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A land of flint and fallow-deer: human persistence at Middle Pleistocene Qesem Cave

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Abstract

Qesem Cave is a Middle Pleistocene site in Israel occupied between 420-200ka and assigned to the Acheulo-Yabruidan Cultural Complex (AYCC) of the Levant. Excavations have revealed a wealth of innovative behaviors, most likely practiced by a new hominin lineage. These include early evidence for the habitual and continuous use of fire, the repeated use of central hearths, meat roasting and marrow extraction, systematic flint and bone recycling, very early blade production technologies, the production and use of bone retouchers, social hunting strategies and meat sharing practices and more. The Qesem evidence indicates a new mode of adaptation exercised throughout the 200,000 years of human occupation of the cave. This paper presents an integrative view regarding the persistence of human occupation at Qesem Cave within the framework of the significant cultural and biological transformations that took shape in the post-Acheulian Levant. In particular, we highlight the following aspects: 1. The chronological and sedimentological depth of human use of the cave; 2. The wealth of natural goods (stone, water, fire-wood, animals and vegetal material) available and used by the cave inhabitants; 3. The high densities of flint items and faunal remains per excavated volume in many cave parts, especially in and around the central hearth. 4. The minute evidence for carnivore's activity at the site. 5. The transmission of knowledge in flint knapping and carcass processing. 6. The repetitive human behavior and cultural continuity throughout the human use of the cave. It is our contention that this specific cave was carefully selected as a site to be persistently occupied by a group well aware of its necessities. The new mode of adaptation practiced at Qesem Cave is fully evident as early as the initial use of the cave some 420ka, and thus a landscape capable of supporting this specific mode of adaptation was chosen. This landscape enabled the cave inhabitants to fully practice their particular adaptation strategies and maintain AYCC life-ways for some 200,000 years.

1. Introduction

In this paper our aim is to discuss the persistence of human occupation at Qesem Cave in the context of cultural and biological transformations that took shape in the Levant some 400 ka ago. We claim that the particular mode of adaptation practiced by the cave inhabitants is significantly different than the one practiced during Acheulian times in the Levant and include elements that had characterized human existence from that time onwards. We contend that the combination of specific circumstances during the late Lower Paleolithic period in the Levant triggered human communities to make use of their extensive cultural and social capabilities as well as their profound familiarity with their environments to develop a new mode of adaptation. The use of fire for roasting meat, innovative lithic technologies, specific hunting, butchering and meat sharing practices as well as extensive recycling procedures, among others, were central elements in this new adaptation. The archaeological evidence from Qesem is consistent with this hypothesis. We start with a general short introduction to the Acheulo-Yabrudian Cultural Complex (henceforth AYCC) as reflected by the plethora of information gathered from the archaeological deposits of Qesem. Then we will focus on aspects relevant to human persistence at Qesem Cave and finally present our hypothesis regarding human persistence at Middle Pleistocene Qesem Cave.

The Acheulo-Yabrudian Cultural Complex

The AYCC is a Middle Pleistocene, late Lower Paleolithic cultural entity of the Levant. The AYCC consist of three lithic industries – the Acheulo-Yabruidan (a flake industry with a notable presence of handaxes), the Yabrudian (a flake industry dominated by Quina and demi Quina scrapers), and the Amudian (a blade-dominated flint industry). Stratigraphically, the AYCC repeatedly postdates the Lower Paleolithic Acheulian and predates the Middle Paleolithic Mousterian. The absolute chronology of the AYCC covers a range of over 200 ka between 420 and ca. 200 ka (Barkai et al. 2003; Gopher et al. 2010). New TL and ESR dates from Qesem and Misliya Caves accord with this range (Falguères et al. 2016, Mercier et al., 2013, Valladas et al. 2013). AYCC sites are known from the central and southern Levant in both caves and open air settings, but mostly in caves or rock shelters.

Blade production in the Amudian industry is one of the major innovations of the AYCC (e.g., Bar-Yosef and Kuhn 1999). Middle Pleistocene blade production is a unique "ahead of its time" technological innovation. In our opinion the systematic and predetermined AYCC blade production should be viewed as a local innovation practiced for 200 ka. Qesem has shown that the Amudian represents a major industry of the AYCC, equivalent in scale to the other known industries (e.g., Gopher et al. 2005; Shimelmitz et al. 2011, 2015). In the Yabrudian industry, the innovative appearance of the Quina *Chaîne Opératoire* for the production and shaping of Quina scrapers is of note. These distinctive scrapers are well known from Middle Paleolithic Mousterian Europe however the Yabrudian is much older than the European manifestations of the Quina phenomenon. In the Levant, Quina scrapers appear in very large numbers in the AYCC Yabrudian (by the thousands at Qesem and Tabun Caves), but cease to appear in post-AYCC Middle Paleolithic Mousterian sites. The fact that Quina scrapers are not known from earlier Acheulian contexts makes their presence in the AYCC quite enigmatic. As for the makers of the AYCC, this remains an open question. The Galillee-Man skull from Zuttiyeh Cave (Freidline et al. 2011; Keith 1927; Zeitoun 2001), and the dental remains from Qesem hint at a new, post-Acheulian, post-

erectus hominin lineage in the Levant ca. 400ka (Hershkovitz et al. 2011,2016; Ben Dor et al. 2011).

As for the use of fire, the evidence indicates that human use of fire during the AYCC in the Levant was common and relatively widely spread (see a review in Shimelmitz et al. 2014). Earlier use of fire in the Levant was reported at Gesher Benot Ya'aqov only (Alperson-Afil and Goren-Inbar 2010; Goren-Inbar et al. 2004), however no burnt bones were reported. On top of that, the purpose of the probable use of fire in the Acheulian was never demonstrated. It is clear that starting at ca. 400 ka, hearths were used for roasting meat and burned bones are found in abundance in post-Acheulian sites (Fernández Peris et al. 2012; Karkanas et al. 2007). Thus in this case, we concur with the statement that during the Lower Paleolithic Acheulian, raw meat was most probably consumed (Bar-Yosef 2006). As for the AYCC, the evidence from Qesem presented below indicates an unequivocal change regarding the presence and use of fire in archaeological sites from this point in time onwards.

Qesem Cave: some relevant insights

Qesem Cave is located on the western slopes of Samaria hills some 12 km east of the Mediterranean at 90 m a.s.l. With near-by large springs, and being at the ecotone between the swampy basins of the coastal plain to the west and the mountainous ridges of Samaria, this location provides a rich Mediterranean zone.

The stratigraphic sequence (still incomplete, as bedrock has not been reached yet) is divided into two major parts—the lower (over 6 m thick), consists of sediments with clastic content, gravel and clays, and the upper (ca. 4.5 m thick) of cemented sediment with a large ash component. Qesem is a Middle Pleistocene (MIS 11-7) sited dated by various methods (over 100 dates) to 420–200 ka (Barkai et al. 2003; Gopher et al. 2010; Mercier et al. 2013; Falgueres et al. 2016). The whole stratigraphic column of the cave is assigned to the AYCC (Barkai and Gopher 2013).

Ongoing research at the site provides ample evidence of innovative behaviors. This pertains for example to serial blade production; the acquisition of raw material for selected tool types from underground sources; the production of Quina scrapers using Quina debitage and retouch technologies; intensive and varied recycling of flint and bone; group hunting of prime age animals (mainly fallow deer); specialized butchering techniques and unique meat sharing habits; intensive use of bone retouchers; the habitual use of fire; hearth centered spatially patterned activities; and more – all well established at Qesem and present throughout the Cave's sequence. Qesem contains two of the three AYCC industries – the blade dominated Amudian and the scraper dominated Yabrudian. Viewing these two as separate entities is at present challenged by data indicating their coexistence at Qesem. Flint procurement and exploitation strategies were oriented to both characterizing flint types used and locating their sources in the landscape. Preliminary results show the use of a large variety of flint types (over 50 types), some of which were selected for specific types of tools or technological requirements. A concentration of over 10 geological sources yielding flint types used at the cave was found in the immediate (5 km radius) vicinity of the site. Several sources are however located some 15 km away from the site (Wilson et al. 2016). Earlier studies based on measuring *in situ* produced cosmogenic ^{10}Be concentration provided evidence for flint procurement by both surface collection and quarrying from specific, designated primary subsurface sources (Verri et al. 2004, 2005). An advanced stage of this study suggests that quarried raw materials were directed towards the

production of specific tool types (Boaretto et al. 2009). It is of note that AYCC Tabun cave has shown items made of flint quarried from deep sources too (Verri et al. 2005). Moreover, basalt was brought to the cave in small numbers and limestone was used as well for the production of spheroids/polyhedrons.

Amudian blade production at Qesem shows a full *Chaîne Opératoire* including well selected flat flint nodules, core shaping, blade production, use and discard. Amudian blades were mostly used for cutting, butchering and defleshing activities of soft tissues and for a short time (Lemorini et al. 2006). Moreover, homogeneity in blade production technology and in blade characteristics was discerned throughout the Levant reflecting a shared AYCC template regarding the properties of the target blades (Shimelmitz et al. 2016). Amudian blade production looks, at first glance, simple with little core shaping or preparation and little core maintenance. However, it is a systematic, intensive, thoughtful and straightforward laminar industry – a conscious technological choice of skilled flint knappers constantly used for over 200 ka (Shimelmitz et al. 2011,2016).

The production of small sharp items by means of recycling "old" flint items is a clear component of the AYCC and should be taken into account as a significant component of flint economy and human decision making. Detailed studies of recycled items and products of recycling indicate technologically well-established trajectories for the production of designated types of specific sharp flakes and blades (Barkai et al. 2010; Parush et al. 2015; Parush et al. 2016; Assaf et al. 2015) for targeted purposes (Lemorini et al. 2015). At Qesem this involves the systematic use of old "parent" flakes, tools and patinated items for the production of small, sharp, mostly hand-held cutting tools (mostly produced from the ventral face of the “parent” flake). The scale of recycling may reach almost 10% of the debitage at Qesem (the highest densities may reach 180 recycled items per 1 m^3, see Gopher et al. 2016) and if recycled patinated items are added, the scale rises significantly. Recycling as a whole may be looked at as an integral part of the techno-typological system and products of recycling show distinct functional peculiarities and are anything but expedient. There seems to be no good reason to assume that recycling was a result of scarcity of raw material (available abundantly in the area to the present day) and is most probably oriented towards the intensification of cutting activities.

Another innovative aspect of the AYCC is the appearance of Quina and demi-Quina scrapers (Lemorini et al. 2016; Zupanchich et al. 2016). Yabrudian assemblages show an abundance of Quina and demi-Quina scrapers comprising up to 50% of the shaped items while blades are less abundant. As opposed to the case of blade production, the *Chaîne Opératoire* for Quina scrapers is mostly missing from the cave. We thus assume that selected flakes or finished scrapers were imported to the cave.

A small group (n=16 published, more found since than) of shaped stone balls (Spheroids/Polyhedrons) was found concentrated in specific stratigraphic and spatial Amudian contexts (Barkai and Gopher 2016). Biface production continued in the AYCC, however bifaces are indeed marginal at Qesem, and appear as single items in both Amudian and Yabrudian assemblages (Barkai and Gopher 2013). Flint selection for the 14 items found to date indicate preference of specific type of stone (Willson et al. 2016) and the single items analyzed for ^{10}Be shows low content indicating carefully selected sources (Boaretto et al. 2009).

The use of fire is apparent throughout the sequence at Qesem both directly by the large amounts of wood ash and the presence of hearths (Karkanas et al. 2007; Shahack-Gross et al. 2014) and indirectly by the large amounts of burnt flint and burned bones, the organization of activities around the hearth and the presence of charcoal fragments in human dental calculus (Hardy et al. 2016). Thus, it is our contention that fire was used habitually, commonly and repeatedly as early as 400 ka and one of its most important functions was meat roasting and most probably cooking (see Speth 2012, 2015).

The faunal record is extremely rich in all of the assemblages, and is dominated by fallow deer, supplemented by red deer, horse, aurochs, wild pig, and wild ass. Small ungulates such as goat and roe deer, and small prey such as birds, are also present (Stiner et al. 2009, 2011; Blasco et al., 2014, 2016a, 2016b; Sánchez-Marco et al. 2016). Among the small prey, tortoises show a slightly higher level of representation (Blasco et al., 2016b). The faunal assemblages are characterized by an extremely rare presence of carnivores (Stiner et al., 2009, 2011; Blasco et al., 2014, 2016a).

A significant amount of anthropogenic bone damage has been detected along the stratigraphic sequence, including at the earliest levels of the cave. The taphonomic characteristics indicate that all assemblages were generated solely by humans occupying the cave and were primarily damaged by their food-processing activities. The ungulate mortality profile is dominated by adult-aged individuals and, in the case of fallow deer, the relative abundance of infants and young individuals suggests the development of seasonal hunting episodes (Stiner et al., 2009, 2011; Blasco et al., 2014, 2016a).
In tables 1, 2 and 3 we present updated data based on large faunal samples, which represents the whole 15 meters of human occupation at the cave and an updated and upgraded state-of-the-art of the faunal research at the site. Different types of butchery cut marks have been identified in the form of incisions, sawing marks, scraping marks, and chop marks (Figure 1), with ratios between ~1% and ~3% (Table 3). These percentages may seem relatively low; however, cut mark frequencies in archaeological faunal assemblages show values highly variable, given the significant number of factors that determine them (see a discussion in Domínguez-Rodrigo and Yravedra, 2009). For example, in the case of Qesem, the high fragmentation could influence significantly on the general frequencies, making necessary a qualitative approach to assess the outcomes. The locations of cut marks on bones has been argued to be more useful for addressing questions related to butchering behaviors (Domínguez Rodrigo et al., 2007; Domínguez-Rodrigo and Yravedra, 2009). At Qesem the locations of cut marks indicate that both long-bone epiphyses and shaft fragments bear cuts, although there is a clear predominance of damage on limb shaft fragments –which are associated with defleshing of large muscle masses. It is also worth mentioning that carcass size or specific animal features could also play a major role in differences in cut mark frequencies. For example, tortoise bones from the earliest levels show a relatively high rate of incisions (13.2%; Blasco et al., 2016b) in comparison to the ungulate rates (see Blasco et al., 2014, 2016a).

The faunal assemblage also includes damage caused during bone breakage to access marrow with similar proportions along the sequence (Table 3). The studied samples preserved diagnostic elements of breakage both on long and flat bones, although limb shafts show the highest proportions even if we consider the anatomical composition of the assemblage (Blasco et al., 2014, 2016a). The bone surface damage comprises percussion pits, notches (Figure 2), impact flakes, counterblows and peeling. The presence of some of these features indicates that the technique used to break open bones is direct percussion.

Recycling can also be approached by means of faunal specimens based on bone damage characteristics (Rosell et al., 2015). Twenty-four bone fragments from the Amudian contexts (9 from the hearth unit and 15 from the earliest levels; Blasco et al., 2013a; Rosell et al., 2015; Rosell et al., submitted) and 16 from the Yabrudian ones (all from the rock shelf area –only one of these comes from the brown sediments) show percussion marks related to the shaping of stone tools. All of these items correspond to the long bone shafts of small, medium, and large-sized animals showing damage typically caused by the use of bone as retoucher (Figure 3, Tables 1-3). These items seem to become a significant part of knapping toolkits for the AYCC, acquiring a special role within lithic reduction sequences in subsequent periods. The use of bones to shape lithics then should not be looked at in isolated phenomenon but rather as a component of a wide-ranging cultural transformation in the Levant.

Burning damage is present at Qesem Cave since the earliest moments (units with elevations of 1050 below datum) with percentages ranging from ~20% to ~45% in all the analysed assemblages (Tables 1-3). The Yabrudian levels seem to show a higher thermal impact on faunal specimens (31.4%-44.7%; Table 3); nevertheless, we have to take into account that the studied samples come from different areas, and depending on the area, the percentages of burning could vary regardless of the adoption of fire at the site (for example, in the hearth unit, 63.95% of burnt bones come from the fireplace, and 11.06% from the area around the hearth [Blasco et al., 2016a]).

One of the main characteristics of the faunal record from Qesem Cave is the scarce presence of carnivores (both bones left behind from their activities and their own skeletal remains) in relation to the very abundant human presence. This phenomenon is especially significant, since the actions that the carnivores generate on a faunal assemblage, either by modifying or adding elements, are an essential tool for inferring the existence of periods of human abandonment of the site. At Qesem Cave, the percentages of carnivore-induced damage do not exceed in any case 0.3% in the Amudian units and 0.1% in the Yabrudian, units (Table 3). Thus, the human abandonment periods at the site should not have been so long as to allow setting up of carnivore dens.

Qesem Cave contains one of the richest known deposits of microvertebrate remains in the Near East, nearly a quarter of a million specimens (Maul et al. 2011, 2016; Smith et al. 2016). Over 16,000 bones have been identified to the genus level. The identified taxa mostly appear in Israel up to the present day. An unusual aspect in the assemblage is the super abundance of the reptilian component and of a single species of *Chamaeleo* within it (Smith et al. 2013, 2016).The taphonomic data obtained so far suggest Barn Owl as the predominant accumulator. Barn Owls, in turn, are sensitive to disturbance and unlikely to have occupied the cave at precisely the same time as the hominins. The palaeoecological implications of the microvertebrates allow inferring a mosaic of open palaeoenvironment with sparse vegetation, shrubland, Mediterranean forest, rocky areas and riverbanks. Comparing the lower with the upper levels of the microfauna-bearing profile shows a slight shift towards more wooded conditions (Maul et al. 2011).

The organization of human activities around the central hearth is of relevance here. Spatially, the central hearth is an evident focus of intensive activities and is very dense in both faunal and lithic finds. We focus on the hearth itself and the area adjacent to it to the south, which seems to be related to the hearth (Blasco et al. 2016a, Shahack-Gross et al.

2014). The succession of cycles of combustion at the same location in the cave suggests a repeated behavior and a patterned use of space during recurrent human occupations. This situation resulted in a significant quantity of faunal and lithic remains, as well as evidence of the spatial differentiation of activities around the hearth. The hearth and the area south of it cover an area of approximately 15 m^2 excavated to a maximum depth of 60 cm. The faunal assemblage comprises 37,304 specimens, of which 15,464 come directly from the hearth and 21,840 from surrounding zones. The 2995 specimens identified to the species level (8.03%) include 15 taxa and a minimum number of 81 individuals (fallow deer MNI = 41; red deer MNI = 8; horse MNI = 6; auroch MNI = 5; wild pig MNI = 3; wild ass MNI = 3; rhinoceros MNI = 2; goat MNI =1; roe deer MNI = 2; large bird MNI = 3; and the tortoise MNI = 4, Blasco et al., 2014, 2016a).

Perhaps one of the best examples of spatial differentiation is the plot based on the size of the bone fragments composing this assemblage and the degree of thermo-alteration of the bones. Burned bones, mainly those showing a higher degree of damage, are clustered in the main combustion area. In contrast, the area around the hearth comprises less than 1% of the total number of specimens retrieved with this degree of damage (Blasco et al., 2016a). This apparent organization of the remains is most obvious if we consider the length of the bone fragments. Although the smallest specimens (<20 mm, the most abundant in the assemblage) are distributed over the entire occupied surface, the highest concentration is observed in the hearth area. Yet, the most significant observation is the distribution of large bone fragments (>40 mm), in the outer area (Blasco et al., 2016a). This spatial distribution seems to fit roughly with the model of cultural formation of hearth-related assemblages observed by Binford (1978, 1983) in the Nunamiut camps. The drop area is characterized by small bone splinters and lithic fragments resulting from different domestic activities, such as bone breakage for marrow extraction or the processes of core reduction and stone tool shaping. The toss zone, by contrast, consists of larger fragments, that have been intentionally tossed away to areas further removed from the activity areas. On this basis, a tentative standardized pattern can be observed along the sedimentary formation of the hearth. Both the spatial distribution around the hearth and the subsistence strategies can be considered as factors that are linked to the emergence of reference places of a residential character –that is, places that would fit with the concept of the home-base discussed by Rolland (2004).

A general spatial data based on a study of lithics density of 18 assemblages throughout the stratigraphic column and in different parts of the cave is of note (Gopher et al. 2016). When lithic densities of the hearth area and the area to the south of it are compared to the studied assemblages throughout the cave or, more specifically to assemblages of similar stratigraphic position and roughly contemporary some interesting results are evident. The lithic assemblage of the hearth area consists of 18,837 items and shows the highest density of all the assemblages of the cave [6144 lithic items per 1 m^3 for the hearth itself, see Gopher et al. 2016), indeed indicating intensive lithic production, use and discard in this area. This is reflected in the relatively high density of cores and core trimming elements too (61 and 121 per 1 m^3 respectively). The area to the south of the hearth is somewhat lower in density (3106 items per 1 m^3) but yet shows high densities of cores and CTEs (37 and 63 per 1 m^3 respectively). A conspicuous aspect of the hearth area and the area south of it is the high density of cutting tools including blades and Naturally Backed Knives (NBKs) made on blades (both showing a density of 77 per 1 m^3), as well as Naturally Backed Knives made on flakes that are prominently dense in the area (98 per 1 m^3). Another outstanding aspect is the fact that the highest density of recycling is evident in the hearth area including both the recycled 'parents' and the recycling products (45 and 142 per 1 m^3 respectively) and south of the

hearth (32 and 134 per 1 m^3 respectively). Since many of the products of recycling have shown meat cutting use wear signs (Lemorini et al. 2015), this fact joins well with the relatively high density of meat cutting blades and NBKs (Lemorini et al. 2006) in this area and could be interpreted as a set of meat-cutting cutlery densely concentrated in the meat roasting area. Interestingly, the hearth shows a medium-low density of shaped items (tools) while the area south of the hearth shows a very low density of shaped items. This may indicate a possible frequent use of unshaped items (mostly characterized by sharp edges) in the hearth area and south of it. We may add that while blades and other cutting tools (including recycling products) are conspicuous in the hearth assemblage itself and the area south of it, assemblages of similar stratigraphy to the west and northwest of the hearth are poorer in blades and NBKs, poorer in recycled items and recycling products and richer in shaped tools including a conspicuously high density of scrapers (27-43 scrapers per 1 m^3 compared to 6 and 5 scrapers per 1 m^3 in the hearth and the area to the south of it). This may indicate the use of blades and of recycling products in some areas around the hearth and scraper-related activities in other distinctive and separated (though near-by and contemporaneous) areas of the cave. This accords well with past statements based on preliminary observations hinting at spatial patterning around the hearth according to lithic typology as well function.

For now, Qesem yielded dental human remains only, altogether 13 teeth from different parts of the stratigraphic column. The basic morphometrical study indicates that the Qesem teeth are clearly not of *Homo erectus* (*sensu lato*) and has highlighted the general similarity to late Pleistocene local populations of Skhul and Qafzeh caves dated to ca. 100 ka while some of the traits are more Neandertal-like (Hershkovitz et al. 2011, 2016). A 3D scanning of some of the teeth and various analyses resulted in similar conclusions yet Neandertal (NEA) affinities were more emphasized in some of these teeth (Weber et al. 2016). The dental evidence from Qesem augmented by the Galillee-Man skull from Zuttiyeh Cave may indicate a new, post-Acheulian, post- *erectus* hominin lineage starting ca. 400ka. Obviously the question why has a biological change occurred in the Levant around 400 ka is of major interest. Based on a bio-energetic model, conjoined with the cultural transformations demonstrated at Qesem, we offer an explanation accounting for the demise of *Homo erectus* and the appearance of a new locally evolved, post *Homo erectus* hominin lineage some 400 ka in the Levant (Ben-Dor et al. 2011). The model suggests that the disappearance of elephants from the human diet in the Levant around this time triggered a selection process in favor of those who were better adapted to hunting larger numbers of smaller, faster animals with high fat content – i.e., lighter, more agile, and cognitively capable humans. The ingredients of this model include well known data such as the fact that the elephant is a unique and ideal food package exploited by Lower Paleolithic groups in the Levant for hundreds of thousands of years. It is of note that no elephants are found in Levantine post Acheulian sites – i.e., this significant part of Acheulian life and diet has ceased to appear in post Acheulian sites. Additionally, protein and vegetal food consumption have known and generally accepted ceilings, and fat is thus a compulsory component in human diet for sufficient Daily Energy Expenditure (the elephant being an outstanding package of fat, see details in Ben-Dor et al. 2011).The habitual use of fire for roasting and cooking and the new lithic technologies may be listed here as two of the important new elements related to this transformative biological and socio-economic era.

Archaeological evidence for knowledge transmission is mostly translucent and/or difficult to attain. We suggest a change in knowledge transmission mechanisms between the Acheulian and the AYCC in the Levant relating to new adaptive strategies and innovations in the lithic sphere, hunting techniques and butchering practices, the habitual use of fire

(firewood collection, making and maintaining fire) and meat (and may be other foods) roasting and cooking (Barkai and Gopher 2013). These new AYCC behaviors necessitated knowledge transmission mechanisms, different to a degree from those practiced in the Acheulian, and supported by a new social milieu, based on a possible new socio-cultural discourse (see Barkai and Gopher 2013; Ben-Dor et al. 2011; Assaf et al. 2016). A study on lithic knowledge transmission carried out at Qesem recently relates to the techno-typological characteristics of a lithic assemblage from the southern parts of the cave (>300 ka). The study of knapping trajectories (mainly a detailed analysis of core's life histories and flint raw material properties) demonstrated distinct features in this assemblage when compared to lithic assemblages from other areas of the cave. These features reflect various levels of knapping skills, most probably characterizing both skilled knappers and knappers in the process of learning. This may permit a preliminary assessment of knowledge transmission relating to flint knapping that has taken place in a designated area (Assaf et al. 2015; Assaf, Barkai and Gopher 2016). Moreover, knowledge regarding all other tasks, such as gathering, food preparation, butchering etc., was most probably also transmitted by AYCC knowledge transmission mechanisms (e.g. Blasco et al. 2013b).

The chosen land: some end notes

Eleven meters (up to now, bedrock has not been reached yet) of sediments exceptionally packed with archaeological assemblages are a testimony for human use of Qesem Cave throughout 200,000 years between 420 to 200ka. At the moment we have no clear evidence regarding the duration and intensity of each human occupation, as well as the possible gaps between human occupations during which the cave might have not been used by humans. In those gaps in human occupation, the cave might have been the home of birds of prey, and specifically the barn awl. However, the impressive density of finds, the spread of absolute dates, the estimated huge quantities of goods brought to the cave (stone, animal body parts, fire wood and more), the intensity of using flint and prey (including recycling), site organization (and especially hearth-related activities) and the paucity of evidence for carnivore activities all hint, in our opinion, to prolonged human presence at the cave in the course of recurrent "visits" of most probably one AYCC human group.

When dealing with the aspect of persistence, we would like to suggest a distinction between two terms: "recurrence", which refers to a referential place for the human groups in their movements along the territory; and "permanency", which could be related to the stability of a human group in a site for a long time (in the meaning of the Isaac's "Home Base"). While both terms might imply "persistence" in a locality, the first would involve also repeated short-human occupations. We cannot at the moment decide if the archaeological evidence from Qesem Cave is consistent with any of these categories or perhaps with a combination of both. We intend to investigate this issue in the future.

The AYCC was a period of transformations in human biology and culture. The significant changes in human behavior necessitated new knowledge transmission mechanisms in order to cope with the many new aspects of behavior adopted. AYCC hominins had to learn how to produce blades and Quina scrapers following strict standards. Knowledge and skills regarding the identification of flint sources and quarrying techniques and procedures had to be transmitted, as well as the concept and practice of flint and bone recycling. The focus on hunting prime-aged fallow deer, with the highest fat content, necessitated precise

identification of specific deer to be targeted according to the color of the fur and the brightness of the skin. Since we believe that Acheulian hominins hunted game including elephants and medium sized animals, it comes without saying that parts of the tracking and hunting procedures of the AYCC were already practiced in the Acheulian. However, since elephants contain large quantities of fat year round (Ben-Dor et al. 2011), fat-content related choices have been marginal. When elephants were not consumed any more in the AYCC and later, it made a whole lot of a difference which deer is being hunted in order to supply not only meat but also fat and thus new tracking and hunting capabilities took front stage. After hunting, specific butchering practices characterized the AYCC at Qesem, and these had to be culturally transmitted as well. Last but not least, the habitual use of fire in the AYCC brought about a new set of knowledge and capabilities that had to do with firewood collection, production and maintenance of fire; ventilation of the cave in order to reduce pollution and more. Of course meat (and may be other foods) roasting and cocking had to be culturally transmitted too. The new AYCC adaptations necessitated, therefore, elaborate knowledge transmission mechanisms, quite different than those practiced by the Acheulians.

We assume that elephants (and especially their fat) had an important role in the diet of Acheulian hominins. The disappearance of elephants triggered hunting an increased number of smaller and faster animals to maintain protein supply and an adequate fat content in the diet, and this was the evolutionary drive behind the emergence of a new hominin lineage in the Levant. The need to hunt larger numbers of selected medium-sized individuals with high fat content might have encouraged new social relations based on new meat sharing practices. The habitual use of fire for roasting meat and cooking might be connected to the need to extract more calories from every food item (e.g. Carmody and Wrangham 2009; Carmody, Weintraub and Wrangham 2011; Groopman et al. 2015, Wrangham 2016), and the new lithic technologies might have been aimed at a better manipulation of smaller game. The use of Quina scrapers and small cutting tools made of recycled items might have been related to newly-introduced processing methods. Thus, the circumstances of the AYCC appearance in the Levant and its characteristics provide a context for investigating for human persistence at Qesem Cave. Acheulian human adaptation is regarded by us as highly successful, and has enabled Lower Paleolithic communities in the Levant to thrive for over one million years. Modifying this long lived adaptation mode and initiating with a set of transformations characterizing the Levantine AYCC must have followed very good reasons. Around 400 ka in the Levant human groups came out with a new adaptation mode that enabled them to thrive for another 200 ka, until the next set of transformations took place as reflected by the appearance of Middle Paleolithic Mousterian life ways.

It is our contention that this specific cave was carefully selected as a site to be persistently occupied by a group well aware of its necessities. The new mode of adaptation practiced at Qesem Cave is fully evident as early as the initial use of the cave some 420-400 ka, and thus a landscape capable of supporting this specific mode of adaptation was chosen. This landscape enabled the cave inhabitants to fully practice their particular adaptation strategies and maintain AYCC life-ways for some 200,000 years.

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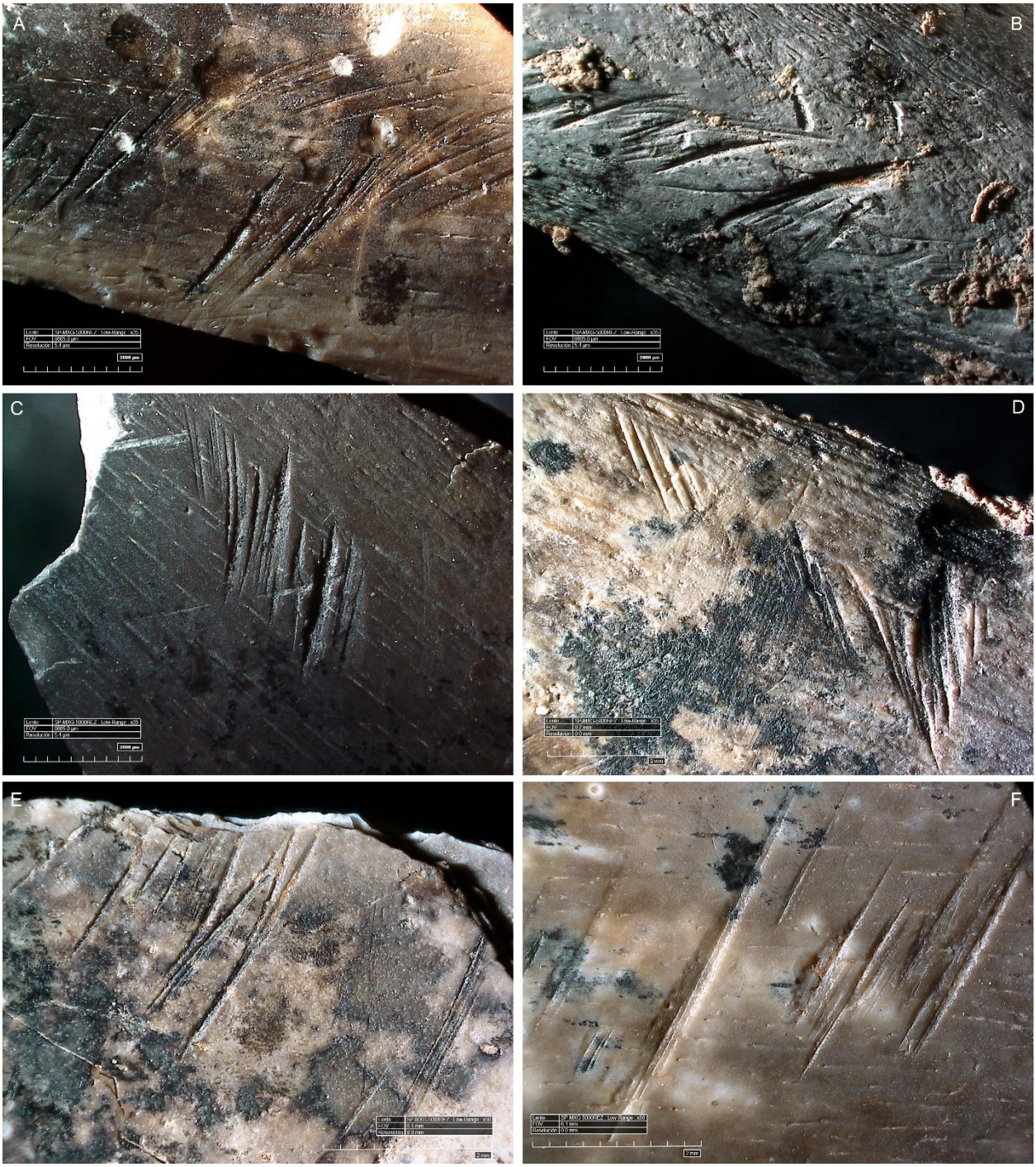

Figure 1. Examples of cut marks identified on the bones from Qesem Cave.

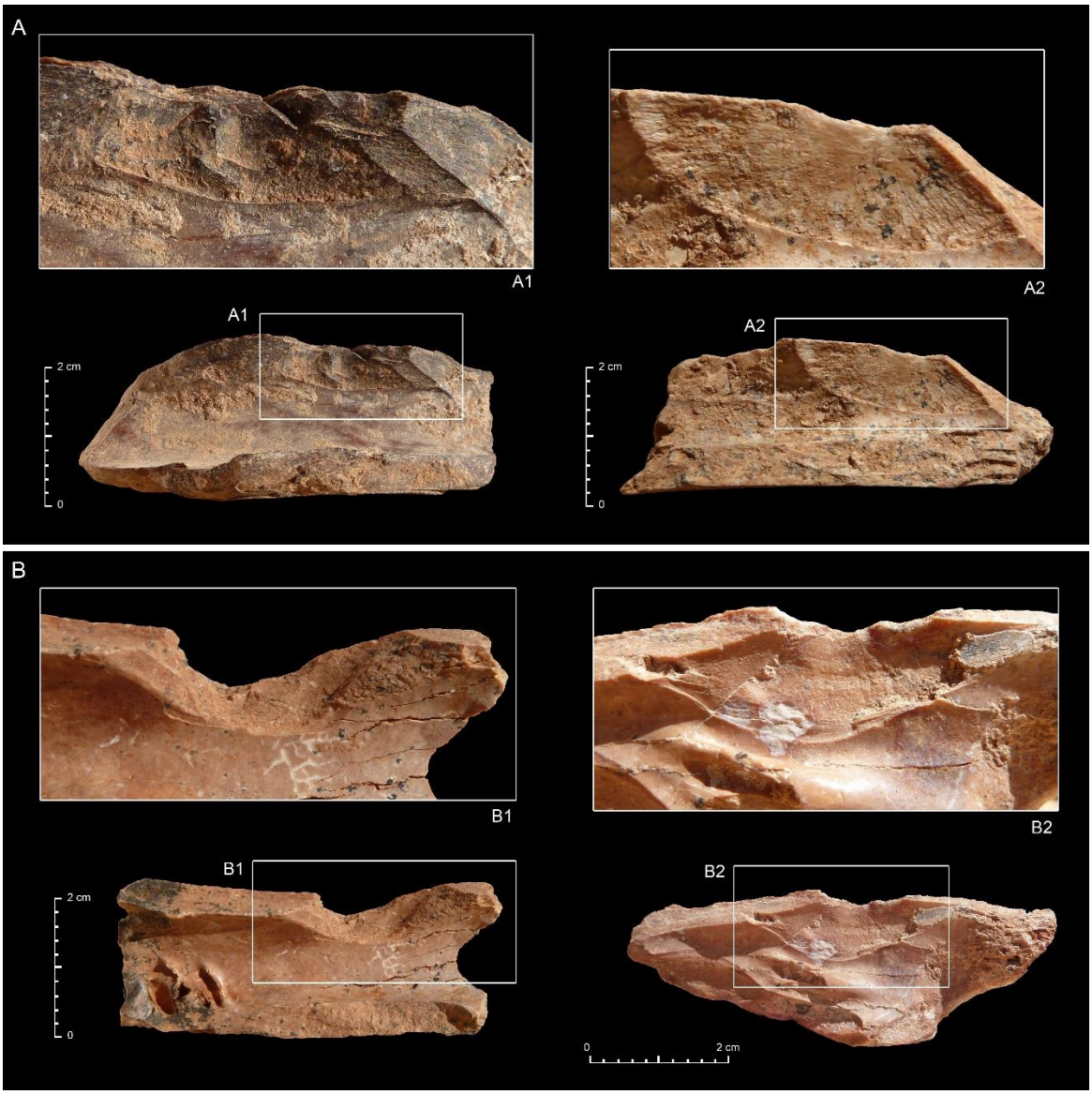

Figure 2. Notches related to bone-breakage from Qesem Cave.

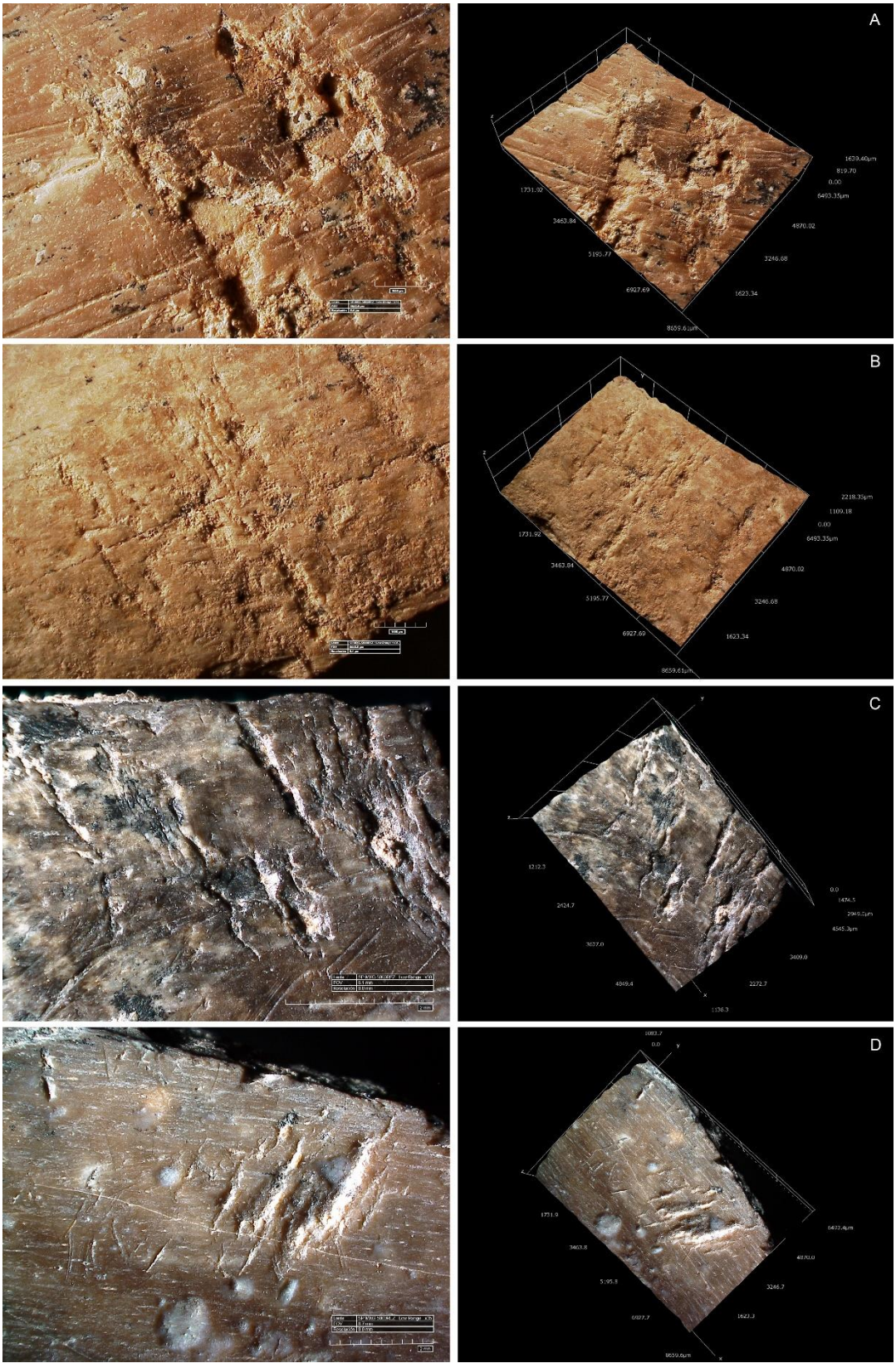

Figure 3. Bone retouchers from Qesem Cave.

Table 1. Anthropogenic damage from Amudian archaeological contexts from Qesem Cave

Taxa/Size body class	Hearth and around					Under the rock shelf																					
	Z= 535-605					Z=655-770 (LSBS)					Z=835-1050 (DBS)					Z=870-1050 (SCW)					Z=910-1050 (SLYBS)					Z=1015-1050 (LGS)				
	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt
Carnivora	1			1																					1			1	
S. hemitoechus	12					2					1					2									3				
Equus ferus	103	1		23		9					5					3			2		4			1		1				
Equus hydruntinus	18	1		4																										
Sus scrofa	38			2		3					3					1					3					8	1		2	
Cervidae	28	2		10							2																			
Dama cf. *mesopotamica*	2370	287	118	640	1	466	74	24	138	1	438	46	30	117	3	323	16	4	91		219	21	7	78		217	14	3	65	
Cervus cf. *elaphus*	213	22	9	57	1	49	2		12		51	6	2	12	1	32	1		12		18	1	1	3		17		1	4	1
Bos primigenius	123	2	1	13		16			3		15			1		32			1		12					22				
Capra aegagrus	1					4			1		3															1				
cf. *Capreolus capreolus*	25			1		5	1		1		4	1									1									
Testudo sp.	57			17		52	6	2	24		30	2		13		7	1		3		9			1		9	1		2	
Large bird	2	1		1		1	1	1																						
Corvus, medium size	3	1																												
Columbidae	1	1																												
Aves, unident.						1										1														
Very large size	4			1																										
Large size	1988	51	46	653	2	362	5	10	123		311	2	8	80	2	304	2	3	100		149	2	3	28		208	1	1	30	
Medium size	6510	109	175	2912	4	862	13	21	240	2	603	10	12	181		625		7	225		311		3	79		384	1	2	82	
Small size	24484	242	344	7629	1	5137	46	49	1871		3024	49	47	807	2	3004	15	14	937	2	1380	14	10	355		1956	13	8	442	1
Unident.	1323	2	12	340		343		1	121		380		5	120		461		1	152		168			49		297			34	
Total	**37304**	**722**	**705**	**12304**	**9**	**7312**	**148**	**108**	**2534**	**3**	**4870**	**116**	**104**	**1331**	**8**	**4795**	**35**	**29**	**1523**	**2**	**2274**	**38**	**24**	**594**	**0**	**3124**	**31**	**15**	**662**	**2**
%		**1,9**	**1,9**	**33**	**0,02**		**2,02**	**1,48**	**34,7**	**0,04**		**2,4**	**2,14**	**27,3**	**0,2**		**0,7**	**0,6**	**31,8**	**0,04**		**1,7**	**1,1**	**26,1**	**0**		**1**	**0,5**	**21,2**	**0,1**

Ctm=Cut marks; BBr= Bone breakage (diagnostic elements); Burn=Burnt bones; BRt= Bone retouchers

Archaeological contexts (Acronyms): DBS=dark brown sediment; SLYBS=soft light-yellow-brown sediment; LGS=light grey sediment; SCW= [cemented/soft] sediments close the wall; LSBS=large stones in brown sediment

Table 2. Anthropogenic damage from Yabrudian archaeological contexts from Qesem Cave

Taxa/Size body class	Unit I					Under the rock shelf															South Western area				
	Z=130-175					Z=460-590 (Orange)					Z=520-540 (Brown)					Z=500-700 (Shelf Yabrudiense)					Z=545-635				
	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt	NSP	Ctm	BBr	Burn	BRt
Carnivora (cf. Hyaenidae)																8	3	1	3						
Hyaena																2									
S. hemitoechus	1															3					15			1	
Equus ferus	3					1										4			1		11			3	
Equus hydruntinus																									
Sus scrofa											1			1		13			3		7				
Cervidae																									
Dama cf. *mesopotamica*	65	6	1	19		82	2	2	27		101	6	2	35		936	123	45	351	4	205	2	1	41	
Cervus cf. *elaphus*	9			2		9					9	1	2	3		111	13	3	35		22			1	
Bos primigenius	8					4			1		5					38			6		10				
Capra aegagrus						3										7	2		3		3				
cf. *Capreolus capreolus*	1					3			3		6			1		17	1		5		1				
Testudo sp.	1			1		3		1	2		12	1		5		78	2		23		9			3	
Large bird																									
Corvus, medium size																									
Columbidae																1									
Aves, unident.																									
Very large size	2					3			3							13			5		5				
Large size	125		3	55		28			14		265	1	2	126		757	19	26	319	2	245	1	2	108	
Medium size	145	1	3	72		66	1	2	30		346	2	2	155		1063	42	53	407	3	320	3	5	133	
Small size	932	6	4	428		488	2	4	138		2854	13	3	1140	1	8632	113	95	3095	6	2672	5	6	883	
Unident.	208			94		24			6		307		1	134		583	1	3	240		306			124	
Total	**1500**	**13**	**11**	**671**	**0**	**714**	**5**	**9**	**224**	**0**	**3906**	**24**	**12**	**1600**	**1**	**12266**	**319**	**226**	**4496**	**15**	**3831**	**11**	**14**	**1297**	**0**
%		**0,9**	**0,7**	**44,7**	**0**		**0,7**	**1,26**	**31,4**	**0**		**0,6**	**0,31**	**40,96**	**0,03**		**2,6**	**1,8**	**36,7**	**0,1**		**0,3**	**0,4**	**33,9**	**0**

Ctm=Cut marks; BBr= Bone breakage (diagnostic elements); Burn=Burnt bones; BRt= Bone retouchers

Table 3. Hominin and carnivore-induced damage from Amudian and Yabrudian archaeological contexts from Qesem Cave

Archaeological contexts				NSP	Ctm		BBr		Burn		BRt		Carniv	
					NSP	%	NSP	%	NSP	%	NSP	%	NSP	%
Yabrudian	**Unit I**		Z=130-175	1500	13	0,87	11	0,73	671	44,73	0	0,00	0	0,00
	Under the rock shelf	**Orange**	Z=460-590	714	5	0,70	9	1,26	224	31,37	0	0,00	1	0,14
		Brown	Z=520-540	3906	24	0,61	12	0,31	1600	40,96	1	0,03	0	0,00
		Shelf Yabrudian	Z=500-700	12266	319	2,60	226	1,84	4496	36,65	15	0,12	9	0,07
	South Western area		Z=545-635	3831	11	0,29	14	0,37	1297	33,86	0	0,00	2	0,05
Amudian	**Hearth and around**		Z=535-605	37304	722	1,94	705	1,89	12304	32,98	9	0,02	69	0,19
	Under the rock shelf	**LSBS**	Z=655-770	7312	148	2,02	108	1,48	2534	34,66	3	0,04	20	0,27
		DBS	Z=835-1050	4870	116	2,38	104	2,14	1331	27,33	8	0,16	16	0,33
		SCW	Z=870-1050	4795	35	0,73	29	0,60	1523	31,76	2	0,04	2	0,04
		SLYBS	Z=910-1050	2274	38	1,67	24	1,06	594	26,12	0	0,00	3	0,13
		LGS	Z=1015-1050	3124	31	0,99	15	0,48	662	21,19	2	0,06	3	0,10
Total (Yabrudian)				**22217**	**372**	**1,67**	**272**	**1,22**	**8288**	**37,30**	**16**	**0,07**	**12**	**0,05**
Total (Amudian)				**58752**	**1090**	**1,86**	**983**	**1,67**	**18904**	**32,18**	**24**	**0,04**	**113**	**0,19**

Ctm=Cut marks; BBr= Bone breakage (diagnostic elements); Burn=Burnt bones; BRt= Bone retouchers; Carniv= Carnivore-induced damage

Archaeological contexts (Acronyms): DBS=dark brown sediment; SLYBS=soft light-yellow-brown sediment; LGS=light grey sediment; SCW= [cemented/soft] sediments close the wall; LSBS=large stones in brown sediment