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Cult paraphernalia or everyday items? Assessing the status and use of the flint artefacts from Nahal Hemar Cave (Middle PPNB, Judean Desert)

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ABSTRACT

Since its discovery in the 1980s, Nahal Hemar Cave has been interpreted as a cult site where ceremonies were performed, as indicated by the extremely selected and highly symbolic repertoire of objects found in the cave (e.g., stone masks, modelled skulls, bone figurines, etc.). The finds, dated to the 8th millennium cal. BC and assigned to the Pre-Pottery Neolithic B (PPNB) period, also consisted of other artefacts often found in contemporaneous sites, such as flint tools or stone beads. In this paper, the status and use of the unique lithic assemblage found in the cave is assessed through a comprehensive approach integrating techno-typological and use-wear analyses and, secondly, contextualized within current lithic research and in the broader context of the Middle/Late PPNB in the southern Levant. The study resolves some of the major questions concerning the production, use and meaning of the flint tools, also bringing some light to the ritual, spiritual or unconventional activities associated with the use of the cave. It concludes that the flint assemblage found in the cave was the result of a series of episodes of deposition of objects over a relatively lengthy period of time, that a varied group of social agents was involved in the production of the said tools and, finally, that the tool producers, and likely, the cave users, were farmers from the agricultural villages in the Mediterranean woodland region. In addition, use-wear analysis indicates that the flint tools found at the cave had a previous history of use before being abandoned/deposited in the cave and some of them may have participated in the ritual activities. Finally, we propose that, in the particular case of the Nahal Hemar knives, they could be related to the processing/dismembering of human bodies, a hypothesis further supported by the remains of 23 individuals (mostly cranial) found in the cave.

1. Introduction

Nahal Hemar Cave (henceforth NHC) is a small chamber (ca. 4 × 8 m^2) with a narrow entrance on the right bank of the homonymous dry riverbed in the southern Judean Desert, 11 km south of the modern town of Arad and at about 210 m.a.s.l. (Figs. 1 and 2). The cave, after being discovered and partly looted, was excavated in 1983 by Bar-Yosef and Alon (1988), revealing one of the most conspicuous Pre-Pottery Neolithic B (PPNB) assemblages ever found in the Levant (Fig. 3). The finds, dated to the mid-second half of the 8th millennium cal. BC, consisted of objects of obvious cultic/ritual significance (a stone mask, modelled skulls, remains of an anthropoid statue, bone figurines, etc.) and included well-preserved organic remains (mats, wooden beads, basketry, knotted netting and twined fragments of linen) as well as other artefacts often found in contemporaneous PPNB sites, such as flint tools, a complete sickle, stone beads and seashells from the Red Sea and the Mediterranean.

Since its discovery, the cave was interpreted as a place of ritual significance, whether as a site in which cult paraphernalia were stored or, alternatively, where cult ceremonies were performed. The special issue of 'Atiqot published soon after the excavation, revealed the most significant and basic aspects of the varied assemblages found in the cave, which were interpreted as revered objects of ritual significance. Preliminary results of the chipped lithic assemblage indicated that only some special types of flint tools and blanks (complete blades) had been selected and brought to the cave. Together with the absence of flakes and cores in the assemblage, this demonstrated that the flint artefacts found in the cave had not been produced *in situ*. In addition, the new term 'Nahal Hemar knife' was coined to define the numerous large and pointed blades with two proximal opposed notches found, at that time, exclusively in the cave.

The discovery of such a unique site and set of artefacts obviously

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Fig. 1. NHC in the context of the Middle and Late Pre-Pottery Neolithic B in the Levant.

raised much interest among the worldwide community of scholars studying the Neolithic period in the Near East, making NHC one of the best-known and most-cited sites in Neolithic literature on the Levant. In spite of this, the site subsequently received only intermittent and partial attention (e.g., Goren et al., 1993; Connan, 1996; Barzilai, 2010; Bar-Yosef, 2011) and was never re-studied as a whole, thus impeding a full comprehension and contextualization of one of the most enigmatic and fascinating Neolithic sites in the Levant. Recently, a renewed study of the NHC finds was launched by one of the authors (O. B.-Y.), combining recent results from other newly-studied finds (Groman-Yarolavski and Bar-Yosef Mayer, 2015; Solazzo et al., 2016). The study of the flint artefacts presented in this paper is part of this initiative as it aims to answer a series of major questions concerning, though not exclusively, the unique set of lithic artefacts found in NHC. Questions such as: 1) What was the total number of complete lithic artefacts (blades, knives, projectiles, etc.) that were really deposited in the cave? 2) Who produced them, farmers from the Mediterranean woodland region or hunter-gatherers from the arid/semi-arid regions of the Negev, Sinai and southern Jordan? 3) Were lithic artefacts produced *ex professo* to be cached into the cave or were used and hafted tools at some point chosen to be cached? 4) If the tools had been used, what for and could it be part of the ritual performed at the cave? And 5) Were 'Nahal Hemar knives' used as knives and are they only to be found at NHC?

In this paper, the chipped lithic assemblage from NHC is, for the first time since its preliminary study 30 years ago, re-studied in its entirety through a comprehensive approach integrating techno-typological and use-wear analyses and, secondly, it is contextualized within current lithic research and in the broader context of the Middle and Late PPNB (8th millennium cal. BC) in the southern Levant. The results of the study answer some of the above-mentioned questions, raise some others, and contribute to fine-tuning our understanding of the site, providing a glimpse into the enigmatic and always elusive spiritual world of the Neolithic communities of the Levant.

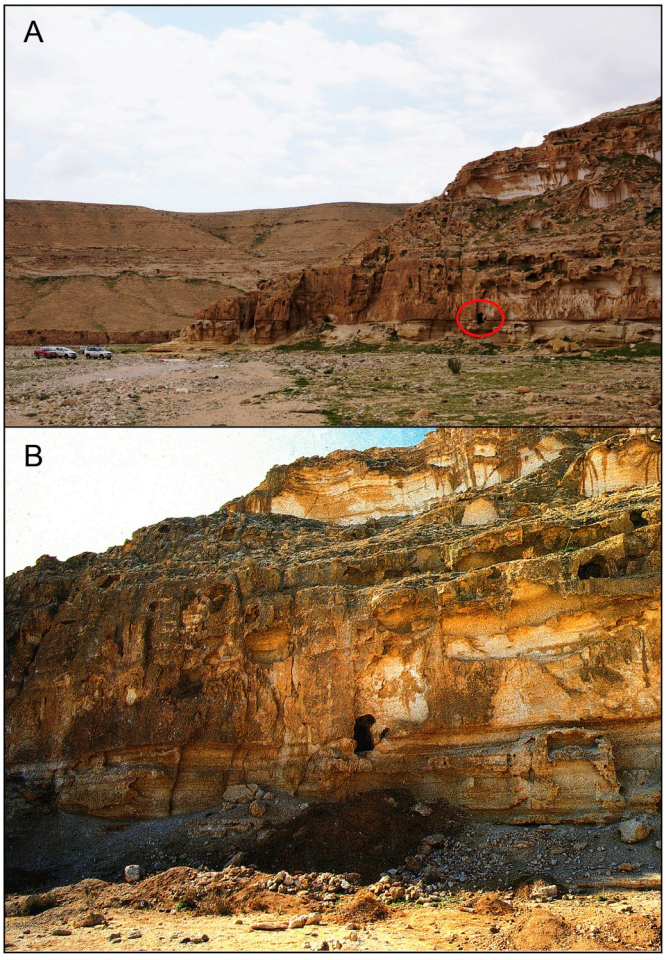

Fig. 2. A: Location of NHC on the right bank of the homonymous dry riverbed during spring 2020. B: Entrance of the cave during the excavation in 1983. Note the dark pile of looted spoil under the entrance (from Bar-Yosef, 1985. © The Israel Museum, Jerusalem).

2. Chronology and integrity of the lithic collection

The lithic assemblage from NHC comes from the different archaeological units (*Strata* 1 to 4) identified during the excavation of the site in 1983, as well as by sieving the spoil heaps with around 16 m^3 of sediments left by looters outside the cave. The uppermost archaeological unit (*Stratum* 1) is made up by a mixture of organic materials (coprolites, twigs, branches, etc.) accompanied by a few sherds attributed to the Early Bronze Age I and Byzantine-Early Arabic periods. The underlying archaeological unit (*Stratum* 2) contained large quantities of limestone rubble, coprolites and a few Neolithic finds. *Stratum* 3, subdivided into Layers 3a and 3b, contained most of the Neolithic finds together with coprolites, twigs, branches and limestone fragments. Two hearths, one belonging to each layer, were exposed. Three radiocarbon dates obtained for charcoal from the uppermost hearth and one for netting knots allowed Layer 3a to be attributed to the end of the Middle PPNB and Late PPNB (approx. 7700-7100 cal. BC), while the radiocarbon date of a string from Layer 3b dates this layer to the end of the Middle PPNB (around 7700 cal. BC) (Bar-Yosef and Alon, 1988: 5) (Fig. 4). The earliest deposit (*Stratum* 4) covered the uneven cave floor and the cavities under and between the boulders. The sediment consisted chiefly of carbonate sand, broken stalagmites, twigs, branches and some coprolites. Neolithic material was also present, including some of the notable finds such as a complete sickle and conical

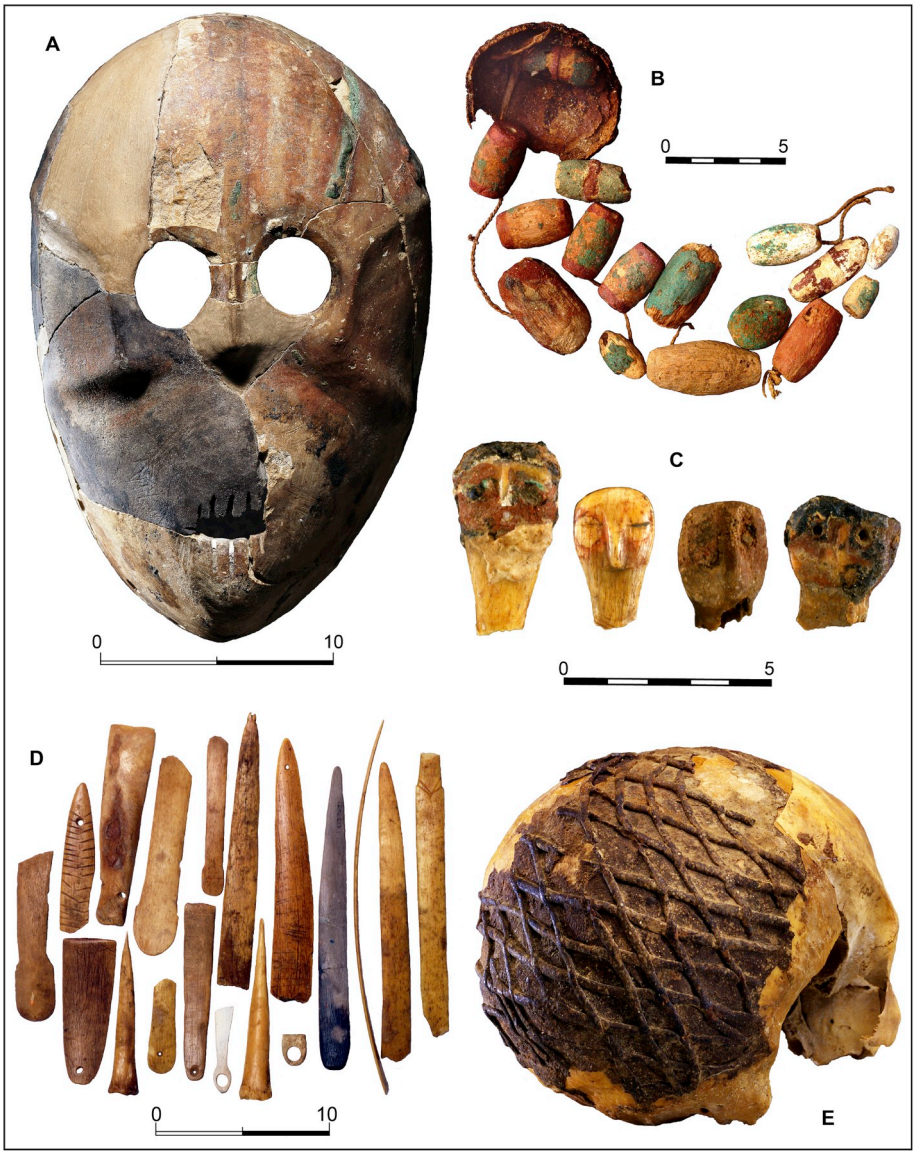

Fig. 3. Some of the outstanding objects found in NHC: A) stone mask, B) wooden and plaster beads, C) anthropoid bone figurines, D) bone tools and E) modelled skull of individual 8. (© The Israel Museum, Jerusalem [Photo A: Elie Posner, Photo B: Nahum Slapak.]).

headgear. Two radiocarbon dates (linen yarn and a piece of knotted fabric) were able to attribute the material from *Stratum* 4 to the Middle PPNB (ca. 7900 cal. BC) (Fig. 4). In light of the intra and inter-*Stratum* coherence of the ^{14}C dates, Bar-Yosef and Alon (1988) assessed the reliability of the Neolithic assemblage, and dated it to a period *grosso modo* between 7900 and 7100 cal. BC (Middle/Late PPNB), even though, as the excavators already noted, it could belong to a significantly shorter time-span. Analysis of the finds according to the original stratigraphy was considered unfeasible at that time, partly due to the circumstances of the discovery of the site and to the fact that part of the Neolithic material was found after sieving the spoil heaps found outside the cave. Those circumstances and the absence of new data concerning the stratigraphy itself or the spatial distribution of the findings, still impedes the chronostratigraphic approach to the lithic assemblage. Accordingly, it will be analysed and presented as one Middle/Late PPNB collection.

3. Methods

The chipped lithic assemblage from NHC has been re-studied in its entirety through a comprehensive approach integrating techno-typological and use-wear analyses and, secondly, contextualized within current lithic research and in the broader context of the Middle and Late PPNB (8th millennium cal. BC) in the southern Levant. Despite the obvious limitations derived from the particular characteristics of the assemblage, composed only of selected artefacts, the main methodological approach is based on the reconstruction of the technical actions and gestures and their chronological sequence along the life cycle of the artefacts/tools found at the cave, from raw-material procurement to its use and final abandonment: its *chaîne opératoire*.

The use-wear analysis was performed through the combination of what were called in the 1980s the 'low power' and the 'high power' approaches (e.g., Plisson, 1985; Vaughan, 1985; Van Gijn, 1989; González and Ibáñez, 1994). This refers to the identification of use-wear traces (microscarring, rounding, striations and polish) through binocular and incident light microscopes that are compared to traces observed in an experimental reference collection. Archaeological tools were observed through a stereomicroscope Olympus SZH at between 5x and 40x magnification and an incident light microscope Leica DM2500, at between 50x and 400x magnification. Archaeological traces were interpreted by comparing them with those observed in the reference collection stored in the use-wear analysis laboratory in the Milà i

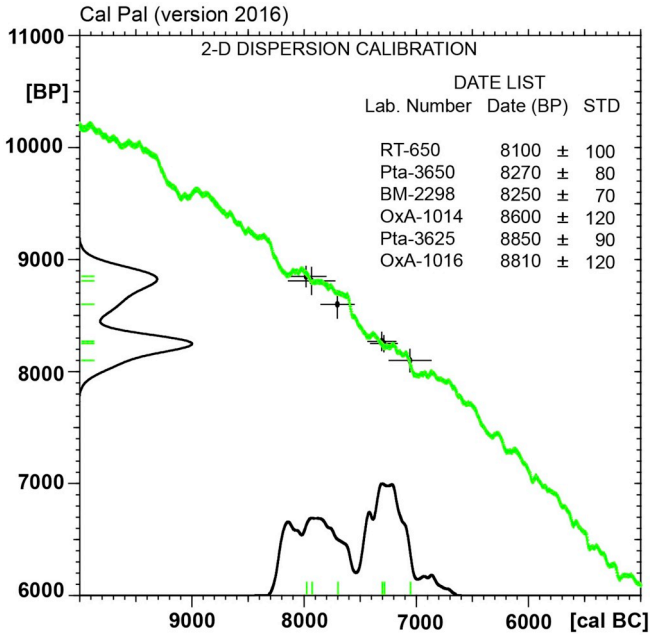

Fig. 4. Chronology of the site (^{14}C dates with error intervals greater than 150 have not been included). Generated in CalPal (Weninger et al., 2007) using IntCal13 (Reimer et al., 2013).

Fontanals Institution (CSIC, Barcelona) (Traceotheca; http://www.asd-csic.es/facilities/?tx_things=reference-collection). This reference collection includes more than 1,000 experimental tools of which around 350 were made by one of the authors (JJI) in collaboration with Jesús González Urquijo. Besides this standard methodology, confocal microscopy and texture analysis for the identification of worked materials has also been used. This approach has been based on the methodology previously developed by Ibáñez et al. (2014, 2016) to distinguish between microwear polishes generated by cutting wild cereals growing in natural stands, cultivated wild cereals, domestic cereals and reeds. This innovative methodology, based on the comparison of series of 3D images of glossy surfaces of archaeological and experimental material using multiple parameters of texture analysis of 3D images obtained through confocal microscopy, was used for the analysis and classification of the better preserved (not affected by fire) glossed tool (Fig. 21: A). The 3D images of 650 × 500 μm were obtained with a Sensofar Plu Neox confocal microscope, using a 20X (0.45 NA) objective, with a spatial sampling of 0.83 μm, an optical resolution of 0.31 μm, a vertical resolution of 20 nm and a z-step interval of 1 μm. Twenty-seven samples of 200 × 200 μm were taken from the 650 × 500 μm areas and these samples were processed and measured with the Sensomap software, from Digital Surf.

4. Location and accession of archaeological materials

The studied lithic collection is stored at the facilities of the Israel Antiquities Authority in Bet Shemesh, with the exception the 21 blades/knives and the complete sickle, with three sickle inserts, which are stored in the Israel Museum in Jerusalem. The complete sickle is in the permanent exhibition of the museum and due to the extreme fragility of the tool, which advised against handling it, it had to be studied from the Museum's showcase. In return, the Museum kindly provided high quality pictures of the sickle taken during the restoration process, facilitating the study of this unique tool. Unfortunately, seven artefacts, including a double-notched Nahal Hemar knife (Bar-Yosef and Alon, 1988: 7, No.1), a Nahal Hemar knife with cord remnants (Bar-Yosef and Alon, 1988: plate II, No. 2), the largest Jericho point (Bar-Yosef and Alon, 1988: 8, No. 1) and a 'Canaanean (?) blade' were not found. However, they have been included in the inventory and basic data (e.g., blank, measurements, etc.) have been estimated through previous descriptions, pictures and drawings. The collection stored in Bet Shemesh was temporarily transported to the facilities of the Centre de Recherche Français à Jérusalem (CRFJ-CNRS) where it was analysed during two short study seasons (December 2017 and February 2019), while the artefacts preserved in the Israel Museum were directly studied at the facilities of the museum itself in February 2019. Use-wear analysis of a selection of 46 artefacts, including a range of retouched tool types and blanks, was performed during 2018 at the facilities of the Spanish National Research Council in Barcelona (IMF-CSIC). All necessary permits were obtained for the described study, which complied with all relevant regulations. All analyses were non-destructive and did not involve sampling.

5. Results

5.1. Raw materials and alterations

The NHC lithic collection that has been studied totals 626 flint artefacts (2.783 kg). No concretions were observed but identification of the flint types used is difficult due to the fact that the vast majority of the artefacts (82.3%) display heavily burnt surfaces, in many cases including different degrees of intense thermal damage, such as heat cracks and pitting. Their colour, also altered, ranges from very light grey to almost black. In some cases, the surface of the heavily burnt artefacts, apart from being cracked and very fragile, is glossy, indicating that high temperatures were reached. Another 7.5% was moderately affected by fire, apparently only affecting the original colour of the flint, which can be guessed despite being slightly 'blackened' due to fire. Only a small proportion (9.4%) of the artefacts bear no signs of thermal alteration. Most of the non-burnt artefacts (43 out of 59) are made of fine-grained homogeneous flint, beige to light brown in colour, often with paler concentric bands and with tiny white and/or orange dots/inclusions. Light brown medium-grained flint (10 artefacts) and very fine-grained toffee-coloured flint (3 artefacts) are also present. The rest of the non-burnt artefacts correspond, interestingly, to three unique small projectiles, each of a different type (Khiam, Helwan and Haparsa) and each made of a different flint variety (fine-grained red flint, fine-grained glossy white/light grey flint and fine-grained light brown very translucent flint, respectively). Five of the missing artefacts remain as indeterminate, accounting for 0.8%.

Most of the flint artefacts were found broken (72.5%, n = 454). After a series of intense refitting sessions, a total of 25 broken pieces, which had been listed individually in both the original inventory and our own, were refitted, allowing complete measurement of ten more Nahal Hemar knives and two blades. A detailed observation of the fractures of the 454 broken artefacts reveals that in most cases (80.8%, n = 367) breakage of the artefacts occurred after being burnt; in some cases before being burnt (15.2%, n = 69); rarely both before and after being burnt (2.9%, n = 13); while the time of the breakage could not be determined only in a few cases (1.1%, n = 5).

In addition to thermal damage and fragmentation, black material has been observed adhered to the surface of 45 artefacts, including Nahal Hemar knives, retouched and unretouched blades, etc. Based on the assumption that the other black residues found in the cave (e.g., used for coating the baskets, for modelling skulls and for hafting the flint elements to the complete sickle) would be asphalt and, secondly, on the fact that natural asphalt is reported not far from the cave (Nissenbaum and Connan, 1999), the black residues observed on the lithic artefacts were originally tentatively identified as 'possible asphalt' (Bar-Yosef and Alon, 1988: 9) and interpreted as the result of using the flint tools for preparation of the asphalt that coated the baskets (Bar-Yosef and Alon, 1988: 9). However, different studies on the black residues from the site, though never of those found directly on the lithics, have repeatedly revealed that they are not asphalt but animal collagen

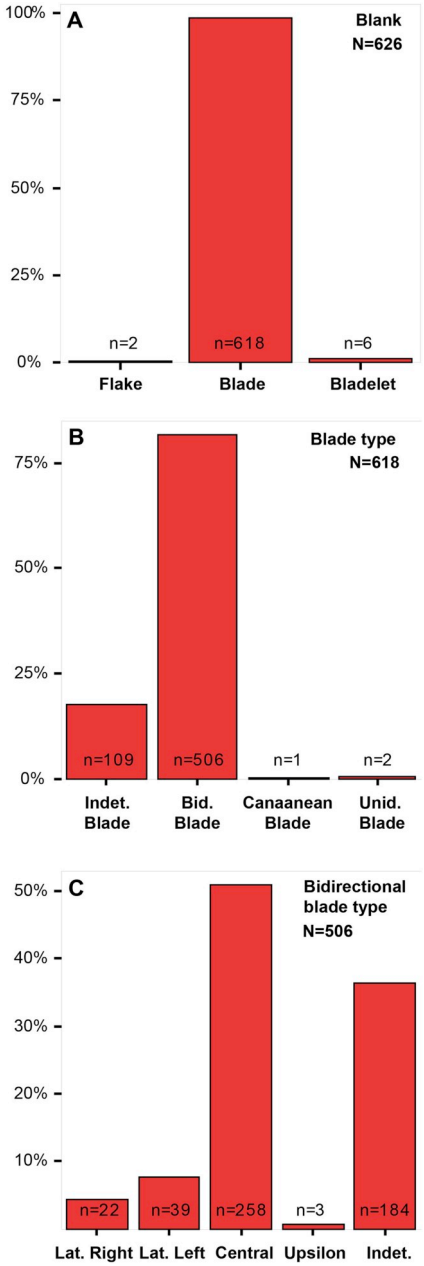

Fig. 5. Breakdown of the studied lithic assemblage.

(Connan, 1996; Nissenbaum, 1997; Solazzo et al., 2016) and were used as adhesive. Even a paste from bone collagen modelled as a knife handle is mentioned in one of the earliest publications (Nissenbaum, 1997). In the case of the residues found on the lithic artefacts (which have not been analysed), the distribution and shape of the black stains, sometimes very irregular and fluid-like, sometimes covering the whole proximal or ventral faces and sometimes restricted only to the proximal end of the artefact, suggests that they are deposits resulting from the carbonization of organic materials that, in some cases, could have been part of the hafting system of the tool (handle/shaft and adhesive).

5.2. Technology. Producing the blanks

The lithic assemblage from NHC consists of 618 blades, 6 bladelets and only 2 flakes (Fig. 5: A). No cores, no core tablets, no chips, no chunks and, as said, practically no flakes were found in the cave. Flint artefacts found in the cave were undoubtedly not produced there, and only selected blanks and tools were brought to the cave. Even the retouching of the tools seems to have been performed off-site. This particular aspect of the lithic assemblage greatly hinders the reconstruction of the chaîne opératoire and reduction sequence/s involved in the production of the stone tools and the technological skills and behavioural patterns of their producers.

Bidirectional blade technology was the formal method for producing the blades found at the cave (506 out of the 618 blades) (Fig. 5: B). The scarcity of blades clearly obtained from single-platform cores (n = 2) and the strong similarity of indeterminate blades with bidirectional blades, make it reasonable to assume that almost all the blades classified as indeterminate (due to their fragmentary state) should, in fact, be interpreted as bidirectional blades. A similar phenomenon occurs with the small number of bladelets found in the cave, which do not seem to correspond to specific bladelet production but to by-products of the exploitation of opposed-platform cores. Taken together, these observations point towards a technologically highly homogeneous and consistent assemblage of almost exclusively bidirectional blades. Within bidirectional blades, and despite the significant number of indeterminate bidirectional blades (36.4%), there is no doubt that targeted central blades (51.0%), also known in the literature as 'predetermined' blades (Abbès, 2003), were the preferred support at NHC (Fig. 5: C). Central blades are generally large, robust, straight and naturally pointed. In many cases, they display the negative removals of two pairs of opposing lateral blades (also known as *débordantes*) on their dorsal face, as shown for instance in Abbès's publication (2003: 187), often accompanied by other blade/let extractions for minor distal and proximal correction of the surface of the core (Fig. 6).

However, the characteristics of a non-negligible number of blades suggest certain variability in the organization of the knapping sequences involved in the production of the bidirectional blades from NHC (Figs. 6 and 7). These blades are quite narrow central blades and lateral blades (although they do not show negative removals from the lateral of the core) with naturally pointed and very acute distal ends and, sometimes, with a slightly curved longitudinal section in the proximal and/or distal ends. Percussion point is, even in the lateral blades, always located in the middle of the butt, and the *débitage* axis is the same as the morphological axis of the blade. In addition, some of these blades show at least one negative removal from the opposite platform that almost runs from platform to platform (Fig. 6: A and B; Fig. 7. A-C). All these features, which all together can sometimes hinder clear distinction between lateral and central blades (Fig. 6: K and L), suggest the existence of a knapping sequence that in some aspects differs from that of the widely-spread in the southern Levant 'predetermined-upsilon' variant, as defined by Barzilai (2010). In this particular scheme, the number of lateral blades and of blades/flakes for proximal and distal correction (including upsilon blades) would be significantly lower than in the 'predetermined-upsilon' variant. Accordingly, a significant number of central and lateral blades would run almost from platform to platform, through probably on a quite narrow working surface. This set of features resembles those observed in other variants of bidirectional technology identified in the Levant where the maintenance of the working surface is fairly limited or almost non-existent, such as the 'off-set' (Borrell, 2011) or 'one-on-one' (Khalaily et al., 2007; Barzilai, 2010) variants, which have a very different chronological and geographical distribution (Borrell, 2017). The lack of cores, core-trimming elements and other technologically significant products at NHC, however, impedes a full understanding and reconstruction of this potentially different scheme (variant?). It is thus not possible to determine if it was oriented to producing alternating extractions of non-typical (not predetermined) pointed central blades (similar to the 'one-on-one' variant), opposed pairs (partly superposed) of partly lateralized central blades (not comparable to the predetermined ones) or, thirdly, more or less typical central blades but prepared with a limited number of lateral blades (sometimes running from platform to platform) and other preparation blades/flakes. In any

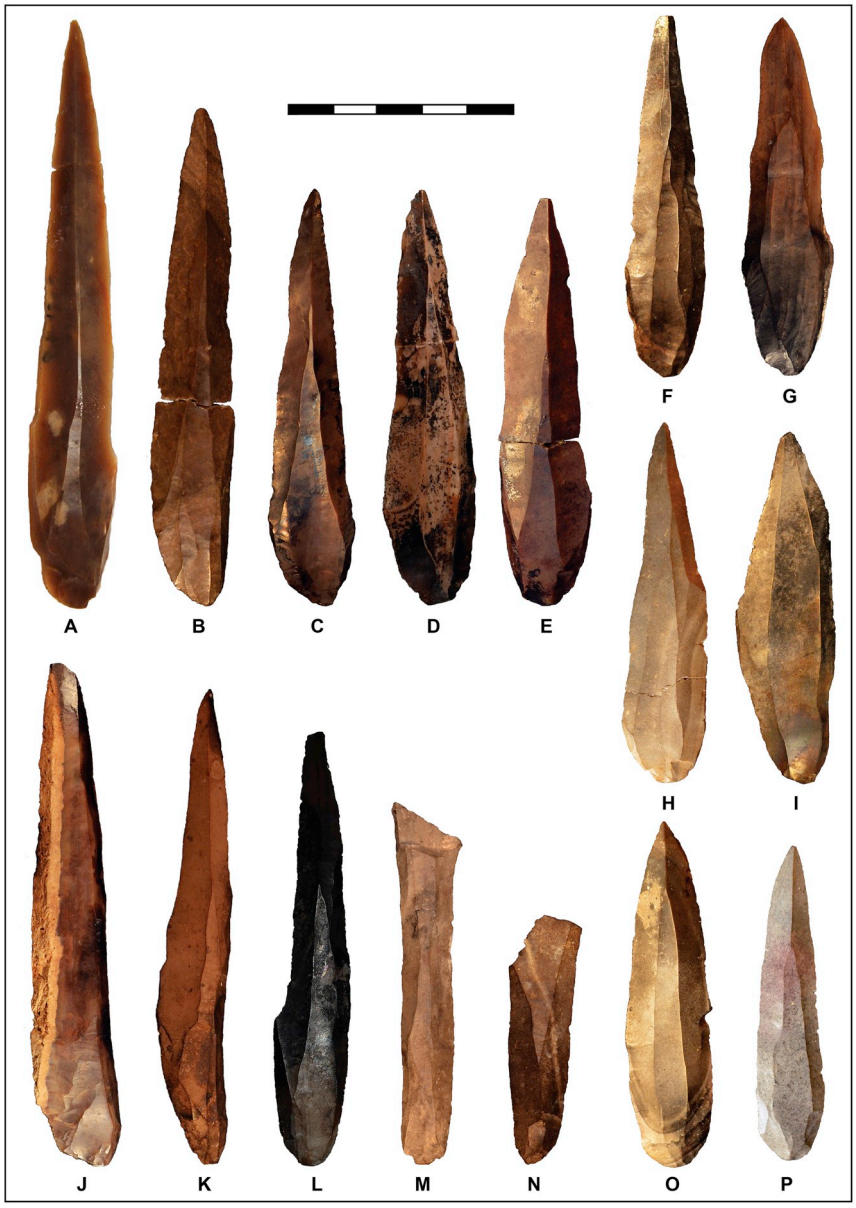

Fig. 6. Bidirectional blades from NHC: A-I, O and P) central blades, J) lateral blade, K and L) central-lateral blades, M) surface maintenance blade (to eliminate hinged opposite removal) and N) upsilon blade.

case, whatever the organization of the exploitation of the blades was, core preparation seems to have involved the configuration of a frontal ridge, as indicated by the presence of a mesial fragment of a bifacially-flaked ridge and of four blades (three retouched into Nahal Hemar knives) displaying part of the negative removals of a frontal ridge on their dorsal face (Fig. 8: C and F). Configuration of the back of the core remains uncertain. The subsequent removal of the blades involved careful preparation including the abrasion of the platform edge and the removal of other tiny flakes, while the relatively marked bulbs, small flat or punctiform platforms and general configuration of the blades, indicate that the blade component at NHC was produced using a soft-stone hammer, probably combined with a hard-stone hammer for the configuration of the core.

Complete blades (both directional and indeterminate) range from 4.5 to 13 cm in length, with the bulk of them between 6 and 10 cm long (Fig. 9). This variability, and the proportion in which they are found, indicates that the selected blades represent all the stages of the knapping sequence, from the first full exploitation blades, measuring up to 13 cm, to the last blades produced before abandonment of the core, just over 4.5 cm long. Accordingly, if the largest full-exploitation blades measured around 13 cm in length, it is possible to estimate that bidirectional cores used to produce the blades at NHC initially measured around 14–15 cm in length, and that the nodules used were of medium size, probably ranging from 15 to 20 cm in length. In addition, the presence of 36 blades with cortical surfaces (8 central bidirectional + 19 lateral bidirectional + 7 indeterminate bidirectional + 2 indeterminate blades) (Fig. 6: G and J; Fig. 18), especially in an assemblage of highly selected blanks, indicates that knappers used relatively thin nodules or tabular flint with convenient original forms for bidirectional blade knapping that did not need intense preparation and decortication during the initial configuration of the preform/block. Consequently, cores often display cortical surfaces on the lateral or back of the core (see the cores from PPNB site of Kharaysin as an example [Borrell et al., 2019]).

5.3. Typology: Producing the retouched tools

The studied lithic collection comprises 299 retouched artefacts

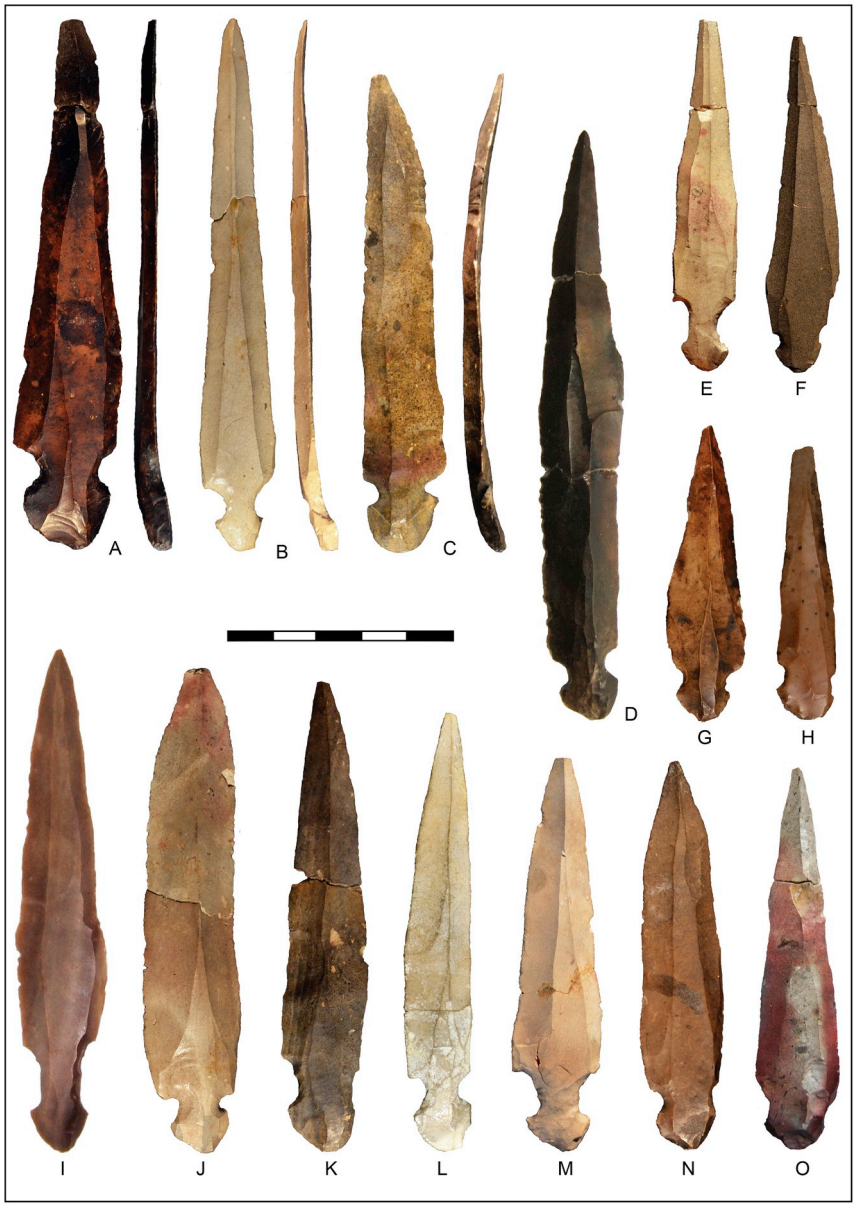

Fig. 7. Nahal Hemar knives.

(47.8%), while a further 60 (9.6%) display macroscopic use-wear chipping. Despite the very high percentage of retouched tools, which cannot be compared to any other site in the Levant and emphasizes the uniqueness and unconventional use of the cave, the range of formal tools represented is extremely limited. The most common formal tools are, by far, Nahal Hemar knives (194, 64.9%) (Figs. 7 and 8) followed by, albeit in much smaller percentages, projectiles (16, 5.4%) (Fig. 11), sickle elements/inserts (7, 2.3% [three of which constitute a complete sickle]) (Fig. 12) and borers (6, 2.0%). A series of artefacts (12, 4.0%) have been included in a category of knife/projectile as they show ambivalent features ranging between those two categories (Fig. 8: D, H and I). Finally, undiagnostic retouched blades represent a quarter of the retouched elements (64, 21.4%).

Nahal Hemar knives are therefore the most common formal tool at the site, with a total of 194 artefacts (Figs. 7 and 8). They characterize the lithic collection found at the site, where the term and definition of such tool type was coined (Bar-Yosef and Alon, 1988: 9). They are naturally pointed blades with a pair (or two pairs in three cases) of opposed notches in the proximal part of the blade. Almost all of them are made from pointed bidirectional blades (192 out of 194) with a clear preference towards central blades (104 central, 22 lateral and 66 indeterminate bidirectional). Despite the clear selection of the blade types used, the collection from NHC displays remarkable variability in the size of the blades, with complete Nahal Hemar knives (n = 78) ranging from 5 to 13 cm in length (Fig. 9). The shape and symmetry of the blades also vary quite often, from extremely well-shaped, straight, pointed and highly standardized central blades to some that are roughly made, thick and even hardly symmetric. In addition, some of the largest Nahal Hemar knives have a slightly curved longitudinal section due to, as mentioned in the previous section, the minor preparation of the distal end of the core and some blades (central and lateral) almost running from platform to platform (Fig. 7: A-C).

The pair of opposed notches in the proximal part of the blades have traditionally been interpreted as a way to facilitate the hafting of the knife (one of the Nahal Hemar knives not seen in this study was found with a cord around the tang [Bar-Yosef and Alon, 1988: 9, Plate II:2]). This feature, which characterizes and *de facto* defines the Nahal Hemar knives, also displays significant variability. In most cases, the notches are quite well delineated, between 4 and 5 to 10 mm wide and 4–6 mm deep. However, in some cases the notches are quite diffuse, as much as

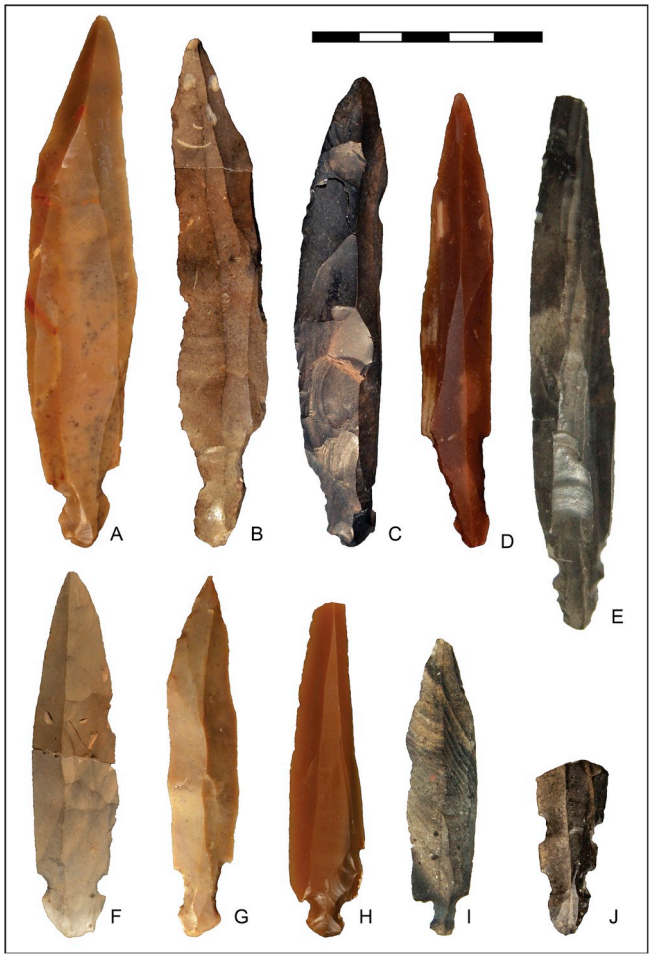

Fig. 8. Nahal Hemar knives (A-C, E-G and J) and other tools displaying ambivalent (knife/projectile) features (D, H and I).

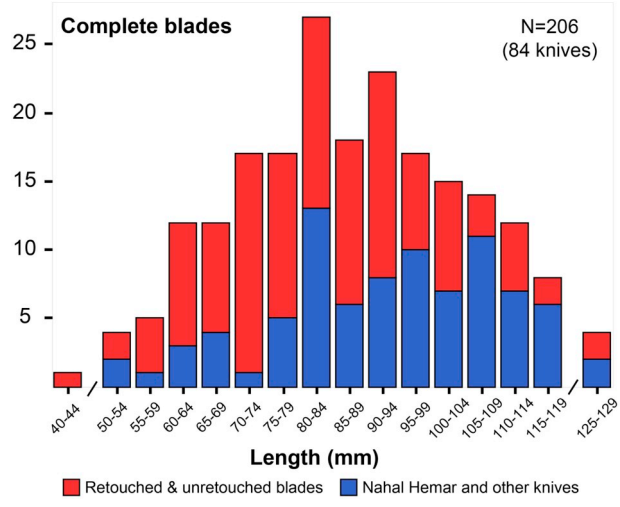

Fig. 9. Total length of complete bidirectional (201) and indeterminate (5) blades (retouched and unretouched) compared to those used for producing the complete Nahal Hemar (n = 78) and other knives (n = 6). Artefacts missing the extreme distal tip have been included when the missing part was estimated to be shorter than 10 mm, which has been added to the total length of the item.

15 mm wide and only 1 or 2 mm deep (Fig. 7: H, K and O; Fig. 8: B-D), which can make it difficult to identify the tool as a Nahal Hemar knife (the term tanged blades was used in the original publication [Bar-Yosef and Alon, 1988: 11, nº 1-3]). The retouch is generally continuous semi-abrupt to abrupt, mostly direct but often combined with simple inverse retouch in one, only rarely in both, of the notches. Abu Gosh and other forms of similar pressure retouch are also used to produce the notches and sometimes to partially retouch the proximal part of the blade, the 'butt' or 'pommel' of the knife, which is often also left unretouched or minimally retouched. Interestingly, although difficult to explain, the notches are often not well aligned and one of the notches is slightly deeper and more 'pointed' than the other (Fig. 7: B, C, H, K and M).

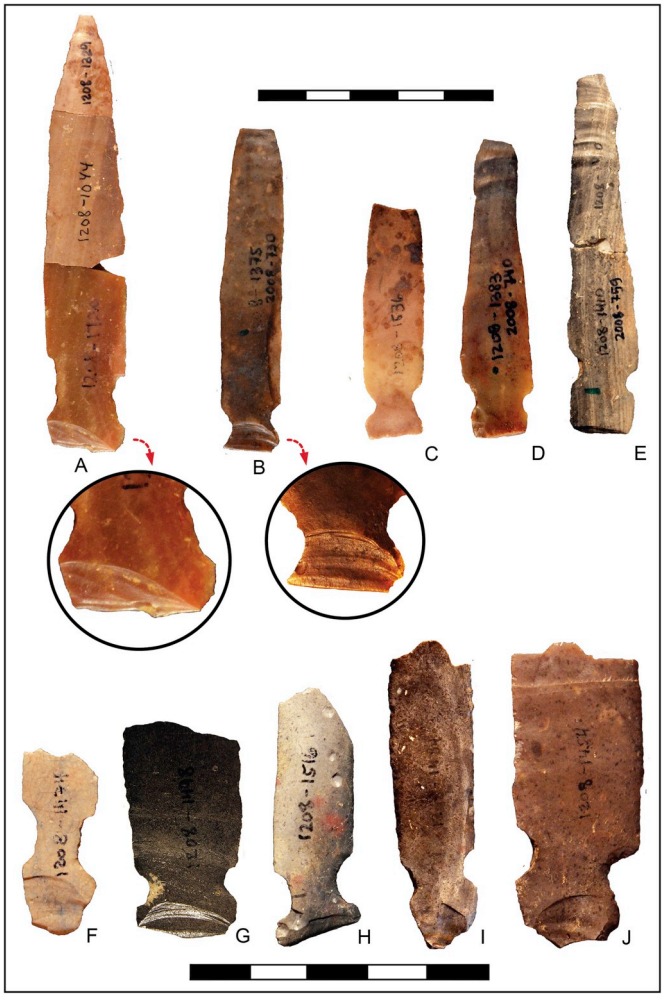

Fig. 10. Nahal Hemar knives with the characteristic proximal fracture *en languette inférieure*.

Configuration of the Nahal Hemar knives was not restricted to the notches and 'pommel' as some displayed continuous, usually direct retouch, on one or two of the edges of the blade, often also affecting the tip of the knife despite them being naturally pointed blades. Retouch was often marginal and non-invasive (Fig. 7: B) but sometimes was quite invasive and affected the general shape/morphology of the blade (Fig. 8: B), which should be interpreted as the probable result of intensive sharpening of the edge/s and re-use of the tool.

Finally, as regards the Nahal Hemar knives, it has to be noted that a number of those tools display a characteristic fracture that partially removes the butt and bulb from the ventral face (Fig. 10). This fracture, which has also been observed in a few of the retouched and non-retouched blades, was initially interpreted as intentional and aimed at thinning the proximal part of the blade to facilitate the hafting of the knife. However, after closer inspection and further discussion with J. Pelegrin (personal communication February 2020), it can be concluded that these fractures are to be interpreted as the typical detachment

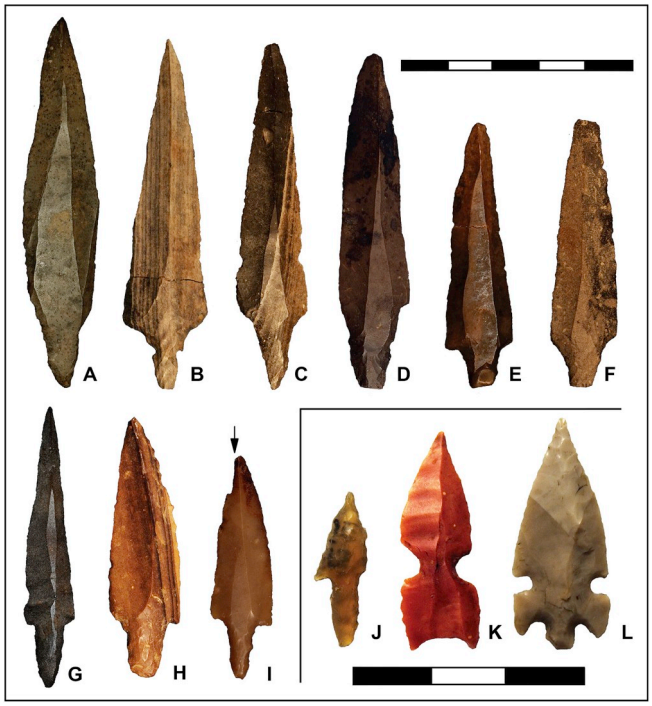

Fig. 11. Projectiles from NHC.

accident known as *cassure en languette inférieure* or 'proximal break with lower tongue', as originally defined by Bordes (1970) and Roche and Tixier (1982).

Projectile points are the second most common formal tool with a small collection of 16 artefacts (Fig. 11). The assemblage is formed by a relatively homogeneous group, albeit not in their size, of 13 medium-to large-sized tanged projectiles that correspond to the Jericho and Byblos projectile types (Fig. 11: A-I), which together with Amuq points constitute the basis of the projectile points for the Middle and Late PPNB in the Levant. They are almost exclusively made on central bidirectional blades. The length of the complete artefacts ranges between 5 and 9 cm and the weight between to 2 and 9 gr. Configuration of the tang was mostly done by bifacial semi-abrupt retouch, while only some of them display Abu Gosh and/or other types of pressure retouch. Besides this group of relatively homogeneous and coherent set of projectiles, three other small-sized and very different points were found at NHC: a Khiam point, a Helwan point and a Haparsa point (Fig. 11: J-L). These three smaller points (length between 3 and 2 cm and weight less than 1 gr), made with indeterminate blades of very different raw materials (interestingly, not burnt), do not fit with the rest of the lithic collection nor with the chronological timespan of the main occupation of the cave (Middle/Late PPNB).

A total number of four sickle inserts and a complete sickle (with three inserts) were found at the cave. The former, only two of which were identified in the original publication, are made with different types of relatively large and robust bidirectional blades (two complete [102 and 92 mm in length], one almost complete and one mesial fragment). The two that had been previously identified as sickle inserts display well developed parallel gloss on the ventral and dorsal faces of the right edges of the blades. In one of the cases, the edge is finely denticulated with inverse retouch, a very common feature of sickle inserts in the southern Levant during the Middle PPNB. The other two inserts, a complete blade and the small mesial fragment, display not very intense gloss (parallel in the case of the complete blade) on the ventral and dorsal face, respectively, of the right edge (not retouched) of both blades. With the exception of the small mesial fragment, the gloss distribution, together with the shape and size of the sickle elements, indicates that they were inserted parallel to a slightly curved shaft, similarly to the complete sickle found.

Fig. 12. Complete sickle from NHC with the reconstructed zigzag motif (© The Israel Museum, Jerusalem).

The complete sickle is relatively small in size (26.5 cm long) (Fig. 12). According to the original publication, it was made with a caprine horn handle that was bent and modified by heat (Bar-Yosef and Alon, 1988: 16), although we cannot confirm this. Three flint pieces (indeterminate blades) inserted in a longitudinal groove constitute a slightly curved active cutting edge of about 13 cm. The flint inserts were fixed to the handle with a black adhesive, probably made of animal collagen, and no macroscopic gloss nor retouch was observed on the active edges of the blades, which seem slightly damaged. Despite the apparent absence of macroscopically visible gloss, and based on the fact that many of the artefacts from NHC were used (see the use-wear section below), it seems reasonable to assume that the sickle also had a previous use before being deposited in the cave. Finally, one side of the part of the shaft in which the sickle elements were inserted is decorated with a triple incised zigzag motif, which makes the sickle from NHC a unique specimen in the prehistory of Southwestern Asia.

The least abundant of the formal tools are the borers/perforator/

Table 1
List of artefacts sampled for use-wear analysis and summary of the results.

NUMBER	TYPOLOGY	ALTERATION	USE
NH-1984-1806	N.H. knife	Burnt	Cutting hide (with ochre)
NH-1984-1835	N.H. knife	Burnt	Cutting hide (with ochre) + Proximal abrasion
NH-1984-1824	N.H. knife	Burnt	Cutting soft material
NH-2008-757	N.H. knife	No	Cutting soft animal tissue and butchery + Proximal abrasion + G polish
NH-2008-713	N.H. knife	No	Cutting soft animal tissue and butchery
NH-2008-732	N.H. knife	No	Cutting activity
NH-654733	N.H. knife (frag)	No	No traces
NH-1984-1810	N.H. knife	Burnt	Indeterminable
NH-1984-1815	N.H. knife	Burnt	Indeterminable
NH-1984-1812	N.H. knife	Burnt	Indeterminable
NH-1984-1809	N.H. knife	Burnt	Indeterminable
NH-1984-1808	N.H. knife	Burnt	Indeterminable
NH-2008-718	N.H. knife	Burnt	Indeterminable
NH-1984-1816	N.H. knife	Burnt	Indeterminable
NH-655243	N.H. knife (frag)	Burnt	Indeterminable
NH-655960	N.H. knife	Black residue	Indeterminable
NH-2008-798	N.H. knife	Black residue	Indeterminable
NH-1984-1838	N.H. knife	Black residue	Indeterminable
NH-1984-1830	N.H. knife	Black residue	Indeterminable
NH-655657	N.H. knife (frag)	Black residue	Indeterminable
NH-2008-753	Knife/ Projectile	No	Cutting mineral material + G polish
NH-2008-751	Knife/ Projectile	No	Cutting soft animal tissue and butchery + G polish
NH-2008-831	Retouched blade	Black residue	No traces. Residue (hafting?)
NH-1984-1850	Blade	Burnt	Proximal abrasion
NH-654738	Blade	No	Cutting soft animal tissue and butchery
NH-1984-1863	Blade	Partially burnt	Cutting soft animal tissue and butchery
NH-2008-744	Blade	Burnt	Proximal abrasion
NH-1984-1862	Blade	Black residue	Cutting mineral + Perforating mineral
NH-655954	Blade	Burnt	Indeterminable
NH-1984-1847	Blade	Burnt	Indeterminable
NH-1984-1859	Blade	Burnt	Indeterminable
NH-2008-727	Blade	Black residue	Indeterminable
NH-2008-829	Blade	Black residue	Indeterminable
NH-655742	Blade	Black residue	Indeterminable
NH-1984-1853	Blade	Burnt	Indeterminable
NH-2008-732	Blade	Black residue	Indeterminable
NH-1984-1855	Blade	Black residue	Indeterminable
NH-654762	Blade	Black residue	Indeterminable
NH-1984-1854	Glossed tool	Burnt	Sickle blade
NH-2008-755	Glossed tool	Burnt	Sickle blade
NH-2008-756	Glossed tool	No	Sickle blade
NH-2008-792	Perforator	No	Mechanical drilling of mineral
NH-655162	Perforator	No	Perforating mineral
NH-1984-1797	Jericho point	No	Impact traces
NH-1984-1800	Jericho point	Burnt	Indeterminable
NH-1984-1792	Byblos point	Burnt	Indeterminable

awls, represented only by six artefacts. All of them are made with blades (five bidirectional) and display different morphologies, such as an elongated perforator or complete blades with retouched distal ends. In addition, the distal tip of one of the Nahal Hemar knives was modified into a borer with bifacial abrupt retouch.

5.4. Use-wear analysis

In the original publication by Bar-Yosef and Alon (1988: 9), a sample of artefacts, no details of which are given, were examined by I. Sala (Institute of Archaeology, London University) concluding that they did not exhibit clear polish that could be easily interpreted, so the question of whether the artefacts from NHC had been used or not remained unanswered. As part of the re-study of the lithic collection from NHC, a total number of 46 tools were submitted for use-wear analysis (Table 1). Standard use-wear analysis methodology was applied to 20 Nahal Hemar knives (three fragmented), two indeterminate knives/projectiles, 16 bidirectional blades (15 unretouched), three glossed blades, two perforators and three projectiles (two Jericho and one Byblos types). Thermal alterations and the presence of black residues on some artefacts have impeded identification of any use-wear traces, polish and striations on 25 artefacts, making the interpretation of their function impossible. Use-wear has been identified on 19 artefacts, despite being slightly burned and some having been partially covered by residue. The remaining two artefacts showed no use wear.

Six out of the seven Nahal Hemar knives whose edges were not heavily affected by thermal alterations nor covered by black residues bear quite consistent use-wear traces. In some cases, use-wear caused by cutting soft animal tissue and butchery, concentrated in the medial and distal areas of the tool, has been identified (Fig. 13). Microwear traces are characterized by extended areas with polish of irregular topography and spots of polish with flat topography and linear features in the most protuberant areas of the edge, caused by contacts with bones and cartilages. Other artefacts were clearly used for cutting hide with the addition of ochre powder (Fig. 14), sometimes using both edges, though always only the medial and distal areas of the edges. In two of these knives (Fig. 15), the proximal part was abraded with stone (probably a soft stone) and characteristic flat and brilliant G polish (generated by the friction of the flint surface with other flint objects and normally related with the transport of the tools in packages where blades are in contact with one another) has been identified on the right edge in the proximal area of one of them (Fig. 15). Finally, another Nahal Hemar knife had been used for cutting an unknown material (traces are poorly developed on the medial and distal areas of the left edge).

Two of the ambiguous artefacts showing features of both Nahal Hemar knives and projectiles were also analysed. The medial and distal areas of their edges were used to cut a mineral material (Fig. 16) and to cut animal tissue and in butchery (Fig. 17: A). Interestingly, G polish has been observed in the proximal part of the two artefacts.

A total of 16 complete naturally pointed bidirectional blades, mostly central/predetermined, were sampled for use-wear analyses. These were unretouched or with minor isolated retouch (only one showed continuous retouch on the proximal part). The surfaces of ten of them were heavily affected by thermal alterations thus impeding the identification of their use. Use-wear has been identified on all the other artefacts. In three cases, the medial/distal areas of the blades had been used for butchery (Figs. 17: B and 18), and another blade for cutting an indeterminate soft material. On another complete blade, partially affected by fire, abrasive traces from scraping hide were observed in the proximal area of the left edge (Fig. 19: A). Besides being used for cutting and processing soft materials, complete blades were also used for other purposes such as for cutting mineral material with the edges (Fig. 19: B), and the tip for boring (Fig. 20). Finally, one of the blades, partially burnt and with the edges covered with black residues (so they could not be analysed), showed intentional abrasion in the proximal part.

The three complete or almost complete sickle inserts with gloss (the fourth was a small medial segment of a blade) were analysed (Figs. 21 and 22). Despite two of the artefacts showing thermal alterations causing fissures or cracks in the gloss, it has been possible to identify that they were used for reaping cereals. On the other hand, observation of the distribution of the gloss at a microscopic scale reveals it is more invasive in the central part of the cutting edge and one or both extremities of the edge are free of polish. This confirms that these flint elements were inserted parallel to a slightly curved shaft, in the same way as observed in the complete sickle.

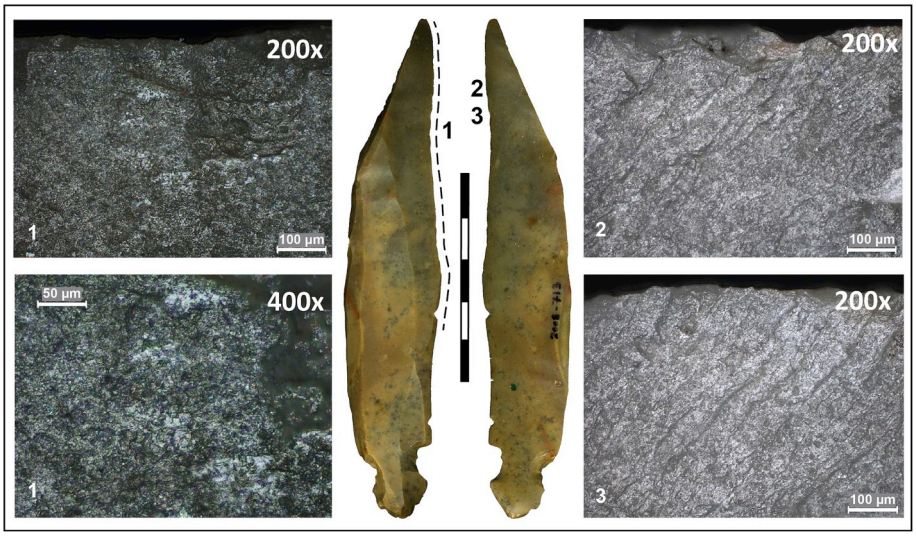

Fig. 13. Nahal Hemar knife used for cutting animal tissue and butchery (NH-2008-713).

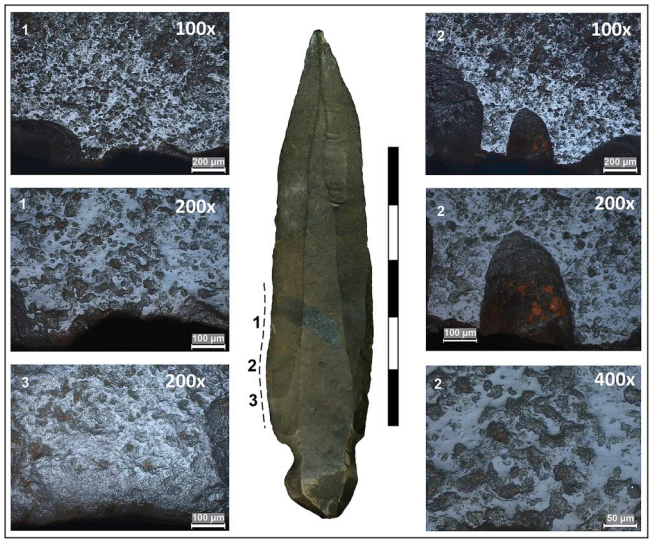

Fig. 14. Nahal Hemar knife used for cutting hide with the addition of ochre powder (NH-1984-1835).

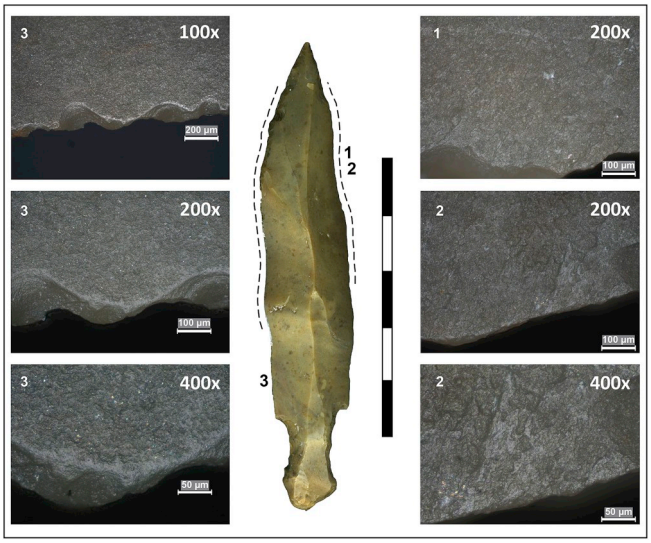

Fig. 15. Nahal Hemar knife used for butchering and showing proximal abrasion (for hafting?) and G polish (NH-2008-757).

In order to be able to determine if the sickle insert not affected by fire (Fig. 22: A) had been used to cut wild cereal in natural stands, cultivated wild cereals, domestic cereals or reeds, the glossy area was analysed using texture analysis of 3D images obtained through confocal microscopy. The results obtained relate this tool with the group of experimental tools used for harvesting domestic cereals that were cut in an advanced state of maturity, as more than 80% of the 27 image samples were classified in the group of cutting domestic cereals (Table 2).

Finally, two perforators and three projectiles (two Jericho type and one Byblos) were analysed with positive results. The long perforator had been used to drill a mineral material (Fig. 22: B). The intensity and regularity of the traces identified suggest that the perforator was the stone tip of a mechanical drilling device. The tip of the second perforator analysed, an almost complete blade, had been retouched and displayed use-wear generated by perforating mineral material. In turn, one of the Jericho points possesses a burin-like fracture at the apex, due to a violent impact, thus in concordance with its use as a projectile (Fig. 23).

6. Summary and discussion

The comprehensive study of the lithic assemblage from NHC, formed by 626 flint remains, corresponds to a minimum number of 405 flint tools/artefacts (397 blades [one Canaanean blade and two unidirectional blades], six bladelets and two flakes) has produced significant results that cast light not only on the production and use of the unique collection of flint tools found at the cave but also on some more general aspects of the use of NHC itself during the PPNB.

One of the most relevant aspects revealed by the study is that in many aspects the lithic assemblage from NHC is extremely homogeneous and consistent.

The bulk of the lithic assemblage was produced using a relatively limited range of flint types, basically very fine to fine-grained light brown to beige flints, which in many cases display lighter concentric bands or watery stains and often also display whitish and/or reddish inclusions. This is not only based on the few non-burnt artefacts but on the fact that more than half of the burnt artefacts display, despite the change in colour and the cracks and the gloss, the characteristic concentric bands observed in the non-burnt flints. On the other hand, the presence of cortical artefacts (n = 36) displaying a well-defined chalky

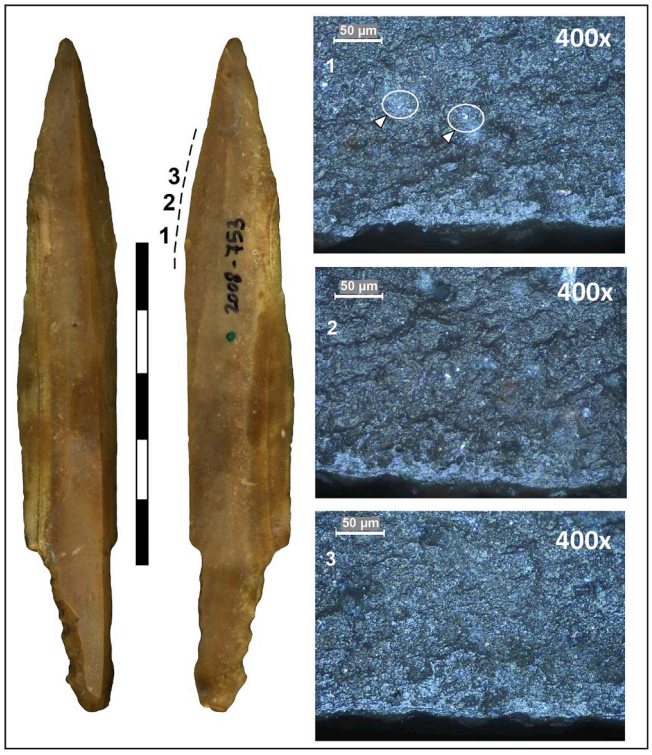

Fig. 16. Nahal Hemar knife/projectile used to cut a mineral material (NH-2008-753). Some residues of mineral material can be observed on the edge, bluish in colour (see white arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

cortex about 1–3 mm thick indicates that the nodules that were exploited to produce the stone tools at NHC derived from primary outcrops rather than from wadi gravels or river terraces and, secondly, that the nodules used were, as will be shown, relatively large and narrow. Other raw materials apart from the light brown and beige types are virtually anecdotal, all of which suggest a certain idea of continuity and/or homogeneity in the procurement and use of the flint types exploited to produce the tools that were to be introduced into the cave.

The homogeneity observed in the flint types used is also seen in the production of the blades. The bulk of the flint assemblage is formed almost exclusively by complete bidirectional blades. These blades were knapped by direct soft/hard stone percussion from opposed-platform cores with a bifacially-flaked frontal ridge, in most cases using the 'predetermined-upsilon' variant of bidirectional blade technology, as defined by Barzilai (2010) and roughly corresponding to the two modalities of extraction of superposed predetermined blades defined by Abbès (2003). Such homogeneity is, however, not that surprising if we take into account that by the mid-8th millennium cal. BC bidirectional blade technology already formed the basis of flaked-stone industries in most, if not all, the Levant (e.g., Nishiaki, 2000; Abbès, 2003; Borrell, 2017) and is the almost exclusive knapping method identified at many large PPNB sites (e.g., Kharaysin [Borrell et al., 2019]). In the case of NHC, the highly selected blanks (mostly complete pointed central blades), not because of their size but because of their shape and general morphology, were obviously produced off-site and brought to the cave, whether introduced as blanks or already as retouched tools.

Concerning the retouched tool types, the homogeneity of the assemblage is also striking with the massive presence of Nahal Hemar knives and a very limited number of other tools (projectiles, sickles and perforators/borers). Altogether, this supports the original interpretation made by Bar-Yosef and Alon (1988) about the integrity of the collection and its chronology. The only exceptions are a very limited number of

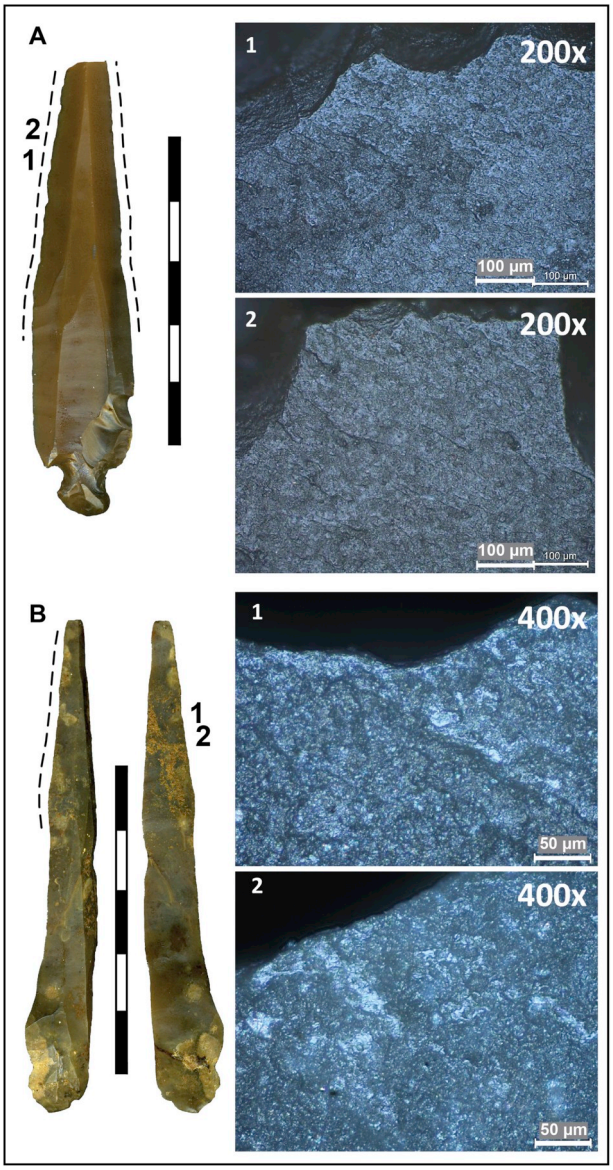

Fig. 17. A: Nahal Hemar knife/projectile used to cut animal tissue and in butchery (NH-2008-751). B: Complete lateral blade used for butchery.

artefacts: The 'Canaanean blade', the three small projectile points (Khiam, Helwan and Harparsa types) and the two flakes. These clearly differ technologically and chronologically from the rest of the collection, suggesting that these artefacts should not be considered part of the lithic tools associated with the ritual use of the cave during the Middle/Late PPNB.

The complete sickle found in *Stratum* 4 constitutes an extraordinary find in the context of Near Eastern prehistory. Complete or almost complete sickles are very rare in the region, only found at other distant prehistoric sites like Jarmo (Hole, 1983: 280) and Tell es-Sawwan (El Wailly and Abu el Soof, 1965) in Iraq, Hacilar (Mellaart, 1970) in western Anatolia or Halula (Borrell and Molist, 2007) in northern Syria. In addition, the sickle from NHC constitutes one of the earliest examples (and the only complete one) with a curved haft in the southern Levant, a type of sickle which originated and rapidly expanded in the Northern Levant from the mid-9th millennium onwards (Ibáñez et al., 2008, 2016; Borrell, 2015; Pichon, 2017), and that has traditionally been associated with an increase in the intensity of agricultural tasks, enabling the gathering of cereal stalks and quicker cutting/harvesting of dense fields of cereals (Ibáñez et al., 1998; Ibáñez and González-

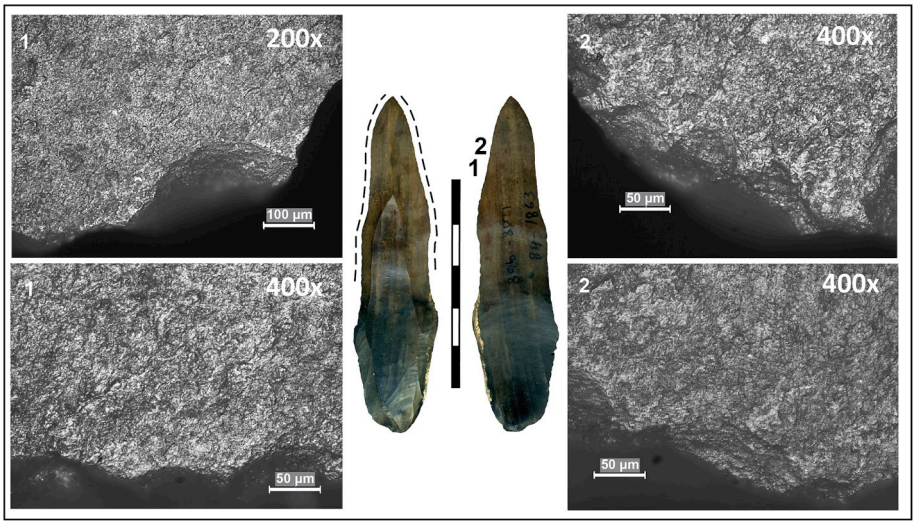

Fig. 18. Complete central blade used for cutting soft animal material and butchery (NH-1984-1863).

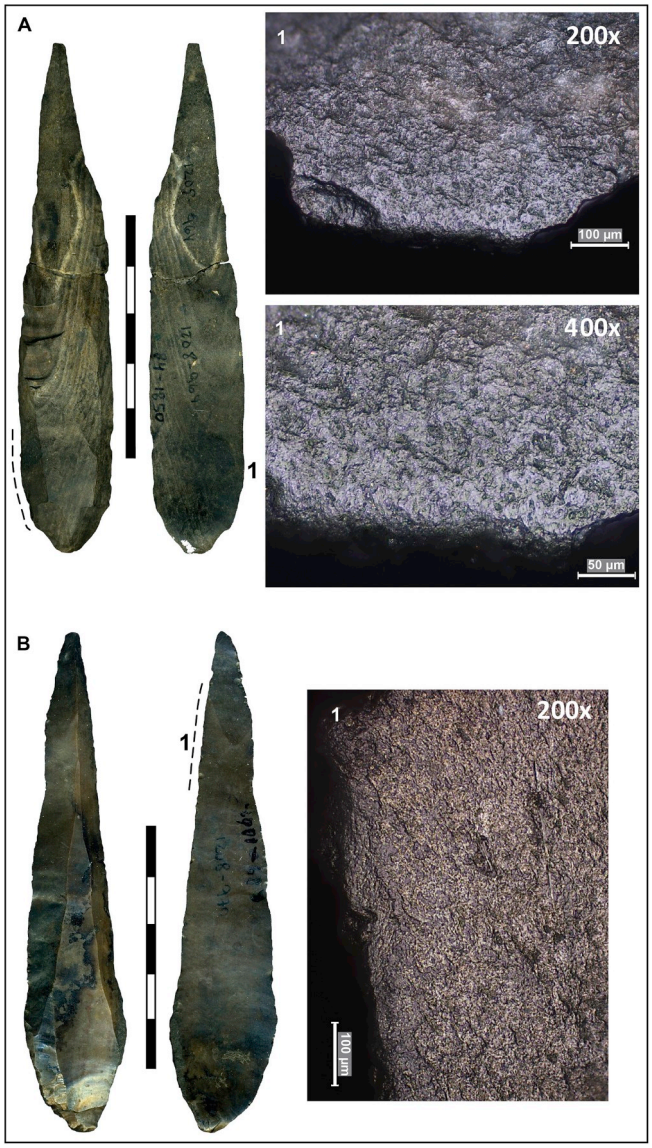

Fig. 19. A: Complete central blade used for scraping hide (NH-1984-1850). B: Complete central blade used for cutting mineral material with the edges and for boring with the tip (NH-1984-1862).

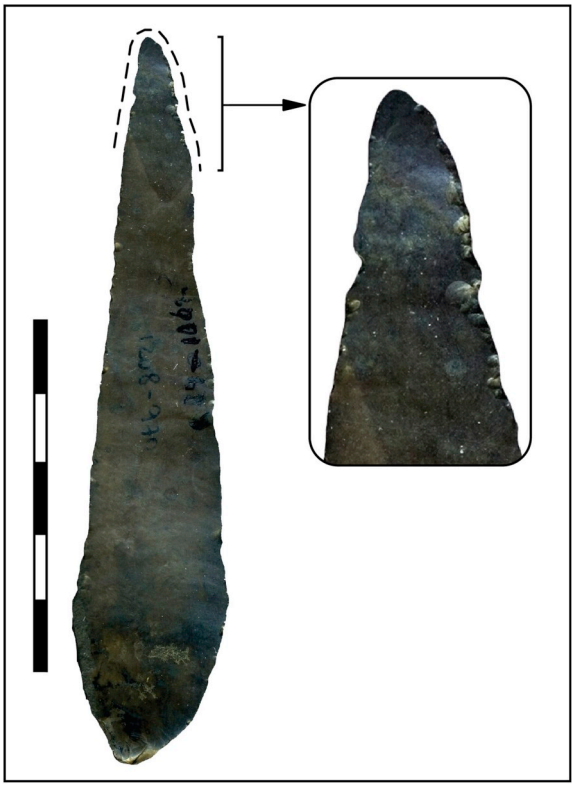

Fig. 20. Microscarring generated by the unidirectional boring of a mineral material with the tip of the blade (NH-1984-1862).

Urquijo, 2006; Astruc et al., 2012). It thus greatly improves our understanding of the development and evolution of harvesting technologies during the origins and consolidation of agriculture in the Near East. The sickle element analysed through confocal microscopy was classified in the experimental group of harvesting ripe domestic cereals. The first evidence of cereals in the process of domestication in the southern Levant was found in the Early PPNB levels of Tell Qarassa North (mid 9th millennium cal. BC) (Arranz et al., 2016). Between 8200 and 7400 cal BC, during the Middle PPNB, the proportions of cereals with solid rachis (proportions of solid rachis > 10% testify manipulation leading to domestication) are very uneven in the region, with proportions between 0 (e.g., Basta) and 100% (e.g., Azraq 31) (Neef, 2004;

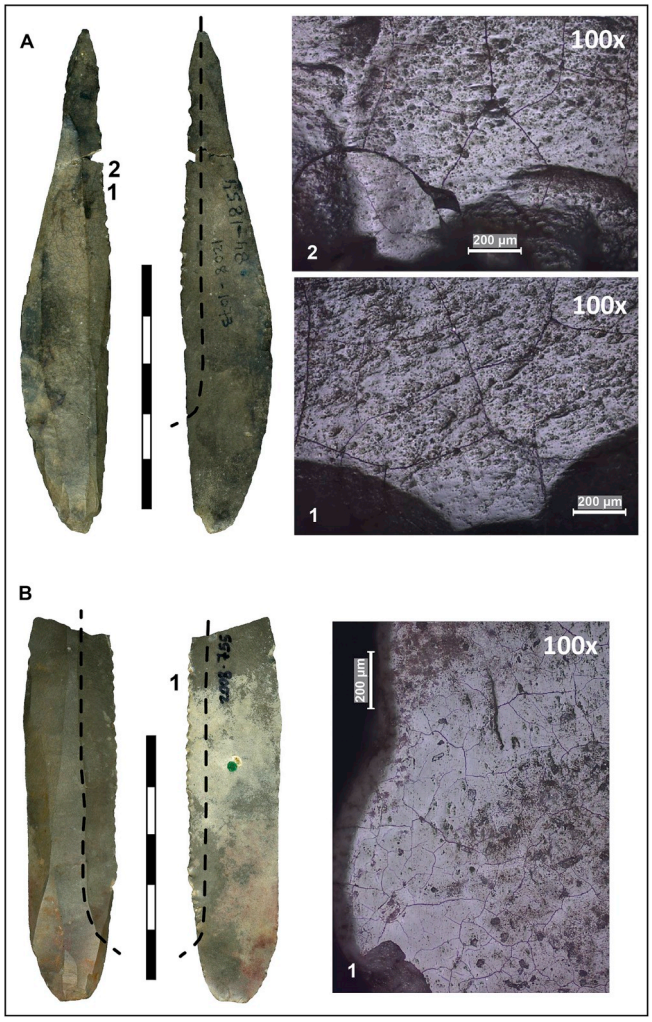

Fig. 21. Sickle blades from NHC (A: NH-1984-1854; B: NH-2008-755).

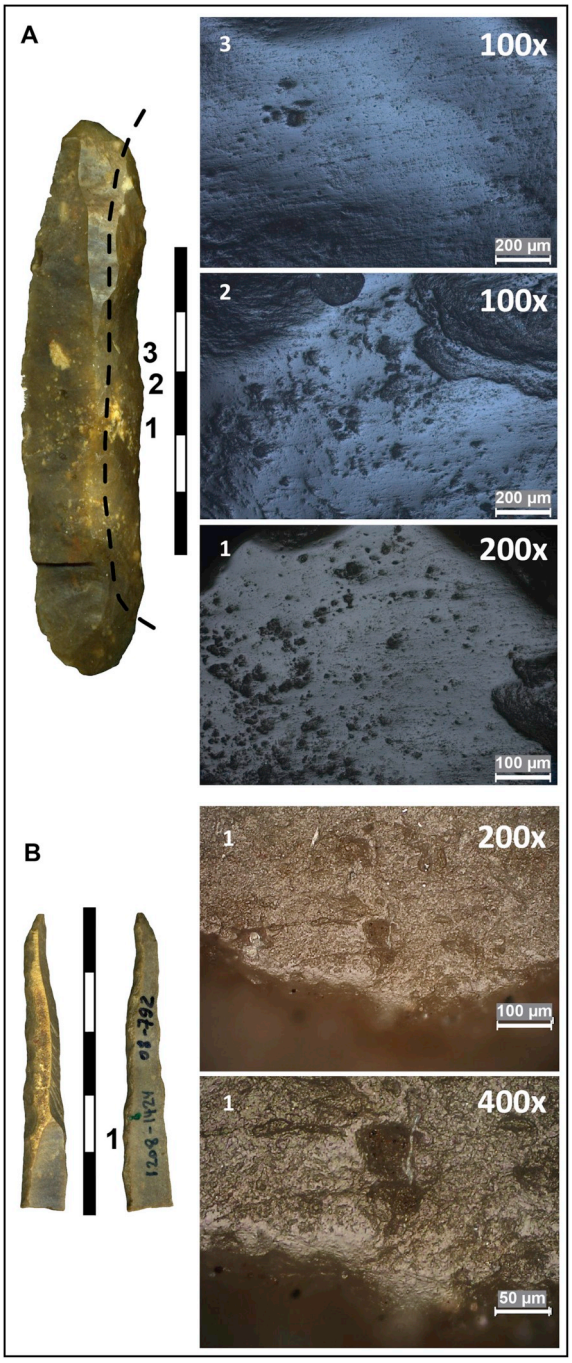

Fig. 22. Sickle blade (A: NH-2008-756) and perforator (B: NH-2008-792) from NHC. Harvesting gloss is cracked because the tool was affected by fire.

Garrard et al., 1996). Our analysis of sickle elements through texture analysis and confocal microscopy from several sites in the Middle Euphrates (Northern Levant) indicates that harvesting of ripe cereals starts to become dominant from the Middle PPNB levels at Tell Halula, in the mid-8th millennium cal. BC. The sickle from NHC was used for reaping cereals in an advanced state of maturity, so they were most probably domestic cereals, in a period when domestic cereals were present in the area although they were not grown in all the sites.

The above-mentioned remarkable homogeneity of the assemblage should not be understood as evidence that the flint tools were produced and brought to the cave in a relatively short point in time during the long chronological time span of around 500-800 years indicated by the ^{14}C dates. On the contrary, many factors point towards a different scenario. The first one is the variability observed in the reduction sequences involved in the production of the bidirectional blades, in some cases not fitting the 'classic' scheme of the dominant 'predetermined-upsilon' variant. The second one is the variability observed in the size, regularity and 'quality' (long, narrow, thin, symmetric, etc.) of the blades, which is related to the expertise of the knappers involved in their production. The last factor is the great morphological diversity of Nahal Hemar knives: they all share a common and very simple concept of tool but with an extremely varied execution, to the point that in some cases they are hardly recognizable as such and look as if they were bad copies or imitations of a design that was becoming increasingly diffuse or in the process of being abandoned. In this sense, it seems likely that those more standardized knives were the first to be produced, probably by specific individuals (specialists?), and that the rest were produced later by various (less competent) individuals across time and space. All these factors together indicate that the flint assemblage found in the cave was the result of a long series of episodes of deposition of objects over a relatively lengthy period of time, in accordance with the radiocarbon dates, and that a varied group of social agents was involved in the production of the said tools.

More light can be shed on who produced the lithic tools found in NHC if we correctly assume that the tool producers were directly involved in the final deposition of the items in the cave. This is especially relevant due to the location of NHC in the southern Judean desert, in between two cultural zones: that of the large permanent Neolithic villages of the Mediterranean woodland region to the North; e.g., Abu

Table 2
Classification through texture analysis of the samples of 3D images from glossed tool NH 2008 756 obtained by confocal microscopy.

PREDICTED GROUP MEMBERSHIP				
Wild cereals in natural stands	Cultivated wild cereals	Domestic cereals	Reeds	Total
4 (4.8%)	0	22 (81.5%)	1 (3.7%)	27 (100%)

Fig. 23. Burin-like fracture in the apex of a Jericho point produced by impact, probably when the projectile was fired (NH-1984-1797).

Gosh (Khalaily and Marder, 2003), Motza (Khalaily and Vardi, 2019), Yiftahel (Garfinkel et al., 2012) and that of mobile hunter-gatherer bands inhabiting the arid regions to the South; e.g., Nahal Efe (Borrell et al., 2015), Nahal Reuel (Ronen et al., 2001), Nahal Hava I (Birkenfeld and Goring-Morris, 2013), Nahal Issaron (Carmi et al., 1994) and Ayn Abu Nukhayla (Henry and Beaver, 2014). The lithic collection at NHC basically consists of naturally-pointed central bidirectional blades, obtained through the 'predetermined-upsilon' variant (Barzilai, 2010). This bidirectional blade technology was the most common and widely spread variant throughout the southern Levant by the mid-8th millennium cal. BC, with the exception of the southernmost peripheral regions such as the Negev and Sinai deserts (Barzilai, 2010; Borrell and Khalaily, 2016; Borrell, 2017). In this arid to semi-arid region, a less sophisticated variant of bidirectional blade technology termed 'single-dominant platform' variant (Barzilai, 2010) was predominant during the Middle and Late PPNB. Most of the blades at NHC could not have been obtained with this variant as cores are shorter and quite wide and no central blades are produced. Accordingly, from the point of view of the technology of the lithic tools, it can be proposed that the production of such tools and, subsequently, even the use of the cave as a ritual site, is to be connected with the agricultural villages in the Mediterranean woodland region where, for example, sickle blades were a common tool and domestic cereals were grown, and not with the hunter-gatherers from the Negev. Thus, it is proposed that the tool producers, and likely, the cave users, were farmers from the North.

Our results show that Nahal Hemar knives and the other artefacts found in the cave had been used. However, the intensity of their use was limited and the activities (e.g., butchery, hide cutting) carried out with them did not cause much damage to the active areas. This is indicated by the fact that although some rounding and microscarring of the edges has been observed, it did not affect the cutting and scraping capacity of the tools and, secondly, that the tips of both the projectiles and perforators were also still acute enough to be effective. The knives were mainly used for cutting soft animal tissue (butchery and hide). The butchery traces are often quite intense, showing areas with points of contact with bone during the cutting and disarticulating activities. Knives were also sporadically used for a range of other activities such as scraping hide, cutting and perforating mineral materials or cutting hide with addition of ochre powder. A range of objects made of rocks and minerals were recovered in the site, such as beads, masks or figurines. However, all these are finished objects and no byproducts from the fabrication process of mineral objects were found, so the tools employed with mineral materials were most probably used in these activities elsewhere. Non-retouched pointed blades were used in a very similar way to the knives and to perform almost the same activities.

In relation to the question of whether lithic tools from NHC were hafted or not, the large number of burnt artefacts and the relative frequency of black residues (not to be removed!) covering the surface of a significant number of tools has prevented inferring hafting systems solely from the direct observation of traces (microscarring, striations and polish), unlike when the conditions of preservation of archaeological tools are optimal (e.g., Rots, 2010). However, a series of converging and complementary evidence/features, while rarely observed in a single artefact, indicate that Nahal Hemar knives and some blades were or had been hafted: 1) the proximal notches in the case of the knives (in one case with a cord still attached around it), 2) use-wear traces distributed in the medial/distal parts of the tool while the proximal areas are free of use traces, 3) abrasion of the proximal part of the edges (rubbed with an abrading stone) to eliminate its sharpness and, finally, 4) the concentration of black residues in the proximal third of some knives/blades. Other Nahal Hemar knives and blades could also have been used without being hafted. The distribution of traces in the medial and distal part could be the result of handling the tool by its proximal end; the edge may have been rubbed (abrasive traces) at the proximal end to avoid cutting the hand accidentally during use; the proximal notches may have been used to tie a cord around them and hang the tools by them during transport.

The rest of the tools (sickles, borers and projectiles) were also used, for reaping cereals (probably domesticated), perforating (mineral) and as part of a thrown weapon, respectively. In sum, the lithic tools found at NHC had a history of use behind them before they were deposited, still usable (and in some cases hafted), in the cave. The fact the lithic tools had been previously used together with the range of activities identified (butchery, harvesting cereals, hunting, hide-cutting, stone-cutting and perforating…) could be interpreted as evidence that such tools had not been produced *ex professo* for ritual purposes but for daily activities and that, at some point, they were integrated and 're-used' whether as symbolic items to be ritually deposited inside the cave or as a future reserve of tools hidden in the cave. However, this completely logical interpretation does not rule out another equally plausible option. It could well be that the activities performed with the lithic tools from NHC, whether they took place inside or outside the cave, could already be part of the ritual activities, and not domestic tasks, whose final stage would be the ritual abandonment of the said tools (with the other paraphernalia) in the cave. This hypothesis, which is reinforced

by the non-intensive (sharp edges, no evidence of curation/reuse of the artefacts) and task-specific (no superimposed uses or activities have been observed) use of the analysed flint artefacts, re-opens the possibility that these tools, and Nahal Hemar knives in particular, were made specifically (by experts?) to participate in ritual activities, thus becoming, in the specific case of the knives, in light of their rarity in other PPNB sites, task-specific ritual tools (ritual slaughter?).

In the initial publication of the site, Bar-Yosef and Alon (1988: 10) cautiously suggested that the proliferation of Nahal Hemar knives in the cave was in all likelihood related to the specific and unconventional activities performed at the site such as, for example, the application of asphalt to basketry found in the cave, whether it was done for domestic or cult purposes. After 30 years of intense research in the Near East and the discovery and excavation of dozens of PPNB sites in the Levant, Nahal Hemar knives remain a very rare tool, found profusely only in NHC. Bar-Yosef and Alon reported similar blades with bilateral proximal notches at Jericho, Abu Gosh, Beisamoun and Beidha (Bar-Yosef and Alon, 1988:10; Bar-Yosef, 2011), although they were found in very small numbers and in most cases they could be considered doubtful. Blades with proximal notches resembling Nahal Hemar knives have also been found at Mureybet (Cauvin, 1994: 285) and Dja'de (Coqueugniot, 1994: 320) but again they could hardly be considered the same tool, apart from the fact that these are isolated, almost unique artefacts. In the southern Levant, a few examples of blades with parallel notches at the proximal end have also been reported at, for example, Nahal Issaron (Gopher et al., 1994: 493: Fig. 1) and Nahal Lavan 1006 (Goring-Morris et al., 2006), though always considered 'non-typical' or defined as 'somewhat resembling Nahal Hemar knives' because of their scant numbers and the lack of standardization in knife size, shape and notch production. Only recently have a significant number of Nahal Hemar knives been found at Ayn Abu Nukhayla (Nowell et al., 2014: 177). In this case, the use-wear analysis of four of the 64 Nahal Hemar knives reveals they were used (mostly as knives) for a variety of activities, such as butchery, cutting hard material and cutting soft indeterminate material, together with other uses (burin/engraver) (Kay, 2014: 222). Yet the excavators themselves, who define them as ritual objects, and probably sacred, remark the differences observed when compared with the knives from NHC and note that the dimensional attributes of those found at Ayn Abu Nukhayla 'show significant variability with no real standardization in knife size and notch production'. The latest discovery of NHC knives we are aware of was at Kharaysin (northern Jordan), where a total of 20 knives were recovered, from the layers belonging **to** the Middle PPNB occupation of the site. In this case, the blades, most of which were found cached in a funerary area where rituals including the extraction and re-deposition of human bones and the use of numerous figurines made of flint (Ibáñez et al., 2020, in press), are extremely well-made, large, straight, naturally pointed and quite standardized in shape and morphology, while the notches are very narrow and not at all deep. In conclusion, despite the many PPNB sites discovered and the hundreds of thousands (if not millions) of lithic artefacts studied, the 194 Nahal Hemar knives found at NHC constitute the densest concentration of this tool type (even denser if we consider the small surface they were found in) in the Near East, where all the other sites together have yielded a smaller total number. Furthermore, not a single Nahal Hemar knife comparable to the most standardized and well-made specimens found in the cave has been discovered in the Near East, not even after 30 years of research.

In light of all the above-mentioned evidence, we can only reach the same conclusion as Bar-Yosef and Alon did in 1988; that the concentration of knives in the context of NHC can only be related to the specific activities performed at, or in relation to, the site. Therefore, if NHC is considered a ritual/cultic site, it seems reasonable to assume that the tool type so strongly associated with it should be considered part of the ritual, a ritual tool. Within the framework of this interpretation line, which obviously cannot be fully proven, the subsequent logical question that is asked is what ritual/unconventional activities could the Nahal Hemar knives be part of? If we look inside the cave and take into account that many Nahal Hemar knives (and other blades) were used for butchery (cutting meat and hide and disarticulating activities), the possibilities that come to mind are limited: processing animal or human meat/carcasses. The former does not seem very plausible as the study of the small collection of animal bones from the cave concluded that it might not be related to the anthropic use of the cave (Davis, 1988) and, in addition, because, as explained above, Nahal Hemar knives are extremely rare or absent in other sites, even in the large Neolithic settlements where butchering animals was a common and intensive activity. The second possibility thus seems more reasonable as the partial cranial remains of 23 human individuals were found in the cave (Arensburg and Hershkovitz, 1988); leading to the interpretation that Nahal Hemar knives (and other blades) could have been used for processing/dismembering the bodies of humans.

Finally, it remains to be explained how almost all of the lithic artefacts (and part of the bone tools [Bar-Yosef and Alon, 1988: 13], which were deposited in a very small cave in successive episodes over a relatively long period of time, could have been burnt (reaching very high temperatures) without the rest of the paraphernalia found in the cave (including wood, human and animal bones, botanical remains, etc.) being affected in the same way by such intense fire. In addition, during the excavation two hearths, clearly delimited by the excavators, were excavated but no mention of layers of charcoal or ashes covering the totality or part of the surface of the cave is made while describing the different *Strata* that were excavated. This particular confluence of factors can hardly be explained as the result of an unintentional fire/s affecting the cave, but by the effect of an intentional and controlled fire that was repeatedly applied only on some specific tools to effectively 'purify' or destroy them (while they were still usable) after having been employed in the ritual activities associated with the cultic use of the cave during the Middle/Late PPNB. This interpretation also seems to be reinforced by the fact that all those lithic artefacts that chronologically and technologically differ from the bulk of the lithic collection (Canaanean blade, Haparsa, Helwan and Khiam points and the two flakes found in the cave) were not burnt.

7. Conclusions

Over 30 years after its excavation, despite intense research in the Near East, NHC remains as enigmatic and unique as it was when first discovered. The comprehensive approach to the unparalleled collection of flint tools from the site has revealed, however, some insights not only into the production, use and meaning of such tools but also into a small part of the ritual, spiritual or unconventional activities that occurred in the cave. Results indicate that the cultic use of the cave took place over a relatively long period of time and that different social agents from one or, most probably, several communities of farmers in the Mediterranean woodland region participated or were involved in the activities performed inside or in connection with the cave.

In addition, since its discovery NHC has been interpreted as a place for ritual activities, a cult site where ceremonies were performed, as indicated by the extremely rare and highly symbolic repertoire of objects found in the cave (e.g., stone mask, anthropoid statue, bone figurines, etc.), traditionally defined and accepted as cult paraphernalia. If this did not make NHC special enough, the presence of only cranial human remains of up to 23 individuals must also be taken into account. It seems logical to assume they would play a central role in the configuration of the ritual use of the cave and, consequently, in the meaning and use of the abundant paraphernalia and other artefacts of more complex interpretation, such as the lithic tools, found in the cave. It is within the framework of this particular context, unique to NHC, that the results of the study of the lithic tools have been interpreted. The possibility that such tools were produced *ex professo* to be deposited in the cave as brand new tools, whether as grave goods/offerings or for storage reasons, can now be discarded and alternative interpretations

are contemplated.

In this sense, the highly unconventional context the flint artefacts were part of certainly compels the also unconventional interpretation that at least some of the tools were not only cached objects of ritual significance as initially proposed (Bar-Yosef and Alon, 1988: 27; Bar-Yosef, 2011), but a direct part of the ritual, in the same way as the activities they were used for. These tools played a part in the mortuary practices enacted in the cave by firstly being used for specific highly symbolic activities, then intentionally burnt (destroyed or purified) and, subsequently, deposited/abandoned in the cave as votive offerings and/or grave goods. In accordance with this line of interpretation and with the results of our study, it seems reasonable to propose that the ritual activities Nahal Hemar knives could have been used for were dismembering, processing and disarticulating human bodies; an interpretation that should not be considered far-fetched if one considers 1) the range of PNNB funerary practices that involved manipulation, dismemberment, removal and relocation of human body parts, including skull removal and plastering, as recently summarised by Bocquentin et al. (2016), 2) the increasing number of cutmarks identified on human remains (mostly cranial) from a series of sites throughout the Levant (Simmons et al., 2007; Santana et al., 2012, 2015; Bocquentin, 2013; Kanjou et al., 2015), and 3) the little we know about the tools, necessarily lithic, used to carry out such activities.

To conclude, NHC offers a glimpse of the complexity of funerary practices during the PPNB period, traditionally known for the plastered skulls, by bringing to light contemporary alternative non-conventional (non-normative?) practices such as those that took place in the cave. Those enigmatic practices entailed, at a time when the presence of artefacts accompanying the dead was rare, the accumulation of a large number of artefacts, some of them very significant if not unique, in a small cave of difficult access in the Judean desert, together with the partial remains of 23 individuals. For that period in the southern Levant, it therefore may be the only testimony of collective funerary contexts with associated artefacts (grave goods?), some of which had been used in the rituals that were part of the funerary practices.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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