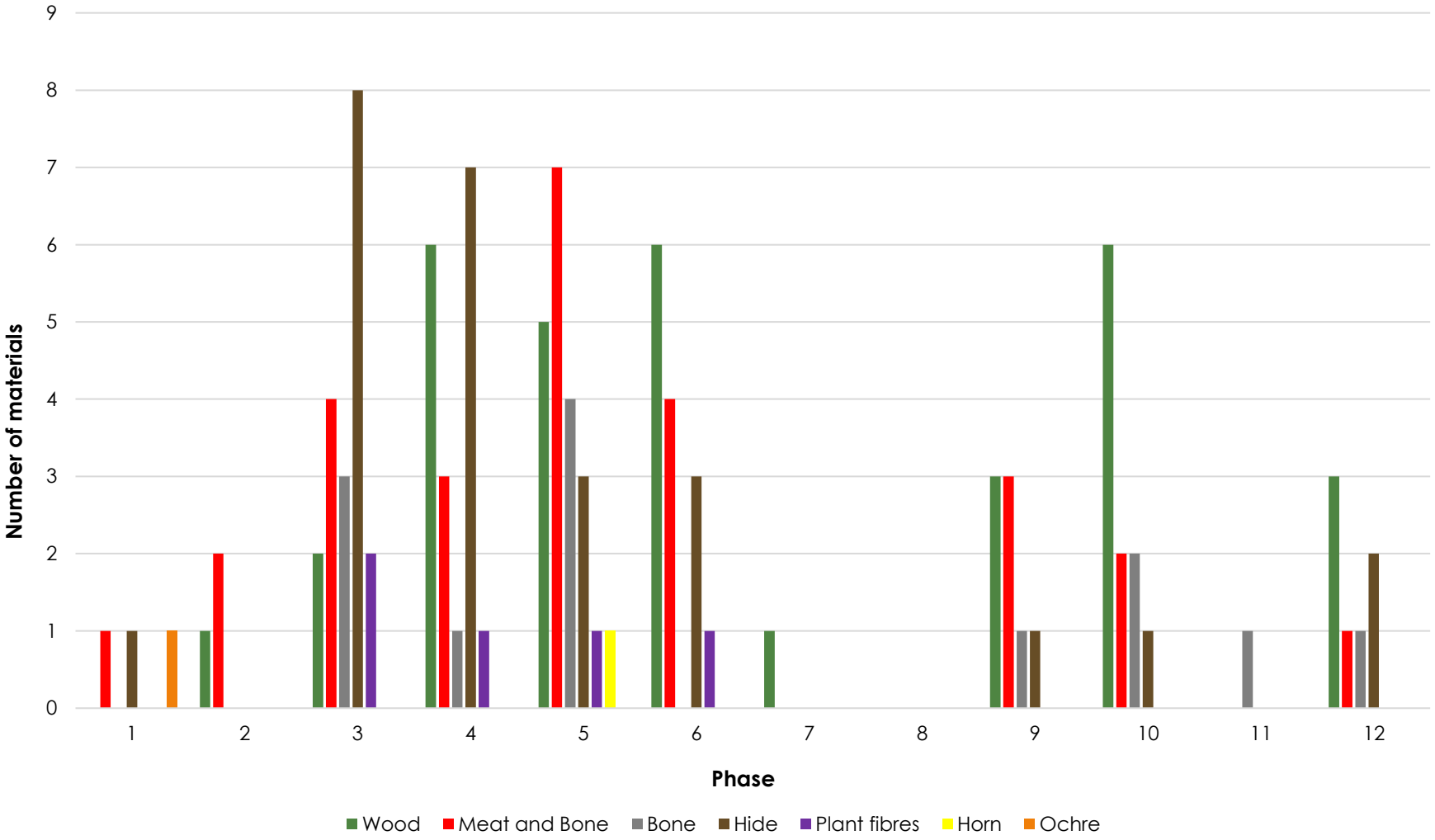


Figure 6-142: *Breakdown of worked materials by chronological phase*

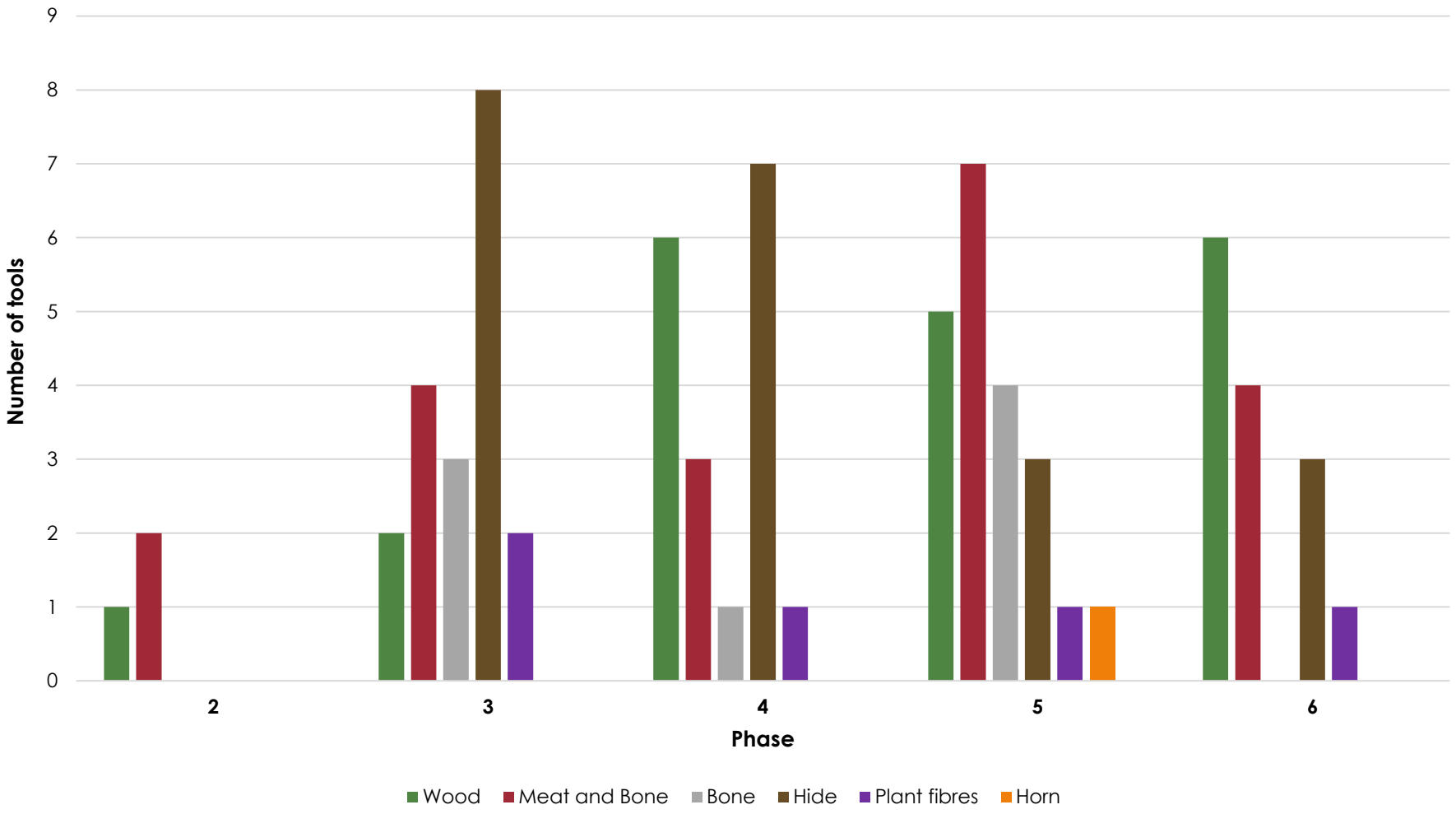


***Figure 6-143**: Worked materials from MIS 3*

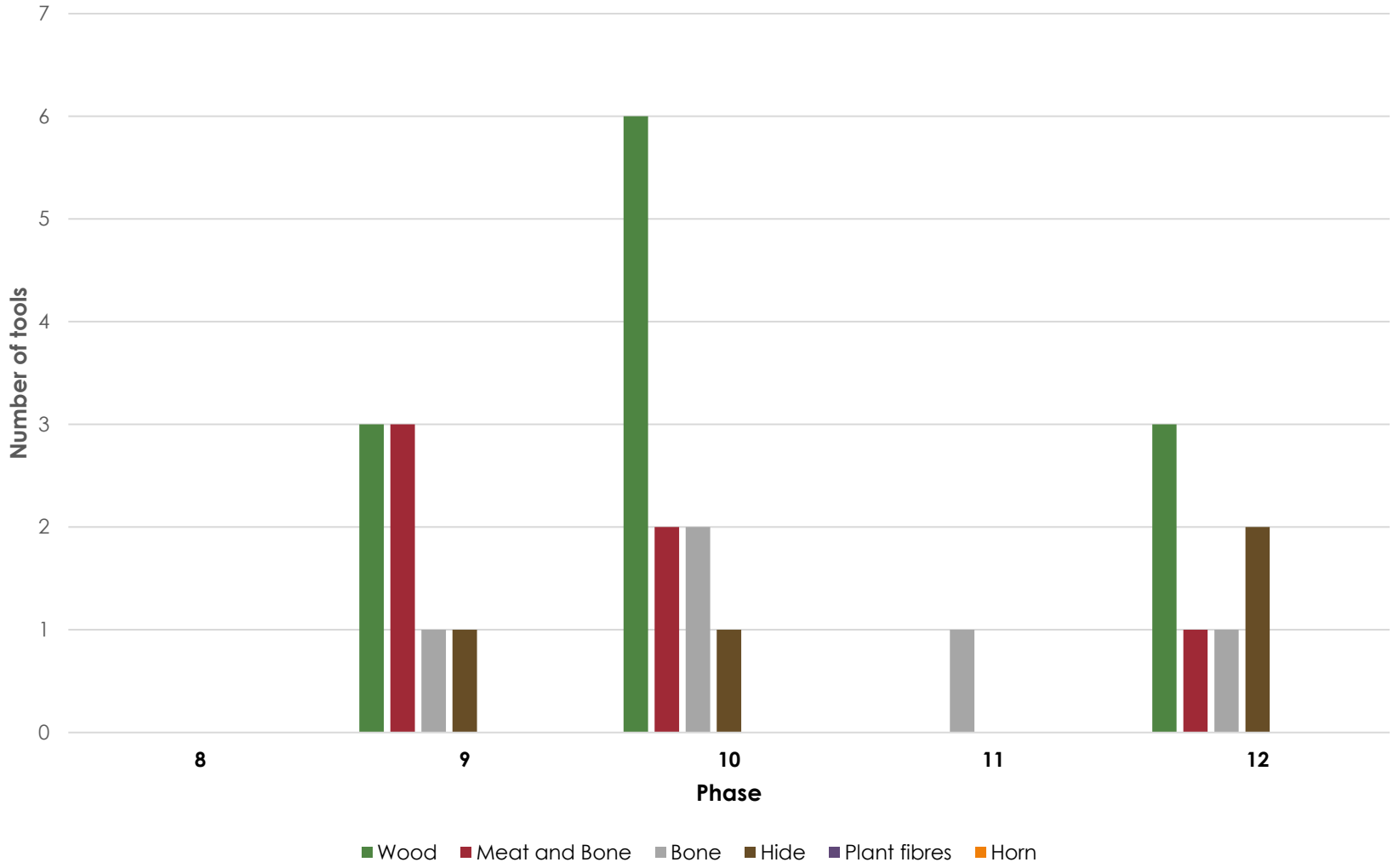


***Figure 6-144**: Worked materials in MIS 5*

A summary of the worked materials by tool types is presented in Table 6-65. There were 13 tool forms which were interpreted as working wood (see Figure 6-145). These include points (Mousterian and retouched), scrapers (side and end), flakes, burins and blades and bladelets. Retouched blades were the most common tool form interpreted as having worked wood (n=8). However, as there are such a high number of tool types, this may suggest that wood working activities at Shanidar Cave could be carried out using a variety of tools.

There were 15 tool forms which were interpreted as working meat (see Figure 6-146). These included tools typically associated with butchery or hunting activities such as points (both forms of Mousterian points, retouched points), as well as blades (unretouched, retouched, crested), bladelets (unretouched, retouched), side scrapers, flakes (unretouched, retouched, cortical, denticulates), burins and informal tools. The wide range of tool types used to work meat at Shanidar Cave may suggest that butchery or hunting activities could be carried out using a variety of tools. The most common tool type was Mousterian points (n=5, n=7 if both types are included) which is to be expected. It should be noted that bladelets are also common (n=5) which was not expected and may reflect some finer butchery activities (e.g. the removal of tendons) for which a large Mousterian point may not be suitable.

There were 10 tool forms which were interpreted as working bone (see Figure 6-147). These include points (both forms of Mousterian points, unretouched point), retouched blades, retouched bladelets, flakes (unretouched, cortical,

denticulates), burins and informal tools. Both forms of Mousterian points (n=5) are the most common tool form, whereas every other tool is only represented by one lithic. This may suggest that points were not solely hunting tools, as has been suggested for Shanidar Cave previously (Solecki and Solecki, 1994) but were also routinely utilised in crafting activities. However, the range of tools used may suggest that any tool form could be utilised for this purpose.

There were 10 tool forms interpreted as working hide (Figure 6-148). These include points (both forms of Mousterian, unretouched and retouched), scrapers (side and end), blades (retouched, crested), retouched bladelets and burins. As would be expected, scrapers were the most common tool form (n=15 for both forms), with side scrapers in particular being the most common (n=11). The bulk of these tool forms would be expected to be associated with hide working, with the scrapers being used to remove sinew (also meat and fat on occasion) to prepare a hide and tools such as burins, bladelets or points being utilised to pierce holes. This may suggest that unlike the other materials, the development of hides at Shanidar Cave required the use of specific tool forms.

There are five tool forms interpreted as working plant fibres (Figure 6-149). These being side scrapers, retouched bladelets, end scrapers, unretouched flakes and burins. Each tool form is represented by one instance of plant working. This may suggest that there is no standardisation for the tools used to work plant fibres. Further, as there are only five instances of plant working in the sequence, this may be an uncommon activity. Alternatively, it may be

the case that the faint traces produced through the working of plant fibres (see section 5.9) did not preserve. This may also be the reason why the working of plant fibres at Shanidar Cave is only evidenced in MIS 3.

There is only one instance of horn working at Shanidar Cave. This was wear was identified on a Mousterian point from MIS 3. The working of horn appears to be an uncommon activity. Again, this may be the result of preservation issues. The circular striations on the point led to the interpretation that the tool was used to drill into a soaked horn (see section 5.10). As the horn would have been soaked prior to working, it is also possible that the working of this material could have been carried out closer to the water source.

Finally, there is again only once instance of possible ochre working at Shanidar Cave. This was done on a large cortical flake from Phase 1 and may therefore be from the Holocene. This tool was clearly ground down at the worked edge and the sheer amount of ochre on it suggests that was the chosen worked material. While ochre is evident throughout the sequence (see section 6.3), no other instance of the preparation of ochre was observed.

Table 6-65: *Worked materials by tool type*

		Wood	***Meat and Bone***	***Bone***	***Hide***	***Plant fibres***	***Horn***	***Ochre***
Mousterian	*Mousterian point*	*5*	*5*	*2*	*1*	*0*	*1*	*0*
	Elongated Mousterian point	*1*	*2*	*3*	*2*	*0*	*0*	*0*
	Side scraper	*6*	*1*	*0*	*11*	*1*	*0*	*0*
Baradostian	*Unretouched blade*	*1*	*1*	*0*	*0*	*0*	*0*	*0*
	Retouched blade	*8*	*2*	*1*	*1*	*0*	*0*	*0*
	Unretouched bladelet	*0*	*1*	*0*	*0*	*0*	*0*	*0*
	Retouched bladelet	*3*	*4*	*1*	*2*	*1*	*0*	*0*
	Dufour bladelet	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Unretouched point	*0*	*0*	*1*	*2*	*0*	*0*	*0*
	Retouched point	*1*	*1*	*0*	*1*	*0*	*0*	*0*
	El Wad point	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	End scraper	*1*	*0*	*0*	*4*	*1*	*0*	*0*
	Bladelet core	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Crested blade	*1*	*2*	*0*	*1*	*0*	*0*	*0*
Indeterminate	*Unretouched flake*	*1*	*1*	*1*	*0*	*1*	*0*	*0*
	Retouched flake	*1*	*1*	*0*	*0*	*0*	*0*	*0*
	Cortical flake	*1*	*2*	*1*	*0*	*0*	*0*	*1*
	Flake core	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Notch	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Denticulate	*0*	*2*	*1*	*0*	*0*	*0*	*0*
	Informal tool	*0*	*1*	*1*	*0*	*0*	*0*	*0*
	Awl	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Burin	*2*	*1*	*1*	*2*	*1*	*0*	*0*

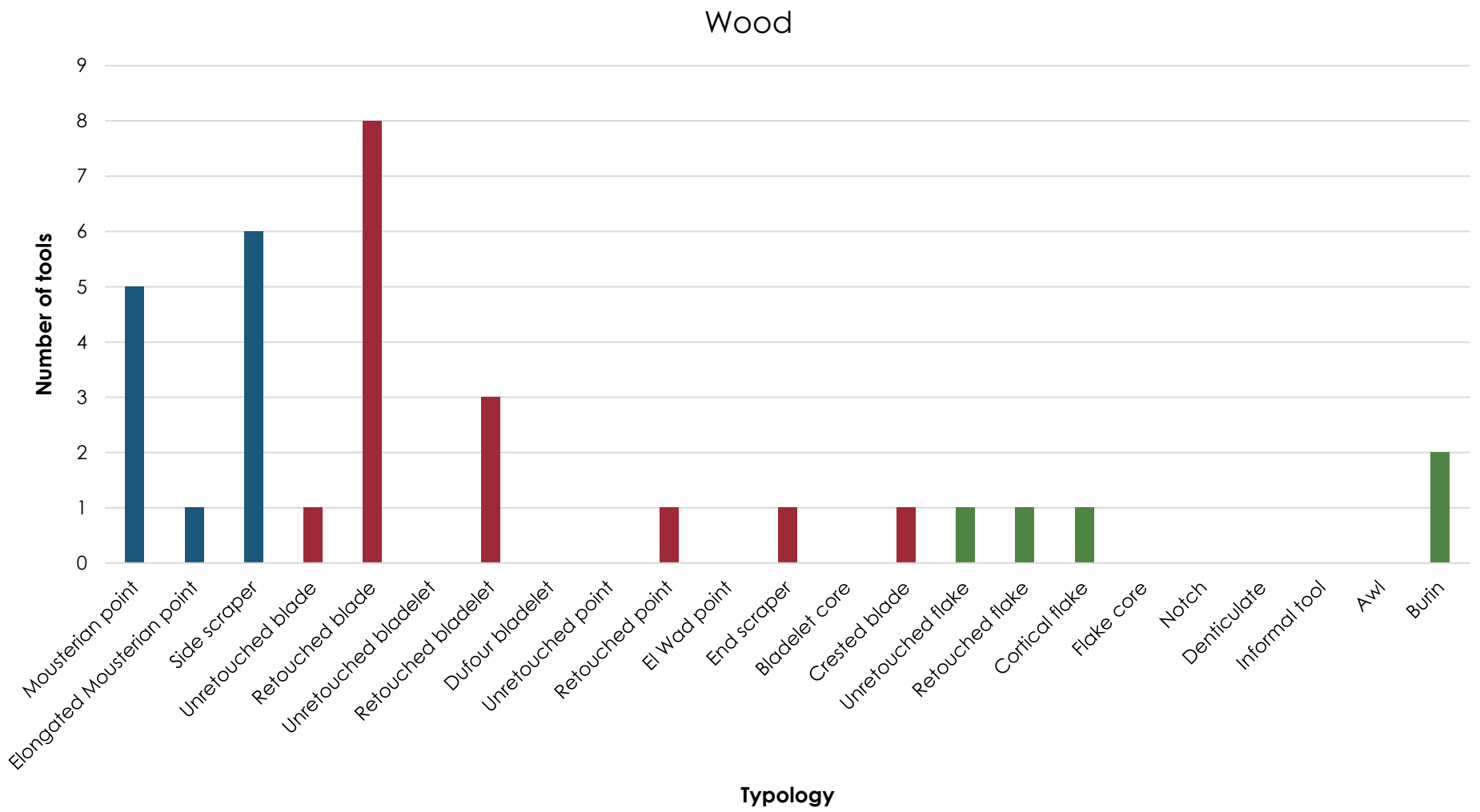


***Figure 6-145**: Typology of tools used to work wood from Shanidar Cave*

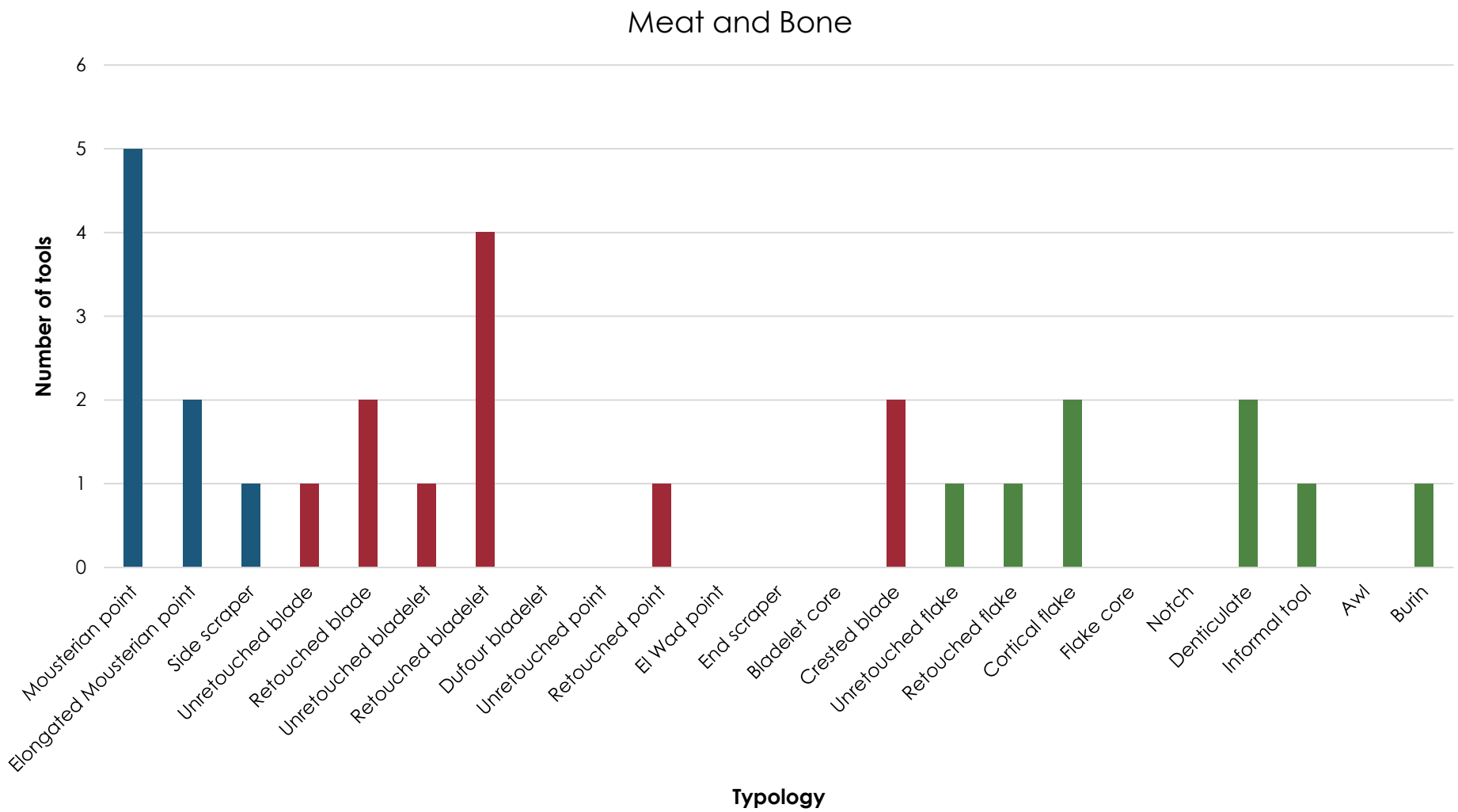


***Figure 6-146**: Typology of tools used to work meat and bone from Shanidar Cave*

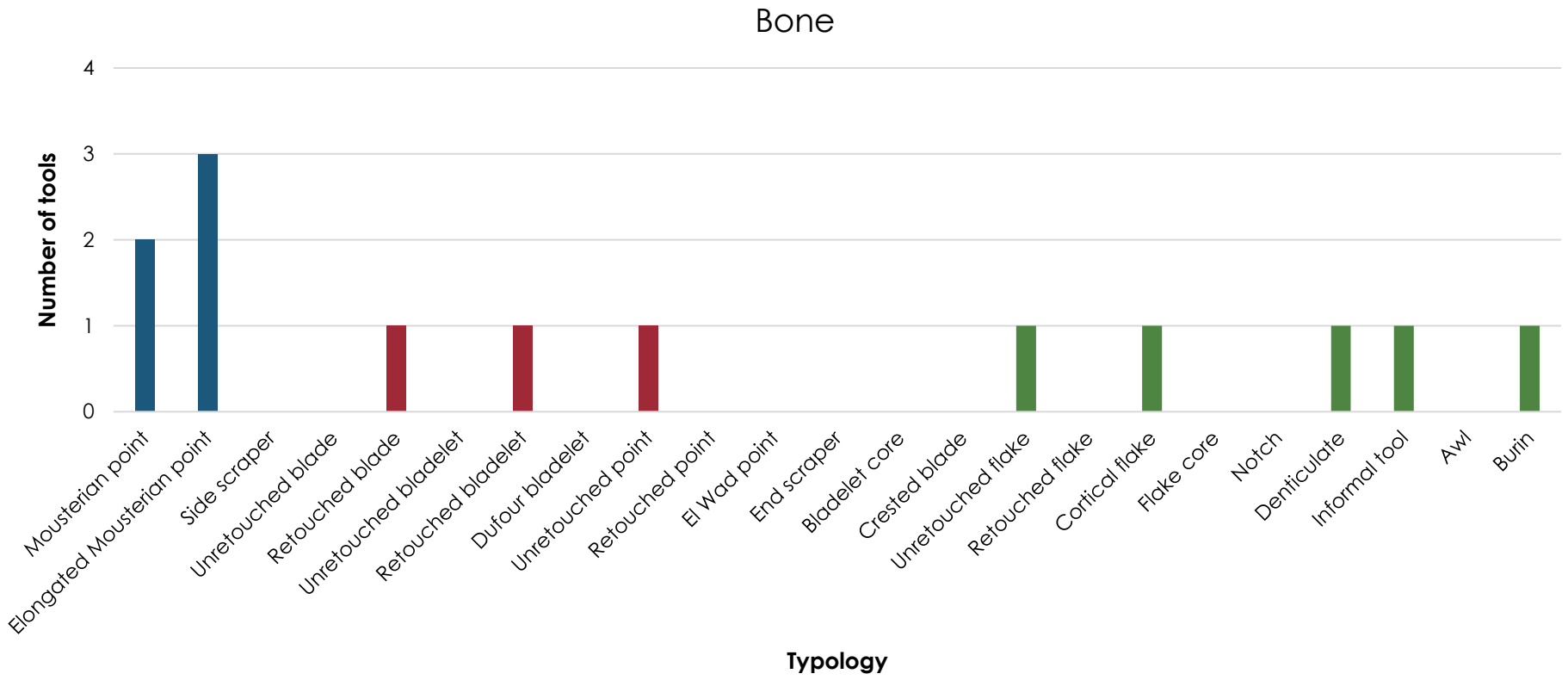


***Figure 6-147**: Typology of tools used to work bone from Shanidar Cave*

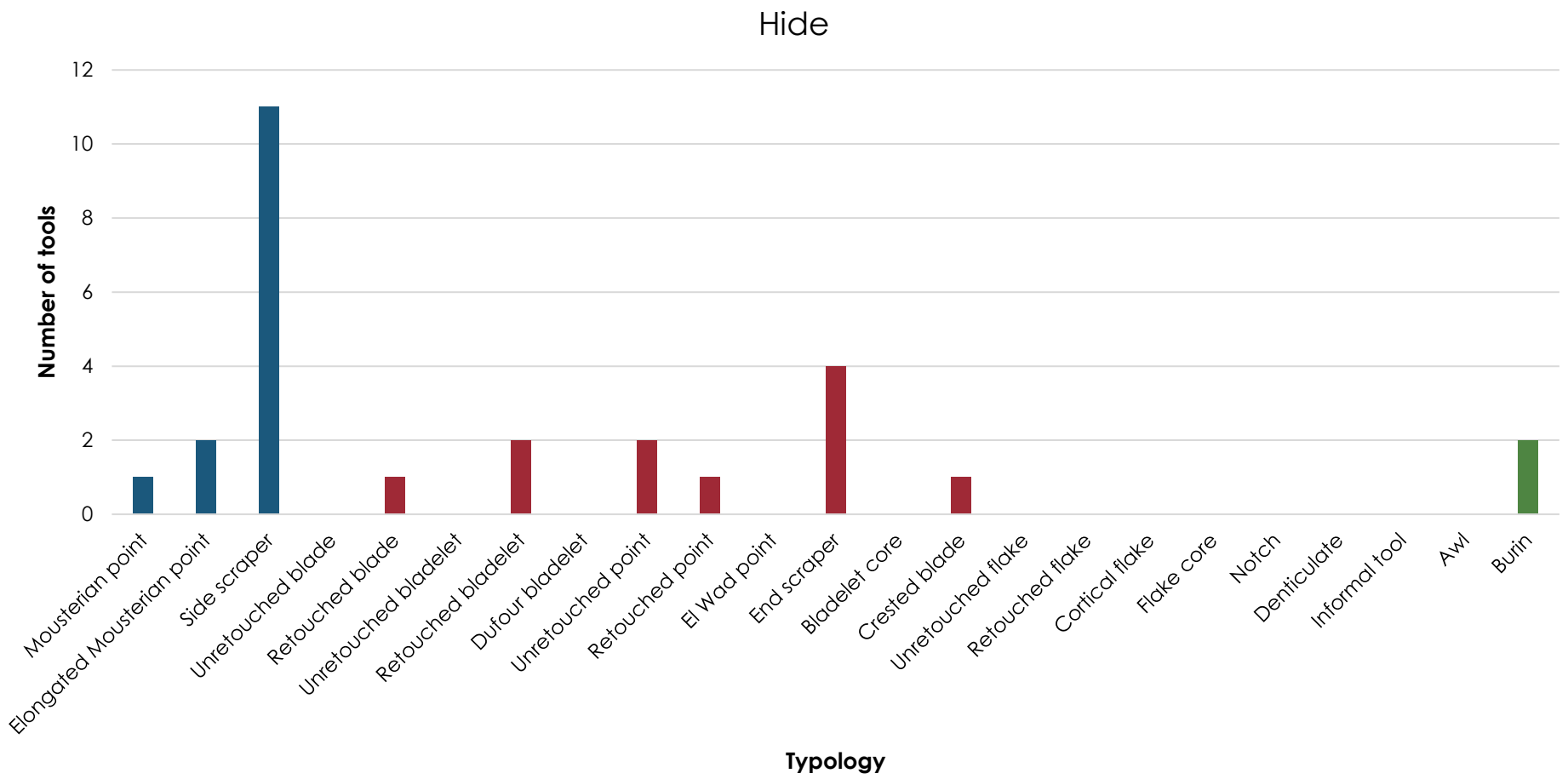


***Figure 6-148**: Typology of tools used to work hide from Shanidar Cave*

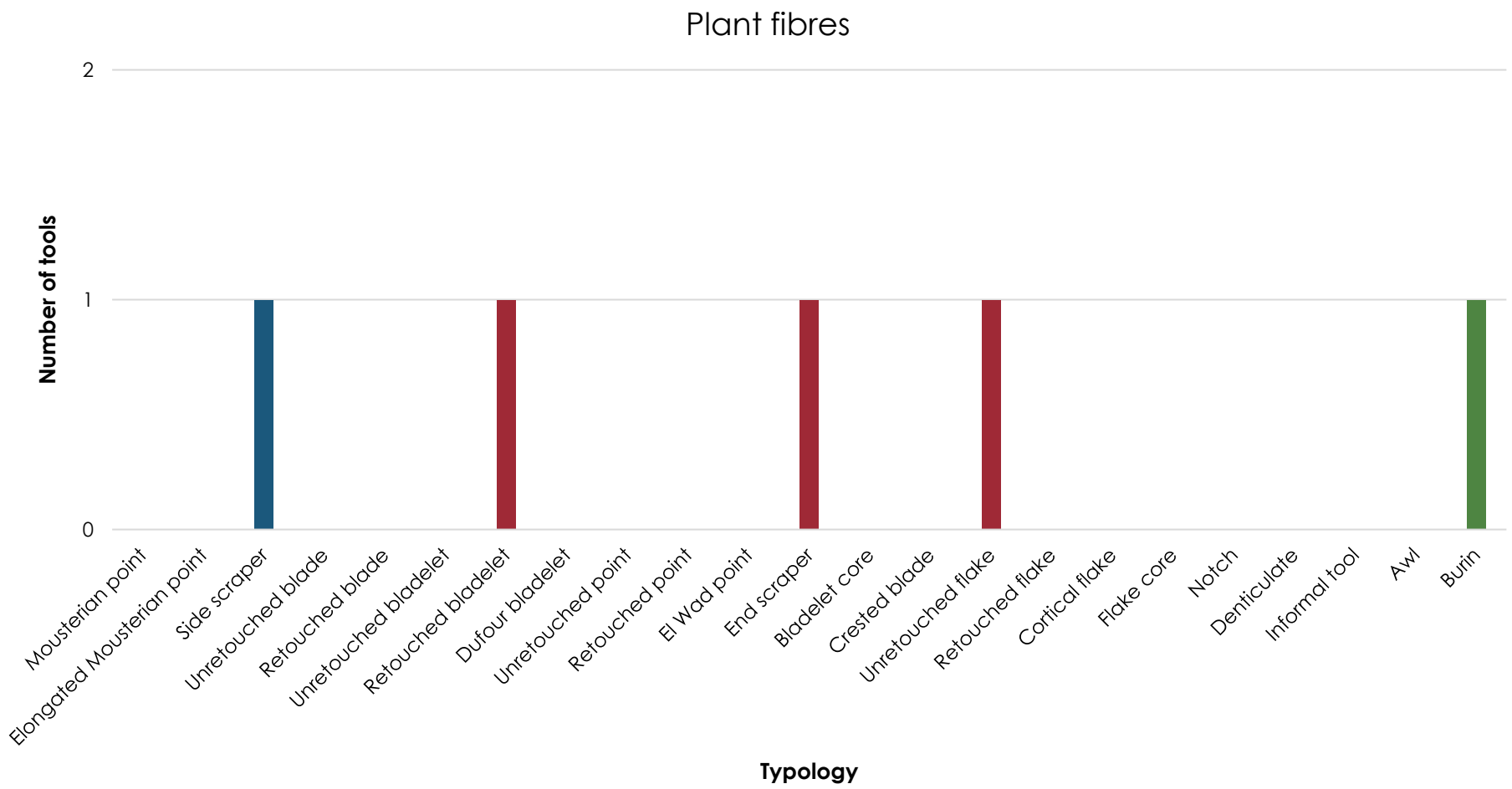


***Figure 6-149**: Typology of tools used to work plant fibres from Shanidar Cave*

Table 6-66 summaries the worked tool types in MIS 3 (n=74) and MIS 5 (n=27). In MIS 3, the bulk of the worked tools can be attributed to the Baradostian lithic industry (n=40). There are 19 tools which can be attributed to the Mousterian lithic industry, and 15 lithics cannot be attributed to either industry. A visual representation is presented in Figure 6-150.

There are fewer worked lithics in MIS 5. This may be due to issues of preservation or could suggest a reduced occupation at the site during this time. The bulk of the lithics are attributed to the Mousterian (n=19). There are only two Baradostian style tools in MIS 5, both from Phase 10. Finally, there are six lithics which are indeterminate to industry in MIS 5. A visual representation is presented in Figure 6-151.

***Table 6-66**: Worked tools in MIS 3 and MIS 5*

		MIS 3					MIS 5				
	Tool Type	**2**	**3**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**
Mousterian	Mousterian point	0	0	2	2	1	0	3	2	0	3
	Elongated Mousterian point	0	0	0	2	1	0	3	0	1	0
	Side scraper	1	2	3	2	3	0	1	3	0	3
Baradostian	Unretouched blade	0	1	0	0	0	0	0	1	0	0
	Retouched blade	1	2	3	2	3	0	0	1	0	0
	Unretouched bladelet	0	0	0	0	1	0	0	0	0	0
	Retouched bladelet	0	2	3	6	0	0	0	0	0	0
	Dufour bladelet	0	0	0	0	0	0	0	0	0	0
	Unretouched point	0	1	2	0	0	0	0	0	0	0
	Retouched point	0	2	1	0	0	0	0	0	0	0
	El Wad point	0	0	0	0	0	0	0	0	0	0
	End scraper	0	3	1	0	2	0	0	0	0	0
	Bladelet core	0	0	0	0	0	0	0	0	0	0
	Crested blade	1	1	0	2	0	0	0	0	0	0
Indeterminate	Unretouched flake	0	1	0	1	1	0	0	1	0	0
	Retouched flake	0	0	0	1	0	0	1	0	0	0
	Cortical flake	0	0	2	0	1	0	0	1	0	0
	Flake core	0	0	0	0	0	0	0	0	0	0
	Notch	0	0	0	0	0	0	0	0	0	0
	Denticulate	0	0	0	1	0	0	0	1	0	0
	Informal tool	0	1	0	0	0	0	0	0	0	1
	Awl	0	0	0	0	0	0	0	0	0	0
	Burin	0	3	0	2	1	0	0	1	0	0
	Total	**3**	**19**	**17**	**21**	**14**	**0**	**8**	**11**	**1**	**7**
	Total in MIS Stage	**74**					**27**				

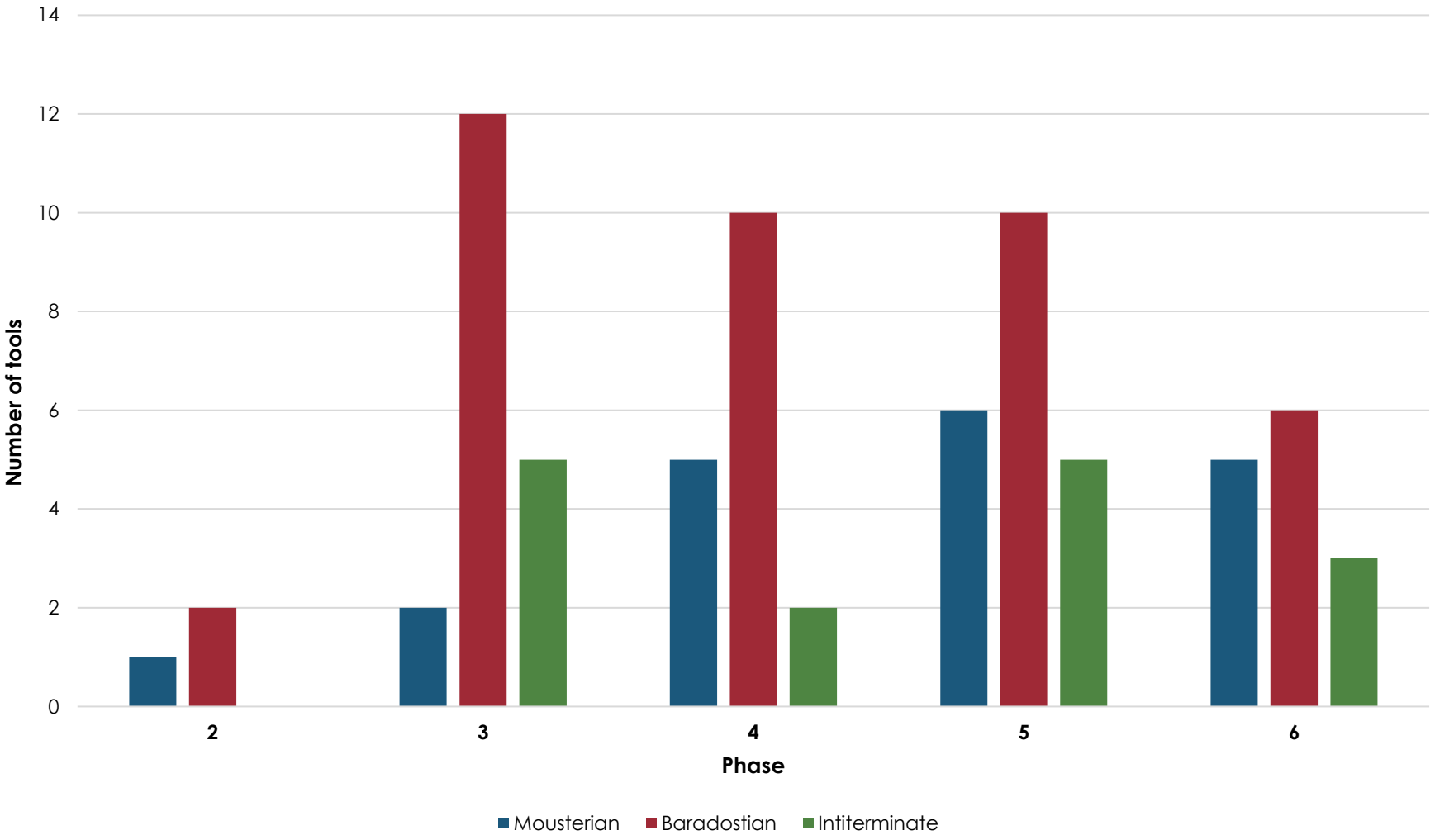


Figure 6-150: *Worked tools by industry from MIS 3*

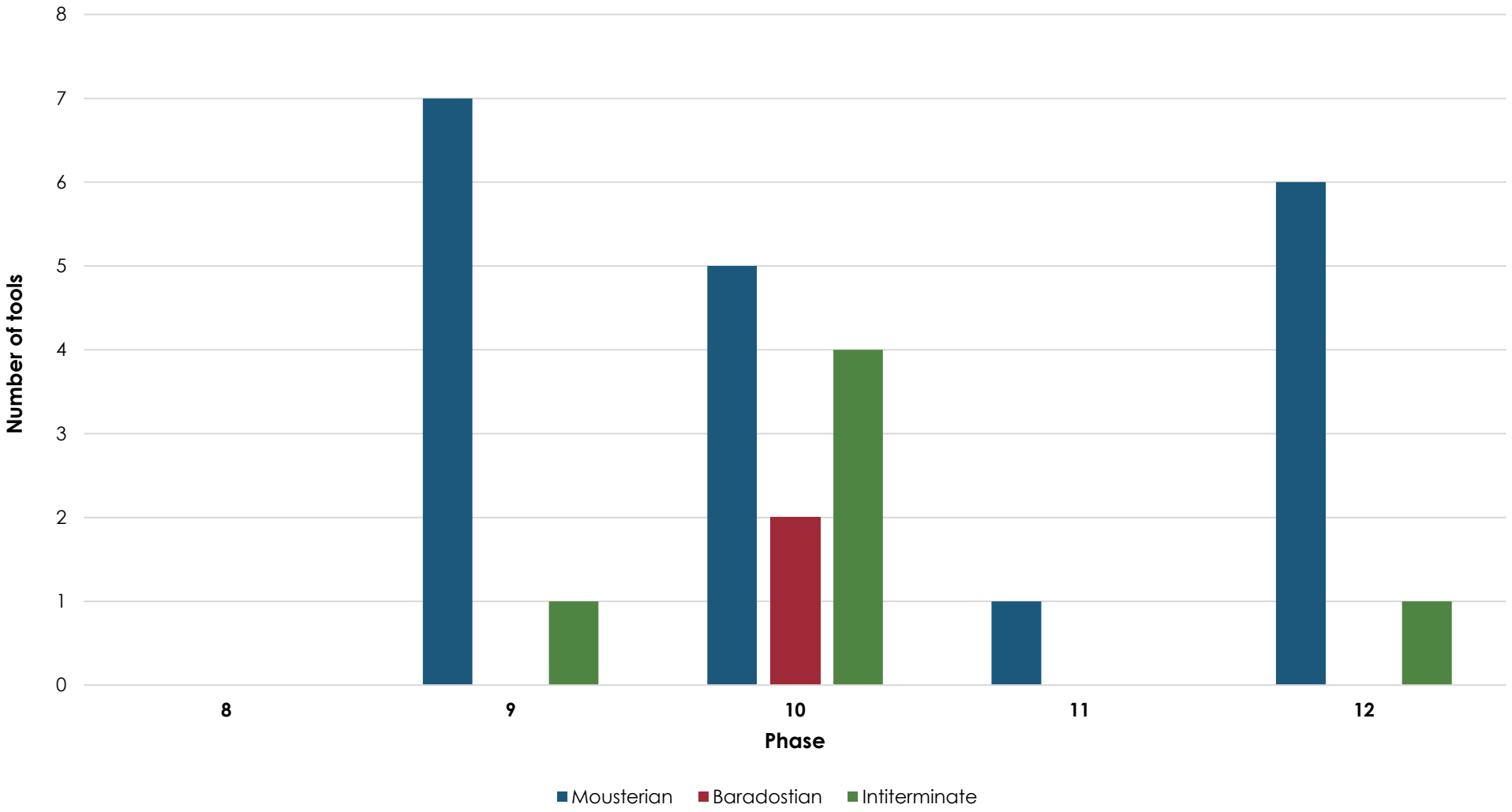


***Figure 6-151**: Number of worked tools by industry from MIS 5*

6.2.19.1 Chi-Square

A chi-square statistical test was conducted to determine whether there were any significant differences in the numbers of materials worked between MIS 5 (archaeological Phases 12 – 9) and MIS 3 (Phases 6 – 2). Because some of the values were below 5 (e.g. the total number of horn working tools [n=1]) the appropriate test was the Fisher-Freeman-Halton exact test. Results are provided in Table 6-67. The p-value (significance) is greater than the generally accepted 0.05 threshold (Agresti, 2013). Therefore, the null hypothesis must be accepted – there is no significant difference in materials worked between MIS 3 and MIS 5. This might suggest continuity in the behaviours of hominins occupying Shanidar Cave through time.

***Table 6-67**: Results for chi-square statistical test for worked materials in MIS 3 and MIS 5*

Chi-Square Tests						
	Value	**df**	**Asymptotic Significance (2-sided)**	**Monte Carlo Sig. (2-sided)**		
				Significance	**99% Confidence Interval**	
					Lower Bound	**Upper Bound**
Pearson Chi-Square	6.682[a]	5	.245	.251[b]	.240	.262
Likelihood Ratio	8.159	5	.148	.176[b]	.166	.186
Fisher-Freeman-Halton Exact Test	6.190			.266[b]	.254	.277
N of Valid Cases	102					
a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .26.						
b. Based on 10000 sampled tables with starting seed 2000000.						

Given the association with Baradostian tools in MIS 3 and Mousterian tools in MIS 5, a second Chi-square was conducted to determine if the difference in worked tools was statistically significant between the MIS stages (Table 6-68). Again, the appropriate test was the Fisher-Freeman-Halton exact test. The p-value (significance) was lower than the generally accepted 0.05 threshold (Agresti, 2013) therefore, the null hypothesis must be rejected – there is a significant difference in the worked tools in MIS 3 and MIS 5.

Table 6-68: *Results for chi-square statistical test for worked tools in MIS 3 and MIS 5*

Chi-Square Tests						
	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		
				Significance	99% Confidence Interval	
					Lower Bound	Upper Bound
Pearson Chi-Square	27.771[a]	16	.034	.022[b]	.018	.026
Likelihood Ratio	33.623	16	.006	.014[b]	.011	.017
Fisher-Freeman-Halton Exact Test	26.473			.010[b]	.007	.012
N of Valid Cases	101					
a. 28 cells (82.4%) have expected count less than 5. The minimum expected count is .27.						
b. Based on 10000 sampled tables with starting seed 475497203.						

6.3 Residue

Residues were identified on 59 tools. Results are presented in Table 6-69. The most commonly identified residue was ochre which was found on 34 tools, the majority of which were excavated from the upper sequence of Shanidar Cave (Phases 5 – 1, MIS 3) (n=18). This could suggest that the use of ochre was a behaviour more typical of Upper Palaeolithic rather than Middle Palaeolithic hominins at Shanidar (see section 2.2.3; Lawson, 2012; Velliky et al., 2018: Hodgkiss, 2020: Rosso et al., 2025). Conversely, that fewer tools from Middle Palaeolithic contexts preserved ochre could reflect issues of preservation (Oudemans and Erhardt, 1996; Cnuts and Rots, 2024; Keller et al., 2025).

Manganese oxide was identified on 23 tools. Manganese oxide is very commonly identified on archaeological material excavated from cave settings due to high levels of moisture and the decomposition of organic matter within caves (Northup et al., 2001; White et al., 2009; Frierdich et al., 2011; Carmichael et al., 2015). Where it appears randomly distributed across a tool's surface it might be considered as of little consequence (Bordes et al., 2017; Velliky et al., 2018). However, four tools (ID: 319, 19b, 482 and 408) had distinct linear bands of manganese along their worked edges (Figure 6-152). This has been attributed to the working of biological matter such as meat, hide, plants, etc (Luong et al., 2017, 2019; Venditti et al., 2019; Pedergnana, , 2020).



Figure 6-152: *Butt of lithic 19B, a retouched bladelet from Phase 4. Linear bands of manganese oxide are present in association with edge rounding. The interpretation of this tool is that it was hafted – linear bands might indicate the application of an organic adhesive (e.g. mastic) which has since deteriorated, whilst the edge rounding may have been caused by friction between the tool and a potential binding material e.g. leather. Scale represents 0.5mm*

Finally, an indeterminate brown globular residue was found adhering to four tools from Phases 3, 5, 10, and 12 (Figure 6-153). These tools were sent to a residue specialist for further analysis. Results were not available at the time of writing.



***Figure 6-153**: Brown, globular residue observed on lithic 870 (Mousterian point) from Phase 12.*

A breakdown of the phases from which residues were recovered and the tool types retaining residue are presented in Figures 6-154 and 6-155.

***Table 6-69:** Summary of tools with residue*

Specimen ID	Context	Phase	Tool type	Residue
488	-	**1**	Side scraper	Manganese
489	-	**1**	Cortical flake	Ochre
319	629	**2**	Retouched blade	Manganese in linear band, ochre
58	518	**3**	End scraper	Ochre
62	748	**3**	Retouched blade	Ochre
106	1037	**3**	Side scraper	Ochre
107	1043	**3**	Retouched point	Manganese
109	1034	**3**	Burin	Ochre
112	1037	**3**	End scraper	Ochre
131	1043	**3**	Informal tool	Ochre

Specimen ID	Context	Phase	Tool type	Residue
874	2538	**3**	Retouched point	Ochre
141i	568	**3**	Unretouched point	Ochre
141k	1037	**3**	Burin	Globular residue
19b	537	**4**	Retouched bladelet	Manganese in linear band
148	537	**4**	Retouched bladelet	Ochre
163	1400	**4**	Unretouched point	Manganese
170	1433	**4**	Unretouched point	Manganese
297	560	**4**	End scraper	Ochre
299	1653	**4**	Mousterian point	Manganese
330	1609	**4**	Side scraper	Manganese
873	2530	**4**	Retouched bladelet	Ochre
908	2530	**4**	Retouched bladelet	Manganese
39	750	**5**	Retouched bladelet	Globular residue
46	708	**5**	Retouched point	Ochre
64	748	**5**	Retouched bladelet	Manganese
115	1118	**5**	Retouched bladelet	Manganese
116	1213	**5**	Retouched bladelet	Manganese, ochre
165	1369	**5**	Elongated Mousterian point	Manganese, ochre
167	1410	**5**	Elongated Mousterian point	Ochre
255	1325	**5**	Retouched flake	Manganese
298	632	**5**	Retouched bladelet	Ochre
317	1638	**5**	Mousterian point	Manganese
480	2125	**5**	Side scraper	Manganese
402	1852	**6**	Unretouched flake	Manganese
403	1845	**6**	End scraper	Ochre
407	1868	**6**	Side scraper	Manganese, ochre
410	1823	**6**	Unretouched bladelet	Ochre
419	1816	**6**	Retouched blade	Manganese, ochre
467	1845	**6**	Retouched blade	Manganese

Specimen ID	Context	Phase	Tool type	Residue
470	1861	**6**	Side scraper	Ochre
479	1876	**6**	Mousterian point	Manganese, ochre
481	2043	**6**	Elongated Mousterian point	Manganese
482	2041	**6**	Retouched blade	Manganese in linear band, ochre
555	2263	**7**	Mousterian point	Manganese
222	1507	**9**	Mousterian point	Manganese
566	2283	**9**	Mousterian point	Ochre
567	2283	**9**	Elongated Mousterian point	Ochre
571	2284	**9**	Retouched flake	Ochre
580	2303	**9**	Elongated Mousterian point	Manganese
687	2284	**9**	Elongated Mousterian point	Ochre
379	1924	**10**	Burin	Ochre
406	1924	**10**	Unretouched blade	Ochre
408	1933	**10**	Side scraper	Manganese in linear band
585	2312	**10**	Mousterian point	Globular residue
602	2340	**12**	Mousterian point	Manganese
857	2560	**12**	Side scraper	Ochre
870	2518	**12**	Mousterian point	Globular residue
878	2512	**12**	Mousterian point	Manganese, ochre
906	2560	**12**	Side scraper	Ochre

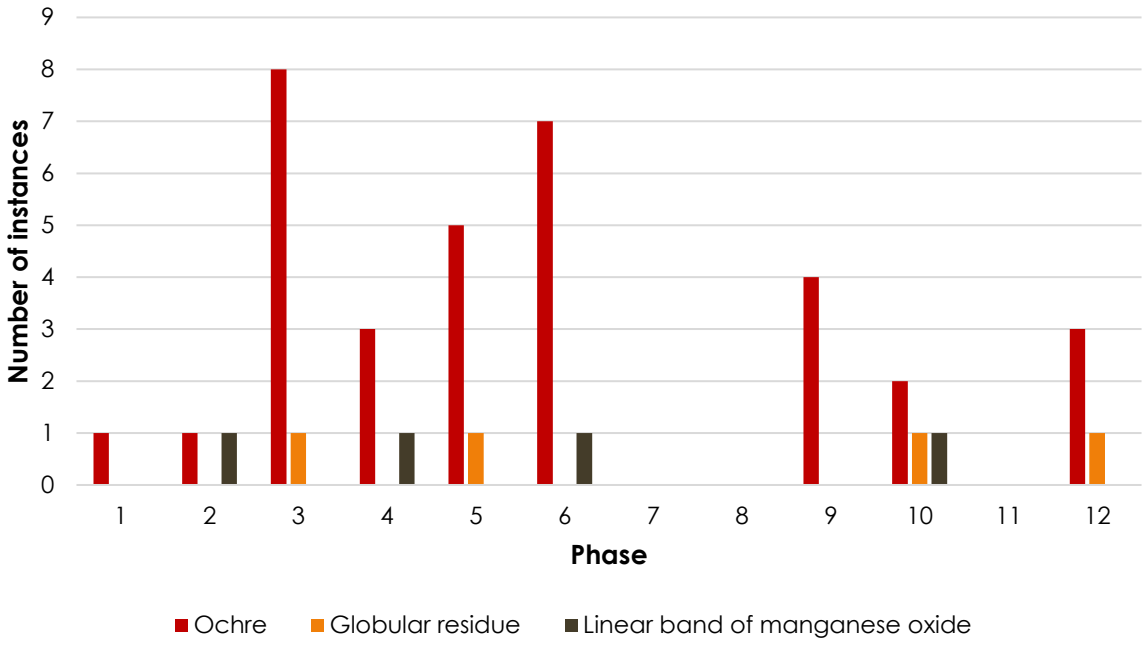


Figure 6-154: *Identified residues by chronological phase*

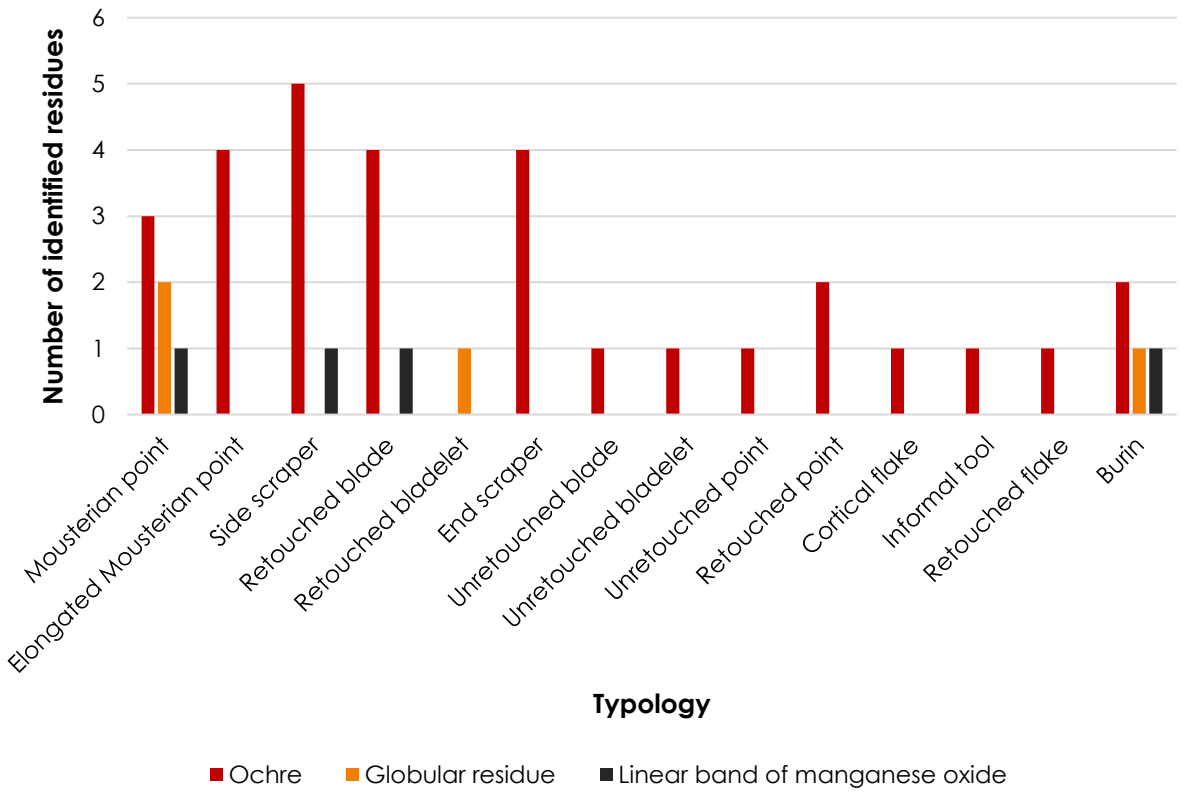


Figure 6-155: *Residues by tool type*

6.3.1 Animal and Plant Fibres

A total of 49 lithics were re-washed in hydrochloric acid (HCl)10% solution, being soaked for 15 minutes in order to remove any adhering sediment or residue. These included the lithics with manganese oxide except for those where the manganese formed in linear bands as described above, lithics identified as having no wear in the first round of analysis, and lithics used to work hard materials such as wood or bone. Lithics were again examined blind to contextual information and the prior interpretation using the same equipment to rule out any bias. The interpretation of the use of one lithic was revised following re-washing, as detailed above (section 4.4.1, 6.2.1).

Several animal and plant fibres were discovered upon analysis of the resulting wash. These were sent to specialists to enable determination of the exact species exploited by hominins at Shanidar Cave, allowing for more detail than could be provided by use-wear analysis alone (Venditti et al., 2019; Fullagar et al., 2013; Fullagar and Jones, 2004; Rots et al., 2016). Preliminary results show that an animal hair removed from a burin from Phase 6 (MIS 3) is likely to have come from a caprid, likely West African ibex (*Capra aegagrus*) (Figure 6-156). Indeed, this tool (ID: 389) was interpreted as a hide working tool used in an awling (drilling) motion. A bast fibre removed from a retouched blade from Phase 5 (MIS 3) was deemed to most resemble fibres from the Cupressaceae (cypress) family, particularly juniper (*Juniperus* sp.) (Figure 6-157) (C. Hunt, pers. comm., 2026). This tool (ID: 69) was interpreted as having been used to scrape soft wood.

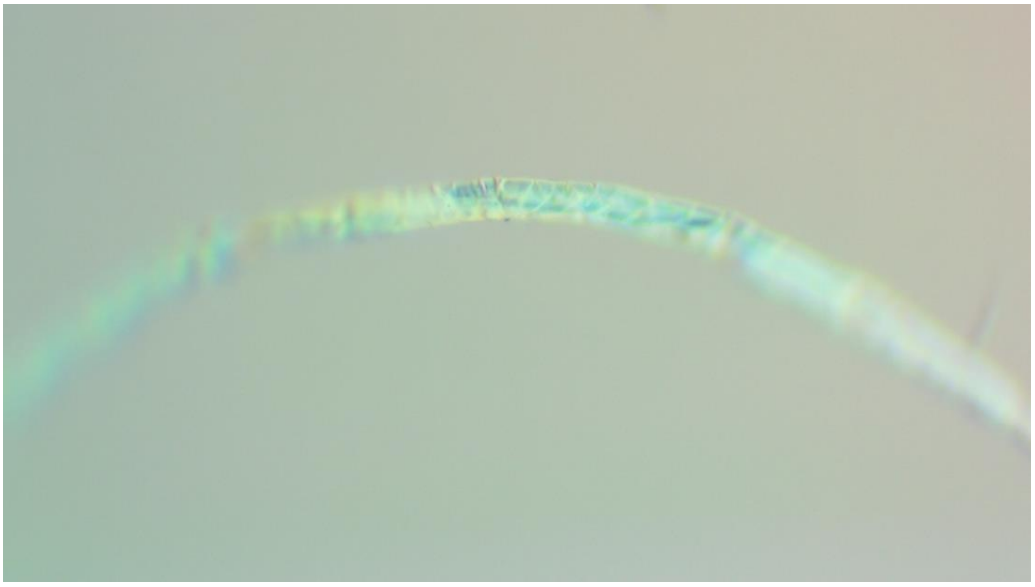


Figure 6-156: *Animal hair recovered from the HCl-10% wash from lithic 389, 200x magnification, Nomarski illumination. The hair is suspected to belong to a caprid, likely West Asian ibex (*Capra aegagrus*) which is common in Zagros faunal assemblages (C. Hunt, pers. comm., 2026). Lithic 389 is a burin from Phase 6 interpreted as a hide working (awling) tool. Photo by C. Hunt*

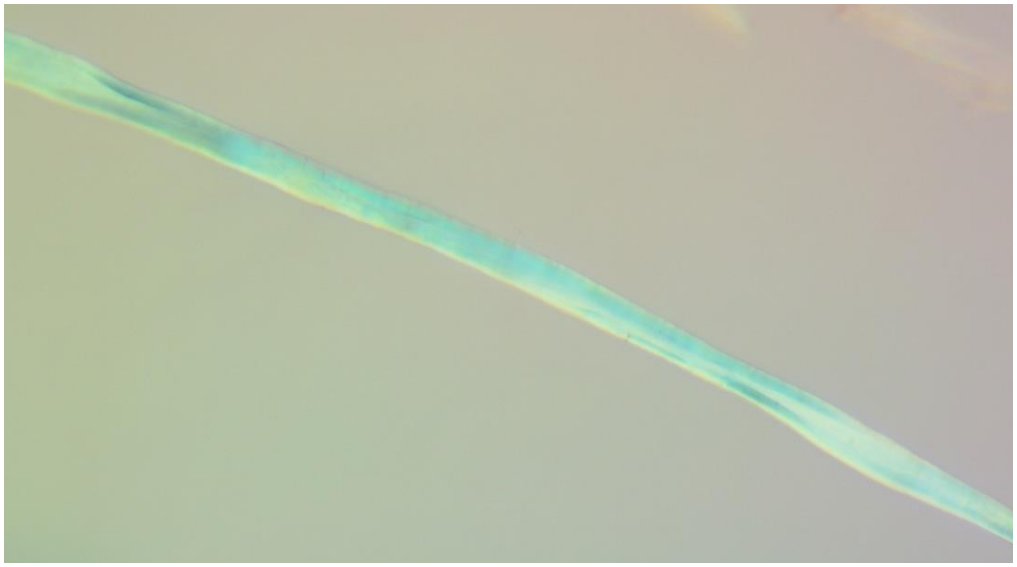


Figure 6-157*: Plant bast fibre recovered from the HCl-10% wash from lithic 69, 200x magnification, Nomarski illumination. The fibre most resembles fibres from* Cupressaceae *sp., particularly juniper (*Juniperus *sp.) (C. Hunt, pers. comm., 2026). Lithic 69 is a retouched blade from Phase 5 interpreted as soft wood scraping tool. Photo by C. Hunt*

6.4 Anomalous Finds

Three special finds which were unable to attributed to a particular typology but were of note are detailed below.

6.4.1 Engraved Stone

A pebble with apparent cut marks was recovered from Phase 5 which is associated with MIS 3 and the burial of the Shanidar 3 Neanderthal. The marks were deemed not naturally occurring because they occur in groups, with lines overlapping and changing orientation. The centre of the pebble which is where the majority of cut marks are located is worn, and manganese oxide is apparent in linear bands suggestive of the working of organic material (Luong et al., 2019) (Figure 6-158). A comparison to a quern stone was made therefore, but the small size of the pebble (<10 cm) makes it an impractical cutting surface. A possibility is that the cut marks are not the result of a functional activity, rather they represent a series of abstract lines. Mounting evidence suggests that Neanderthals were capable of abstract thought, and capacity for abstract thought in anatomically modern humans is widely accepted (Zilhão, 2012, 2020; Marquet et al., 2023; Leder et al., 2021; Bicho et al., 2007; Beck, 2000; Kind et al., 2014).

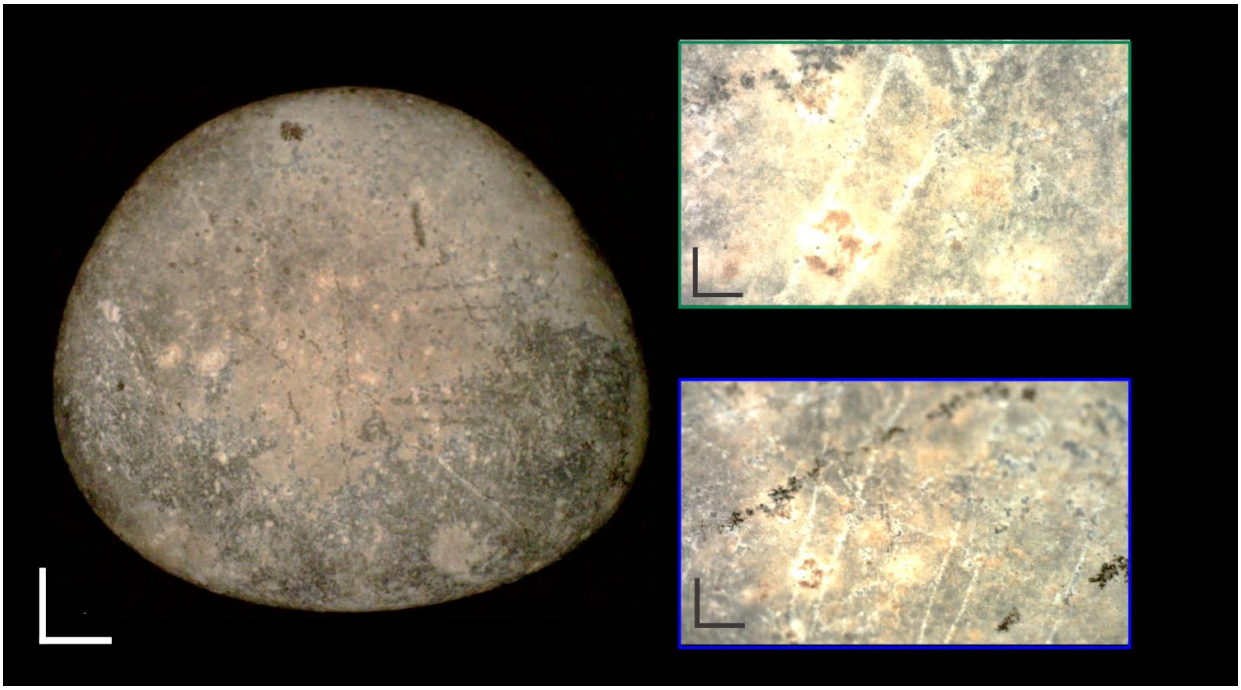


Figure 6-158: *Engraved stone from Phase 5 (context: 1459, ID: 161a). Macro scale 5mm. Green square (magnification 55x, scale 0.5 mm) shows linear cuts to the surface. Blue square (magnification 230x, scale 0.2mm) shows further linear marks and bands of manganese*

6.4.2 Limestone Tools

Shanidar Cave is karstic – it is formed of limestone (Solecki, 1953, 1955; Stevanović et al., 2009; Mustafa and Merkel, 2015; Forti et al., 2021). Most limestone material recovered from the excavations therefore has been interpreted as naturally occurring, having fallen from the roof of the cave for example (Solecki and Solecki, 1994). However, two unstratified pieces of limestone were recognised as having been knapped due to the presence of striking platforms and retouched edges (Figures 6-159 and 6-160). One artefact appears to have been knapped in the Levallois tradition which has not been recognised otherwise within the Shanidar lithic assemblage. Modified limestone was also reported by Solecki and Solecki (1994), who

noted two "portable-sized" rocks that "exhibited shiny polish as though from attritional wear". It could be argued that there are more limestone tools from Shanidar Cave that have gone unrecognised.

Experiments conducted in the 2022 season using limestone from the bottom of the Shanidar Cave talus slope have shown that whilst the material could be knapped and worked it was not easy to use. Unlike chert or flint limestone does not fracture conchoidally meaning that the results of knapping were less predictable. Further, limestone tools did not retain their edges for long. This material might have been used as a last resort when resource availability was limited therefore.



***Figure 6-159**: Unstratified limestone flake (context 1603, ID: 342). Magnification 5x, scale 10mm. The morphology suggests it has been knapped in the Levallois tradition. There is an apparent striking platform at the base*

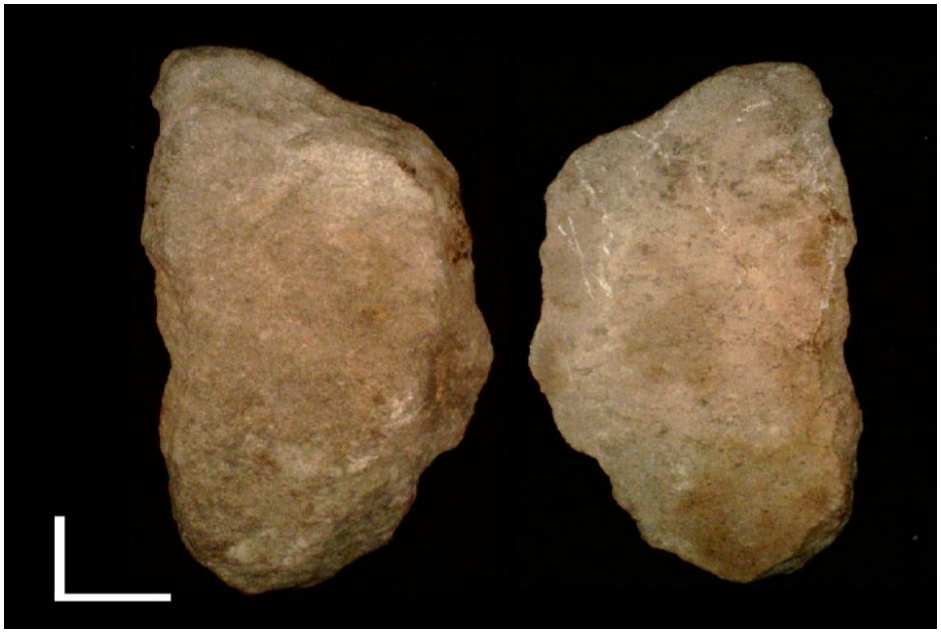


***Figure 6-160**: Unstratified limestone flake (context: 1736, ID: 281). Magnification 5x, scale 10 mm. The morphology of the flake is similar to that of a scraper; however, retouch is lacking. There is an apparent striking platform at the base of the tool. Linear marks on the tool were caused by the scraping of a trowel during the excavation process*

6.5 Conclusion

This chapter has covered the results of typological assessment, use-wear, and residue analyses on the Shanidar Cave lithic assemblage. Tools were identified to type and to industry (Mousterian or Baradostian) where possible and their position in the stratigraphic sequence was recorded. Wear traces, where apparent, were described and assessed with reference to experimentally produced lithics (see Chapter 5) and to published literature. Tools preserving residue were also described. Finally, anomalous finds – an

engraved pebble and limestone flakes – were detailed. The following chapter serves to discuss these results and place them into the context of the region and the wider discussion around the capabilities of Neanderthals and anatomically modern humans.

Chapter 7 - Discussion

7.1 Introduction

The previous two chapters have covered the results from the experimental and archaeological components of this thesis. For the experimental component, flakes were knapped from flint sourced in the UK and used to work a series of materials (e.g. raw meat, wood, and hide) in a series of actions (e.g. drilling, cutting, scraping) for a predetermined amount of time (see Chapter 5). The results from the experimental component served as a reference for the analysis of the archaeological material from Shanidar Cave (see Chapter 6).

This chapter discusses the results of the archaeological analyses which served to provide answers to research questions 1 and 2, i.e. whether the lithic assemblage from Shanidar Cave is typologically similar to others in the Zagros, and what lithic use- wear can add to understanding of the behaviours of the occupants of Shanidar Cave through time. In addition, Chapter 7 addresses research questions 3 and 4, i.e. is the lithic assemblage from Shanidar Cave typologically similar to others in the Zagros, and what can be understood about the behaviours of the occupants of Shanidar Cave through time as suggested by lithic use-wear? These findings are used to contribute to the ongoing debates surrounding the cognitive capacities of Neanderthals.

7.2 Shanidar Cave Lithics

Lithics were analysed stratigraphically blind so as to prevent bias in assigning tools to type and industry. Tools identified from Shanidar Cave are discussed below. Details are provided on the current state of knowledge for each tool type, for example the hominins associated with it and what is currently understood as to the function of that tool. Use-wear results for each tool type are also discussed with reference to the experimental results from Chapter 5.

7.2.1 Mousterian Tools

Stylistically Mousterian tools identified were Mousterian points, elongated Mousterian points, and side scrapers. These tools are considered synonymous with *Homo neanderthalensis* and the Middle Palaeolithic (Bordes, 1961b; Dibble, 1987; Lindly, 1997; Shea, 2013). Neanderthal skeletal evidence has always been associated with Mousterian lithics in the Zagros (Zanolli et al., 2019; Heydari-Guran et al., 2021; Solecki, 1975). However, as both Neanderthals and anatomically modern humans are present in southwest Asia from at least 120,000 years before present and before ~50,000 years ago both species were associated with Middle Palaeolithic industries (Mondal et al., 2016; Shea, 2003; Been and Barzilai, 2024). Without skeletal remains of a particular species, it can therefore be difficult to determine the exact species occupying a site at any given time. Certain sites within the

nearby Levantine region (modern day Israel and Palestine) are palimpsests of successive hominin groups highlighting that both species were utilising cave sites at the same time (Grün et al., 2005; Zaidner et al., 2025). Neanderthal remains associated with Middle Palaeolithic industries are known from the Iranian sites of Bawa Yawan Rockshelter (Heydari-Guran et al. 2021) and Bisitun Cave (Trinkaus and Biglari 2006).Though skeletal evidence for *Homo sapiens* in the Zagros before c. 40,000 years before present is minimal – the earliest known evidence are the butchered anatomically modern human remains from Eshkaft-e Gavi which are associated with the earliest Baradostian lithics at the site – anatomically modern humans are evidenced in the region by genetic data which has supported assumptions based upon lithic assemblages (Hole and Flannery, 1968; Ghasidian, 2014, 2019; Olszewski, 1999; Olszewski and Dibble, 1994; Grün et al., 2005; Zaidner et al., 2025).

Solecki (1955, 1979) found that all ten Neanderthals from his Middle Palaeolithic Layer D at Shanidar Cave were associated with Mousterian tools (analysed in Skinner, 1965; Akazawa, 1975), and that there was a 10,000-year hiatus between the Middle Palaeolithic and Upper Palaeolithic at Shanidar Cave. However, subsequent excavations have shown that Baradostian tools are also present in what would have been Solecki's Layer D and in the more recently discovered Neanderthal-associated contexts (Phases 12 – 10). The results of the blind typological analysis in this study show that Mousterian elements at Shanidar Cave can be found from the base of the sequence to well into MIS 3, about 30,000 years ago (see section 6.1.4). Further, there is no

evidence for a 10,000-year hiatus between the Middle Palaeolithic and Upper Palaeolithic as Mousterian and Baradostian type tools overlap and are present throughout the entirety of the cave's sequence. As above, is difficult to determine which hominin species was the maker of any tool at any given point. As a result, Mousterian tools at Shanidar Cave might also be associated with *Homo sapiens*.

7.2.1.1 Mousterian Points

Mousterian points (including elongated Mousterian points) are the second most numerous of the identified tool types (behind bladelets, n=77), totalling 55 lithics (13.7% of the assemblage). Solecki and Solecki (1994) also identified Mousterian points in abundance. The prevalence of this tool type has been argued to signify the high importance of hunting practices by the hominins using Shanidar Cave (Lindly, 1997; Solecki, 1979; Solecki and Solecki, 1994).

It has been theorised that Shanidar Cave is a site associated short-term rather than long-term occupation. It has been hypothesised that Shanidar Cave acted as a "summer camp" (Solecki and Solecki, 1994; Lindly, 1997) and/or as a mortuary site (Pettitt et al., 2006; Pomeroy *et al*., 2020, in press; Barker and Hunt, 2023). Indeed, Mousterian points from Shanidar are heavily retouched which could indicate repeated re-use and that their makers were highly mobile (see Figure 7-1; Solecki, 1979; Nymark Jensen, 2021; Dibble, 1995). There are no local outcrops of workable chert so any raw material

would have to have been carried for some distance to be worked on site. That tools were resharpened and reused suggests that they were used for as long as possible, perhaps to preserve that raw material. Indeed, it has been claimed that some of the Mousterian points from Shanidar Cave are particularly small for this tool type (Solecki and Solecki, 1994), which is supported by the average size data from this study (Table 7-1). Comparative data from other sites in the region could not be found however.

Mousterian points were found throughout the bulk of the cave's sequence (Phase 12 – 3) but were most common in MIS 5 (n=36). Mousterian points in MIS 3 contexts might be argued as intrusive and the result of recycling within the site itself due to repeated occupation (Solecki and Solecki, 1994), however, given the presence of Neanderthals and Mousterian points up to Phase 4, it is likely that this tool form was in use up to this point. The average measurements of Mousterian (and elongated Mousterian) points do not vary greatly throughout the sequence, which could suggest continuity in knapping techniques through time. Mousterian points are not found from the base of Phase 3 (MIS 3, c. 52 – 42,000 kya). This coincides with the extinction of the Neanderthals in the Zagros region (Heydari-Guran et al., 2021).

Table 7-1: *Average measurements of Mousterian points from Shanidar Cave*

Typology	Length (mm)	Width (mm)	Thickness (mm)
Mousterian point	33.1	21.2	4.8
Layer D "standard-sized" Mousterian point (Solecki and Solecki, 1994)	43.1	24.3	8.0
Layer D "small-sized" Mousterian point (Solecki and Solecki, 1994)	29.9	19.5	6.3
Elongated Mousterian point	40.8	17.3	5.1
Layer D elongated Mousterian point (Solecki and Solecki, 1994)	50.8	18.7	7.6

Wear traces were identified on a total of 22 Mousterian points (14 regular and eight elongated). The most common identified worked material was meat (n=7). This should be expected given the association between this tool form and hunting (Shea, 1990, 2013; Solecki and Solecki, 1994; Villa et al., 2009; Sharon and Oron, 2014). This association is based on use-wear evidence, impact patterns and association with animal remains. It can therefore be inferred that hunting activities were taking place at Shanidar Cave.

Conversely, almost as many points were interpreted as wood working tools (n=6). This may suggest therefore that the Mousterian Points from Shanidar Cave were not solely tools for hunting, highlighting the behavioural flexibility of the Shanidar Neanderthals. Indeed, use-wear studies on Levantine Mousterian assemblages have identified use-wear traces associated with wood working, as well as the working of other materials such as bone, hide and plant fibres (Groman-Yaroslavski et al., 2016; Martin-Viveros, 2023). The same materials were also worked at Shanidar Cave.

It should be noted that the working of wood is not necessarily separate from hunting activities as the use of wooden spears in the Palaeolithic is well established, including at Shanidar Cave itself (Thieme, 1997; Hutson et al., 2025; Pomeroy et al, in press). This also applies to hide working and the working of plant fibres as both can be utilised to make cordage, which could in turn be used for hafting, bags, etc (Hardy et al., 2020; Prince, 2000; Doyon et al., 2025). Therefore, at least at Shanidar Cave the presence of Mousterian points cannot simply be attributed to hunting activities.

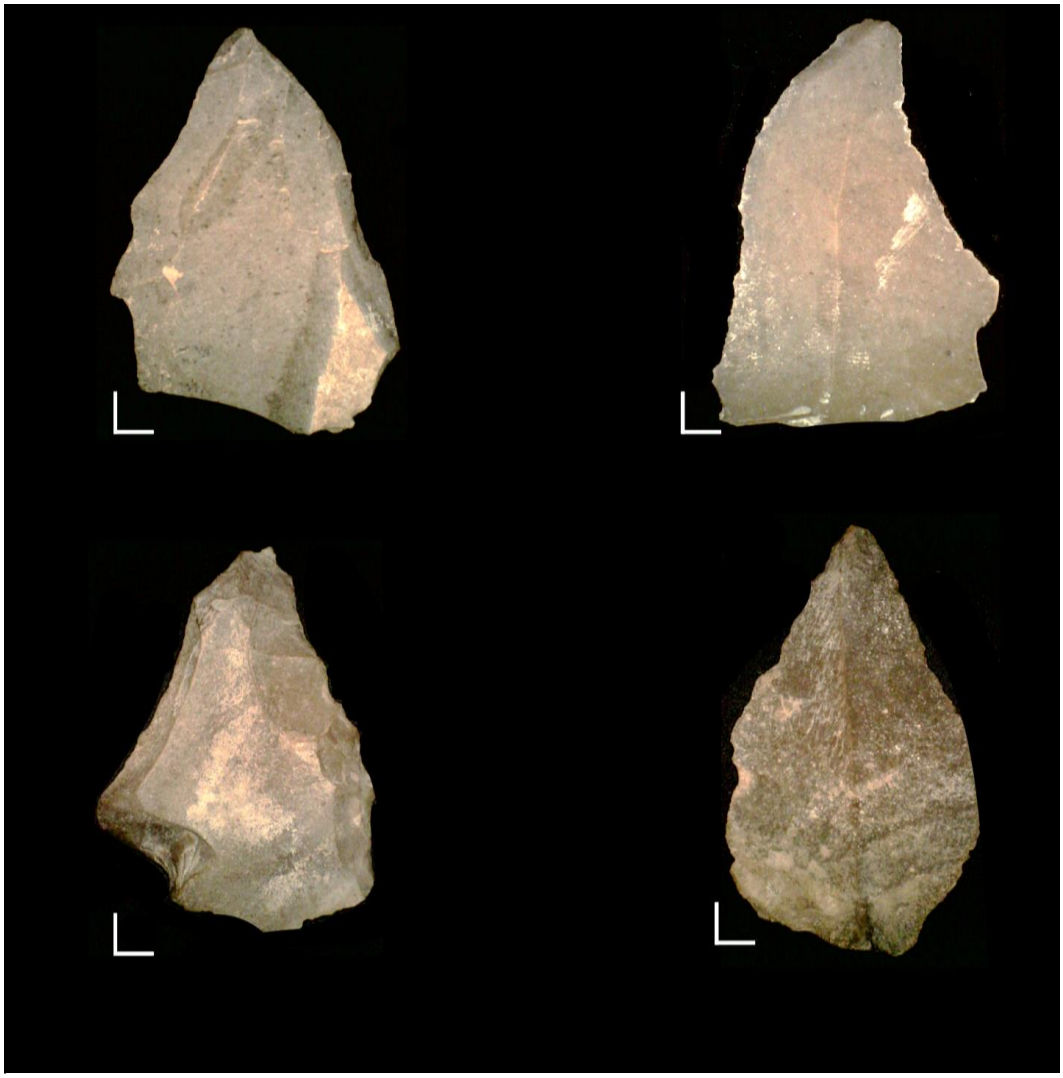


Figure 7-1: *Examples of Mousterian points from the Shanidar Cave assemblage. Scale 10 mm. Top left: chert elongated Mousterian point from Phase 5 (context 1410, ID: 167). Top right: chert elongated Mousterian point from Phase 11 (context 2326, ID: 593). Bottom left: retouched Mousterian point from Phase 9 (context 1507, ID: 222). Bottom right: Mousterian point from Phase 10 (context 1924, ID: 421)*

7.2.1.2 Side Scrapers

31 side scrapers were identified, accounting for 7.8% of the Shanidar Cave assemblage. The presence of side scrapers in a lithic assemblage has been used to infer the utilisation of perishable material, predominantly hide (Bordes, 1961a, Binford, 1982; Dibble, 1995; Hayden, 1979; Aleo et al., 2021).

As discussed in 4.4.2, side scrapers can be sub-divided into four distinct categories based on the degree of reduction (Dibble, 1987b, 1995). The side scrapers most commonly identified from Shanidar Cave were double-edge scrapers (n=18), followed by single-edge scrapers (n=12). There were two convergent scrapers and no transverse side scrapers. The argument can be made therefore that the occupants of Shanidar Cave were not working their side scrapers to the fullest extent (Dibble, 1987a). This might suggest that there was a variety of tools available and/or that other tools were being used for similar purposes. Use-wear analysis shows that whilst the tools most associated with hide working at Shanidar Cave were indeed scrapers, a range of tools were also connected with such. It is important to note however that with the exception of a Mousterian point and a crested blade that these other tools were not used in a scraping motion. What is not represented in the lithic assemblage is perishable tools such as those made of wood, or tools that might not immediately be recognised as such e.g. bone. Any of these items could also be used to work hide, as is evidenced from sites such as the bone smoothers from Abri du Maras or Combe-Grenal (France)(MIS 5)

(Doyon et al., 2025; Tartar et al., 2012) or the shell scrapers found in Ali Tappeh, Iran (Epipalaeolithic) (Manca et al., 2018).

Side scrapers were found between Phases 12 and 1 at Shanidar Cave but were most numerous in Phases 12 which is associated with MIS 5 hominins. The limited number of tools found in later phases (3 – 1) may suggest recycling within the site rather than the continued use of the form. Indeed, the numbers of such appear to trend towards decline from the earliest to the latest phases (see Table 6-9). It is possible therefore that the makers of this tool form at Shanidar were Neanderthal. It should be noted however, that the use of side scrapers at some West Asian sites continues well into the Holocene (e.g. el-Jafr Basin, Jordan, Quintero et al., 2002). Examples of different side scrapers from Shanidar Cave are provided in Figure 7-2.

Wear traces were found on 19 side scrapers from Shanidar Cave. As could be expected, the bulk of them (n=11) were associated with the working of hide (Bordes, 1961a, Binford, 1982; Dibble, 1995; Hayden, 1979; Aleo et al., 2021). The association between the form of scrapers and their inferred purpose was mainly based on ethnographic data (Weedman, 2005; Handly, 2020; Ruth, 2025). Use-wear data from a number of Palaeolithic sites, however, have shown that a range of materials were worked using side scrapers including wood and plant fibres (Pedergnana & Ollé, 2020; Rots et al., 2015; Stileman et al., 2024). These materials were also worked using side scrapers at Shanidar Cave. In addition, one tool was interpreted as having cut meat, suggesting that there was a degree of flexibility with regards how side scrapers were

used. Whilst there is a preference towards the scraping of hide, the hominins from Shanidar were capable of utilising these tool forms to work a range of materials.



Figure 7-2: *Examples of side scrapers from the Shanidar Cave assemblage. Scale 10 mm. Top left: chert single-edge side scraper from Phase 5 (context 802, ID: 55). Top right: chert convergent side scraper from Phase 3 (context 1037, ID: 106). Bottom left: chert double-edge side scraper with notch from Phase 6 (context 1868, ID: 407). Bottom right: jasper double-edge side scraper from Phase 9 (context 2284, ID: 573)*

7.2.2 Baradostian Tools

Stylistically Baradostian tools identified in the assemblage include blades, bladelets, points, and end scrapers. These tool forms were also identified in previous studies of the Shanidar Cave lithics (Solecki, 1958; Reynolds et al., 2018, 2022). Upper Palaeolithic tool industries are blade-based and have traditionally been considered as indicating the arrival of *Homo sapiens* to a region (Skinner, 1965; Shea, 2003, 2013; Golovanova et al., 2025; Stringer and Andrews, 1988; Churchill and Smith, 2000; Mellars, 2006). However, typologically Upper Palaeolithic tools have also been associated with Neanderthals for example in France (Carmignani and Soressi, 2023; Roussel et al., 2016).

7.2.2.1 Blades

There are a total of 45 blades in the Shanidar assemblage accounting for 11.3% of the entire assemblage. The use of blades is seen in numerous early Upper Palaeolithic sites across the Zagros (e.g. Otte, 2022; Shea, 2003, 2013; Ghasidian, 2019; Olszewski, 1993, 1999). It has also been associated with the Zagros Mousterian (Otte and Kozlowski, 2011; Reynolds et al., 2022; Guran, 2025; Golovanova, 2025). At Shanidar Cave, they are noted throughout the sequence and may therefore be attributable to either anatomically modern humans or Neanderthals.

Blades are not typically diagnostic as to any specific behaviours as they serve as the base for multiple tool types (Kozlowski, 2001). This is supported by the results of use-wear analyses on blades from Shanidar Cave which show that blades were used to work a variety of materials in a range of motions (sections 6.2.4 and 6.2.5). Examples of blades from Shanidar Cave are provided in Figure 7-3.

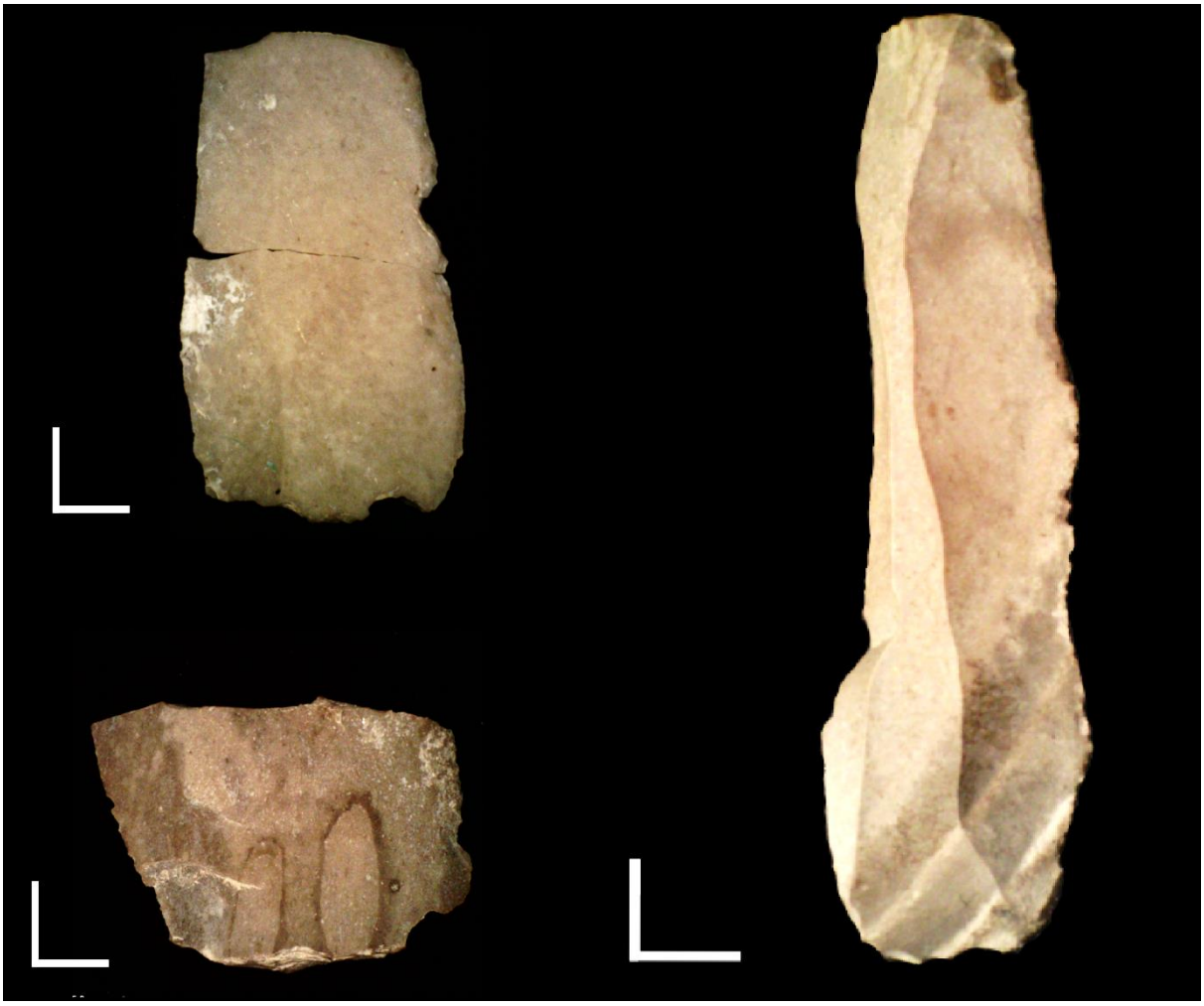


Figure 7-3: *Examples of blades from the Shanidar Cave assemblage. Scale 10 mm. Top left: partial chert retouched blade broken on a notch, refitted from Phase 6 (context 2041, ID: 482). Bottom left: chert retouched blade butt from Phase 4 (context 1438, ID: 149). Right: truncated chert retouched blade from Phase 3 (context 1107, ID: 111)*

7.2.2.2 Bladelets

A total of 77 bladelets were identified in the Shanidar assemblage, accounting for 19.3% of the entire assemblage. The majority of bladelets are retouched (n=66). Bladelets become very common in assemblages from Europe and Asia by c. 36,000 years before present (Olszewski and Dibble,1994, 2006; Shea, 2013) but at Shanidar they are numerous even in MIS 5c, c. 80 – 100,000 years before present (n=14).

The number of bladelets from Phase 12 at Shanidar Cave is similar to that of Phase 3, which dates to MIS 3 (c. 42 – 52,000 years before present) (n=17). This might suggest that this tool form does not originate with the arrival of *Homo sapiens* to the Zagros region. Neanderthals have been associated with bladelets in the Zagros (Otte and Koslowski, 2011) as well as in European contexts for example Quincay and Bau de L'Aubesier in France (Roussel et al., 2016; Carmignani and Soressi, 2023).

That Baradostian tools coexist with Mousterian tools at Shanidar Cave up to MIS 3 suggests that this Upper Palaeolithic industry developed within the Zagros, rather than it was brought to the Zagros (see Warwasi, Olszewski and Dibble, 1994; Olszewski, 2007; Tsanova, 2013; see Yafteh, Otte and Koslowski, 2011; Otte, 2022). Nevertheless, that bladelets become the most dominant tool form by middle to later MIS 3 at Shanidar Cave whilst Mousterian tools become rare suggests a shift away from flake-based to blade-based technologies and might reflect a gradual change in the occupying species of the region (Ghasidian, 2014, 2019; Olszewski, 1993, 1999; Otte et al., 2007)

(Figure 7-4). This goes against the idea proposed by McBurney and Payne (1969) that the Iranian plateau was simply a corridor of population movement rather than the origin point for the initial Upper Palaeolithic.

Wear traces were identified on 12 bladelets. The worked materials identified included meat (n=5), wood (n=3), hide (n=2), bone (n=1) and plant fibres (n=1). Given the small size of these tools, it is presumed that these were used for jobs requiring more precision (e.g. the removal of tendons, cutting of plant fibres or the engraving of bone (Binneman and Mitchell, 1997; Normand et al, 2009; Riordan et al., 2023). There is therefore no clear association between this tool form and a specific activity, again showing a degree of flexibility with regards tool use at Shanidar Cave.

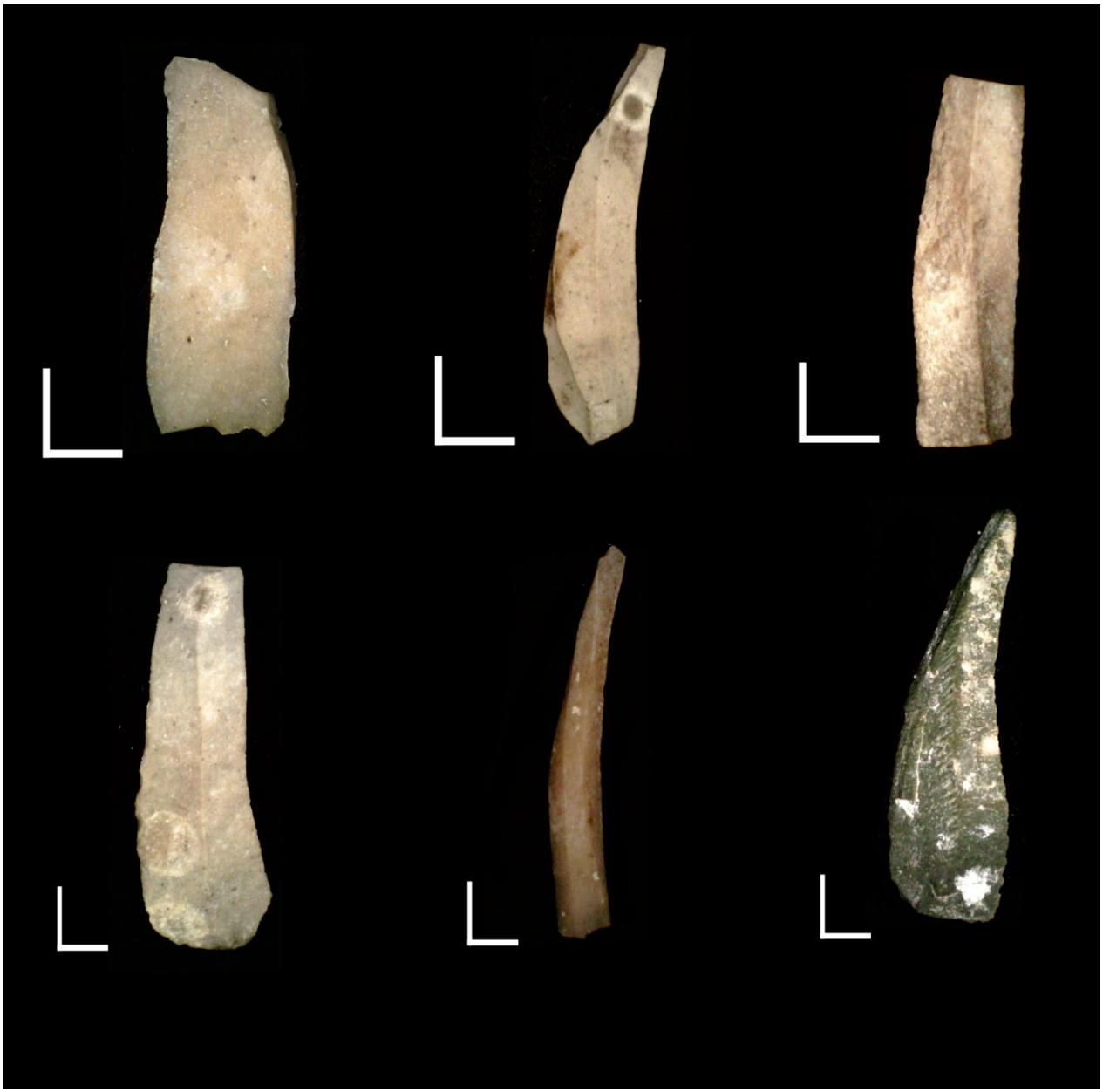


Figure 7-4: *Examples of MIS 3 bladelets from the Shanidar Cave assemblage. Scale 10 mm. Top left: chert retouched bladelet from Phase 5 (context 1118, ID: 115). Top centre: chert retouched bladelet from Phase 5 (context 748, ID: 64). Top right: chert retouched bladelet from Phase 5 (context 750, ID: 39). Bottom left: chert retouched bladelet from Phase 5 (context 1213, ID: 116). Bottom centre: chert retouched bladelet from Phase 3 (context 1418, ID: 230). Bottom right: chert retouched bladelet from Phase 4 (context 2530, ID: 908)*

7.2.2.3 Points

There are 12 points in the Shanidar Cave assemblage, accounting for 3.1% of the total identified tools. These points are distinguished from Mousterian points by their smaller overall size and their morphology, typically being blade-based (Groman-Yaroslavski et al., 2016; Shea, 2006, 2013) (Figure 7-5). These were recovered from MIS 3 only as could be expected of blade-based tools (Phases 5 to 2). Retouched points appear to increase in size from late MIS 3 to later MIS 3 which could indicate an improvement in knapping techniques, however, it is difficult to determine true trends in size throughout the sequence of the site due to the small sample size (n=6). It is difficult to determine which species is associated with Baradostian-type points at Shanidar Cave given that Neanderthals are also present in MIS 3.

The presence of an El Wad point is of interest as this tool form is typically found in Levantine sites in the Early Upper Palaeolithic period c. 40,000 years before present (see section 6. 1.2.8; Gennai et al., 2023). This form has not been found at Shanidar Cave previously (see Solecki, 1958; Reynolds et al., 2018). Its presence may be attributed to independent development of this form through accidental knapping, or it could indicate migration, exchange or trade (Shott, 1994; Muller and Clarkson, 2023; Mathias et al., 2025; Féblot-Augustins, 1993; Fernandes et al., 2008; Marciani et al., 2016). The excavation of part of one of Solecki's spoil heaps in 2016 (unpublished; C.O. Hunt, pers. comm., 2025) revealed many artefacts of bladelet size, suggesting perhaps that Solecki's sieving strategy was inadequate to recover all small artefacts thus explaining the absence of rare forms like El Wad points. However, that El

Wad points are also absent from recent excavations in which there is a robust sampling strategy suggests that this form might not have been in use at Shanidar Cave, despite being present at other Zagros sites (e.g. Warwasi Olszewski and Dibble, 1994*)*.

Wear traces were identified on a total of six points. Half had wear traces associated with hide working (n=3). Wear traces associated with wood, bone and meat were each also identified on the remaining worked points. While it may appear that there is a clear association between points and hide working, the low sample size means that any trends will not likely reflect the assemblage as a whole.

As stated above, the presence of points in an assemblage has been argued to reflect hunting activities (Shea, 1990, 2013; Villa et al., 2009; Sharon and Oron, 2014). However, only one of the worked tools at Shanidar Cave was identified as a meat working tool. As such, the points from Shanidar Cave could have been used for an array of activities.

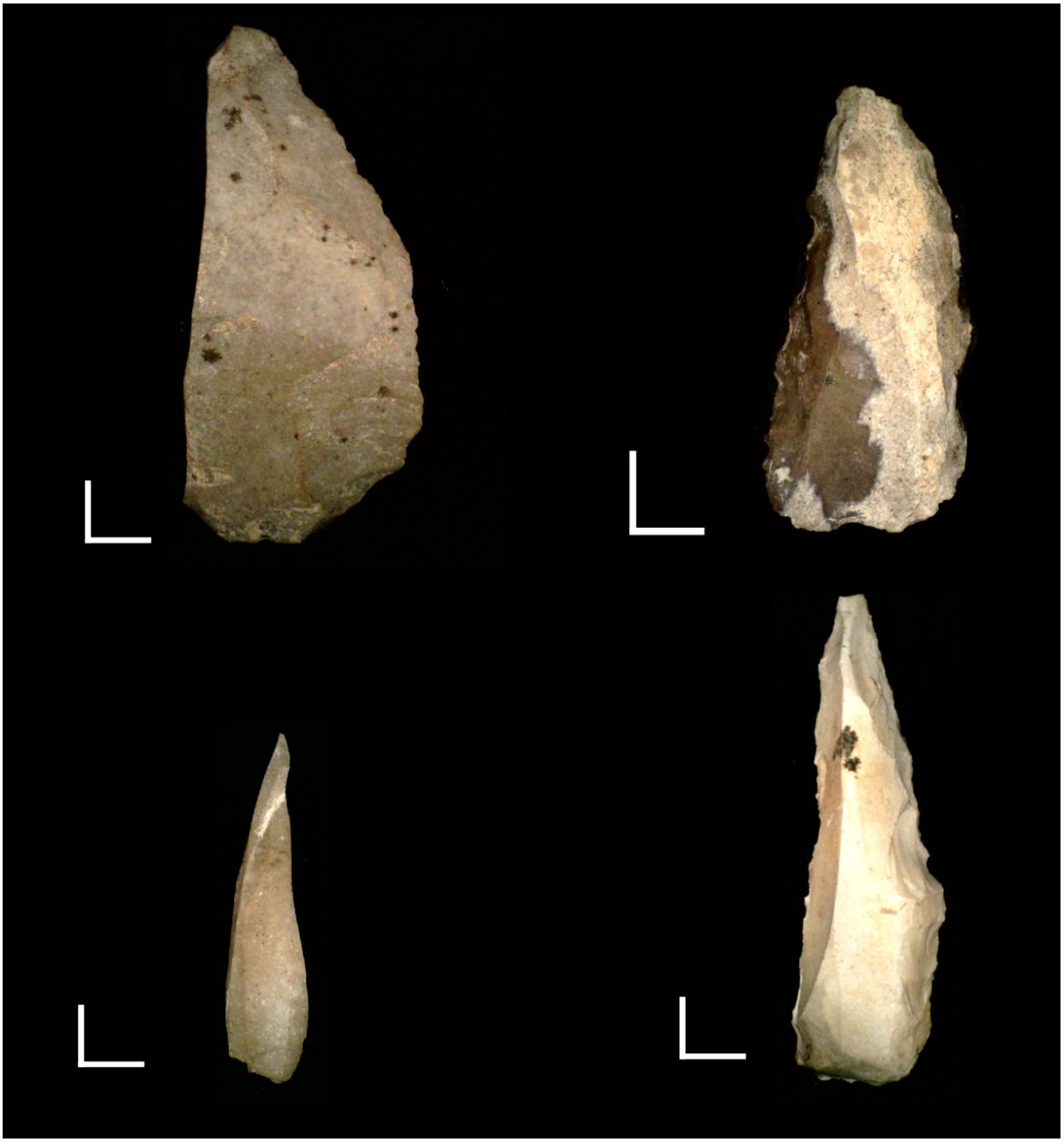


Figure 7-5: *Examples of points from the Shanidar Cave assemblage. Scale 5 mm. Top left: chert unretouched point from Phase 4 (context 1433, ID: 170). Top right: chert retouched point from Phase 3 (context 2538, ID: 874). Bottom left: chert unretouched point from Phase 4 (context 1400, ID: 163). Bottom right: chert point from Phase 4 (context 1458, ID: 147)*

7.2.2.4 End Scrapers

Eight end scrapers were identified accounting for 2.0% of the assemblage. In Europe the arrival of end scrapers is usually associated with the arrival of *Homo sapiens* and coincides with an abrupt end to the use of side scrapers (Flas, 2008; Aleo et al., 2021). At Shanidar Cave end scrapers first appear during MIS 4 and they are represented well into MIS 3 as might be expected based upon the literature (Figure 7-6; e.g. Warwasi - Olszewski and Dibble, 1994; Ghar-e-Boof - Ghasidian, 2014; Yafteh - Hole and Flannery, 1967). The presence of end scrapers at Shanidar therefore could signify the point at which anatomically modern humans arrive to the region. It should be noted however, that unlike some European assemblages, side scrapers continue well into MIS 3 at Shanidar, suggesting coexistence of species. Further, t*he association between anatomically modern humans* and end scrapers is not absolute as there are end scrapers in Neanderthal associated contexts (Roussel et al. 2016). Like retouched points, end scrapers appear to increase in size from their first appearance in MIS 4 to later MIS 3 (Phases 7 to 3) which could indicate an improvement in knapping techniques, however, it is difficult to determine true trends in size throughout the sequence of the site due to the small sample size (n=8).

As with side scrapers, the presence of end scrapers at Shanidar Cave signifies the working of perishable materials such as hides and wood (Aleo, 2023; Shea, 2013). Indeed, this is reflected in the use-wear results where the majority of the worked end scrapers (four out of six) were identified as hide working tools. The association between scrapers and the working of hides is

well established (Bordes, 1961a, Binford, 1982; Handley, 2020; Tartar et al., 2022), and the use-wear results from Shanidar Cave appear to support this association. However, it should be noted that the sample size for worked end scrapers is very small (n=6). One end scraper was identified as a wood working tool and another as a tool used to work plant fibres. As with side scrapers, end scrapers have been identified as having worked an array of materials at other Palaeolithic sites also (Rots, 2005; Loebel, 2013; Aleo, 2023).

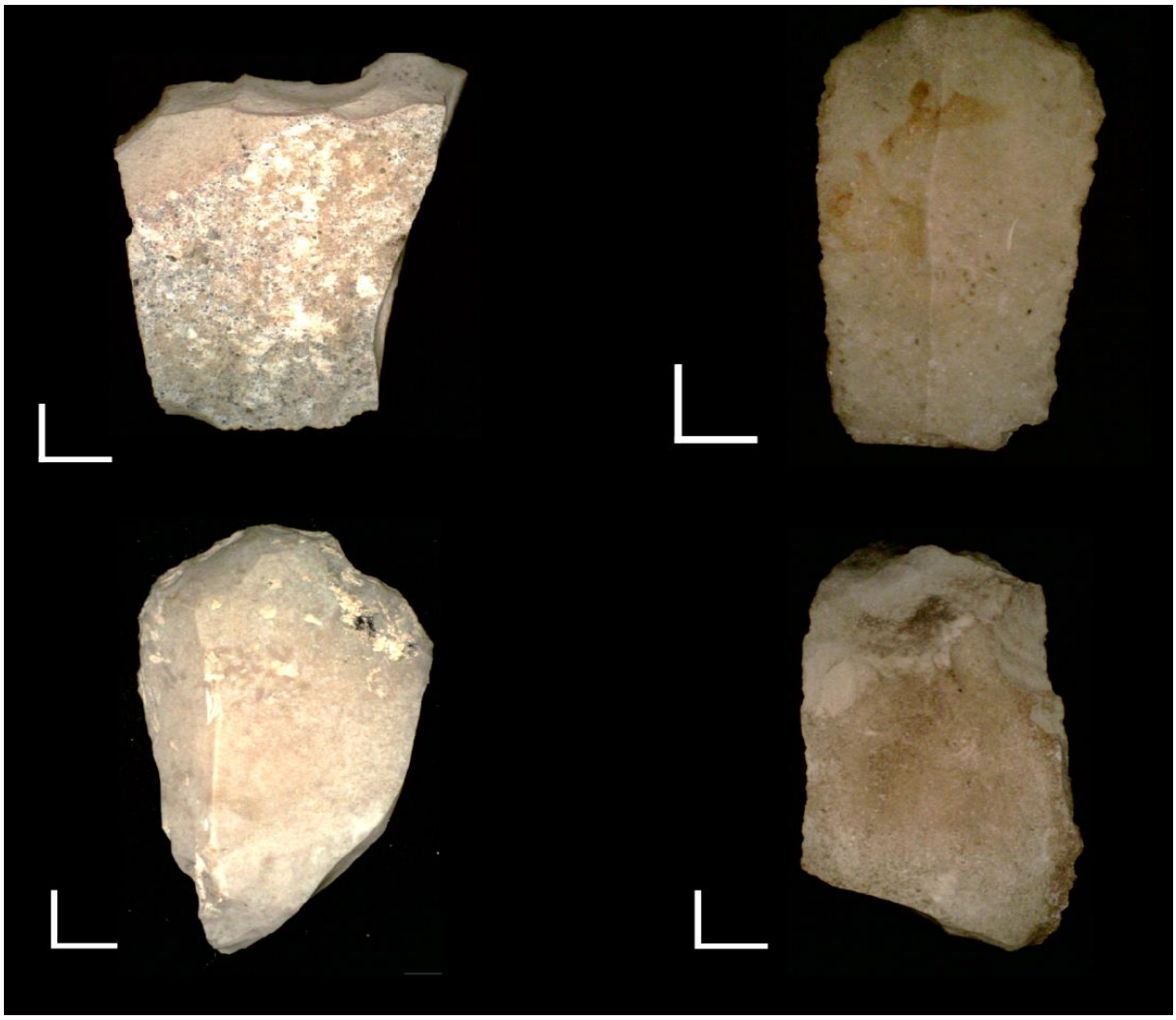


Figure 7-6: *Examples of end scrapers from the Shanidar Cave assemblage. Top left: chert end scraper from Phase 3 (context 518, ID: 58), scale 10 mm. Top right: chert end scraper from Phase 3 (context 1037, ID: 112), scale 5.0 mm. Bottom left: chert end scraper from Phase 4 (context 560, ID: 297), scale 10 mm. Bottom right: chert end scraper from Phase 3 (context 1418, ID: 172), scale 10 mm*

7.2.2.5 Bladelet Cores

15 bladelet cores were identified, accounting for 3.8% of the entire assemblage. The presence of bladelet cores reflects the change to blade-based knapping from the earlier flake-based method, as described above. Bladelet cores are therefore associated with *Homo sapiens*, especially in the latter half of the Upper Palaeolithic and into the Epipalaeolithic (Shea and

Sisk, 2014; Shea, 2013; Mellars 2006). However, these tools forms have also been associated with late surviving Neanderthals (Roussel et al., 2016). At Shanidar Cave, bladelet cores were only recovered from MIS 3 (Figure 7-7). They are most numerous in Phase 3 (MIS 3, n=7). This phase lies above the most recent Neanderthal body (Shanidar 5). This could suggest that bladelet cores can be attributable to *Homo sapiens* at the site. However, four bladelet cores were also identified from Phase 5 which is broadly associated with the Shanidar 1 and Shanidar 3 Neanderthals. It is difficult therefore to state conclusively that bladelet cores are only associated with anatomically modern humans at Shanidar Cave.



Figure 7-7: *Examples of bladelet cores from the Shanidar Cave assemblage. Scale 10 mm. Top left: chert bladelet core from Phase 5 (context 752, ID: 44). Top right: chert bladelet core from Phase 3 (context 714, ID: 42). Bottom: large chert bladelet core from Phase 5 (context 546, ID: 11)*

7.2.3 Indeterminate

The Indeterminate tool group accounts for the tools which cannot be definitively attributed to either the Mousterian or the Baradostian. These tool forms have their origins in the Middle Palaeolithic or earlier are continued into the Upper Palaeolithic (Bordes, 1961; Pargeter et al., 2020; Muller and Grosman, 2025; Burton, 1980; Li et al., 2025).

7.2.3.1 Flakes

There are 85 flakes in the Shanidar assemblage, accounting for 21.4% of the total assemblage. Because they are by-products of the knapping process, flakes are ordinarily amongst the most common lithics recovered from archaeological sites (Andrefsky Jr., 2007; Speth, 1972; Rinehart, 2008; Turq et al., 2013; Faivre et al., 2017; Muller and Clarkson, 2023). Flakes can also be created intentionally. Flakes are found throughout the Shanidar Cave sequence from Phases 12 to 1 (MIS 5c to MIS 1) with the exception of Phase 8 (the location of the Shanidar 4 burial cluster) (Figure 7-8).

The presence of cortical flakes suggests that knapping activities were taking place on site at Shanidar Cave. In addition, cortical flakes become narrower and shorter between MIS 5 and MIS 3 at Shanidar. This may reflect a shift from prepared core technologies into blade-based technologies at this time, which coincides with the decline of the Neanderthals

(Skinner, 1965; Tostevin, 2000; De Stefani et al., 2012; Peresani and Taranto, 2013; Derevianko, 2010; Muller and Clarkson, 2016, 2023; Higham et al., 2014; Trájer, 2023*)*.

Wear traces were identified on 11 flakes from Shanidar Cave. The identified worked materials were meat (n=4), wood (n=3), bone (n=2), plant fibres (n=1) and ochre (n=1). As with blades, flakes can form the base of other tool forms and as such, no trends would be expected with regards how these tools were used (Speth, 1972; Rinehart, 2008; Turq et al., 2013; Faivre et al., 2017; Odell, 2004). Because flakes are generally produced as a by-product of the knapping process, the fact that these tools are used at all at Shanidar Cave illustrates that there was not necessarily an association between tool forms and the actions taking place.

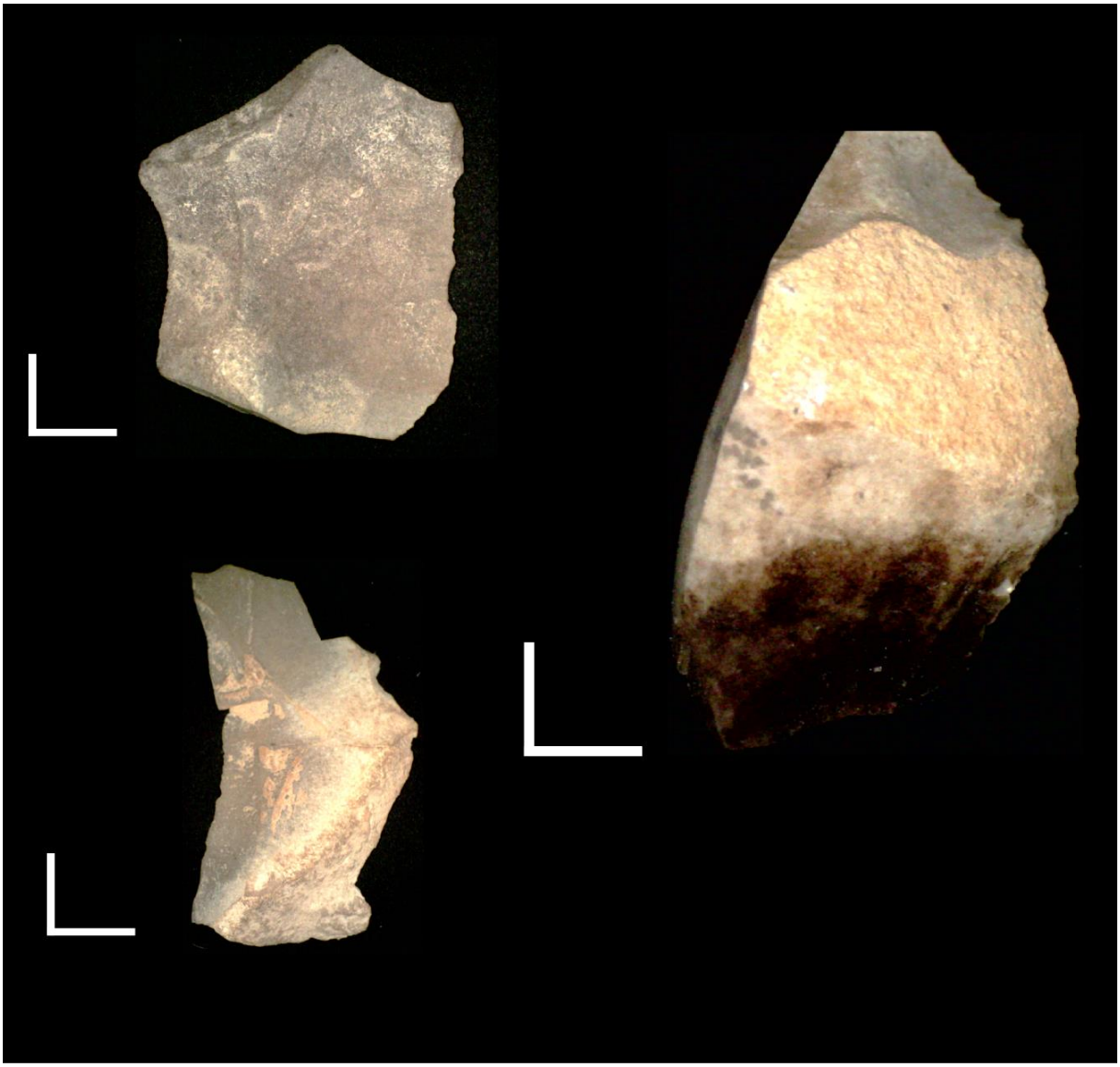


Figure 7-8: *Examples of flakes from the Shanidar Cave assemblage. Top left: chert unretouched flake from Phase 10 (context 1935, ID: 459), scale 5 mm. Bottom left: chert cortical flake from Phase 6 (context 1852, ID: 425), scale 10 mm. Right: burnt chert cortical flake from Phase 4 (context: N/A, ID: 3), scale 5 mm*

7.2.3.2 Flake Cores

18 flake cores were identified, accounting for 4.5% of the total assemblage. Given the high number of flakes identified and thus the inference of knapping taking place on site it stands to reason that flake cores would also be represented. The percentage of flake cores is comparable to that of bladelet cores (section 7.3.2.5). It could be argued therefore that knapping activity at Shanidar Cave was somewhat consistent through time even where technologies changed and regardless as to the hominin groups inhabiting the site. Flake cores are recovered from contexts associated with MIS 5, MIS 4, and MIS 3 at Shanidar indicating that flake-based technology was used throughout the sequence. They are best represented in MIS 3 however (n=12; e.g. Figure 7-9) which would not necessarily be expected given that flake-based technologies are typically associated with MIS 5 hominins (Skinner, 1965; Lindly, 1997; Golovanova et al., 2025; Shea, 2013; Speth, 1972; Andrefsky, 2001, 2007; Faivre et al., 2017; Odell, 2004). Still, flake cores are slightly outnumbered by bladelet cores in MIS 3 at Shanidar (n=15), suggesting that both flake-based and blade-based technologies were in use at this time. Again, this makes it difficult to determine the makers of each technology.

As discussed above, it has been hypothesised that Shanidar Cave was a site of short-term (perhaps seasonal) occupation (Solecki and Solecki, 1994; Lindly, 1997; Pomeroy et al., 2020; Barker and Hunt, 2023). There are no outcrops of chert within the vicinity of the cave (Reynolds, T. pers. comm,

2024). Materials brought to the site therefore would have been only what could be carried (Solecki, 1979; Lindly, 1997; Nymark Jensen, 2021). It could be argued then that the raw material brought to site would have been worked to its fullest extent. This is suggested by the high degree of retouch exhibited on the majority of tools from Shanidar Cave (see also Dibble, 1995).



Figure 7-9: *Example flake core from the Shanidar Cave assemblage. Scale 10 mm. Chert flake core from Phase 6 (context 733, ID: 54).*

7.2.3.3 Notches and Denticulates

Four notches and five denticulates (Figure 7-10) were identified from the Shanidar Cave assemblage, accounting for 1.0% and 1.3% of the assemblage respectively. These tool types are associated with both Middle and Upper Palaeolithic assemblages as demonstrated by data from other sites in the Zagros e.g. Warwasi (Olszewski and Dibble, 1994) Gelimgoush (Heydari-Guran et al., 2021), Yafteh (Ghasidian, 2019), Mar-Tarik (Otte et al., 2009).

No traces of wear were identified on any of the notches from Shanidar Cave. Two denticulates however were interpreted as butchery tools (n=2) and one as a bone working tool (n=1). An association between the Shanidar denticulates and butchery activities is apparent, however, is again a very low sample size (n=3).

Denticulates have been argued to not be the result of deliberate retouch, rather the result of working hard materials (Xhauflair et al., 2020). One of the Shanidar denticulates was interpreted as a bone working tool and would produce a "hard" wear pattern which may possibly be misidentified as retouch (Odell, 2004). This was also highlighted in the experimental series in Chapter 5, where an undulating scar pattern was developed when hard materials were sawn (see sections 5.4, 5.8.2 and 5.10).



Figure 7-10: *Examples of denticulates from the Shanidar Cave assemblage. Top left: denticulate from Phase 10 (context 1523, ID: 203). Scale 5 mm. Top right: denticulate from Phase 5 (context 1836, ID: 400). Scale 5 mm. Bottom: jasper denticulate from Phase 5 (context: 1836, ID; 400)*

7.2.3.4 Informal Tools

There are 18 informal accounting for 4.5% of the total assemblage. The production and utilisation of informal tools has been interpreted as evidence of cognitive complexity – an informal tool could be the result of a failed knap or could be produced as a by-product during the knapping of another tool, indicating an ability to adapt and improvise (Shott, 1994; Muller and Clarkson, 2023; Mathias et al., 2025). Informal tools are found throughout the Shanidar Cave sequence from MIS 5c to MIS 3 (Figure 7-11).

Given the cognitive capacities of both *Homo neanderthalensis* and *Homo sapiens* (see Chapter 2) it is probable that both species produced and utilised informal tools at Shanidar Cave.

That these tools were not the intended outcome is reflected in the limited number of worked informal tools (n=2). Only one tool each was used as a bone working tool and a meat working tool. There is no clear pattern in the activities this tool form as could be expected.

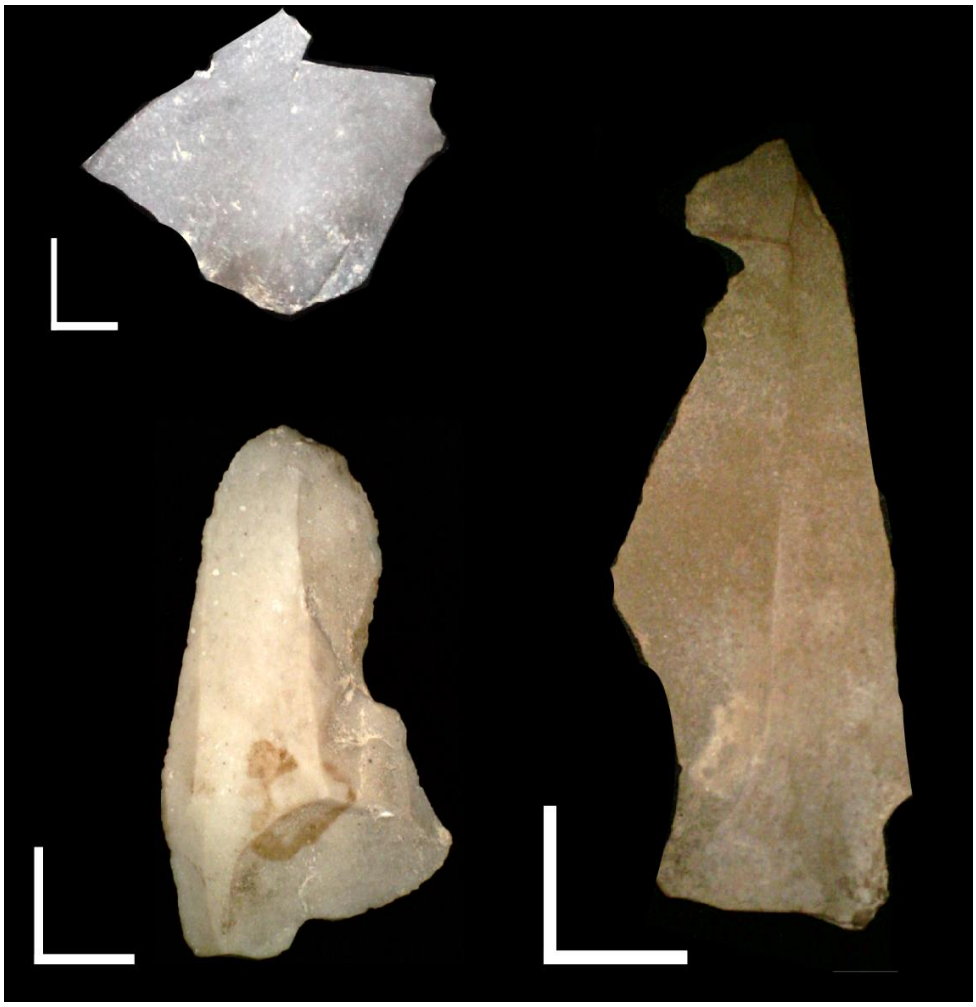


Figure 7-11: *Examples of informal tools from the Shanidar Cave assemblage. Scale 10 mm. Top left: chert informal tool from Phase 4 (context 735, ID: 38). Bottom left: chert informal tool from Phase 3 (context 1043, ID: 131). Right: chert informal tool with a notch from Phase 12 (context 2545, ID: 900)*

7.2.3.5 Awls and Burins

There are 11 awls and eight burins in the Shanidar Cave assemblage, accounting for 2.8% and 2.0% of the total respectively. Awls and burins are known from numerous Upper Palaeolithic sites, and they continue to be used into the Neolithic period (e.g. Trájer, 2024; Otte et al., 2007; Pitulko and Pavlova, 2022). Though there is less evidence, Neanderthals are also known to have used awls and burins (Dibble and Holdaway, 1993; Solecki, 1994; Shea, 2013; Roussel et al., 2016). At Shanidar Cave, awls and burins are represented in both MIS 5 and MIS 3 (Figure 7-12). Whilst the number of awls decreases over time from seven in MIS 5 to four in MIS 3, the number of burins increases from two in MIS 5 to six in MIS 3. Because the production of burins has been seen as "complex" this might suggest advances in knapping techniques over time (Pitzer, 1977; d'Errico et al., 1998; Karavanić, 1995). The significance of having identified awls and burins within the Shanidar Cave lithic assemblage suggests the use of perishable materials such as hide (Venditti et al., 2016).

No traces of wear were found on any of the awls from Shanidar Cave. Seven burins were identified as having traces of wear. The materials worked were interpreted as wood (n=2), hide (n=2), meat (n=1), bone (n=1) and plant fibres (n=1). There does not seem to be a correlation between burins and a specific worked activity. With the exception of the burin used to work plant fibres, the tip or burin- bit was the location of the worked surface. This may indicate that these tools, much like bladelets were used for more delicate

activities (e.g. awling hide). Indeed, burins have been demonstrated to have been used to work a range of materials (Iwase et al., 2014). As with the previous worked materials, no clear pattern with respect to tool use and activities is observed. What can be determined therefore is whilst the Shanidar hominins made a vast array of tools, they did not seek out specific forms in order to complete specific tasks.



Figure 7-12: *Examples of awls and burins from the Shanidar Cave assemblage. Top left: chert awl from Phase 5 (context 718, ID: 53), scale 10 mm. Top right: chert burin from Phase 5 (context 721, ID: 51), scale 10 mm. Bottom left: chert burin from Phase 3 (context 1034, ID: 109), scale 10 mm. Bottom right: chert burin from Phase 3 (context 1043, ID: 110), scale 0.5 mm*

7.2.4 Choice of Raw Materials

Most of the Shanidar lithics are knapped from a grey chert which is not available within the vicinity of the site (n=368). The Shanidar Project's attempts to find local chert outcrops have proven fruitless. It is thought that the chert veins occur further downstream along the Greater Zab River (Figure 7-13) and upstream towards the region of Barzan, closer to the Iranian border. Therefore, the hominins of Shanidar Cave would have had to travel to collect this raw material, lending support to the hypothesis that they were highly mobile (Nymark Jensen, 2021; Solecki, 1979). Knapping activity on site is evidenced by the presence of cortical flakes and cores, however, the lithic assemblage is made up of considerably fewer lithics than assemblages from other sites in the region (Warwasi (Braidwood and Howe, 1960), Bawa Yawan (Dibble, 1984; Heydari et al., 2024) and Tang-e Eshikan (Hourshid and Tsuneki., 2014) section 7.4.1). This supports the idea that material was carried to site by "itinerant" hominins (Solecki and Solecki, 1994). However, it is important to note that the current excavations at Shanidar Cave (2015 – present) have been conducted in a much smaller area than was excavated by Solecki (1955, 1961, 1975, 1979). This might account for the reduced number of lithics recovered.

In addition to the grey chert there are tools formed of red jasper (n=38). Jasper is readily available in the vicinity of Shanidar Cave and can be found less than 4 km from the site along the Greater Zab. Knapping and use-wear experiments using jasper from the Shanidar region have indicated that it is more difficult than chert to shape and it does not hold its edge when working

meat or bone (see section 4.2.2). It could be argued that jasper was used out of necessity. This is supported by the potential working of siliceous limestone from Shanidar Cave itself (see section 6.4.2). Conversely, it could be argued that the colour of the jasper played a role in it being selected as a raw material. Selection of raw material as an outlet for "individuality" rather than for its effectiveness is argued as a facet of behavioural modernity and as such it is ordinarily associated with anatomically modern humans (Dapschauskas et al., 2022, Hayes, 2010). As detailed in section 2.3.2 however, Neanderthal selection for aesthetics is increasingly hypothesised, for example the use of iridescent feathers or of ochre as potential adornments, or the carrying of personal effects such as fossils (Garofoli, 2017; Nielsen et al., 2012; Zilhão et al., 2012; Navazo-Ruiz et al., 2024). The moss agate flake from Phase 7 (MIS 4) might also represent another example of this. The colour is a pale green which stands out in stark comparison to the rest of the assemblage. Agate may occur naturally in the ophiolites to the north of Shanidar Cave (C. Hunt, pers. comm., 2025) but as with chert, modern day excursions have failed to find any source of it. The number of tools for each raw material type is presented in Figure 7-14 and 7-15.



Figure 7-13: *View of the Greater Zab River, Sep 2022. (Photo by M. Hitchcock)*

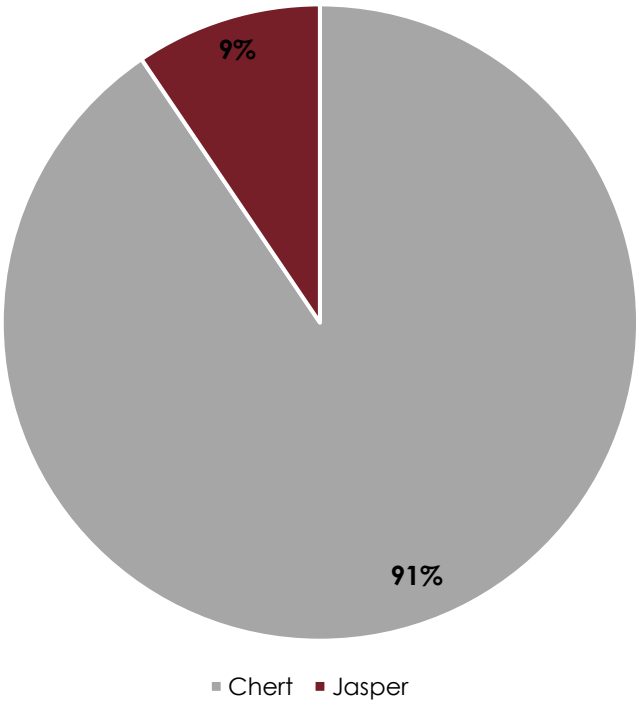


Figure 7-14*: Percentage of lithics made from chert and Jasper from Shanidar Cave*

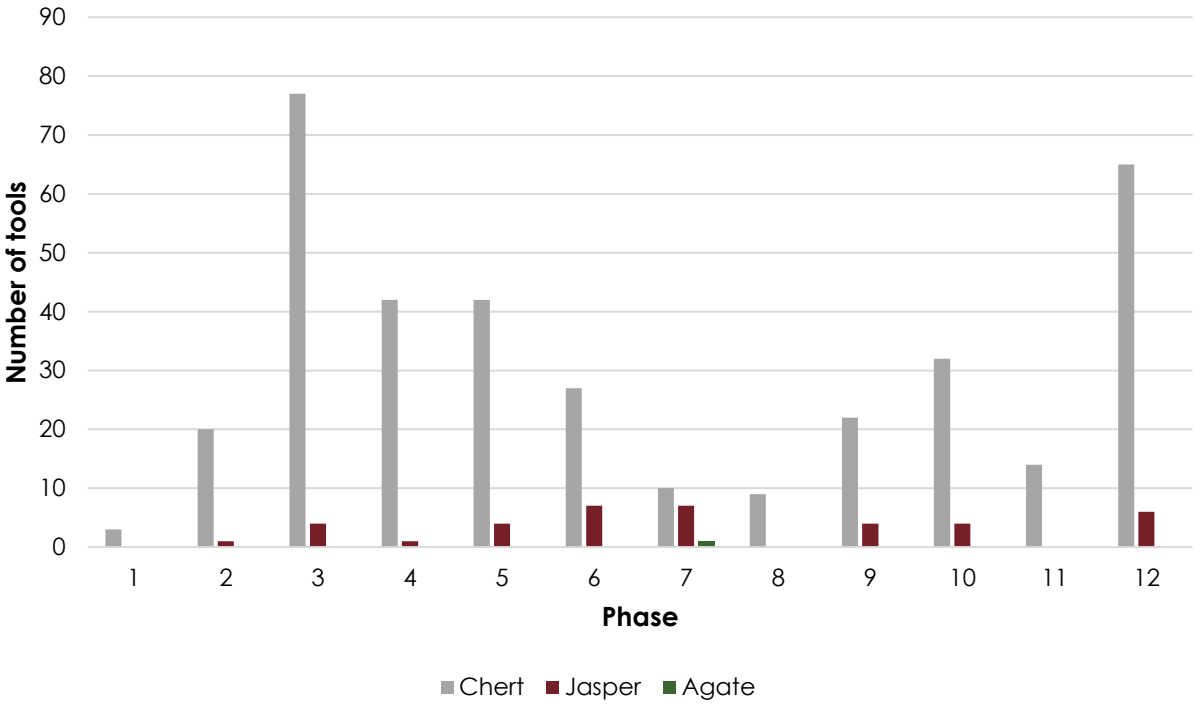


***Figure 7-15**: Lithic raw material by chronological phase*

7.2.5 Lithics Conclusion

As detailed in section 4.3, the current excavations at Shanidar Cave follow a strict, systematic approach, with all contexts being recorded and all artefacts positioned in three-dimensional space using a total station (Reynolds et al., 2016). As such, the position of every artefact can be recorded onto the Harris matrix. Further, it has been possible to identify the original location of some the material excavated by Solecki (1951 – 1960), notably the position of the Neanderthal remains, by using Solecki's measurements and photographs and overlaying them with the current trench site (Pomeroy et al., 2020, in press). The result is that every lithic in situ noted in this study can be placed in a specific context. Due to the

complexity of the Harris matrix, as described in section 2.8.3, the decision was made to simplify the stratigraphy for the purposes of this study.

Following his excavations in the 1950s, Solecki hypothesized that there was a 10-thousand-year hiatus in the occupation of the site between his Layer D (associated with *H. neanderthalensis*) and his Layer C (hypothesised to be associated with *H. sapiens*) (Solecki, 1955, 1958, 1964; 1971; Reynolds et al., 2018, 2022). The results of this study show that there was no hiatus in the occupation of Shanidar Cave because there are no archaeologically sterile layers. Further, there is no clear transitional layer with regards to lithic industry – in fact, both Mousterian and Baradostian tools are found throughout the temporal sequence (MIS 5c to MIS 3 – 2). Further, Solecki initially placed Shanidar 1 in Layer C before changing his mind (Solecki, 1955).

It would be expected based upon previous research that there would be a higher proportion of Mousterian type tools in earlier phases/contexts associated with evidence of Neanderthals, and Baradostian type tools becoming more dominant in later contexts associated with anatomically modern humans (Bordes, 1961a; Solecki, 1975, 1979; Dibble, 1984). This is indeed reflected in the results of typological analysis.

Mousterian tools are evident throughout the sequence whereas Baradostian tools increase in number from phase 6 onwards, peaking in phase 3. Blades and bladelets are noted in every phase from 12 to 2, meaning that these tool types may also be associated with Neanderthal contexts at Shanidar Cave. It is important to recognise that the latest Neanderthal skeleton, Shanidar 5, is

located in Phase 4 (MIS 3, c. 52,000– 56,000 years BP), and the highest concentrations of typologically Baradostian tools are located above and below this individual. As stated above, the presence of bladelets at other sites within the region is mostly associated with *Homo sapiens* from circa 35 kya onwards (Otte et al., 2011).

Neanderthals are known to have utilised blade-based tools and as such, we could surmise that the Shanidar Neanderthals could have developed and utilised blade-based techniques prior to the arrival of anatomically modern humans to the region (Conard, 1990; Revillion, 1995; Revillion and Tuffreau, 1994; Carmignani and Soressi, 2023). This lends support to Dibble's (1984) hypothesis that the Baradostian/Zagros Aurignacian developed *in situ* and was adopted and further developed by modern humans upon their arrival to the region (see also Olszewski and Dibble, 2006; Otte et al., 2007).

Skeletal evidence from the Levant shows that *Homo sapiens* were in the region c. 100,000 years before present so it is possible that small migratory groups visited the Zagros before the species became established in the region (Hershkovitz et al., 2015; Stringer et al., 1989; Shea and Bar-Yosef, 2005). If this were the case and they were visiting Shanidar Cave then it would be expected that alternating bands of Neanderthal and modern human material culture and other remains would be observable, as within the sequence as at Skhul, Israel (Grün et al., 2005), or Apidima, Greece (Harvati et al., 2019), but this is not evident at Shanidar Cave.

The Zagros has been interpreted as one of the most likely region in which the admixture of Neanderthal and *Homo sapiens* DNA occurred (Guran et al., 2024). The only hominins evidenced by skeletal remains at Shanidar Cave are the Neanderthals (Solecki, 1975; Pomeroy et al., 2017, 2020, in press). The presence of anatomically modern humans has been assumed based upon the lithic evidence. However, past populations were adaptable and capable of developing tools to suit their needs (Binford, 1982). It is difficult therefore to attribute a specific typology to a species, especially where there is no clear separation in tool forms. It is likely that therefore that Shanidar Cave was a palimpsest, with both species coexisting and using the site within the same broad time period.

Traces of wear were identified on 106 lithics which amounts to 16.3% of the studied assemblage. The most commonly worked material was interpreted as wood, followed by meat and bone (proxy for butchery activities), hide, bone, plant matter, horn and ochre. The high proportion of wood working is interesting. It is not uncommon for this form of wear to be identified, but butchery activities are usually most common form of wear (Hardy et al., 2013; Hardy and Moncel, 2011; Rots et al., 2015). This may suggest that the use of wooden tools was habitual at Shanidar Cave.

It has been argued that activities such as bone working, hide working, and wood working are secondary, "less urgent" activities, suggesting a group that has time to sit and craft rather than focus solely on procuring food (Odell, 2004). This appears an oversimplification however as items made from these

materials could play integral roles in survival e.g. the production of bone tools for hide working, which has been evidenced through use-wear analysis from Shanidar, the preparation of leather or pelts for clothing or for shelters (Campana and Crabtree, 2019; Binford, 2012), or the development of wooden spears for hunting or interpersonal violence as has been evidenced which has been evidenced at a number of Palaeolithic sites including at Shanidar Cave (Thieme, 1997, Hutson et al., 2025; Pomeroy et al., in press). These examples also indicate that stone tools were not the only tools used by past hominins, but they are the only tools available to researchers. This highlights the issue of preservation bias and also indicates that it might be necessary to revisit any associated faunal assemblages in search of tools or trauma caused by lithic and non-lithic weapons.

It should be noted that one tool from Shanidar Cave was interpreted as having worked horn. This was based on experimental data as well as the published literature (Pawlik, 1993). This tool was from Level 5 and is therefore broadly contemporary with Shanidar 1 and Shanidar 3. Therefore, this is the first instance of horn working identified on a Neanderthal associated lithic. Animals such as Aurochs (*Bos primigenius*) have been noted in the Shanidar faunal assemblage (Evins, 1980).

As illustrated in Figure 7-16, evidence of wear was more prevalent in the upper sequence of the cave (Phases 6 – 2, MIS 3) than in the lower phases (Phases 12 – 7, MIS 5c – MIS 4). A total of 77 tools dated to MIS 3 preserved wear traces compared to 27 tools from MIS 5. This could suggest that there

were longer occupations of Shanidar Cave during this stage, but it is more likely that this reflects time as a factor in preservation. Further, there were no traces of horn, ochre or plant working observed in the lower sequence of the site (MIS 4 and MIS 5). This may again be due to preservation issues rather than changes in behaviour. In addition, the small sample size may also impact these findings. It should also be noted however, that with the exception of ochre, all of the identified worked materials were identified in phases associated with Neanderthal skeletal remains.

As highlighted in section 6.2.19., there was no statistically significant difference in the worked materials between MIS 3 and MIS 5. There was however, a statistically significant difference in the tools being used in MIS 3 and MIS 5. This therefore suggests a continuity in the types of materials worked (e.g. wood, hide, etc), however, using different tools (mainly Mousterian tools in MIS 5 and Baradostian tools in MIS 3). In conclusion, the use-wear results from Shanidar Cave show adaptable people who could use almost any tool in their arsenal to work a wide array of materials.

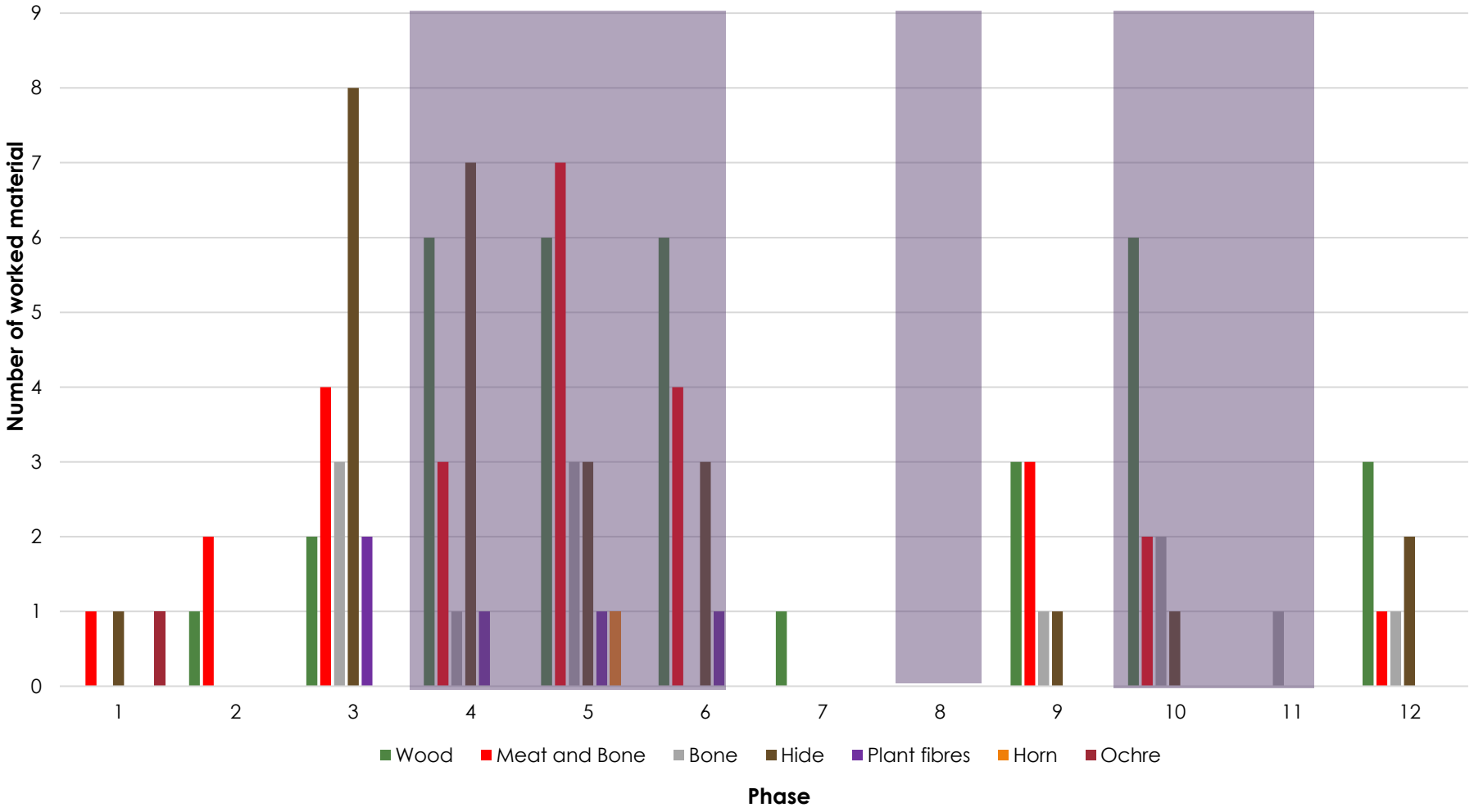


Figure 7-16: *Number of worked materials by chronological phase. Purple bars represent phases from which Neanderthal remains have been recovered*

7.3 Shanidar Cave Lithic Assemblage in the Wider Zagros Region

Shanidar Cave sits within a cluster of Palaeolithic sites which date from the Middle Palaeolithic to the Epipalaeolithic (Skinner, 1965; Lindly, 1997; Solecki and Solecki, 1994, Figure 7-17). This region holds significance for our understanding of Neanderthal capabilities, the expansion of *Homo sapiens* into Eurasia and to the admixture of both species (Guran, 2025). As such it is important to include these sites when discussing Shanidar Cave.

7.3.1 The Zagros Mousterian

The Mousterian of the Zagros as described by Garrod and Bate (1937) and later expanded by Skinner (1965) is typified by the predominance of points and side scrapers, a proportion of narrow blades and a low percentage of Upper Palaeolithic tool types such as end scrapers and denticulates. The lithic material from Solecki's layer D was confirmed to be of the Zagros Mousterian following the work of Akazawa (1975). The Zagros Mousterian is a highly variable industry with Dibble and Holdaway (1993) suggesting separating the Zagros Mousterian into two distinct groups based on the number of blades or Levallois blanks recovered. This was further developed by Guran (2025) who called for the Zagros Mousterian to be reassessed and separated based on the region within the Zagros (e.g. Southern, West Central and Northern).

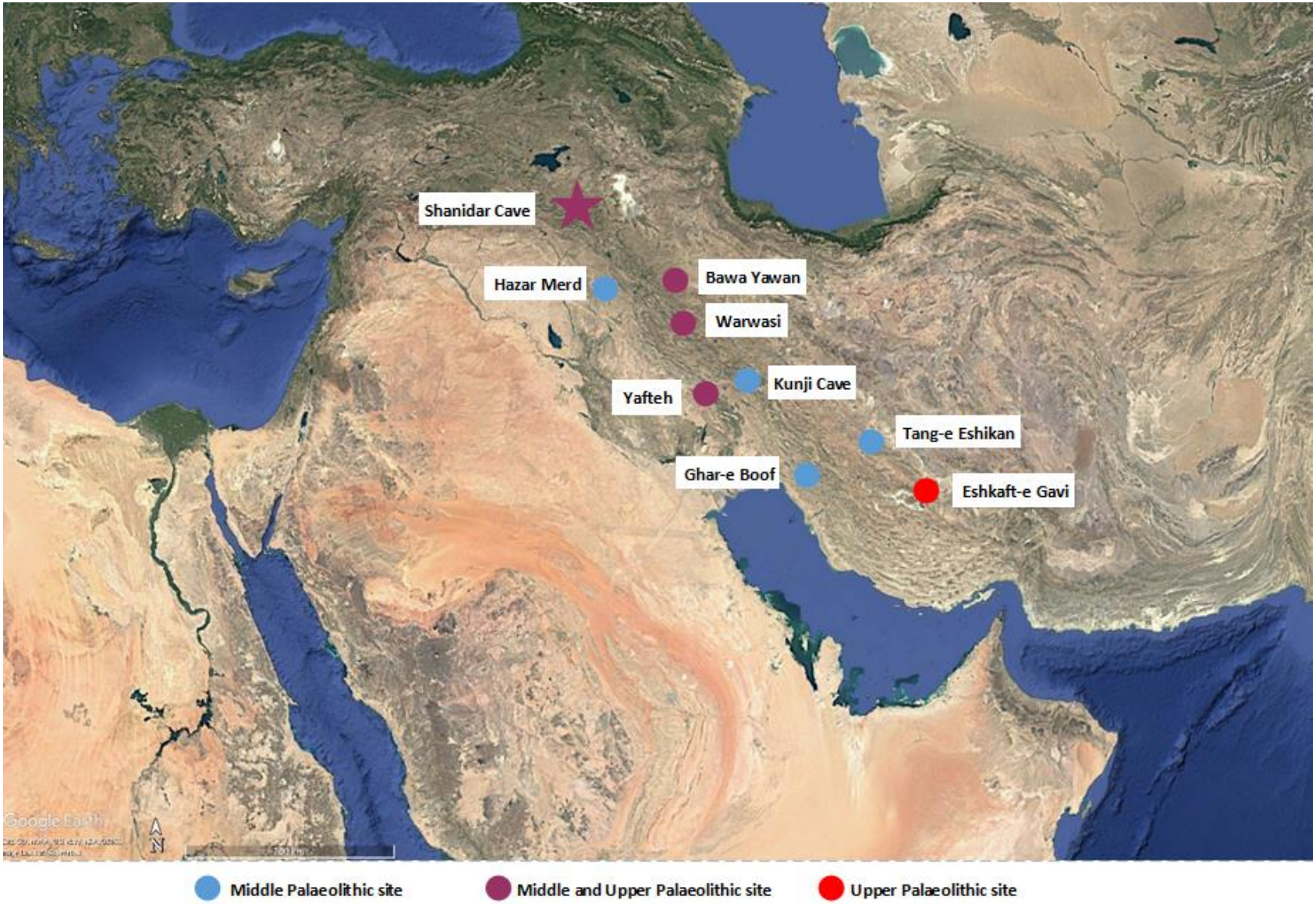


Figure 7-17: *Map of Zagros Palaeolithic sites*

7.3.1.1 Southern Zagros Mousterian Sites

The southern Zagros is limited to very few Palaeolithic sites. Ghār-e Boof and Tang-e Eshikan have both been analysed, however, no lithic analysis from these sites has yet been published.

7.3.1.1.1 Ghār-e Boof

Ghār-e Boof is a cave site located in the Dasht-e Rostam-Basht region of the Southern Zagros Mountains, in Southern Iran. Excavations by Conard and team (Bretzke and Conard, 2017; Mata-González et al., 2022, 2023) have unearthed significant Upper Palaeolithic material as well as a limited amount of Middle Palaeolithic tools from an undisturbed horizon. A report on the Middle Palaeolithic lithic material is not yet available but descriptions from the site reports state that the lithics are predominantly flake-based with limited Levallois flakes being recovered. This is in line with previous descriptions of the Zagros Mousterian (Skinner, 1965; Lindly, 2005).

A difference between the late MP and early UP phases at Ghār-e Boof is described by Conard and team based on the absence/presence of bladelets. Bladelets are not seen at the site before 41 kya, this is in stark contrast to the results from Shanidar which has bladelets well before 80 kya (Mata-González et al., 2022). Aside from this, the description for the Ghār-e Boof material matches that of the Shanidar Mousterian assemblage.

7.3.1.1.2 Tang-e Eshikan

Another Southern Zagros site is Tang-e Eshikan located in the South of Iran. The Middle Palaeolithic tools recovered from the site are described as "similar to those of other Zagros Mousterian sites" (Hourshid and Tsuneki, 2014). The lithic assemblage is dominated by side scrapers and Mousterian points (Rofes et al., 2024) however, unlike Ghār-e Boof, the use of the Levallois technique is well represented. This again shows the variability of the Zagros Mousterian. No Levallois flakes were recovered from the current excavations at Shanidar Cave.

The OSL dates for the Middle Palaeolithic levels are 70 – 55 kya for the oldest contexts and 55 – 45 kya for the youngest. There is an Upper Palaeolithic sequence in the cave's upper layers and again, a stark difference between the MP and UP occupations is noted (Rofes et al., 2024).

The sites of the southern Zagros are typified by the expected Mousterian tools (i.e. side scrapers and Mousterian points). At both sites, a clear separation exists between the MP and the UP phases. No clear transitional period is visible and as described by Bretzke and Conard (2017), there are very few Middle Palaeolithic sites and this may reflect low population density in the Southern Zagros and as such, the occupations of the region may have been a simple replacement rather than assimilation.

7.3.2 West Central Zagros Mousterian Sites

The West Central Zagros region represents the largest cluster of Palaeolithic sites in the region and is notable for its steep and elevated topography and large valleys (Guran, 2025).

7.3.2.1 Kunji Cave

Kunji Cave is located in Southwestern Iran. The site features contextual layers covering the Middle and Upper Palaeolithic. Descriptions of these layers highlight that significant rodent activity has impacted the integrity of the layers and as such, accurate descriptions of context were impossible (Baumler and Speth, 1993). The material recovered from Kunji falls in line with previous descriptions of the Zagros Mousterian, with the assemblage being made up mostly from Mousterian points and various forms of side scraper (Skinner, 1965; Lindly, 2005). The use of the Levallois technique is also noted at this site. Again, this description matches the Mousterian assemblage from Shanidar Cave.

In addition to these tools attributed to the Mousterian, two bladelets were recovered from the same contexts but were described as "intrusives" and as such discarded (Baumler and Speth, 1993). At Shanidar, the sheer number of bladelets in Mousterian contexts makes them unlikely to have simply been "intrusives".

7.3.2.2 Warwasi

Warwasi Cave is located in Western Iran. Excavations in the early 1960s unearthed over 17,000 lithic artefacts (Braidwood and Howe, 1960). The lithic artefacts ascribed to the Mousterian are similar to those of the other Zagros sites (a large proportion of side scrapers and points, limited blade production and little to no other form of Upper Palaeolithic tools) (Skinner, 1965). This is similar to the findings of this study.

At Warwasi, lithics associated with the Baradostian culture were also recovered (see section 7.5.1.2). Again, there is a clear difference between the Middle and Upper Palaeolithic occupations of the site (Tsanova, 2013). Bladelets in particular are only apparent at the site in conjunction with other initial Upper Palaeolithic tool forms such as Dufour bladelets and twisted points in MIS 3. These tool forms are noted at Shanidar Cave from MIS 5c onwards.

7.3.2.3 Bawa Yawan

Bawa Yawan rockshelter is located in the Bisetun-Shahoo mountain range, which also houses Warwasi (see section 7.4.2.2). The recent excavations at the site have yielded a high number of lithics (Guran, 2025). The tools from the Middle Palaeolithic phases are like those described from other Zagros Mousterian sites (Skinner, 1965; Lindly, 2005, Guran, pers. comm, 2025).

The sizes of lithics presented by Guran (2025) are similar to those noted from Shanidar and as such may reflect similar patterns of resource management.

Highly reworked tools account for roughly 15% of the assemblage, this could reflect a higher abundance of raw material compared to Shanidar and other Zagros sites (Dibble, 1984).

As with Shanidar, the proportion of blades increases as time goes on. This may be reflective of local populations developing their technologies in situ or perhaps a change in the occupants of the site. The use of the Levallois technique is again noted at Bawa Yawan.

Bawa Yawan, much like Shanidar Cave also features direct evidence for Neanderthal occupation due to the presence of associated skeletal remains (Heydari-Guran et al. 2021). As such, the makers of specific tool from the associated layer can be directly tied to this species. Further, secure dating of the site places the Mousterian tools between 80 and 58 kya (68% credibility; Heydari et al., 2024). As with the above sites, there is a marked difference in lithic assemblages between the MP and the UP.

7.3.3 Northern Zagros Mousterian Sites

With the exception of Shanidar, the most significant Palaeolithic site in the Northern Zagros is the Hazar Merd complex of caves (Garrod, 1930).

7.3.3.1 Hazar Merd

The Hazar Merd complex of caves is located in the Northern region of the Zagros Mountains in the Sulaymaniyah region of Iraqi-Kurdistan and is the closest of these sites to Shanidar. The site initially excavated by Garrod (1930)

features the typical Zagros Mousterian toolkit, being mostly side scrapers and points. Garrod recorded no evidence for the use of the Levallois technique. She also noted the presence of two bifacial handaxes in the lower level of Dark Cave, something which has not been described in other forms of the Zagros Mousterian. As with some of the material from the West Central Zagros, the material features a high degree of retouch. The complex, inclusive of Dark Cave preserved evidence for Upper Palaeolithic occupation but again, there was a distinct separation between the UP layers and those below.

It is clear that there is no strict definition Zagros Mousterian based on the variation within sites across the region (Skinner, 1965; Lindly, 2005; Guran, 2025). Even in the wider bands proposed by Guran (2025), variations between sites such as the absence or presence of Levallois or blades is evidenced. The core concept of the technocomplex, being heavily retouched tools with a high proportion of side scrapers and pointed tools does apply to the majority of the sites discussed. The material from Shanidar Cave does seem to fit with this general description, as it has done with previous studies (Solecki and Solecki, 1994; Akazawa, 1975).

While sites such as Hazar Merd and Bawa Yawan evidence laminar blade production in phases attributed to Neanderthals, the routine production of bladelets is not evidenced before the initial Upper Palaeolithic (see Warwasi for example, section 7.3.2.2; Tsanova, 2013). Bladelets are evidenced at Shanidar Cave in MIS 5c, with continuous representation throughout the

sequence. The initial excavations at Shanidar did not recover bladelets from Solecki's layer D, but this may be reflective of the methods of the time (Solecki, 1975). Neanderthals are known to have developed and utilised bladelets as far back as MIS 7 (Carmignani and Soressi, 2023). Therefore, the case can also be made of independent innovation for bladelet technology by the Neanderthals of Shanidar Cave and the surrounding Zagros (Otte and Koslowsi, 2011). It should be noted that Shanidar Cave sits in a region where there are four distinct variations of the Mousterian and given that high mobility amongst Zagros Neanderthals has been established (Lindly, 1997) it is possible that new and distinct methods of tool production were developed to aid in this (see Figure 7-18).

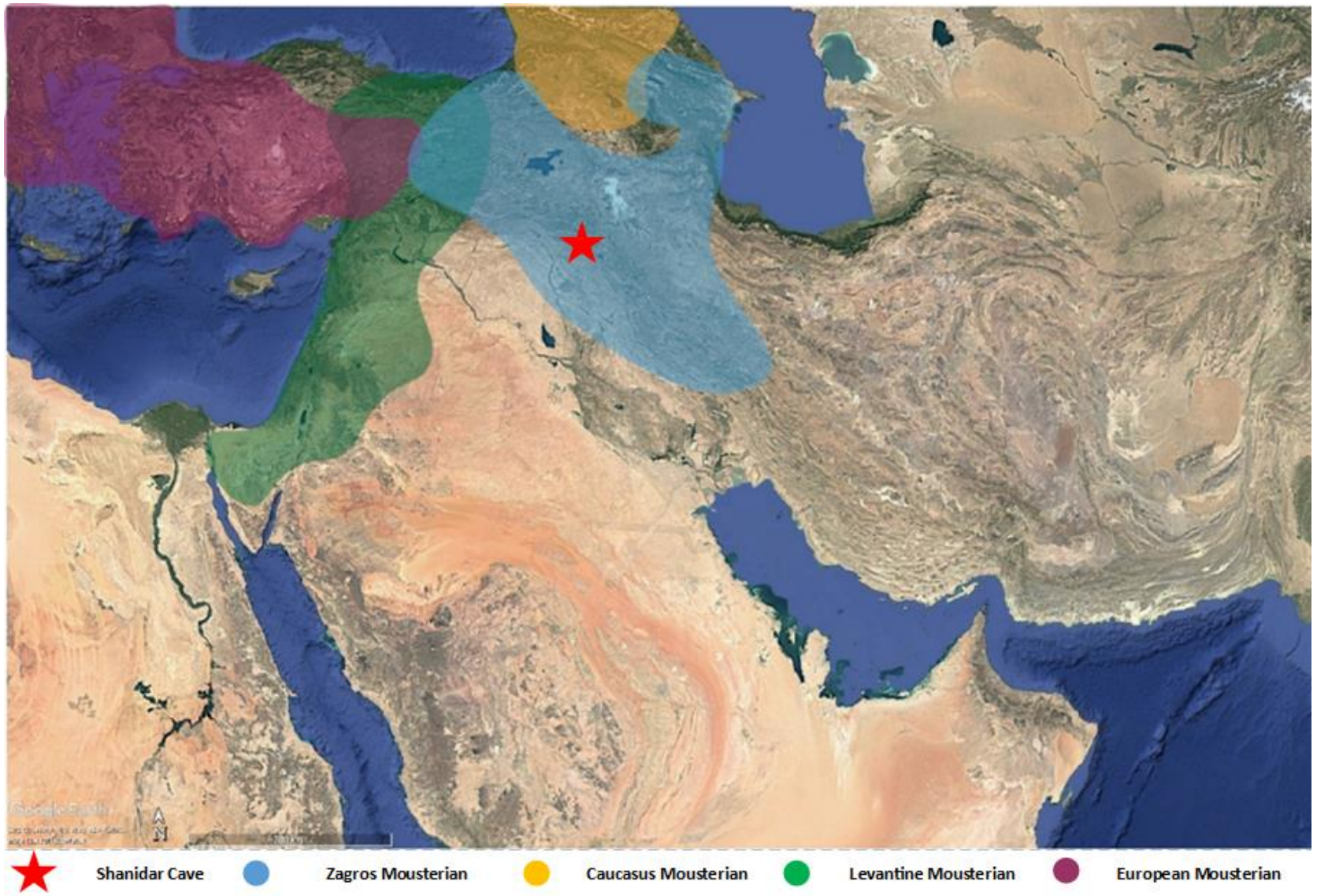


***Figure 7-18**: Map of the Near East showing regional variations of the Mousterian*

7.4 The Zagros Aurignacian

The Baradostian was named by Solecki following his initial work at Shanidar Cave (Solecki, 1958). The industry was similar to that of the Aurignacian found in European Upper Palaeolithic assemblages and on the advice of Dorothy Garrod, he dubbed this industry the Baradostian, for the mountain on which Shanidar Cave is found. This industry is notable for the presence of numerous forms of retouched bladelets, as well as burins, blades and specialised points such as Arjenah Points (Solecki, 1958; Hole and Flannery, 1967; Olszewski and Dibble, 1994). Olszewski and Dibble (1994) proposed calling the industry the Zagros Aurignacian rather than Baradostian, following their work at Warwasi.

It has been suggested that this Upper Palaeolithic industry developed *in situ* in the region, stemming from the Zagros Mousterian (Hole and Flannery, 1967; Olszewski and Dibble, 1994, 2006; Otte and Kozloswki, 2011). At multiple sites in the region however (e.g. Warwasi, Yafteh, Hazar Merd) there is a clear boundary between the final Mousterian and initial Upper Palaeolithic (Garrod, 1930; Hole and Flannery, 1967; Olszewski and Dibble, 1994, 2006; Tsanova, 2013). This boundary is described at every site as separating a mostly flake based Mousterian industry, followed by an initial Upper Palaeolithic industry dominated by retouched bladelets. This initial Upper Palaeolithic bladelet industry is noted across the region from roughly 41 kya (Otte et al., 2011; Tsanova, 2013). This is in stark contrast to the material from Shanidar, where bladelets are noted from MIS 5c onwards.

There is limited direct evidence for *H. sapiens* before the later Upper Palaeolithic of the Zagros, with the exception of the material skeletal material from Eshkaft-e Gavi and from Wezmeh Cave (Scott and Marean, 2009; Trinkaus et al., 2008). It is possible that there were excursions of anatomically modern humans into the region before becoming settled in the region (Hershkovitz et al., 2015; Stringer et al., 1989; Shea and Bar-Yosef, 2005). However, if the sites of the Zagros were occupied by distinct bands of *sapiens* and Neanderthals, one might expect to see this reflected in the lithic assemblages of these sites (Grün et al., 2005; Harvarti et al., 2019; Zaidner et al., 2025).

The material from the Shanidar Cave assemblage does show a continuation of tool traditions from MIS 5 into MIS 3 and therefore supports the theory that the Zagros Aurignacian developed *in situ*. While the makers of the initial Upper Palaeolithic of these sites are difficult to ascertain, there is a marked increase in Upper Palaeolithic tool forms from phase 6, peaking at phase 3 (MIS 3). Perhaps this change in assemblage composition at Shanidar reflects the change in species occupying the site (Figure 7-19). This may therefore also be the point at which to separate the Middle and Upper Palaeolithic occupations of the site. Two of the major Upper Palaeolithic sites are discussed in detail below, these being Yafteh Cave and Warwasi

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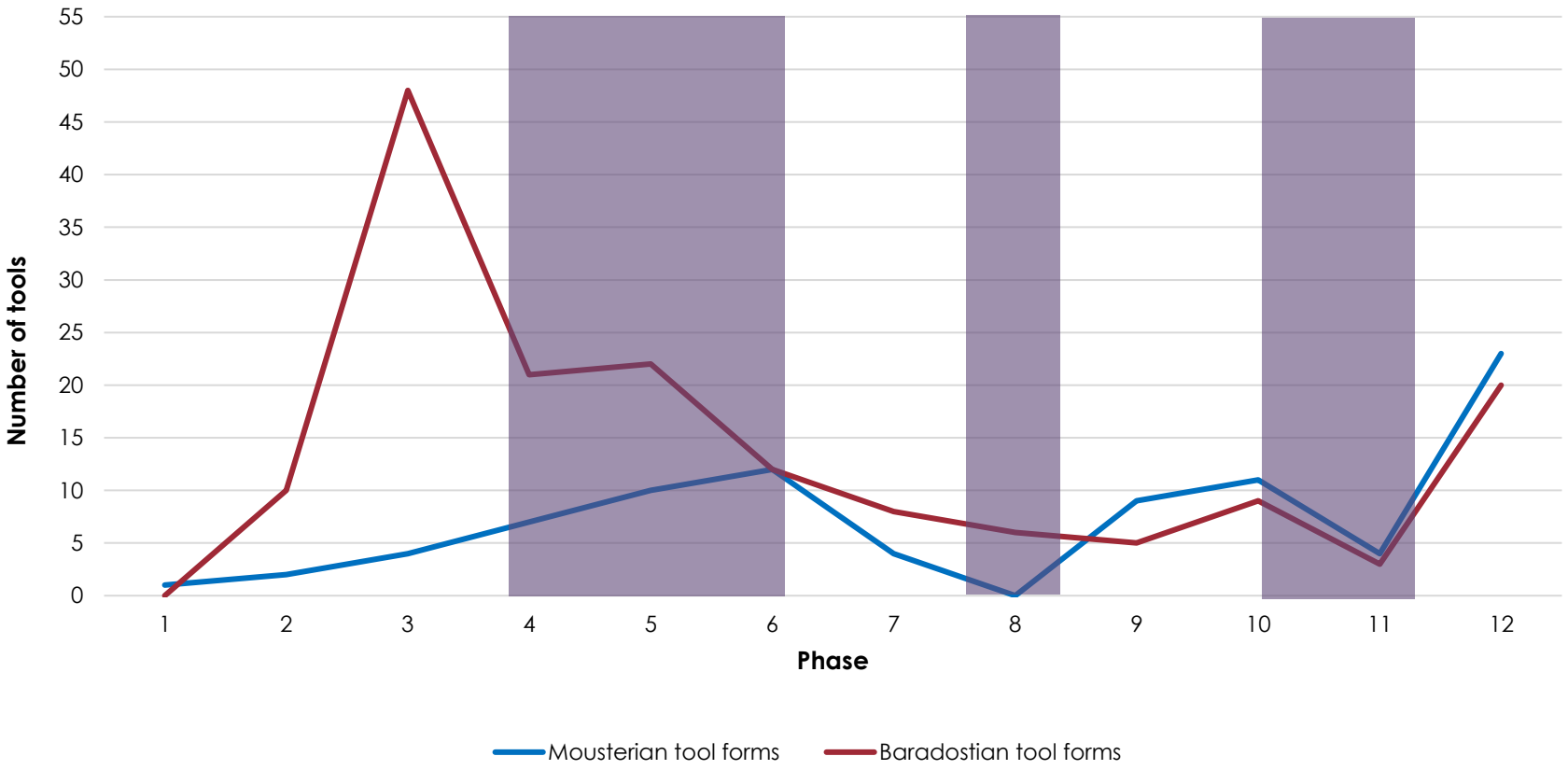


***Figure 7-19**: Number of tools attributed to either industry by phase. Purple bars represent phases in which Neanderthal remains have been recovered.*

7.4.1.1 Yafteh Cave

Yafteh Cave is located in the central region of the Zagros in Western Iran. Initial excavations were carried out by Hole and Flannery (1967), with modern work being conducted by Otte (Otte et al., 2007). The recent excavations of the site were divided into 21 phases, with the bottom part of the sequence dated to c. 35 Kya and the upper sequence dating to c. 33 kya (Otte et al., 2011). The lower sequence is characterised by the production of bladelets, mainly produced from small prismatic cores or from the edges of flakes. Arjenah points and Dufour bladelets were also noted (Ghasidian et al., 2019). The upper sequence of the site was described as mostly carinated pieces and saw a gradual replacement of Arjenah points for twisted bladelets.

The Baradostian material from Shanidar resembles the lower sequence of Yafteh given the abundance of bladelets and small, highly worked cores, while Arjenah points were not noted, two examples of Dufour bladelets were recovered from Shanidar. Otte et al (2011) have argued that the Yafteh sequence may represent the earliest Baradostian in the Zagros.

7.4.1.2 Warwasi

Another notable site for the Upper Palaeolithic of the Zagros is Warwasi. This site has been discussed above in relation to the Middle Palaeolithic industry of the site (see section 7.3.2.2). The site is divided into three main cultural deposits covering the Middle Palaeolithic (see section 7.4.2.2), Upper Palaeolithic and Epipalaeolithic (Olszewski i, 1993; Otte and Kozlowski, 2011).

The Upper Palaeolithic Baradostian layers can be further divided into early and late assemblages, as with Yafteh. The Early Baradostian assemblage consists of bladelets (described as not standardised) and pointed flakes similar to Mousterian points (Dibble and McPherron, 2007; Hole and Flannery, 1967). No clear hiatus between the Mousterian and Early Upper Palaeolithic phases is noted at the site, though a decrease in volume of lithics from the MP into the EUP was observed (Olszewski and Dibble, 1994).

The lithic material from the Late Baradostian phases is characterised by standardised bladelets which are described as long, narrow and pointed (Olszewski and Dibble, 1994). The bladelets at Shanidar do not show a high degree of standardisation, even across the same archaeological phase (see section 7.2.2.2). The initial Baradostian of Warwasi is similar to that of the Shanidar assemblage, being a mostly flake based assemblage with a limited number of blades. No evidence of symbolic behaviours (such as the incised shell from Shanidar, Hunt et al., 2017) are evidenced at Warwasi. This, in conjunction with a lack of dates and skeletal remains makes determining the exact makers of the assemblage at any phase difficult.

As stated throughout, tools that are typically associated with the Baradostian at other sites are associated with Neanderthals at Shanidar Cave, especially in early MIS 3. During Solecki's original excavation, he determined that Shanidar 1 had originated in Layer C (Baradostian) before changing his mind down the line (Solecki, 1955, 1961), as such the Shanidar Neanderthals have

always been linked to the Baradostian culture, making it is difficult to determine the makers of any tool within the site.

The Baradostian material from Shanidar Cave is similar to that of other sites in the region (see section 7.5) with the exception of lacking Arjenah points. The Shanidar lithic assemblage is from a smaller excavation than that of others in the region and this discrepancy may be due to the lower number of lithics recovered.

7.5 Use-Wear Results from the Zagros Region

Use-wear studies from the Zagros are limited to two studies (Claud et al., 2012; Tumung et al., 2020) with very small sample sizes (e.g. sample size for Claud et al. is three lithics).

The results of these studies show a range of activities with the most common activity being butchery. The most common material worked at Shanidar is interpreted as wood, followed by meat and bone. This difference may be due to a number of factors. Firstly, by comparison to these studies, the sample from Shanidar is exponentially larger and this could produce different results. Secondly, the sites analysed e.g. Qualeh Bozi (sampled by Claud et al., 2012) are small rock shelters rather than cave sites. As such, the activities here are more likely to be focused on hunting and subsistence rather than crafting. Beyond this, the burials at Shanidar may suggest a different purpose for the site beyond just surviving and this may have influenced the behaviours of past hominins.

In order to develop a more rounded picture of the results from Shanidar Cave, we must look at the results from studies further afield than just the Zagros. Use-wear studies on older prehistoric sites are less common than those from more recent sites, therefore there are more comparative studies for the Upper Palaeolithic compared to the Middle Palaeolithic (see Table 3-2). Use-wear studies have shown that Neanderthals were capable of exploiting fish and birds (Hardy and Moncel, 2011), small game (Hardy et al., 2013) among

other animal products (Doronicheva et al., 2022; Hardy and Moncel, 2011, Hardy et al., 2013; Navazo Ruiz et al., 2023; Zilhão et al., 2017).

The working of craft materials such as shell, hide, bone or wood is also becoming more common (Bauman et al., 2022; Doronicheva et al., 2022Mateo-Lomba et al., 2024; Vaquero et al., 2017; Hardy and Garufi, 1998; Hardy and Moncel, 2013, 2020; Navazo Ruiz et al., 2023; Zilhão et al., 2017).

All of the materials which have been documented in Neanderthal associated contexts have also been evidenced in Upper Palaeolithic contexts (e.g. Moss, 1983; Aranguren et al., 2007; Hardy, 2008; Aleo et al., 2021; Symens, 1988; Douka and Spinapolice, 2012). With the exception of horn working, the worked materials at Shanidar Cave are similar to those of other studies.

7.6 Residues

59 lithics from the Shanidar Cave assemblage retain some form of residue. Three forms of residue were noted, these being manganese, ochre, and an indeterminate globular residue. Some tools retain both ochre and manganese.

7.6.1 Manganese

Manganese is common within archaeological contexts, especially in cave sites where moisture phases are high (Northup and Lavoie, 2001).

Manganese also signifies the presence of organic matter which has degraded (Luong et al., 2017). It is impossible to distinguish the origins of manganese on the tools, but the occurrence of manganese along a worked or retouched edge may suggest that it was used on biological matter (Luong et al., 2019). Indeed, the washing of manganese on certain liberated animal hairs, vegetable fibres, wood fragments and fungal hyphae. The first three of these may be linked with the materials worked, while the fungal hyphae could have infested perishable and decaying materials which did not survive on the lithics. Nearly all of the lithics with manganese also had signs of use (92.6%) (e.g. Figure 7-20).

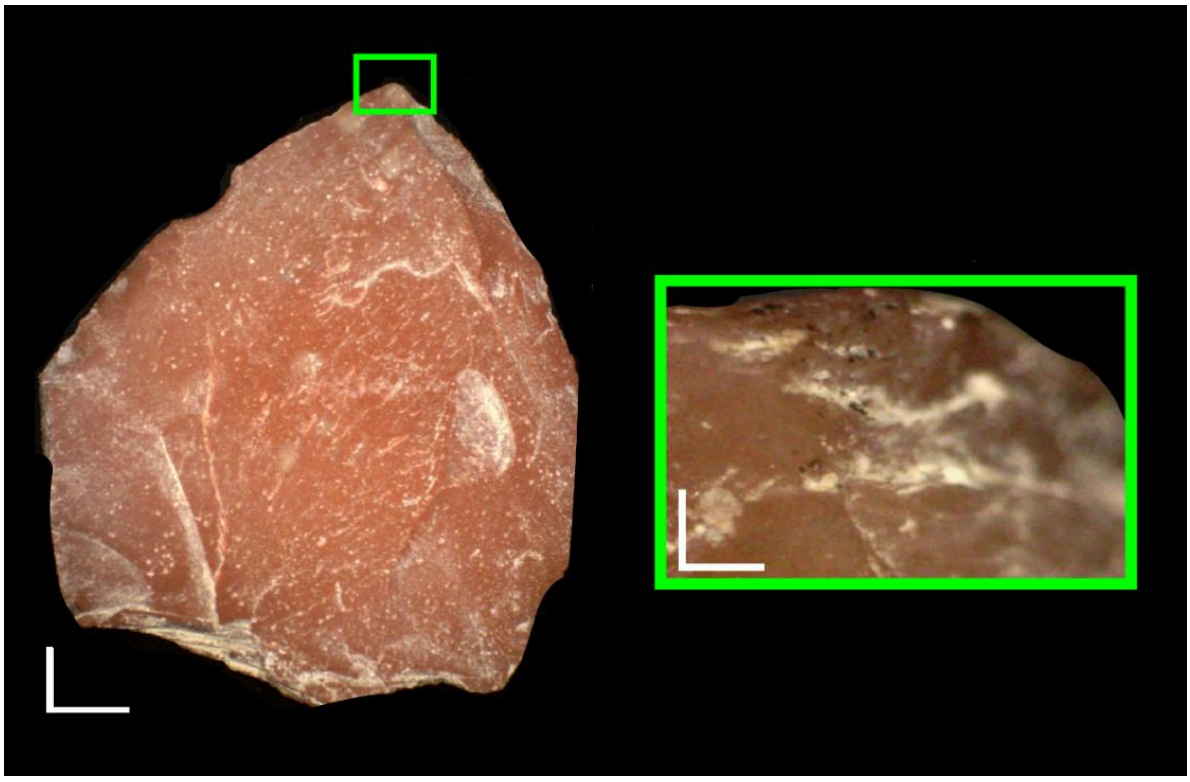


***Figure 7-20**: Jasper Mousterian point used for hide working from Phase 4 (context: 1653, ID: 299. Scale 10 mm. Green square (magnification 200x, scale 5 mm) shows manganese is in association with the worked edge.*

7.6.2 Ochre

Ochre is common within Palaeolithic sites (Nielsen et al., 2012; Zilhão, 2012). The use of ochre for personal adornment or cultural expression has typically been seen as a facet of behavioural modernity within the *Homo* clade (Dapschauskas et al., 2022). Red and yellow ochre has been recovered from Shanidar Cave, though only red ochre was observed adhering to tools analysed in this study (see Figure 7-21). Tools with traces of ochre originated in almost all phases at Shanidar suggesting that the use of ochre was consistent through time. Ochre can also be combined with bitumen to create a strong adhesive which can be used for hafting (Schmidt et al., 2024). Ochre is observable on six tools from the Shanidar Cave assemblage which also show wear traces of hafting (e.g. base rounding).



***Figure 7-21**: Red ochre recovered from Shanidar Cave. Magnification 230x*

7.6.3 Globular Residue

A globular residue was observed adhering to four tools. Due to its texture and brown colour, it was hypothesised that it was a form of plant matter (Figure 7-22). This is to be substantiated by analysis using Fourier transform infrared (FTIR) microscopy at a later date. The use of plant matter in adhesives is well established at other Palaeolithic sites (e.g. Schmidt et al., 2024). It is possible that this residue may be a form of mastic which is readily available around the site (Fiacconi and Hunt, 2015; Henry et al., 2011).

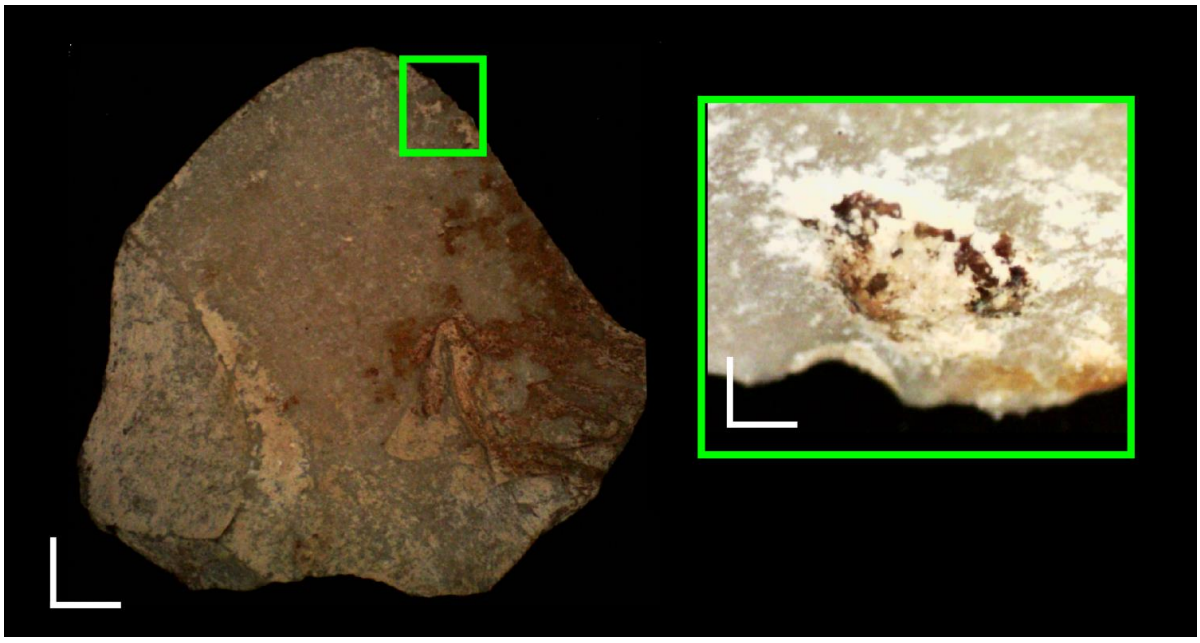


Figure 7-22: *Mousterian point used to work bone from Phase 10 (context: 2312, ID: 585). Scale 10 mm. Green square (magnification 50x, scale 5 mm shows brown globular residue adhering to the worked edge*

The identified residue by phase is presented in Figure 7-23. What can be seen clearly is that the use of ochre becomes more apparent following Phase 6 (MIS 3). This may then suggest that the use of ochre was more habitual in the later occupations of the site. Further, two of the globular residues are from contexts directly associated with Neanderthals, suggesting they were utilising this residue, likely as an adhesive (Schmidt et al., 2024).

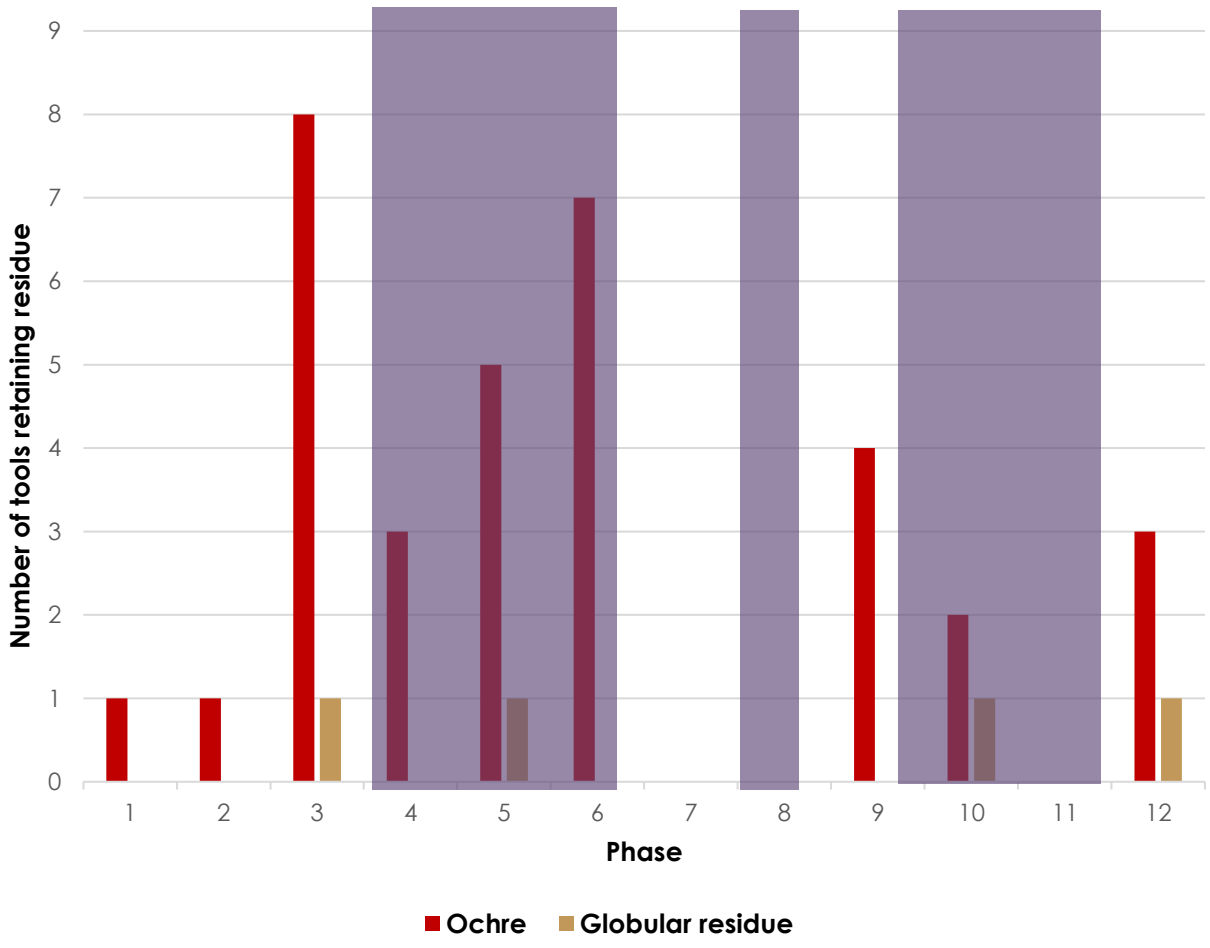


***Figure 7-23**: Identified residues by phase. Purple bars represent phases in which Neanderthal remains have been recovered*

7.7 Shanidar Cave Hominins in MIS 3 and MIS 5

The original excavations at Shanidar Cave were divided into five distinct cultural bands, representing two distinct species of human, Neanderthals and *Homo sapiens* (Solecki, 1955, 1975, 1979; Stewart, 1977). The results of this study show that *there* is no clear boundary where use of lithics characterised as typical of the Middle Palaeolithic ends and tools regarded as typical of the Upper Palaeolithic starts. In terms of the lithics analysed, we see a continuation of flake-based tools (e.g. side scrapers and Mousterian points) well into MIS 3, as well as blades and bladelets occurring throughout the cave's sequence suggesting a continuity in behaviour. Trinkaus (1989) separated the Neanderthals at the site into Eastern (1,3 and 5) Neanderthals in MIS 3 and Classic Neanderthals (2,4,6,7,8,9,10) in MIS 5.

With regards the differences between both groups of hominins, we see little variation in terms of typology and no significant differences in materials worked. There is a statistically significant difference in the tools which were being worked in MIS 3 or MIS 5. By phase 3 and the close to the end of MIS 3, we see a shift to more Upper Palaeolithic tools, and this may reflect an end to the Neanderthal occupation of the site.

7.8 Shanidar Cave and the Case for Neanderthal Behavioural Complexity

Shanidar Cave has always been important to discussions of Neanderthal complexity (Solecki, 1961, 1971, 1975; Pomeroy et al., 2017, 2025, in press). The debates surrounding the mortuary practices continue to this day, but the fact remains that multiple generations of Neanderthals returned to this site to deposit their dead (Hunt et al., 2017, 2024; Pomeroy et al., in press).

This study contributes to discussions on Neanderthal complexities from the site. The results from the typological study show the production of blades and bladelets as far back as MIS 5c. While it is possible that *Homo sapiens* developed these tools during brief visits to the region, the presence of Neanderthal bodies in MIS 5 makes them the likely makers of this tool type. Neanderthals have been evidenced as making bladelets in Europe, but this is the first instance of Neanderthal bladelet production in the Zagros.

Further, the use-wear results show that a wide range of materials were worked at the site. While the exact activities cannot be gleamed from the wear traces (for example wood could be used to make shelter, tools, firewood, etc.) the fact that a wide range of materials was worked suggests a population which was adapted to their environment. That no significant difference between the materials worked in MIS 3 and MIS 5 was observed suggests a continuity in behaviours.

While we cannot determine the hominins occupying the site at any point, Neanderthals are present during both of these phases, as evidenced by their skeletal remains. Finally, the results from the residue analysis show routine utilisation of ochre throughout the cave's sequence. Neanderthal use of ochre was not previously evident at Shanidar Cave.

The results from this study goes to show that there is little difference between the Neanderthals and the humans of the Upper Palaeolithic, with regard to their lithic technology or its use. Indeed, it is highly likely that both species were occupying the site in the same broad time frame. The work of McBrearty and Brooks (2000) questioned earlier ideas of a cognitive revolution between the Middle and Upper Palaeolithic. The results of the work described in this thesis similarly show that at Shanidar, hominin capabilities and activities do not seem to have changed greatly between 100,000 and 30,000 years ago.

7.9 Conclusion

This chapter has discussed the findings of the lithic technological analyses. The results for the typological analyses and the use-wear analyses were detailed and discussed in relation to the site's Harris Matrix and the implications of such were covered. The predominant impression from the typological and use-wear studies is that there was a very high degree of continuity of typology and use-wear from 100,000 to 30,000 years ago and

across the likely transition from Neanderthals to modern humans. The results from Shanidar Cave were compared and contrasted to other Palaeolithic sites in the region. The final chapter will summarise the answers to the research questions established in Chapter 1 and outline suggestions for future research.

Chapter 8 – Conclusion

The previous chapters have covered the research background, methods and results for this project. The preceding chapter took these findings and discussed the significance of such. This chapter details the conclusions of the study. To reiterate the research questions set out in Chapter 1:

1) What is the typological composition of the Shanidar lithic assemblage, and where are these tools situated within the site?
2) Where tools are recovered, do they retain evidence of use? If so, what types of wear are represented, and where are these tools located within the site's stratigraphy?
3) Is the lithic assemblage from Shanidar Cave typologically similar to assemblages from other sites in the Zagros? How do the activities performed at these sites compare?
4) What can be understood about the occupants of Shanidar Cave through analysis of the lithics? Do behaviours and activities change throughout time and with different hominins?

In answer to question 1, the Shanidar Cave lithic assemblage is comprised of stylistically Mousterian tools, stylistically Baradostian tools, and tools that would fit with either industry. Given the complexity of the site's Harris matrix, a simplified model of 12 phases was devised based upon absolute dates and site landmarks (section 2.8.3). Lithics were recovered from each of these

phases. Mousterian tools were recovered from all phases with the exception of phase 8 which is associated with the Shanidar 4 Neanderthal burial layer. Baradostian tools were recovered from all phases inclusive of the Shanidar 4 burial layer, which produced two retouched blades and four retouched bladelets. The implication is that there is no clear separation between tool industries and no hiatus in occupation at Shanidar Cave, as had been suggested previously (Solecki, 1975). Further, the lithics from Shanidar Cave demonstrate that it may not always be possible to assign a particular industry to a particular species of hominin. This has implications for other sites in the region. Whether the presence of Baradostian tools in MIS 5a indicates innovation by the Shanidar Neanderthals or signifies the early arrival of anatomically modern humans to the region is impossible to determine and thus warrants further research.

Previous studies on the Baradostian have suggested that the industry developed *in situ* in the region from the Zagros Mousterian (Dibble, 1984; Ghasidian, 2014, 2019; Olszewski, 1999; Grün et al., 2005; Otte and Koslowski 2011). The continuation of Mousterian tools into MIS 3 and the overlap between Mousterian and Baradostian tool types in the Shanidar sequence support this.

In answer to question 2, some 106 tools retain some evidence of use. Wear traces were related to the working of wood, hide, meat, bone, plant fibres, horn and ochre. Tools retaining use were recovered from all phases with the exception of phase 8 (Shanidar 4 and Shanidar A burial layers). There was no

significant difference between MIS 5 and MIS 3 in terms of worked materials and associated actions, which indicates that there were no significant changes to behaviours over time. There was however, a significant difference to the tools worked during MIS 3 or MIS 5. This may reflect a change in the occupants of the site or may reflect the evolution of lithic traditions within the Zagros region. Finally, there appears to be no clear correlation between the tools used for any specific activity.

Residues were identified from 59 tools across the sequence with the exception of Phases 8 (Shanidar 4 burial cluster) and 11 (Shanidar A burial). This included ochre, manganese, and an as-yet unidentified globular residue. This is to be investigated using FTIR microscopy at a later date.

Question 3 aims to relate the material studied in this thesis to that of the wider Zagros region. The material culture from both of these industries had previously been attributed to the Zagros Mousterian and the Zagros Aurignacian respectively (Skinner, 1965; Akazawa, 1975; Reynolds et al., 2016). The analysis of the new Shanidar lithic material agrees with this previous assessment. The material falls in line with the general descriptions of both industries with the exception of bladelets occurring throughout the Mousterian assemblage. Bladelets are noted in the Zagros, but this have not previously been directly associated with Neanderthals and have not previously been associated with Neanderthals at Shanidar Cave(Otte et al., 2011).

The continuation of Mousterian type tools into the Upper Palaeolithic is observed at Shanidar Cave, as it is with other sites in the region such as Warwasi and as such supports the hypothesis that the Zagros Aurignacian/Baradostian developed *in situ* from the Mousterian (Dibble, 1984; Ghasidian, 2014, 2019; Olszewski, 1999; Grün et al., 2005).

In answer to question 4, there is no statistical difference in terms of worked materials or the worked tools in MIS 3 and MIS 5. As such, it is likely that behaviours with regards crafting and subsistence strategies did not change much during this time. As stated throughout this study, the exact makers of any tool within the site are difficult to determine but given the Neanderthal bodies between Phases 11 and 4, it can be assumed that they were the makers of some tools within these phases. If this is the case, we can argue that the Neanderthals of Shanidar were capable of producing and utilising a wide array of tools on a wide array of materials. This builds on past work from the site which has been at the forefront of understanding the capabilities of Neanderthals. It should be noted however that Shanidar Cave is not a typical Palaeolithic dwelling and may have served a more significant role in the lives of it's occupants. Therefore, any results from this site may not be reflective of hominin behaviour as a whole, rather reflective of the behaviours of this specific site.

8.1 Future Research

In addition to FTIR analysis of residues from Shanidar Cave, future work should include the reanalysis of the lithics recovered in Solecki's original excavations which are currently housed in the Smithsonian Institution in Washington D.C., United States, and at the Baghdad Museum, Iraq. This is because the results of the present study suggest that typological analysis alone is not sufficient to determine the behaviours of past hominins, and analysis of all of the Shanidar material using the same methods would enable a better understanding of the entirety of the sequence. Further, as has been stated throughout, the sample size of this study was relatively small and could therefore benefit from more material to compare to.

Since 2023 a number of obsidian artefacts have been recovered from Shanidar Cave. At the time of their recovery lithic analysis had already begun so they were not incorporated into this study, however, it is essential to analyse them in order to have a complete understanding of the stone tool assemblage. Previous research has suggested that because obsidian is brittle in comparison to flint and chert, post-depositional modification is more likely to occur and signs of wear e.g. polish can be obscured (summarised in Setzer, 2012). The analysis of such would therefore require the development of an additional experimental series. The results of use-wear analyses suggest that stone tools might have been accompanied by tools less likely to preserve in the archaeological record such as those made from wood and bone. Evidence for the use of bone and wooden tools have recently been recovered from Shanidar Cave (Pomeroy et al., in press). This highlights the

necessity to revisit faunal assemblages in search of other potential tools or trauma from lithic and non-lithic tools.

One aspect of research highlighted in this study is the lack of standardisation surrounding cleaning protocols (see Rots et al., 2016; Keeley, 1980 or Vaughan, 1985; Fullola i Percot and Rodón i Borràs, 1990). Of the lithics which were re-examined following wash in HCl-10% solution, one lithic was changed from their original identification meaning that 97.9% (48 out of 49) remained the same. These results show that the need for excessive cleaning protocols is not always needed unless in the case of Rots et al. (2016) the residue is extensive and has already been sampled. The discrepancy in identification before and after cleaning is likely be random variation in the ability of the use-wear practitioner. A re-examination of any random sample of lithics would likely yield similar results. As this is a still developing discipline, the effects of cleaning should be studied further with similar parameters to blind tests aimed at observing the use of a tool.

8.2 Closing Remarks

This thesis has demonstrated that by combining use-wear and residue analysis with traditional typological analysis, a more detailed understanding of hominin behaviours can be achieved. Research at Shanidar Cave has long been at the forefront of discussions about the capacities of Palaeolithic hominins and this research contributes to such (Figure 8-1).



***Figure 8-1**: Facial reconstruction of Shanidar Z produced for the 2024 Netflix documentary 'Secrets of the Neanderthals', Mar 2023. Photo by M. Hitchcock*

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