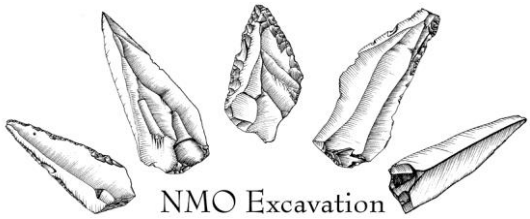

Nahal Mahanayeem Outlet Excavation

Report on the 2012 Excavation Season

Submitted to the Israel Antiquity Authority

The NMO project is supported by:

The CARE Foundation

Introduction

The sixes excavation season at Nahal Mahanayeem Outlet (NMO) lasted four weeks and took place between August 19 and September 13, 2012. Team included students and volunteers from the France, Italy, Spain, Austria, Sweden and the UK. In addition students from the Tel Hai College participated in 2 weeks field school during the 2012 season. The goals of the season were to continue excavating in the main excavation area – Area D, in particular towards the north where the excavated squares are rich in finds, and to the south of the area, where additional levels of occupation were suspected.

Excavation methodology

Excavation grid and datum were based on the data from the previous season (see previous IAA reports). The use of a Leyca total station device enabled us to return to the grid and datum of earlier excavation seasons with very high precision.

The total station was also used for the recording of all finds, soil and other samples, trenches and other reference points and data at the site. Each find or sample has its spatial data recorded and organized within the site's database. Different numbering is used for the recording of flint artifacts, bones, wood and soil samples. The additional category of "other" is used for different raw materials (such as basalt) and for finds that fall outside the above categories.

The water level of the Jordan River was relatively high during the 2012 season. This affected mainly the excavation squares at the northern section of Area D. At these squares, the afternoon water level resulted in covering the excavated surface by water. This limited the possible excavation time to mornings only. During the second half of the excavation, the water level at night rose to the point where water flooded over the lower excavation surface at

the north of the site and filled the site. As a result, the first hour or so of each morning was spent by bucket chains to empty water back into the river (Fig. 1)

Figure 1: Draining the site after Jordan River flooding.

The 2012 season - report by excavation areas

For general location of the areas and trenches see Fig. 2. The primary excavation area of the site, Area D was excavated with the goal of continuing the previous season excavation by enlarging the excavation area in particular sections of interest. The focus of the 2012 season was on squares at the northern, southern and western parts of Area D (Fig. 2). The following description will give an overview of the results according to the Area D parts.

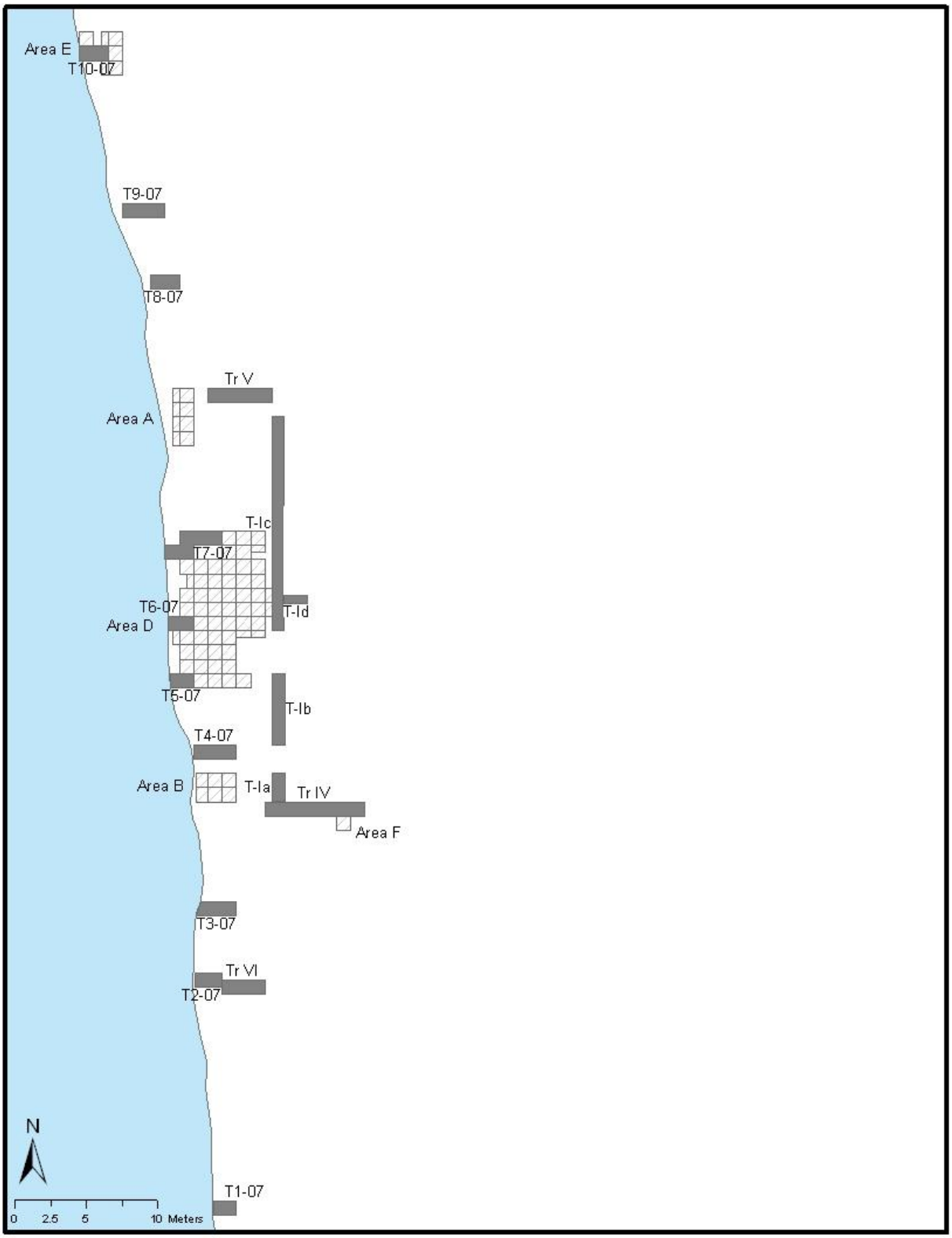

Figure 2: Excavation Location map at the beginning of the 2012 season

North Squares

The goal of excavation in these squares was to enlarge the excavated surface and to continue the work in the squares that were not fully excavated in the previous year, some of which were among the richest in finds in the site. Fig. 3 shows the location of the squares described here.

Figure 3: excavation squares at north of Area D. beginning of excavation.

Excavation of these squares is slow and not easy for the following reasons: 1. the excavation here has reached the rich archaeological layer and one of the primary finds during the 2012 season were large bones that has to be carefully and slowly excavated and removed; 2. Water were constantly coming into the squares from the surrounding sections. Most of the water entered through the 2007 Trench 7 that although filled with sediments, allow water flow. In the afternoon, when water level in the Jordan is high, this has made excavation in these squares inefficient. It is interesting to note that water has also entered the squares from the

section to the north suggesting additional water source except from the river, possibly underground water.

Excavation at the north square has continued to unearth rich assemblage of artifacts and in particular large bovid bones. The bones were unearthed complete (*e.g.* Fig. 4) but all of them were cracked when exposed and fall into many pieces when removed. Much of laboratory conservation and refitting work was invested in order to reconstruct the bones into their original morphology. Refitting and conservation was executed by G. Bainer at the Archaeo-zoology lab at the Hebrew university (see figures below). The bones were found in the Layer 4 typical sediment of grainy and sandy mud as described in previous reports (Fig. 5). This sediment is lying on top of the basalt boulders and cobbles of Layer 5 in agreement with the stratigraphic position of previous excavated squares here.

Figure 4: Large complete bovid Femur at square L161. Note the cracks and breakage probably resulting from post depositional processes.

The bones excavated in square L161 can serve as a good example. The first bones to be exposed, at a level of ca. 58.60, were two large vertebras (Fig. 6). Exposing of these bones indicate that they are lying on the basalt cobbles of Layer 5 towered the south. But, as the basalt of layer 5 is slanting to the north, the bones are "floating" in the sediments in the north.

In the north, the distal side of a large femur was exposed when excavation levels went deeper (Fig. 7). As the other end of this large bone was exposed, a flat bone was found lying on it and between the two bones a flint flake (possibly a point) was embedded (Fig. 8). The flint was so close to the bone that the pressure caused the formation of a notch at one of its lateral edges (Fig. 9).

Such close proximity of bones and flint tools was also observed in previous seasons (see 2008 report for example) as well as in the 2012 season at the close by square of M161 (Figs. 10 - 11). This strong association between the bones and the flint tools is indicative of human agency in the accumulation of the bones and will by further studied in the lab.

But the story is not finished yet. Under the north side of the femur and below it was additional vertebra (Figs. 12-13). This was the end of the excavation of this extremely rich square.

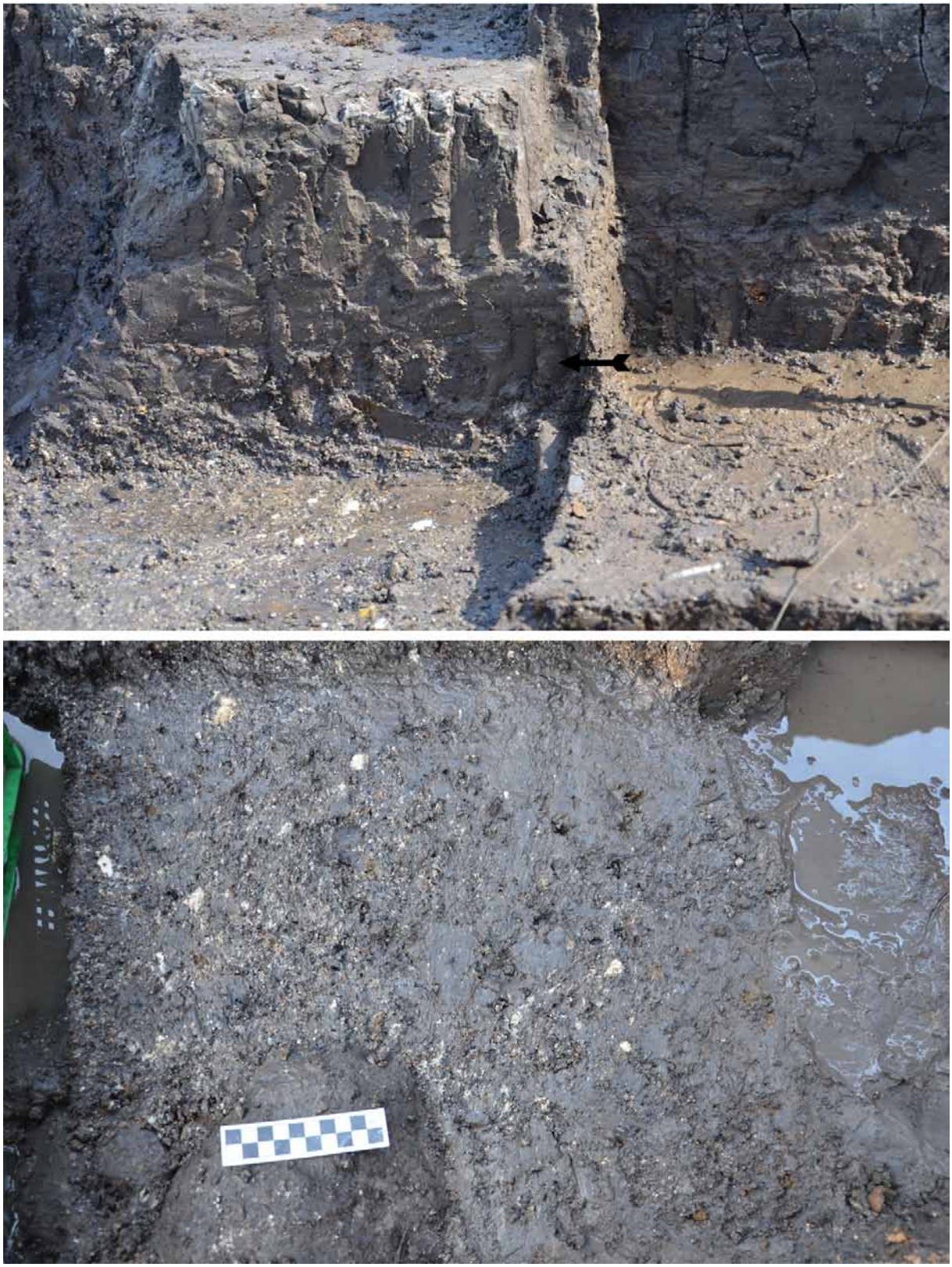

Figure 5: Sediment of Layer 4 at squares L161-M161. Top: Section. Arrow indicates contact between clean mud and the sandier layer 4; Bottom: close up of the Layer 4 sediment in square M161 sub-square a.

Figure 6: Bovid vertebras at square L161 Level 58:60.

Figure 7: proximal side of the large femur exposed at L161.

Figure 8: Femur of square L161 during excavation. At the distal edge a tooth, flat bone and a flint flake are visible.

Figure 9: The flint on the femur at square L161. Note the notch on the flint resulting from the contact with the bone.

Figure 10: Bone at Square M161b. Location of two flints and a close-up.

Figure 11: Bone from square M161b after cleaning at the lab.

Figure 12: additional vertebra below the distal part of the femur.

Figure 13 The lower most vertebra and the remains of the femur. Note the long spine of the vertebra and its deformation due to the contact between the femur and the basalt pebbles.

Excavation at the neighboring square of M161 show similar, yet les dramatic situation with large bones of bovid, such as a jaw and teeth at level 58:70 (Fig. 15-16), flints and smaller

bones “floating” in the mud below it and some large bones on top of the basalt cobbles of Layer 5 (Figs. 14).

Figure 14: final excavation stage at M161 sub squares b & d. arrow indicate contact between clean mud and Layer 4 sandy sediments as discussed above.

Figure 15: Bovid mandible at square M161 Level 58:70.

Figure 16: Bovid mandible (Sq. M161) before and after cleaning at the lab.

Figure 17: bones exposed on basalt cobbles of layer 5 at M161c final excavation stage.

The emerging picture is of an area rich with both stone tools and large bovid bones in strong association with flint flakes and additional smaller bones (Fig. 17). It can be suggested that many of the bones belong to a single animal (bovid) and are the result of a butchering episode in which the large bones as well as the vertebras were thrown to the mud. The excellent preservation of the bones, the fact that they are complete, and the suggested post-depositional damage observed on them suggest a very fast covering by the mud of layer 4. Of course, much more research is needed before additional conclusions can be drawn.

South squares

Excavation at the south of Area D aimed to explore the "top" of the basalt hill of Layer 5 (see previous reports). During the previous season we observed a different nature of accumulation for this area and, in addition, evidences for a higher occupation horizon, "floating" in the mud above layer 4 archaeological horizon was noted. Clarifying these questions was the aim of excavation in these squares (Fig. 18). The results indicate the following: A layer of basalt cobbles and stone tools could be observed in the mud in these squares. This layer, at elevation of ca. 60:10 cm above sea level also included bones in bad preservation state, including the bone of a rhinoceros (Figs. 19-20). The bad preservation state, in comparison to the excellent preservation of the bones in the lower parts of Area D (north squares) can be explained by either post depositional conditions such as drying of the sediments in the past, or by the bones being exposed on the surface for a long period of time before coverage by mud. At any case, this is a layer, not very dance with finds, which could represent an additional occupation of the site prior to the event represented in Layer 4.

At these squares at the south-east section of the site, primary in squares N153 and M153 (Fig. 21) at somewhat lower level from the bones (ca. 60:00), many seeds of holy thistle were exposed, clearly the

remnants of ant nests (Fig. 22). The questions are these ancient or modern nests cannot be answered at the current stage and research is ongoing.

Figure 18: South squares of Area D 2012.

Figure 19: Distal humerus of a rhinoceros. Note the bad preservation state of the bone

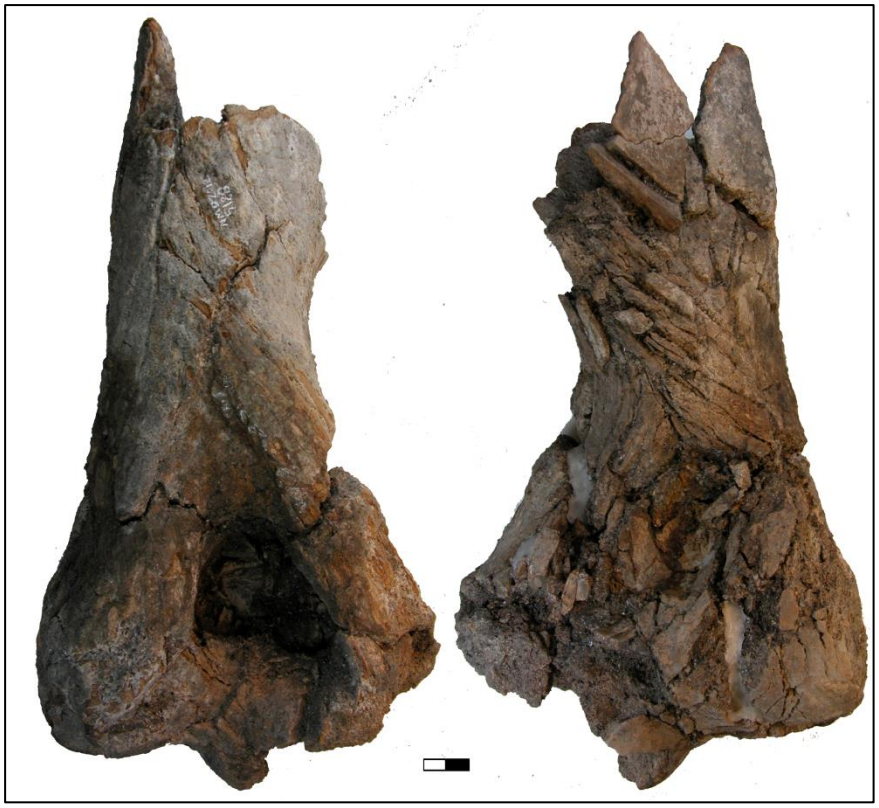

Figure 20: Distal humerus of a rhinoceros after cleaning at the lab.

Figure 21: Squares at south of Area D. Line indicate the layer floating in the mud. Please note basalt cobbles indicating the layer.

Figure 22: thistle seeds in ant nets in square N153

The layer immediately above the basalt of layer 5 at the top of the basalt hill (Fig. 18) is rich in bones and flints. Both find categories are less well preserved than the finds in the lower part of Area D (North squares). The flint tools seem to be somewhat less fresh and the bones are more broken and fragile. The layer includes many flints, some in groups, large bones (Figs. 23-24) and occasionally small wood fragments (Fig. 25).

Figure 23: Scapula in square L153

Figure 24: flint flakes and bone fragments exposed in excavation. Note the numerous small basalt pebbles in the layer.

Figure 25: wood branch and flint flakes excavated in square M153

The basalt of layer 5 exposed in the south west squares of K152 and K151 show different nature with many small cobbles covering the large cobbles and boulders typical of the basalt

in the north and east squares of Area D (Figs. 26-30). This is early observation only and further study is needed.

Figure 26: End of excavation at squares L154-5. Basalt cobbles of Layer 5

Figure 27: End of excavation at square K151. Note the small size of the pebbles in comparison to larger cobbles and boulders at north squares.

Figure 28: Stratigraphy at Square K151 at the end of excavation from top: 1. Modern soil; 2. Paleo-channel of paleo Jordan River; 3. Black mud of layer 3; 4. Archaeological Layer 4; 5. Basalt layer 5.

Figure 29: the basalt of Layer 5 in squares K152-1 at the end of excavation.

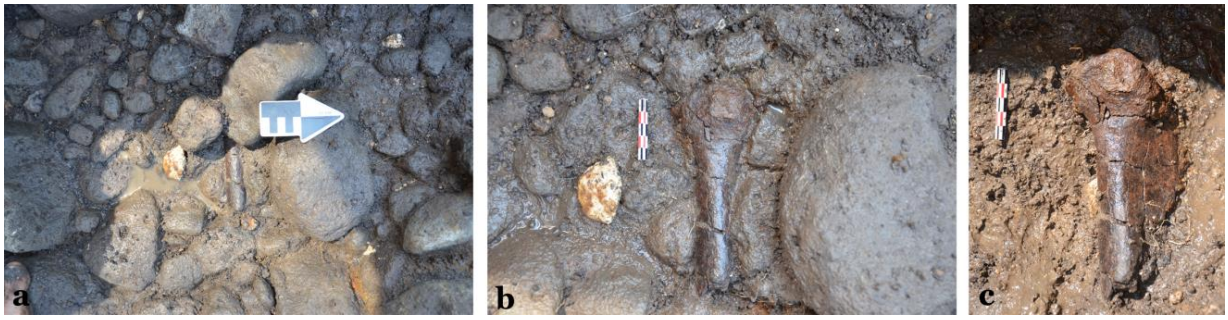

Figure 30: Large bone and limestone at the end of excavation of Square K152. Note the bone covered with the basalts of layer 5.

Appendixes

Recent Papers and Reports

1. Kalbe Johannes. Preliminary report on the Mollusks from three localities at NMO and their environmental implications.
2. Gonen Sharon & Maya Oron. The Lithic Tool Arsenal of a Mousterian Hunter
3. Johannes Kalbe, Gonen Sharon, Naomi Porat, Chengjun Zhang & Steffen Mischke. Geological Setting and age of the Middle Paleolithic Site of NMO (Upper Jordan Valley, Israel
4. איריס אשד .שחזור חברת הצומח בפלייסטוקן העליון בעמק החולה על פי ממצא הזרעים והפירות בשטח E באתר המוסטרי בשפך נחל מחניים לירדן (MNO)

Preliminary report on the Mollusks from three localities at NMO and their environmental implications

By Johannes Kalbe

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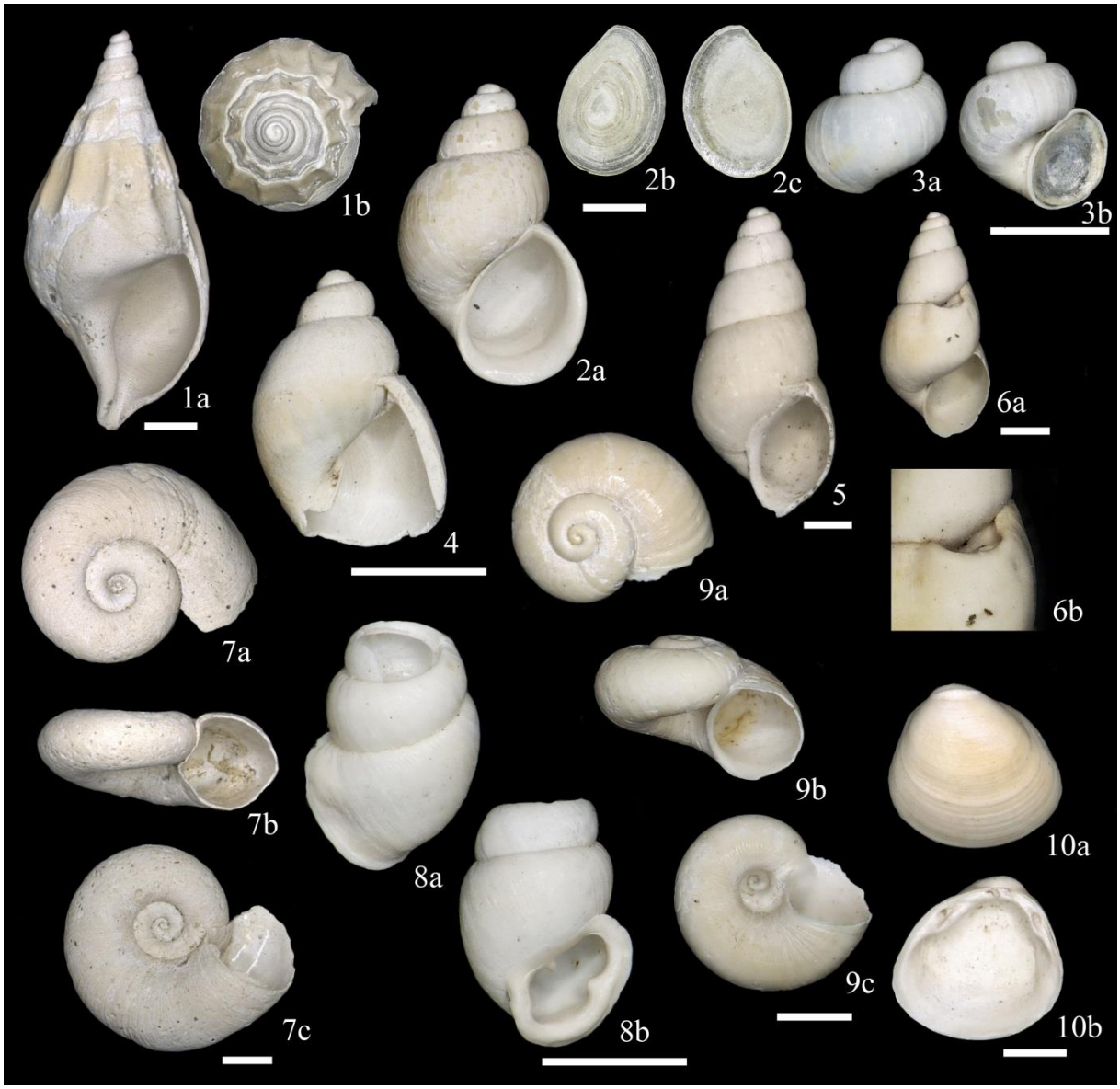


Table 1: 1a-b *Melanopsis praemorsum* (Linné, 1758), 2a *Pseudobythinia* (?) sp., 2b-c operculi of Bithyniidae , 3a/b juvenile *Bithynia* sp. with operculum, 4 *Lymnaea cf. palustris* (Müller, 1774), 5 *Bythinella* (?) sp. , 6a *Bythinella* (?) sp. with pathology, 6b same individuum with close up of pathology , 7a-c *Gyraulus piscinarium* Bourguignat, 1852, 8a-b *Carychium minimum* O.F. Müller, 1774, 9a-c *Valvata saulcyi* Bourguignat, 1853, 10a-b *Pisidium moitessierianum* Paladilhe, 1866; scale bar: 1 mm.

The mollusc assemblage of Area E of NMO excavation shows a typical freshwater fauna. There are quite a lot of *Pisidium moitessierianum* Paladilhe, 1866 in the assemblage, which occurs today from 0.5–20 m depth in the littoral zone of lakes and in wide slow rivers (Zettler and Kuiper. 2002). *Carychium minimum* O.F. Müller, 1774 found with some individuals in the assemblage is a terrestrial gastropod with an amphibious ecology, inhabiting permanent wetland environments such as riparian zones, meadows and swamps (Watson and Verdcourt 1953; Morton 1955; Egorov 2007). *Melanopsis praemorsum* (Linné, 1758) with a costated shell is also present in Area E and is found today mainly in open lakes (Tchernov 1973). Some of the specimen from this assemblage could maybe also be dedicated to *Melanopsis* "saulcyi" (compare Milstein et al. 2012). The determination of species of Bithyniidae and Planorbidae is not complete and needs specialists for the different groups.

The mollusc assemblage of the site represents a freshwater environment. Some elements of the fauna are indicating flowing water. Terrestrial gastropods suggest permanent wetland areas in the periphery of this water body.

West-bank Coquina

At the west bank of the Jordan River, some 20 meters south of the Mahanayeem inlet into the Jordan River a layer of Qoquina was exposed and sampled during the 2011 season. The gastropods in the sample are shown in Fig. XX

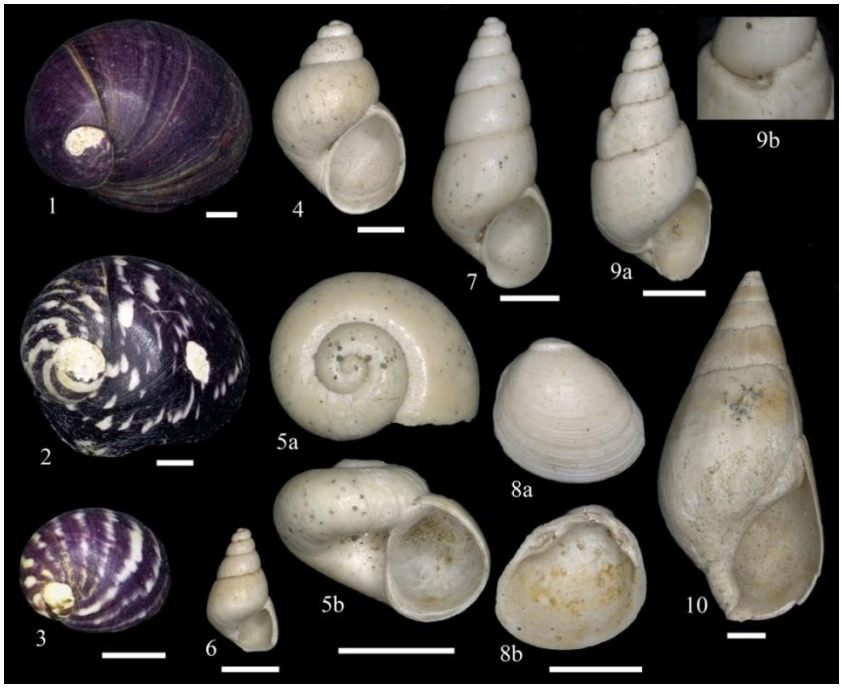
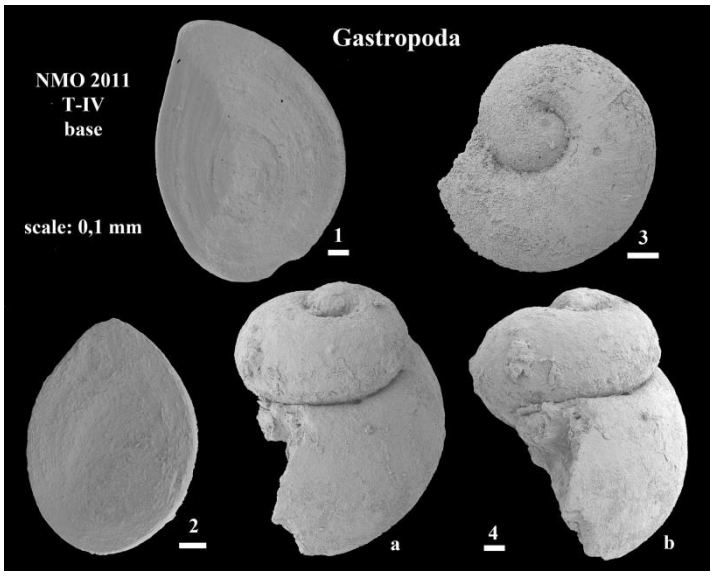


Table 2: 1 *Theodoxus michonii* , 2 *Theodoxus* sp., 3 *Theodoxus* sp. , 4 *Bulimus* sp. , 5a-b *Valvata saulcyi* Bourguignat, 1853, 6 *Bythinella* (?) sp., 7 *Bythinella* (?) sp., 8a-b *Pisidium moitessierianum* Paladilhe, 1866, 9a *Bythinella* (?) sp. with pathology, 9b close up of the same individuum with the pathology , 10 *Melanopsis* cf. *eremita*; scale bar: 1mm

Gastropods from Limmenic sediment at the south section of study area (from geological Trench IV)



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Watson, H. and B.J. Verdcourt. 1953. The two British species of Carychium. Journal of Conchology 23: 306-324.

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The Lithic Tool Arsenal of a Mousterian Hunter

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Abstract

The lithic assemblage excavated from the Mousterian site of Nahal Mahanayeem Outlet (NMO) enables us to reconstruct a brief moment in the life of the Middle Palaeolithic hunter. The site, located on the eastern bank of the Jordan River at its outflow south from the Hula Valley, is a short-term, task specific hunting camp at the shore of the Paleo-Hula Lake. Dated by OSL method to ca. 65000 years ago, the site has yielded a small assemblage of flint artifacts alongside exceptionally well-preserved animal bones and botanical remains. While counting only some 1000 artifacts so far, the lithic assemblage has the highest percentage of tools ever recorded in a Levantine Mousterian site. The primary lithic groups represented are pointed elements (over 10% of the entire assemblage) and cutting tools (over 5%). Other tool types typical of Mousterian sites, such as scrapers, are either absent or represented in very small numbers. The uniqueness of the assemblage is further highlighted by refitted sequences that, when combined with technological observations, suggest a non-Levallois, "blade-core like" reduction sequence. In our view, the NMO assemblage represents the tool kit used for the hunting and butchering of large mammals by a group of Levantine Mousterian hunters. It enables us to explore what tool types were selected for hunting and carcass processing, which tools were brought to the site and which were produced on site, what tools were left behind and much more. The site was inhabited for a very short period (possibly measured in days), providing an opportunity to study hunting practices and human life ways in a resolution rarely possible for Late Pleistocene sites.

Key words

Mousterian, Levant, Lithic technology, Levallois, Jordan River Rift Valley, Hunting Behavior, Refitting

Introduction

Most of our knowledge of the life ways and behavior of prehistoric people comes from large cave sites with long sequences of sedimentary accumulation and a wealth of finds, primarily of stone tools and bones. This holds true for the earliest, Oldowan archaeological sites (Leakey 1971) and, even more so, for the Middle Palaeolithic era in the Levant. Here, almost all that we know originated from the excavation of long sequences of the famous cave sites (e.g. Tabun Cave – Garrod & Bate 1937; Amud Cave - Suzuki & Takai 1970; Abu Zif & Kebara Caves - Neuville 1951; Kebara Cave - Bar-Yosef et al. 2007 & Bar-Yosef et al. 1992; Hayonim Cave - Stiner 2005 & Meignen 2008; Qafzeh Cave – Hovers 2009 and many others). The layers of the cave sites are, in many cases, littered with hundreds of thousands of stone tools and animal bones. Due to time averaging, the cave archaeological horizons represent hard-to-estimate time spans, in which every cubic centimeter may represent a long occupation and an unknown number of different activities. While producing the most significant information on a large scale, the Levantine cave sites are usually not the best localities for high resolution data from which everyday activity patterns can be discerned. This type of data generally originates from open-air, short occupation sites. Recently, Moncel & Rivals (2011) summarized the available data and emerging models describing site and mobility patterns for European Neanderthals. Apparently, even open-air hunting and butchering sites (or layers within sites) are not easy to distinguish within longer duration, multi-activity sites (but see papers in Carbonell, 2012 #3341). Accordingly, many of the models suggested to describe site pattern and mobility activity, such as the foraging and logistical models of Binford (1980), are of a theoretical nature, based upon ethnographic observation or non-empiric consideration rather than upon archaeological data (Binford 1980; Kuhn 1995; Kuhn 1992; and ref. in Moncel & Rivals 2011). When studying the assemblages from the few Levantine open-air sites excavated to date, a complex picture emerges (Hovers 2009). The site of Quneitra, for example (Goren-Inbar 1990; Oron & Goren-Inbar this issue), seems to represent a more intense occupation judging from its large number of stone tools and bones, and its lithic typological composition may suggest different activities. It is clear that at Quneitra, stone tool knapping was a significant activity. While it may be possible to assign all of these activities to the processing of animal carcasses, the presence of many scrapers in the assemblage may indicate that more than just "slicing the meat" activity took place at the site (see Moncel et al. 2009).

The lithic assemblage from the Mousterian site of Nahal Mahanayeem Outlet (NMO) is different. It is relatively small, comprising less than one thousand artifacts. It is unique in its composition with dominancy of pointed elements and cutting tools. In this paper, we present an analysis of the lithic assemblage unearthed during the first five excavation seasons at NMO. We use the unique nature of this assemblage to define and describe the "tool kit" of the group of Mousterian hunters who inhabited the site. The excavation's high resolution made possible by the short-term and task specific nature of the archaeological horizons at NMO, combined with a significant number of refitted knapping sequences, enables us to discuss questions of raw material acquisition strategies, tool mobility and selection, discard patterns and tool use and lithic technology, which rarely can be asked in larger, richer Middle Palaeolithic sites.

The site of NMO

The Mousterian site of Nahal Mahanayeem Outlet at the bank of the Jordan River was discovered during a drainage operation in 1999 (Sharon et al. 2010; Sharon et al. 2002a; Sharon et al. 2002b). The site is located on the east bank of the Jordan River, opposite the outlet of the now artificial channel of the Mahanayeem Stream into the Jordan north of the Benot Ya'aqov Bridge (Fig. 1). The piles of sediments dug by heavy machinery from the channel of the river were found to be littered with flint tools and animal bones in excellent preservation condition, indicating the presence of archaeological horizons worthy of excavation. A team from Tel Hai College and the Hebrew University of Jerusalem began excavating the site in 2007. Preliminary results of the first two excavation seasons have been discussed elsewhere (Sharon et al. 2010). The site is OSL dated to c. 65000 years before present (BP; Kalb et al, this issue). In this paper we focus on the unique flint assemblage excavated at NMO with the goal of describing its special nature and implications for the understanding of Middle Paleolithic (MP) lithic technology and human behavior.

The stratigraphy

The site of NMO is located on the primary geological fault forming the northern section of the Dead Sea Rift, an area subject to constant tectonic activity as well as intensive volcanism (Belitzky 2002; Spiro et al. 2011). The resulting geology is highly complex on a regional scale. However, the local stratigraphy recorded at the site, based on excavation areas as well as on geological trenches and riverbank sections, was observed to be quite straightforward (Fig. 2). At the base of the archaeological stratigraphic sequence lies a layer of basalt boulders and cobbles recorded as Layer 5. The morphology of this conglomerate is of a hill sloping gently towards the north and tilted to the east (Fig. 3). To the west the basalt forms a steep, low cliff to which the artifacts and bones of the archaeological layer are directly attached, indicating the formation of this morphology prior to human presence at the site (Fig. 3). This morphology probably resembles a bar or cutting of mini-streams into the basaltic boulder fans of the nearby Golan Heights stream outlets into the Rift Valley. Despite our current knowledge, we are still far from fully understanding the processes that formed this basalt accumulation (for further discussion and details see Kalbe et al., this issue). The reconstruction of the excavated surface suggests that the NMO inhabitants found this "basalt hill" as part of the landscape at the time of occupation.

The primary archaeological bearing layer (Layer 4; Fig. 2) is a fine silt, dark mud layer with the artifacts and bones found lying immediately on top of the basalt floor as well as in the mud above it. The thickness of the artifact and bone bearing layer reaches up to 40 cm (Fig. 4). An additional archaeological horizon was observed in the mud above Layer 4. This horizon includes a few basalt cobbles, bones of a cow in poor preservation state (when compared to the preservation of the bones in Layer 4) and a few flint artifacts. It can be suggested, therefore, that this horizon represents an additional, short occupation event that should be attached to the basalt hill of Layer 5. Additional excavation is needed before certainty can be reached in regard to this horizon (Fig. 4). On top of archaeological Layer 4 is a sequence of silty mud and clays that accumulated during the Late Pleistocene. This sequence comprises later archaeological entities such as the Upper Palaeolithic assemblage excavated from Area A at the site (Sharon et al. 2010) and, higher up in the sequence, even Byzantine coins and lead fishing net weights. As stated above, the geological and geomorphological history of this sequence is complicated and will not be discussed in detail here (see Kalbe et al., this issue). It should be sufficient to note that the

archaeological Layer 4 was sealed by this mud and was probably never subject to significant post-depositional movement.

The NMO stratigraphy and nature of archaeological accumulation indicate a short-term occupation of Layer 4. The data and observations supporting this conclusion (some of which will be presented in detail below) include the small number of flint artifacts, the techno-typological nature of the assemblage, the fair number of refitted artifacts and their location, and the excellent preservation of flints, bones and botanical remains indicating very fast coverage of the layer with waterlogged mud. Analysis of the stone tools of the site, the best indicator for human behavior, provides a unique opportunity to study a site that was probably occupied for a very short time and, judging from the assemblage, was task specific.

Context of artifacts

Excavation of the NMO Mousterian layers was focused on Area C and D (Fig. 2). Other excavation areas, river bank sections and geological test trenches also yielded artifacts but some of these originated in different layers or are of stratigraphically uncertain context. The NMO database, after 5 excavation seasons from 2007 to 2011, currently holds 1342 flakes and 47 cores and core tools (Table 1). Out of these, the group of 201 artifacts excavated from Area A (Fig. 2 and Table 1) probably belong to the Upper Palaeolithic horizon of the site (Sharon et al 2010). An additional group of artifacts comprising flint implements excavated from Area E are clearly Mousterian, yet the artifacts originated in an occurrence that appears to be very different from the primary Area D Layer 4 assemblage, and will be described elsewhere. Hence, out of the 1342 artifacts recorded, only 670 flakes and 24 cores and non-flake artifacts comprise the integral part of the NMO Layer 4 assemblage. These include the flint artifacts excavated *in situ* from Areas C and D, which together form the primary excavation area at the site. The small number of flakes from Area B (Fig. 2 and see Sharon et al. 2010) is also counted within this assemblage, as the flakes are now known to have originated from the margin of the same archaeological Layer 4. Additional artifacts originated from the 3 sections of the Jordan River exposed and studied during the 2007 season with the goal of clarifying the site's stratigraphy. These sections are now known as Area D (Sharon et al, 2010). Finally, artifacts from Area F and Trench IV are also included in the primary assemblage now that Layer 4 has been verified as their stratigraphic context (Fig. 2).

While we are satisfied with the context of the artifacts excavated *in situ* from the excavation areas, the flint artifact assemblage from NMO comprises additional artifacts whose stratigraphic context is less clear. The vicinity of the NMO site has been heavily disturbed by over one hundred and fifty years of drainage operations. It is also clear from the excavation that after the accumulation of the site, channels of ancient streams cut into its layers causing disturbance to the upper parts of the sequence (Fig. 2). While these ancient disturbances are, in most cases, easily defined and recognizable due to the very different nature of their sediments, special care has been taken to ensure that artifacts taken from disturbed contexts are not mixed with those whose archaeological integrity is verifiable. Therefore, when analyzing the flint artifacts from NMO we applied four "context integrity" categories to their classification: 1. *in situ* – finds excavated from the archaeological layer; 2. *integrity in question* – finds that probably originated in a verifiable archaeological context, however, their integrity cannot be determined with certainty; 3. *mixed context* – finds that can be attributed to an archaeological layer, e.g. artifacts dug out by tractor shovel from a known locality; and 4. *surface* – finds from disturbed contexts.

The classification of the artifacts into these categories is noted when relevant. When the lithics are sorted according to their origin in excavation areas (Table 1), the small assemblage size is even more notable, as many of the artifacts originated from either non *in situ* or non-Mousterian contexts.

Excavation and lithic analysis methodology

The excavation is recorded using a 1 m^2 grid system. During excavation, all artifacts (as well as bones, wood and other finds) are recorded using a Leica total station device, resulting in highly accurate location data. This data is then processed using the ArcMap GIS program of ESRI (see: http://www.esri.com/software). All sediments are wet sieved (2mm mash) and sorted in the lab, and the sorted artifacts are analyzed together with the excavated assemblage. The analysis of the artifacts is based upon the methodology developed for the site of Quneitra (Goren-Inbar 1990) and subsequently modified for other sites (Hovers 1998; Hovers 2009). The method is a combination of morphological, technological and typological observations recorded for each of the artifacts. Specific modifications to the method were made to best describe the NMO assemblages and are presented below in the data section.

The NMO lithic assemblage

According to the "context integrity" categories presented above, the observations presented in this section are derived only from artifacts excavated in the main excavation Areas D and C (Table 1). These artifacts are from a verifiable archaeological context, classified as either category 1 (*in situ*) or category 2 (context in question). This reduces the number of artifacts under study here to only 694 (670 flakes and 24 cores and non-flakes). Nevertheless, it should be remembered that this small number of artifacts represents the entire excavated assemblage of Layer 4 in the site. The advantage of the small number is that we can obtain a full and comprehensive picture of the tool kit used by the site's inhabitants in a resolution very hard to achieve for other, flint rich assemblages (see discussion below).

Artifact density

The primary excavation areas at NMO are Areas C and D (Fig. 2). The total excavated surface within these areas is 54 m^2. Thus, the average density of the lithic artifacts for Areas C and D is approximately 11 artifacts per m^2 (with a range of 1 to 66 lithic items per m^2). This density is very low in comparison to other MP sites in the Levant. This is particularly true for the large cave sites in which density can reach tens of thousands of artifacts per square meter (*e.g.* Hovers 2009; Yeshurun et al. 2007; Bar-Yosef et al. 2007). Note that in some of the caves, such as Hayonim Cave, density is much lower (Meignen 2011). Nevertheless, the NMO artifact density also is low when compared to other MP open-air sites of the Levant. For example, in Quneitra the average density is 83 (Area A) and 100 (Area B) lithic finds per m^2 (Oron and Goren-Inbar, this issue).

Calculating artifact density for the entire excavation area is, of course, somewhat misleading. The artifacts are not evenly scattered on the excavated surface. The spatial distribution of the artifacts in Area D is presented in Figure 5. Clear concentrations of artifacts can be observed in Area D. Detailed discussion of the spatial distribution of the lithic artifacts and their correlation

with other types of evidence such as faunal and botanic finds will be presented elsewhere. For the purpose of the current discussion, it is suggested that these high density areas are the result of human agency and may reflect activity zones (Alperson-Afil & Hovers 2005; Alperson-Afil et al. 2009). The concentration of artifacts indicates that some sections of the site are more densely occupied with stone tools. This evidence is presented here as support for the anthropological nature of the accumulation.

Preservation state

The flint artifacts from Area D at NMO are exceptionally well-preserved. As many as 83.4% of the flakes were recorded as "fresh", meaning here "as fresh as flint tools can get". In no other sites have we seen flakes in better preservation state (Table 2). An additional 10.2% of the flakes were recorded as "slightly abraded", together yielding 93.6% of the flakes in good preservation condition.

Artifact typology – the Bordesian typological system:

Table 3 presents the frequencies of typological types within the assemblage according to the "traditional" Bordesian typological system (Bordes 1961), which has been modified for Levantine MP assemblages (Goren-Inbar 1990; Hovers 1998; Hovers 2009). The following primary observations can be drawn from Table 3:

a. **Exceptionally high percentage of tools**: The percentage of tools at NMO is 34.3% of the assemblage. This percentage seems to be the highest for any excavated Mousterian assemblage recorded to date in the Levant. Typically, the percentage of tools within a Levantine Mousterian cave site assemblage will range around 5%. At open-air sites the percentage of tools is usually higher than for caves. Yet, even for an open-air assemblage the NMO tool frequency is high (Goren-Inbar 1990: Table 32; Hovers 2009: Table 8.4).
b. **Typological composition**: The assemblage is also unique for the tool types that are under-represented. Scrapers of all types form only 2.1% of the flake and flake tool assemblage. Other tool types such as end scrapers, burins and borers (Upper Paleolithic types) form less than 1% when grouped together. Even notches and denticulates, normally a substantial percentage of Mousterian assemblages, appear in very low frequencies at NMO (Hovers 2009).
c. **Levallois knapping method**: Technologically, the use of the Levallois knapping method is low, although it is clearly present. The Levallois index is only 0.04 (Hovers 2009: Table 8.3). Two of the cores were defined as Levallois cores for flakes, yet they are small and atypical. Only 32 flint artifacts, measuring 4.3% of the flakes in the assemblage, show definitive evidence of Levallois technology origin. An additional 76 artifacts (10% of the flakes) were classified as "Maybe Levallois", meaning that they show some attributes of Levallois technology but cannot be classified as such with full certainty.
d. **Low frequency of knapping waste**: The waste includes cores, core waste and core trimming elements. Some of the flakes excavated at NMO are on-site knapping waste, as evident from the results of the refitting presented below. Yet, stone tool knapping could not have been a significant activity at NMO, and the knapping method used on site shows minimal core preparation, resulting in a minimal amount of core waste.

The picture emerging from the typological composition of the site is of a small assemblage, with a very high percentage of tools and low percentage of knapping waste. The tools in the assemblage are somewhat different from other sites, as scrapers and notches are represented in small numbers at NMO, while knives and points are more frequent. As in many cases, the largest category of tools is "retouched flakes", comprising 15.4 % of the entire flake assemblage.

The NMO assemblage has additional technological and typological aspects that the Bordesian typology, developed primarily to describe European sites, seems not to fully cover. The additional, detailed information that follows is intended to provide a clearer description of the assemblage and its unique character.

Technological and Morphological Characteristics of the NMO Assemblage

During the analysis of the NMO flint assemblage, two elements emerged as characteristic of the assemblage: pointed elements and cutting elements. These two elements do not fit easily into the Bordesian typological system which, while open to interpretation, is very rigid in its definitions. For example, the title "point" includes Levallois points and Mousterian points with just a few additional types such as pseudo-Levallois and tanged points. The result is that many artifacts, pointed in morphology and very similar in shape to "real" points are classified as either waste flakes or blades in this system or, at best, as "retouched flakes" since they fail to possess all necessary attributes (Fig. 6). A similar difficulty led Moncel et al. (2009) to suggest a new classification for the assemblage of the MP site of Payre in France using three categories, based upon use marks: tools used to cut, to pierce and to scrape. Such classification enables a fuller description of the assemblage and accounts for technological and morphological aspects beyond typology.

During the analysis of the NMO lithic assemblage, the distinction of "pointed" and "cutting" elements arose from the repeated morphology of artifacts observed during analysis. We describe below the characteristic morphology and technology that define these groups in an attempt to present a repeatable procedure that can be applied to other MP assemblages.

Pointed elements

The pointed elements group is comprised of flakes and blades having pointed morphology ending in a pointed tip. The elements were grouped based on their morphology and on the technological attributes defined below. A total of 75 pointed elements were identified in the NMO Area D assemblage. They comprise 11.2% of the entire assemblage (Table 4). Two technological approaches can be observed in the pointed elements, Levallois and non-Levallois, as described below:

Points created using Levallois technological concept (Boëda 1995): These include primary Levallois points as well as a few additional point types such as Mousterian points and pseudo-Levallios points (in very small numbers; n=3). The NMO points are similar to Levallois points recorded in many other Levantine MP sites. It should be noted, however, that the typical "Tabun B" broad base short points (Hovers 2009; Copeland 1975) are practically absent from NMO. The NMO Levallois pointed elements show carefully prepared faceted striking platforms and comprise 2.4 % (n=19) of the flake assemblage (Fig. 7: a, e & f). Levallois produced elements make up, therefore, up to 25% of the pointed elements. For comparison, see Table 8.3 (Hovers 2009) showing the very low percentage of Levallois points in other MP sites of the Levant.

Points created using non-Levallois knapping method: In addition to the Levallois points, a distinctive group of pointed elements exists at NMO that could not be assigned to the Levallois knapping method (Boëda 1995). These artifacts show the following typical morphological features (Figs. 6-8):

1. They are pointed, showing a basic triangular blank morphology, the distal edge being the narrowest part.
2. Many of them are of elongated, with blade proportions (Fig. 9). No difference was observed in metric proportions between Levallois and non-Levallois pointed elements.
3. The striking platforms are, in most cases, either plain or dihedral and are typically thick (best examples are Figs. 6 h & I). It is clear that, for non-Levallois pointed elements, plain and dihedral striking platforms are dominant. This observation is somewhat circular as one of the definitions of a Levallois element is a facetted striking platform; yet, it is evident that most of the pointed elements in the NMO assemblage originated from non-Levallois cores.
4. On many of the striking platforms, evidence of platform preparation appears that is typically attributed to the production of blades (Fig. 10). These "blade core" preparation morphologies include the presence of many small scars on the proximal distal edge of the tool (angle de chasse – Inisan et al 1999), sometimes evidence of "step scar" morphology resulting from the creation of many small scars in the same place; hinged ending scars, also typical of blade production; and, lastly, clear evidence of abrasion of the striking platform prior to removal of the flake (Fig.10).
5. The scar pattern on the dorsal face of these pointed elements is not convergent as on the typical Levallois points. It is a unidirectional/unipolar non-convergent sub-parallel pattern. In other words, the blanks were produced from a single platform core, designed to produce primary elongated elements based on a parallel or sub-parallel scar pattern (see discussion below).

The morphology of these pointed elements is dictated by their place within the removal sequence of the core (Fig. 11). Some of them follow a single ridge guiding arris, (terminology from Inisan et al. 1999) separating two previous scars. Others follow two such ridges (Arris). The single arris points are elongated, narrow and, in many cases, very fine and esthetic (Fig. 6). The two arris points are wider and, in some cases, end in a tip that is not strictly pointed or with the pointed tip diverging from the middle axis of the point (Fig. 8).

It seems that in addition, a group of pointed blades can be distinguished from among the NMO pointed elements. This is a group of very well-made, long and pointed blades, most of them resulting from single arris removals. They are very similar in proportion to each other and, in most cases, were found unbroken and in mint condition (see Fig. 6 h & i for best examples). This group is too small in number from which to draw further conclusions; nonetheless, it may be suggested that the particular shape and proportion of the points led to their selection by the NMO inhabitants to bring to the site (or to leave behind).

Another important feature of the NMO pointed elements is that they are infrequently retouched. At Quneitra, for example, many pointed elements were retouched and hence classified as convergent or dejete scrapers (Goren-Inbar 1990). Such tools are practically absent from NMO.

We have no way of knowing the percentage of pointed, un-retouched elements in other assemblages, as they will all be classified as either flake or blade waste. One of the goals of this paper is to draw the attention of researchers analyzing Mousterian assemblages to this group of artifacts, as it appears that they were selected specifically by the NMO inhabitants.

Additional support for the classification of these artifacts as points comes from their high frequency of broken tips. Table 5 shows the frequency of breakage patterns for the NMO pointed elements. While 28 (32.2%) of the pointed elements were found complete, as many as 20 (23%) are distally broken and an additional 26 (29.9%) show distal damage, indicating minimal tip shatter. The presence of impact fracture was identified for the NMO points (Yaroshevich et al. 2010; Yaroshevich, A., personal communication) but quantified conclusions await further analysis.

The pointed elements at NMO are numerous. They form more than 10% of the entire assemblage. It is difficult to compare this data to other sites since the same elements in other sites are usually classified as waste and not counted separately. The number of points in most published assemblages rarely reaches over 5% of the tools. At NMO they are probably the most significant aspect of the assemblage. While pointed elements at NMO were produced by applying different reduction sequences, it seems that both the morphology and the size of these pointed elements are very similar. The NMO hunters selected their target tools from a variety of possible blanks and brought to the site (or, more precisely – left behind) a quite homogenous group of tools (Fig. 9). In addition, observations enable us to claim with a high degree of certainty that the high quality pointed elements found were imported into the site and not produced on site.

Cutting and slicing implements

In addition to the pointed elements, a second group of implements was observed at NMO, defined as flakes and blades with a long, uninterrupted, frequently straight, sharp and un-retouched edge (Figs. 12 & 13). Some of these implements are classified as knives according to typological criteria (naturally backed knives and atypical backed knives; see below) while others are grouped here due to the presence of an edge following the criteria described above (Table 6). It is suggested that these implements could all have been used as knives for slicing meat during carcass processing at the site. This functional argument is the basis for grouping them together. The group of cutting and slicing elements at NMO includes:

Naturally backed knives (NBK; Bordes 1961; n=34 – 53% of the cutting tools). These are frequently elongated, narrow blades and flakes that have one lateral edge covered with cortex while the other side is a sharp, untouched edge. Few of the naturally backed knives at NMO would be considered primary blades in the terminology of Shimelmitz et al. (2011) due to the angle between the back and the ventral face that is smaller than the maximum limit of 60 degrees (Fig. 12: a, b, c, f, g).

Atypical backed knives – (ABK; Bordes 1961; n=6 – 11% of the cutting tools). These are blades and flakes that have an abrupt back at one lateral edge that is not shaped by retouch. This

attribute is the reason for their classification as atypical (Fig. 13). No typical knives (back shaped by retouch) were found at NMO.

Blades and flakes with a long, *un-retouched cutting edge* (n=23 – 36% of the cutting tools). This is a group of artifacts classified as cutting tools due to the presence of a sharp, un-retouched edge, longer than 5 cm. Since this is not a typological category, some of these cutting tools actually belong to other tool types according to their retouch (e.g. notches, end-scrapers or retouched flakes) but these retouches do not appear on the cutting edge.

The mean length of the cutting edge of all three categories is 89 mm, with the third group (blades and flakes) showing the highest values with a mean edge length of 107 mm. This is due in part to the fact that some of them have no back and the cutting edge is spread along both lateral edges. A way to illustrate the length of this edge is by testing the ratio of edge to artifact circumference. When calculating this ratio for the entire group of cutting tools the mean is 46.5% length to circumference. When calculating separately for each sub-group, the ratio for the naturally backed knives and atypical backed knives is 40% and 41% respectively, while the value for the blades and flakes is 57%. Again, the reason for this difference is the presence or absence of a backed lateral edge.

Altogether, 64 flakes and blades are classified as cutting tools due to the presence of a long cutting edge (>5 cm). These make up 9.6% of the entire assemblage (Table 6). It is interesting to note that, as in the case of the pointed elements, these artifacts are not retouched. In addition, of particular interest is the scarcity of scrapers, end scrapers and other tools from the assemblage. Of course, at all MP sites one finds a group of artifacts, flakes and blades that possesses a long, sharp edge, suitable for meat processing. The NMO assemblage is unique due to the rarity of other types such as scrapers and the very high percentage of implements suitable for cutting. This observation is emphasized further by the fact that the great majority of the artifacts at the site were not produced in it (see discussion in section on refitted artifacts below). The artifacts that were produced on site (evident from refitting) are also elongated flakes or blades with cutting tool proportions. It is evident that the inhabitants of NMO chose this type of morphology for the tools they imported into the site since many other shapes and types are not represented. Analysis of the NMO lithic assemblage demonstrates that the group of artifacts with a long cutting edge is very prominent. Use wear studies will undoubtedly contribute to the refinement of this observation. Nonetheless, it is clear that the NMO hunters selected elongated, sharp flakes and blades as part of their tool arsenal for the task executed at the site.

Flint Refitting and Technological Implications

The refitting effort at NMO is still in its early stages but already has proven to be very rewarding. To date, as many as 30 artifacts were joined together into eight reduction sequences. This is a reasonably high rate for a site at which most of the artifacts were imported as tools and where some of the flint was subject to the heavy patination typical of waterlogged environments of the Jordan River bank sites (Sharon & Goren-Inbar 1999). The 8 sequences contain 2 to 10 refitted flakes. Some of the sequences consist of flakes joined together while others consist of cores to which flakes could be reattached. One of these sequences is made up of a large, irregular core to which 3 flakes could be refitted. The longest and most significant sequence comprises a combination of 10 flakes and blades representing a number of stages of a single reduction sequence, from which a great deal of technological information can be extracted (Fig. 14). The

refitting effort for the NMO lithic assemblage is ongoing and will be described in detail in the future. Here we focus on the technological information retrieved from the long sequence (Sequence 1) and its application to understanding the lithic technology and economy of the Mousterian hunters at the site.

The long sequence (Sequence 1, Fig. 14) consists of 10 flakes and blades with the core missing. The blank for the core was a cortical nodule of medium quality flint (a knapper would say it is dry, grainy and not very homogenous flint) that is quite common to the site. The flint has different colors and patterns that helped in the refitting effort (Fig. 14).

Observed technology: the presence of cortical primary flakes indicates that the first step applied by the knapper was decortication of the nodule. This was done on site, suggesting that the nodule was brought un-prepared to the site and all reduction stages were conducted *in situ*. This observation is supported by the presence of an additional nodule with only two removals that was probably used to test its raw material quality. This additional nodule was found in square J159 in close proximity to a wild boar mandible. It seems that together with some knapped implements the NMO knappers brought a few un-touched or tested-only nodules into the site to serve as raw material for on-site tool production.

The knapping method applied as reconstructed from the refitted sequence indicates the sequential removal of elongated flakes, in some cases blades, from a single platform. The refitted flake striking platforms are, in most cases, thick and plain. No evidence exists for striking platform preparation by means of faceting that is typical of the Levallois method. Some evidence for abrasion of the platform prior to flake removal can be observed in the form of small scars, but the scars are not as prominent as those on some well-made pointed elements at the site (Fig. 10). The flakes and blades were removed sequentially following along the outer rim of a single platform in a practice typical of blade core method (Shimelmitz et al. 2011; Škrdla 2003).

The products of the reduction sequence are as follows:

- Two small pointed elements (Fig. 14) roughly shaped. They resulted from an early stage of the core reduction and may represent a natural morphology derived from the reduction technology where flakes follow the scars of the previous flakes. Yet, they fit well within the group of pointed elements presented above.
- Three cutting elements with a long cutting edge, one of which is an atypical backed knife.
- Two massive, elongated and thick denticulates.
- Two cortical fragments.
- Small waste flake.

It should be noted that other refitted sequences at NMO also include massive, elongated flakes shaped in the same non-meticulous manner. The efficiency of the sequence is demonstrated by the production of many usable artifacts. Almost all products of the core could be used, while applying minimal time and effort in core preparation and building. Sequence 1 is clearly not a Levallois sequence. It can be described as a blade core method, yet it is differs from the Amudian system by the thickness of the platforms and the resulting products (Shimelmitz et al. 2011). It also differs quite clearly from later, much more delicate and systematic Upper Palaeolithic Early Ahmarian methods (Davidzon & Goring-Morris 2003). It would be inappropriate to speculate or generalize

about the stone technology of the NMO inhabitants on the basis of a single core. Such speculation would be even more inappropriate given that the core is, in our interpretation, the result of ad hoc, on-site, rapid knapping whose goal was to produce cutting tools for meat processing. As such, the reduction sequence of this core cannot reflect the full sequence of careful manufacturing evident from some of the tools at the site. Rather, it is an example of a practice applied by the knappers on-site, most likely in response to the need for processing a great quantity of meat. For this objective, medium-sized nodules were brought into the site and worked *in situ* when other, much better prepared tools were either lacking or inadequate for the task at hand.

The location of the refitted artifacts in the site is illustrated in Figure 15. Detailed discussion of the implications of this distribution is beyond the scope of the current paper, however, it can be seen that artifacts were refitted from a large area of the excavated squares. They were excavated at relatively large distances one from the other, a fact that can be explained by the nature of their use at the site. Tools were knapped in a specific place and used (and discarded) at a distance of a few meters from their detachment locality. The presence of refitted artifacts throughout the area of archaeological Layer 4 indicates that this layer was accumulated during a single event.

Blade Preparation

A special technological feature of the NMO pointed elements and blades is the preparation of the striking platform by means of abrasions on the angle de chasse, the ridge between the butt of the flake and the upper proximal surface (terminology after Inizan et al., 1999). These abrasions, attributed to the removal of overhangs from cores (in particular to facilitate blade removal), were observed on 81 striking platforms in the NMO assemblage. Of these, 38 were observed on artifacts classified as pointed elements. The abrasions generally appear in the form of numerous micro-scars and sometimes in the form of short, hinge-ending, burin spell-like scars (Fig. 10).

This phenomenon, typical of blade production, has rarely been described in the context of Mousterian lithic technology. Moreover, it was attributed as a technological marker dividing Upper Palaeolithic blade technology from the earlier Mousterian technology (Goring-Morris & Belfer-Cohen 2003). Clearly, the NMO platform preparation is unlike the UP indirect blade core preparation observed with the same abrasions. At NMO, the striking platforms are thick and the flakes and blades were most probably removed using hard hammer technique. The platform preparation is also very different from the typical Levallois preparation that the NMO knappers applied for the production of their fine tools. Similar abrasion marks were observed on artifacts from other MP sites including Amud (A. Buler, personal communication) and even on the finely-produced Abu-Zif points from the site of Abu-Zif (Sharon, personal observation). It is suggested that more evidence of such abrasions will be reported when awareness of this phenomenon increases.

Raw Material Economy

Good quality, sufficiently sized flint is unavailable in the basaltic terrain forming the immediate vicinity of NMO. The streams running into the Hula Valley from the north and from the west occasionally carry flint nodules of suitable size and quality that could have probably collected in the river beds a few kilometers from the NMO site. However, the muddy lakeside environment accumulating on the basalt boulders of Layer 5 offered no immediately available raw material to the NMO knappers. It is suggested, therefore, that the NMO tool makers brought into the site both finished tools and flint nodules as a source of raw material for on-site knapping. The small amount of flint waste at the site indicates that only a few such nodules were brought to the site. In addition, as described above, the refitting tells us a lot about the strategy and technology applied to the imported raw material. It is clear that some of the tools were brought as finished tools. Most of these are points.

Basalt as raw material– Basalt is very common in the vicinity of the site in the shape of cobbles and pebbles as well as large boulders. Layer 5, the "floor" of the site, is a layer of basalt cobbles and boulders. The quality of basalt as raw material for tool production is good, and the same raw material was used extensively by the Acheulian knappers at Gesher Benot Ya'aqov (Sharon 2008). Basalt is a significant raw material at the Mousterian site of Quneitra, located in similar basaltic terrain of the Golan Heights, where up to 10% of the assemblage is shaped on this raw material (Goren-Inbar 1990). Given these facts, it is interesting to note that with the exception of a few small, sporadic flakes and possible hammer-stones, no basalt artifacts were identified within the NMO assemblage. This observation supports the suggestion that the tools at the site represent a task specific tool kit, of which basalt tools were not a part at NMO. The presence of basalt tools at the site of Quneitra (Oron & Goren-Inbar this issue) indicates complex activity patterns for MP hominid hunting sites. Many of the basalt artifacts at Quneitra were classified as massive scrapers (Goren-Inbar, 1990). It is interesting that at the site of Fa'ara II in the Northern Negev, massive scrapers were also identified, but there they were produced out of limestone (Gilead 1980, 1988). This makes the absence of basalt artifacts and massive scrapers from the NMO assemblage even more significant and suggests a very task specific nature to the assemblage.

Discussion

The lithic assemblage excavated at NMO is unique among Mousterian assemblages in the Levant. It is a small assemblage, yet it is very characteristic in its typological and technological attributes. The archaeological horizon of Layer 4 unearthed at NMO was accumulated during a very short time prehistorically, possibly measured in days, as a result of the butchering and most likely hunting of large game on the banks of the Paleo-Hula Lake. From observations including the spatial distribution of the artifacts and the refitting data, the *in situ* nature of the assemblage is evident (Figs. 5 & 15). Both archaeological and sedimentological data indicate that the finds of this horizon did not

move from their location of discard (Kalbe et al. this issue). Some of the flint tools and bones were found in an upraised position within the fine sediment, suggesting a muddy environment of accumulation in which some of the artifacts and bones were immediately covered by, or even sank into, soft mud.

The archaeological horizon's short duration is reconstructed from three primary factors: the sedimentology of the layers; the small number of lithic artifacts; and the mint condition of the lithic artifacts, bones and botanical remains. The NMO lithic assemblage is small, containing only a few hundred artifacts. This number is much smaller than that of any other excavated site in the Levant, including open-air sites. For example, at the site of Quneitra, an excavated area of ca. 125 sq. meters yielded a total of almost 13,000 artifacts, while the much smaller excavation at Fa'ara II unearthed over 3,700 artifacts (Goren-Inbar 1990: Table 32). The small assemblage size is the strongest evidence indicating that the site was occupied for only a very short time period. It is further evident from the mint condition of the lithic artifacts (see Table 2), the well-preserved bones and the presence of a large amount of wood and other botanical remains that could not have been exposed to the destructive effect of the harsh Hula Valley sun for a long time. These are the primary observations that enable us to conclude that the bones, botanical remains and lithic assemblage are evidence of a short-term occupation. As explained below, the lithic assemblage includes only those tools that were used (or, more accurately, left behind) by the site's inhabitants for the specific task they executed at the site, namely the processing and most likely hunting of big game, primarily very large cows.

Lithic technology and mobility

As detailed above, the assemblage is comprised primarily of pointed elements and cutting tools. Analysis of the artifacts reveals the use of two primary, identifiable lithic core technologies. The pointed elements, in particular, were knapped by the Levallois core method and a non-Levallois blade core method. The artifacts produced using the Levallois core method were not knapped on-site, as evident from the nearly complete absence of cores and primary waste products. The majority of the items classified as Levallois products at NMO are points; Levallois flakes are rare and very few of them were retouched. It is important to note that the Levallois points at NMO cannot be classified as typical "Tabun B" short, broad-base points since many are elongated in proportion.

The second core method applied by the NMO knappers for the production of their tools, both pointed elements and cutting tools alike, is a non-Levallois – blade volumetric concept. This method is evident from the presence of thick, plain platforms that show clear marks of abrasion and typical blade-core preparation as well as the scar pattern observed on many of the NMO artifacts (Figs. 6 & 8).

Finally, a third, *ad hoc* but very efficient core method was used for on-site knapping. This core method is evident from the refitted sequences at the site as well as from the

presence of chunks of raw material, some tested for raw material quality. This method was used primarily for the production of elongated, thick cutting tools produced from cortical nodules brought into the site as raw material. These nodules were brought for immediate use as dictated by the needs of the site's inhabitants. Hence, two distinct groups can be defined within the assemblage:

- Carefully produced artifacts that were imported into the site in their finished form, including a high percentage of pointed elements and cutting tools. These artifacts were made on high quality flint and reveal a high level of preparation and dexterity,;
- On-site knapped artifacts, including primarily rough, thick artifacts produced using a very efficient but not highly systematic method.

Typology and assemblage composition

The assemblage is characterized by a high percentage of tools to waste. Goren-Inbar summarized the data for excavated Levantine Mousterian sites (Goren-Inbar 1990: Table 32). The highest percentage of tools, up to 26% of the assemblage, was recorded at the site of Quneitra (excluding the tiny, probably selective collection from Adlun and Naame in Lebanon). After Quneitra, the only assemblage comprising over 20% tools is that of VadiHasa 621. In all other sites the values are much smaller, reaching only a few percent in some sites. More recently, Hovers (2009: Table 8.4) presented data from additional sites. Most of the sites recorded have a tool percentage below 10% and, in many cases, below 5%. The highest values are from a few layers in Qafzeh Cave, with Layer XIV being the highest at 16.77%. It should be noted that the layers of the large cave sites range dramatically in their percentage of tools (between 1.8 and 16.8 in Qafzeh). At NMO, the Bordesian typology has revealed a tool percentage of well over 30% of the assemblage. This is high by any standard and the highest value we are aware of in any excavated site in the Levant.

As noted in this section, there are also very few cores, primary cortical flakes and core trimming elements (CTE) in the assemblage. This fact, together with the high tool to waste percentage, demonstrate that the majority of the tools at the site were imported into the site in their discard shape and that knapping was not one of the primary activities at the site. As demonstrated by refitted sequences, the knapping that took place at the site was of complete nodules brought in as raw material to be knapped utilizing a short, *ad hoc* method for the production of elongated, rough flakes and blades.

A very illustrative aspect of the NMO assemblage is the scarcity of many tool types typical of Levantine Mousterian assemblages. Most striking, scrapers of all types form a small percentage of the assemblage: a total of 16 scrapers out of 230 tools or out of 670 flakes. The same holds true for the other tool types (Table 3). This is one of the strongest pieces of evidence demonstrating that the NMO assemblage resulted from highly selective tool behavior. Only very specific tool types were brought into or produced on site, namely pointed elements and cutting tools. All other tool types, for which the

inhabitants most likely had no use for the tasks executed at the site, are either absent or present in very low frequencies. It should be emphasized, again, that the different morphologies, tool types and technologies observed at NMO are found in other, contemporary Mousterian assemblages. For example, many of them were observed in the lithic assemblage excavated at the Amud cave (A. Buler, personal communication and personal observation). It is their frequency, however, and the absence of different tool types that makes the NMO assemblage so unique.

Moreover, many of the NMO artifacts have elongated proportions, further indication of preference for a specific tool type. This is particularly true when examining the better produced, finely shaped tools at the site. The term elongated refers here to an artifact whose length is more than 1.5 times its width (for blades the length to width ratio is 2:1). The assemblage is not laminar as a whole (Meignen 2011) but when the pointed elements and cutting tools are measured as a group they tend to be elongated (Fig. 9).

Two techno-morphological groups of artifacts emerge from the analysis of the lithic assemblage: pointed elements and cutting tools. Together, the artifacts classified into these two groups comprise 21% of the entire assemblage (only artifacts that were classified as excavated from context integrity 1 and 2 are included– see above). The evidence from NMO allows us to suggest that, when preparing for a hunting expedition, Levantine Mousterian hunters equipped themselves with the following:

1. Pointed elements, possibly serving as projectile tips (Shea 2006; Yaroshevich et al. 2010; Villa et al. 2009), as evident from the damage fractures at the tip of many of the NMO points. The morphology of many of the points, in particular the finely made ones, suggests that the NMO hunters had a preference for elongated, narrow, pointed elements.
2. Cutting tools, flakes and blades, some of which are very finely made in the shape of well-balanced blades, possibly used for meat cutting and carcass processing.
3. A few nodules of un-flaked or tested-only flint serving as raw material for *ad-hoc*, yet very efficient, on-site knapping of rough cutting tools and additional tools as needed.

This is the picture emerging from the lithic artifacts the NMO inhabitants left behind them. Parts of it remain unclear. While some of the artifacts seem to have been discarded due to breakage, others seem to be in perfectly usable condition. Discard behavior surely involves patterns beyond the scope of our modern understanding. We are also still lacking any evidence for hafting. Wood has been preserved at NMO; hence, the absence of shafts unearthed to date seems to indicate that the lithic artifacts were discarded without their shafts. It was noted by Villa & Lenoir (2009) that the preparation of a wooden spear shaft is much more time and energy consuming than the shaping of a stone tip. This may explain why wooden shafts have not yet been found at NMO.

Two explanatory models for the different lithic traditions observed in contemporary sites (primarily in the European MP) are being debated in the study of the MP techno-complex. These are the cultural vs. functional models known as the Bordes-Binford

debate (see Wargo 2009 for overview and references). Recently, new evidence from the European MP seems to indicate that both scholars are right. While a cultural shift from the typical Mousterian to the Quina-type Mousterian is observed in many sites, the reasons for this shift are argued to be changing climate and a shift in the fauna hunted. The latter focuses primarily on the hunting of reindeer that required different tool types such as Quina scrapers (Guérin et al. 2012). Furthermore, White (2006) suggested that since reindeer hide is particularly useful for surviving cold environments, the richness in Quina scrapers at sites should be explained by the effort to process these animal skins for clothing (see J. Hawks http://johnhawks.net/weblog). This approach, interpreting the nature and composition of the lithic assemblage according to functional needs emerging from the task executed at the site is the type of model we suggest for the NMO assemblage.

The elongated nature of the NMO artifacts suggests that the assemblage should be attributed to the Early "Tabun D" stage of the Levantine Mousterian. This in contrast with the dates obtained for the site placing it within the final stages of the Levantine MP. However, the NMO assemblage does not herald a new cultural phase in the Levantine MP, nor should it be attributed to a defined stage. The typological composition of the assemblage is a direct outcome of the primary activity carried out at the site: processing the meat of large game.

Conclusion

The tool kit of the Levantine Mousterian hunter included primarily pointed elements and cutting tools. The site of NMO, being of short-term task specific nature enables the reconstruction of this tool kit in a resolution yet unachieved in other, much larger and longer duration sites. This reconstruction is based on the following observations and criteria:

1. The assemblage is very small.
2. The variety of tool morphologies is very limited and includes primarily pointed elements and cutting tools (over 20% of the assemblage).
3. Many tool types, such as scrapers and burins, are either absent from the assemblage or are rare.
4. The pointed elements and cutting tools have a dominantly defined elongated morphology, suggesting morphological selective preference by the site inhabitants.
5. At least three different core methods were used to produce the tools at the site (Levallois, Blade and *ad-hoc*) and the hunters selected their preferred tools from these different technological patterns according to needs and preferences.
6. Refitting studies show that many of the tools were brought to the site fully formed, while some flint was brought in as nodules, raw material for on-site knapping. An efficient ad-hoc technology was applied primarily for the production of cutting tools, most likely as need for butchering tools arose. This suggests pre-planning of "flint economy" by the NMO butchers.
7. We do not understand the "discard policy" of the tools at the site. Some of the tools were discarded in seemingly perfect condition.

8. The primary activity at the site was the processing of large game meat, mainly giant cows (up to 12000 kg. each). Other animals such as wild boar, deer, gazelle and horse are also present in smaller numbers. Slicing and de-fleshing of large quantities of meat (evident from the presence of cut marks on the bones at the site) requires a lot of cutting edge. This explains the frequency of cutting tools at NMO.

Hunting activity is suggested from the presence of many pointed elements, many of which show damage fractures of their tip. Moreover, it is difficult to imagine that so many animals were found dead and scavenged during the short time of the site's occupation. At the current stage of research we are unable to say that both hunting and meat processing took place at the site. It could be that the meat was brought from a nearby hunting location, although the size and quantity of bones at the site suggests that a great weight would then have been carried to the site. Alternatively, the site represents the point where both hunting and meat processing took place. It is clear, however, that other activities such as hide processing or flint knapping were not primary activities carried out at the site. This may suggest that these other activities were not part of the immediate hunting practice and took place in different localities, possibly at the larger, long-term duration cave sites.

The site of NMO is interpreted as a short-term hunting camp where the meat of large game was processed. The site's environment is a lake shore and its geology suggests that it was a high, dry spot surrounded by water on at least 3 sides (Kalb et al., this issue), a good location for meat processing. The unique nature of the lithic assemblage excavated from NMO does not represent a lithic traditional or cultural deviation. Rather, it is a functional selection of specific morpho-typological artifact groups out of the inventory available to the site's inhabitants. It was dictated by the function of and the activity that took place at the site, providing a glimpse into what the Levantine Mousterian hunters selected as their tool kit when going out on a hunting expedition. The assemblage reflects sophisticated behavior, preplanning and knowledge of the environment mastered by Upper Jordan Valley MP hunters during the Late Pleistocene.

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Figures

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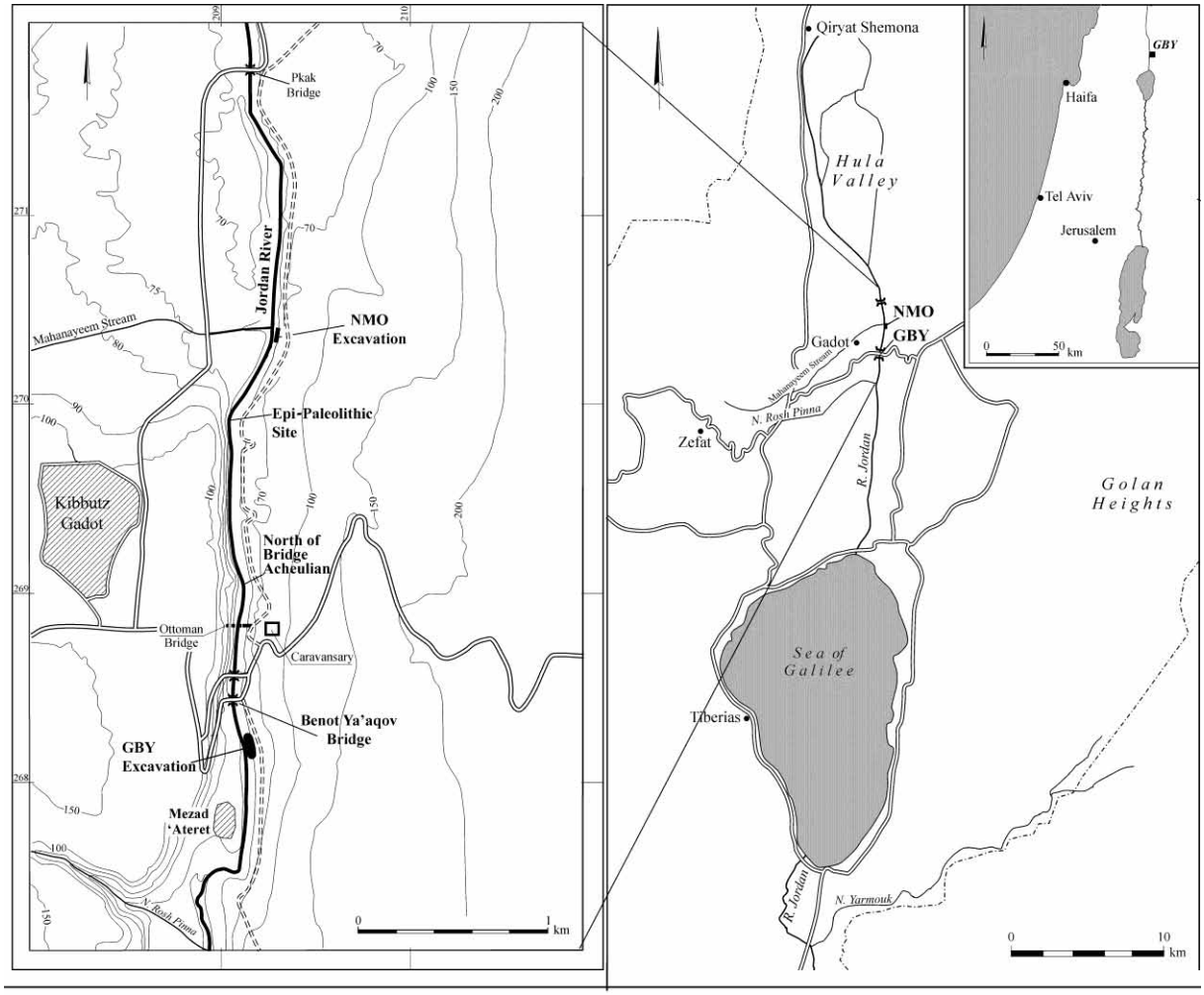
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GBY Excavation
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Gadot
Mahanayeem Stream
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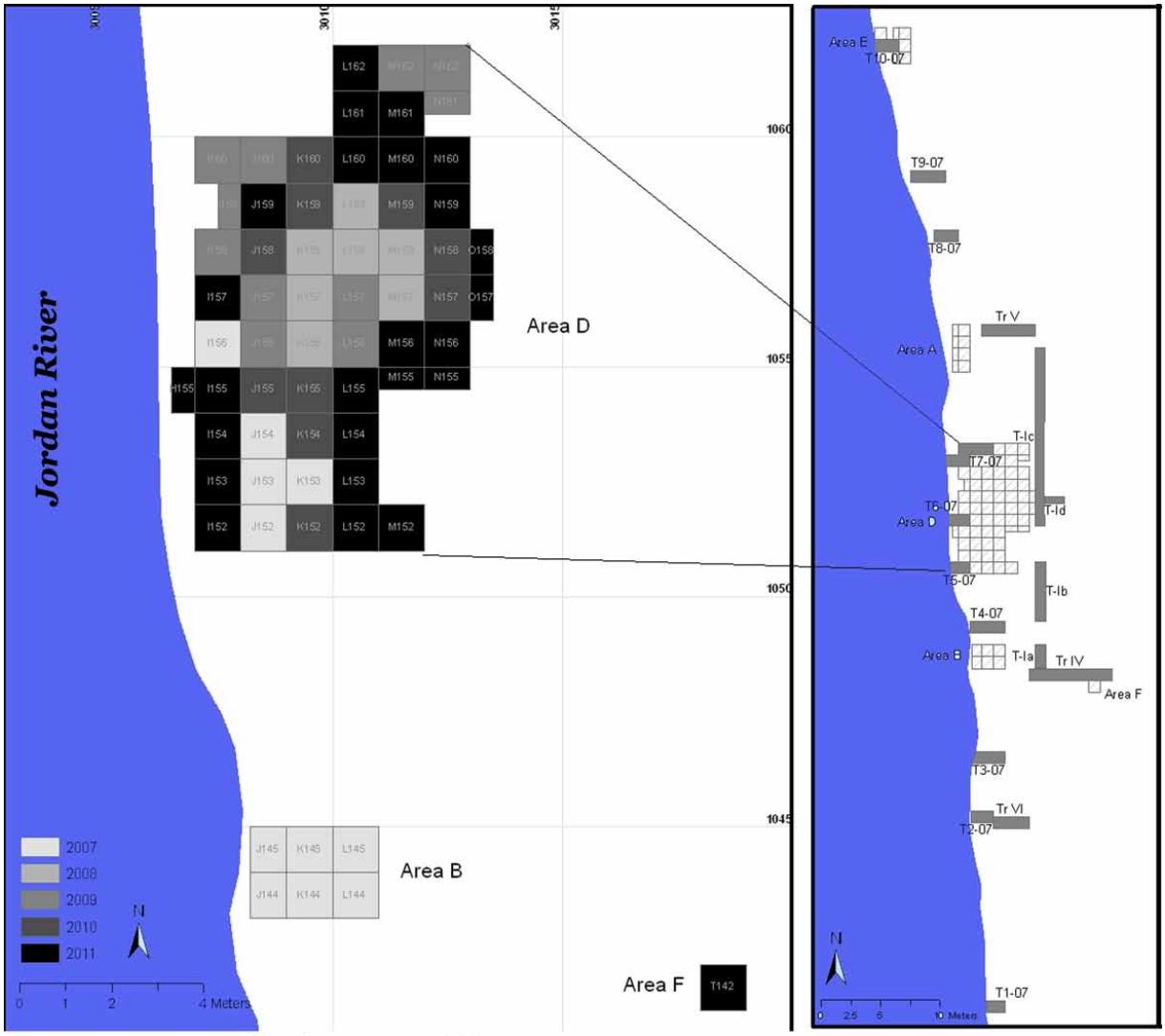
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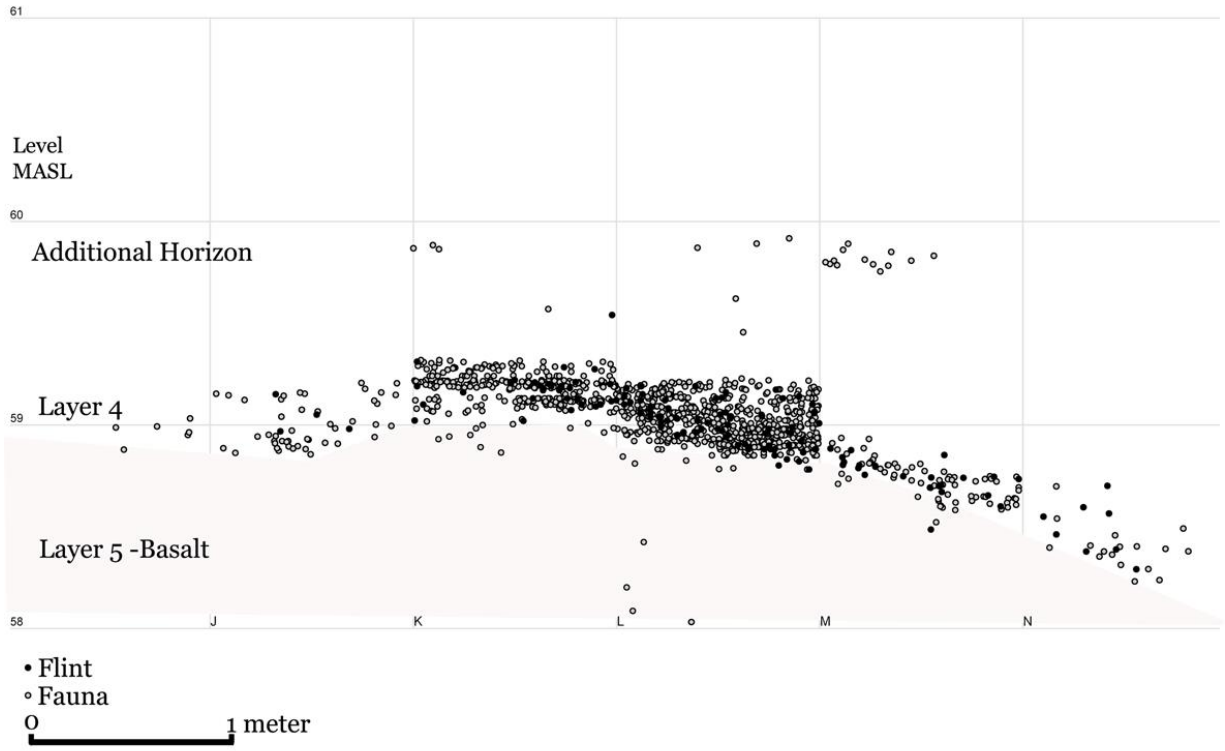
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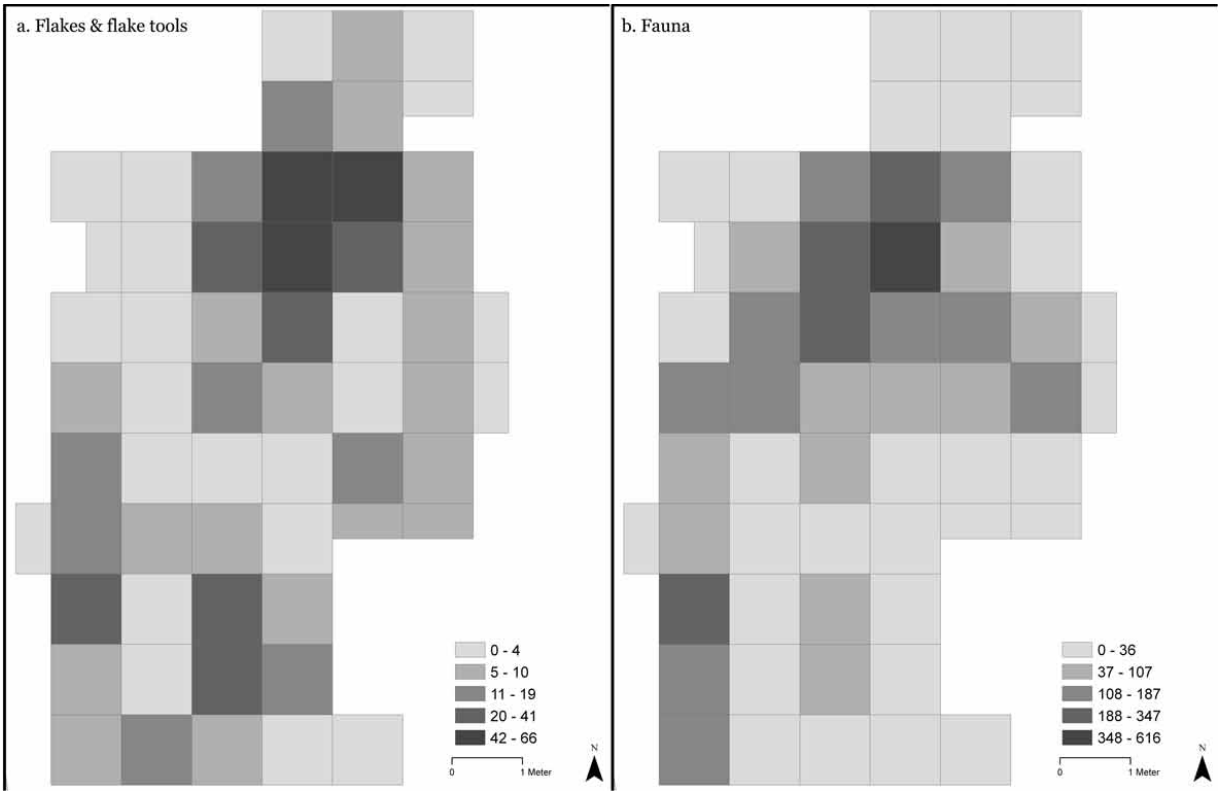
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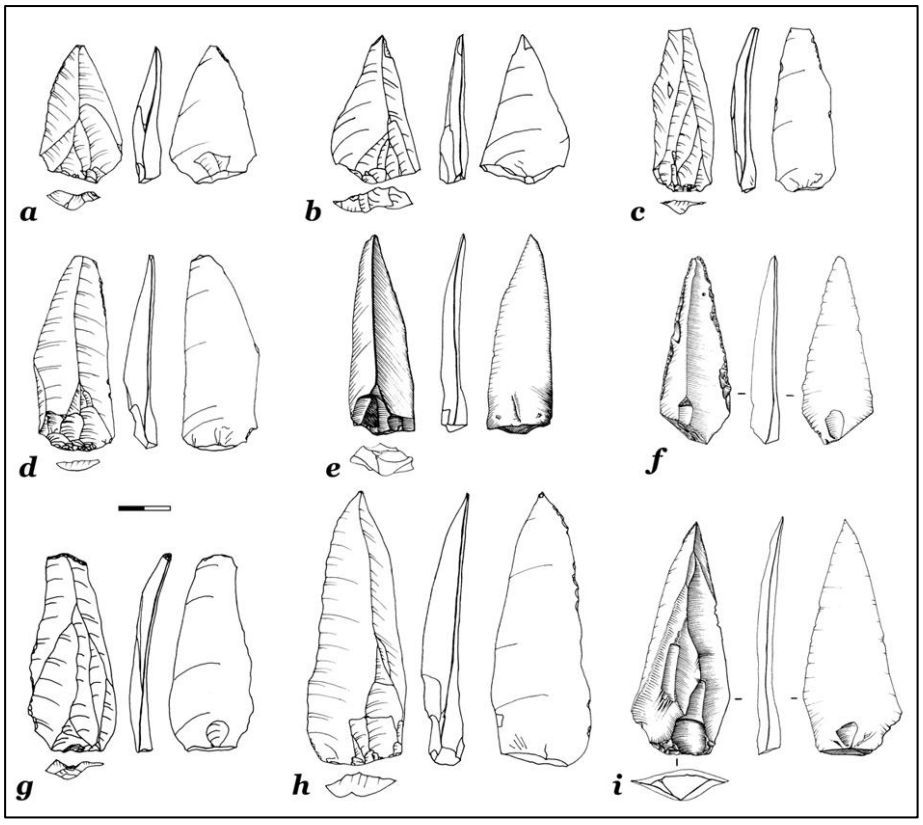
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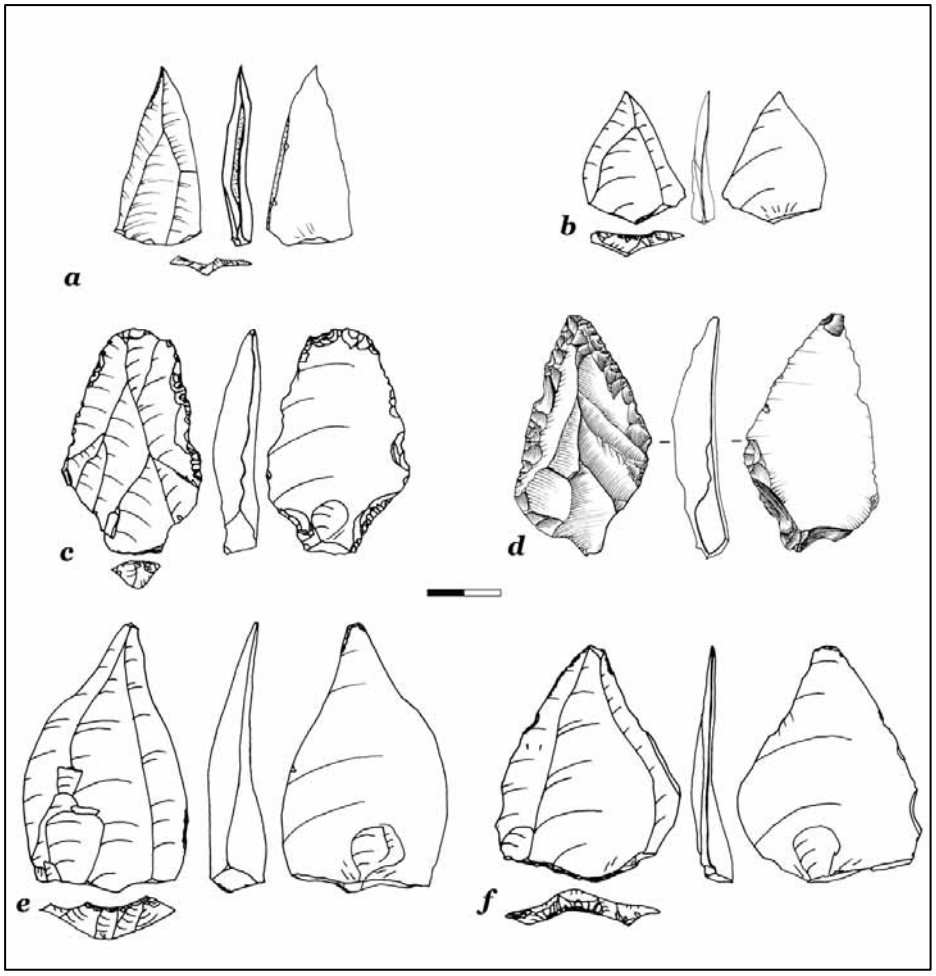
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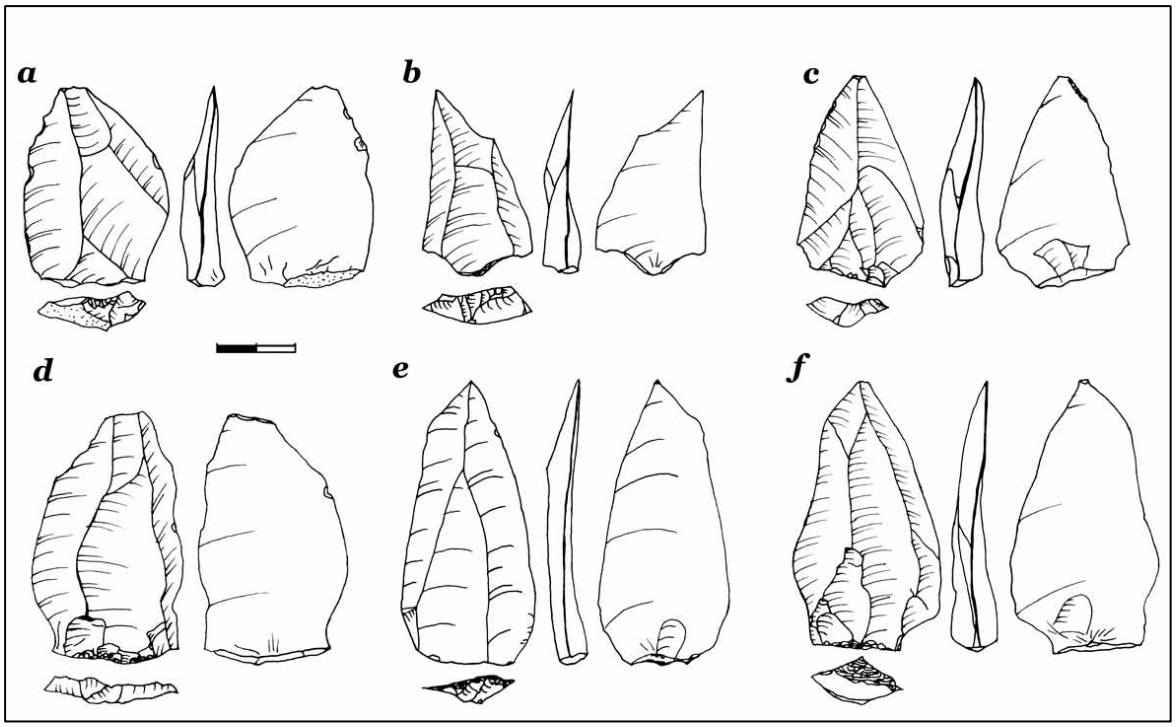
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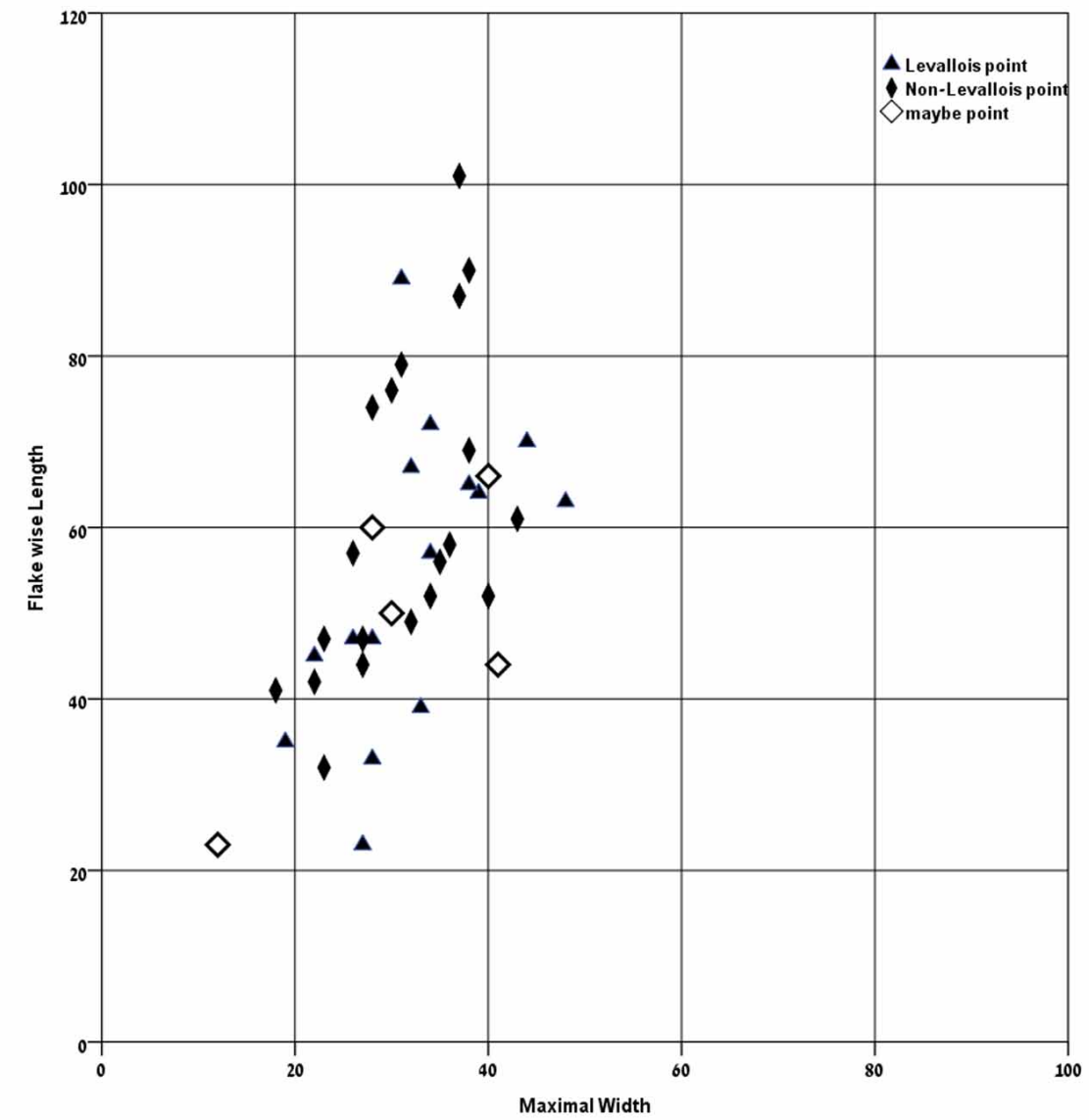
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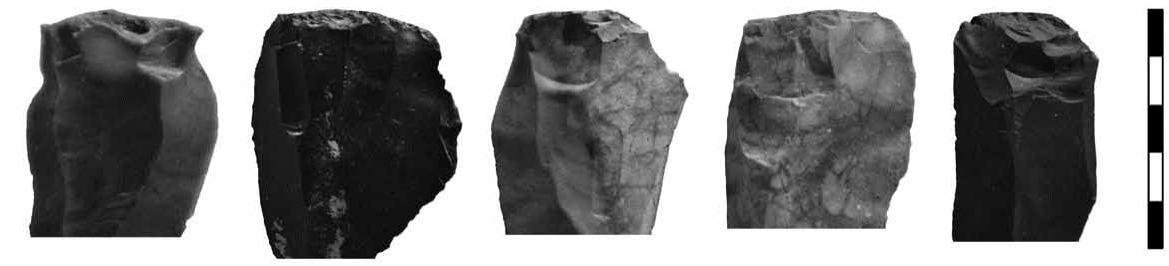

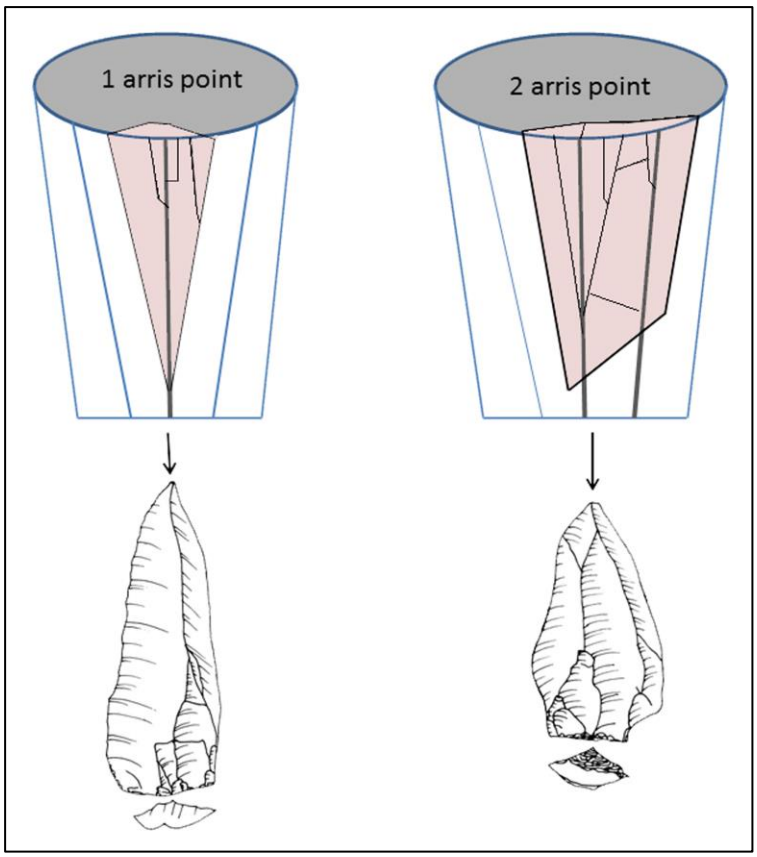
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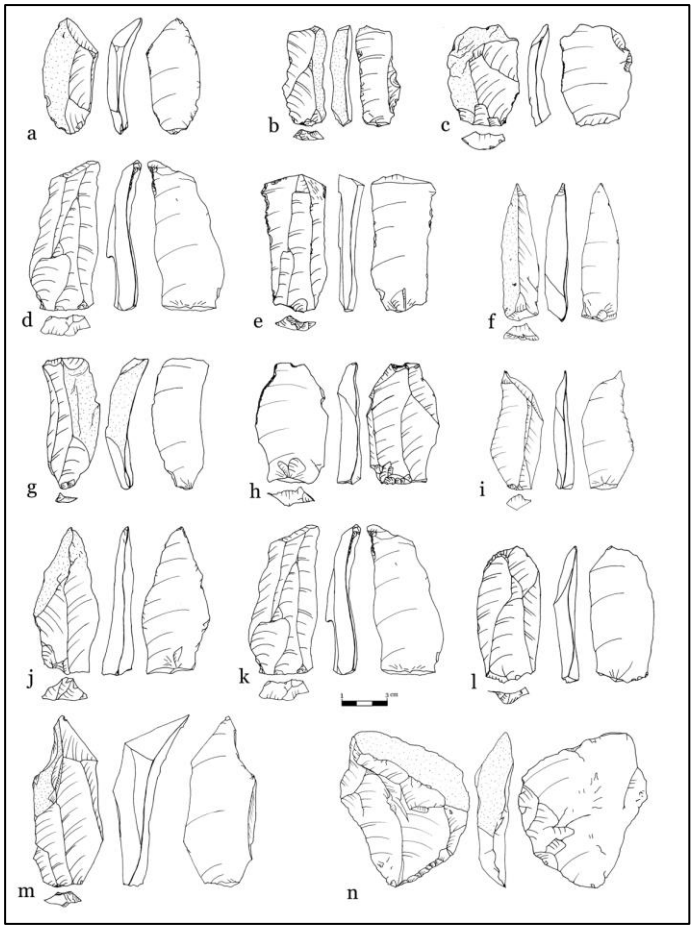
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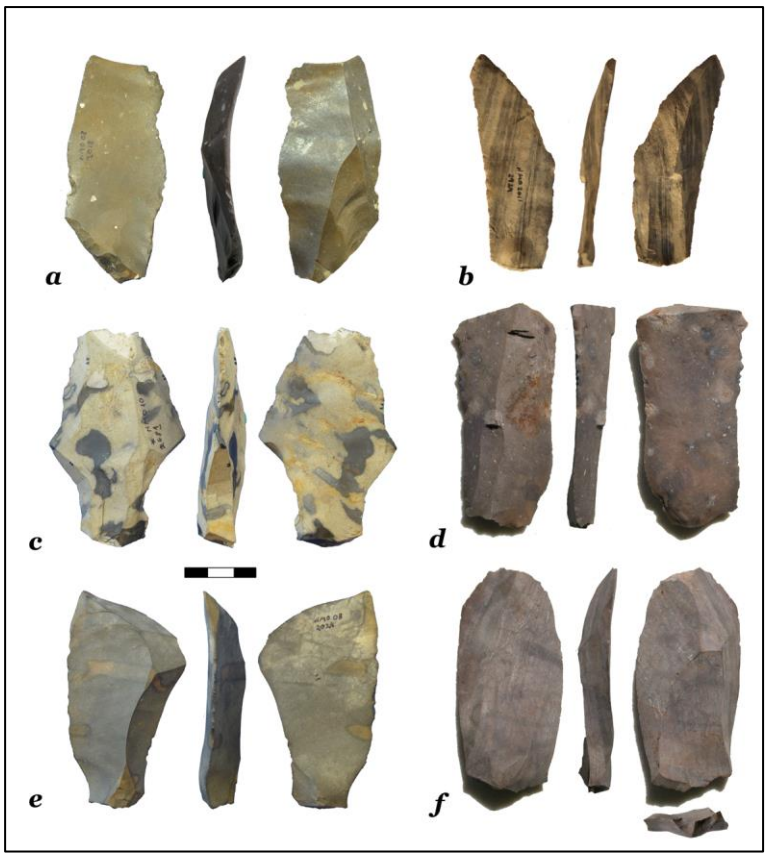
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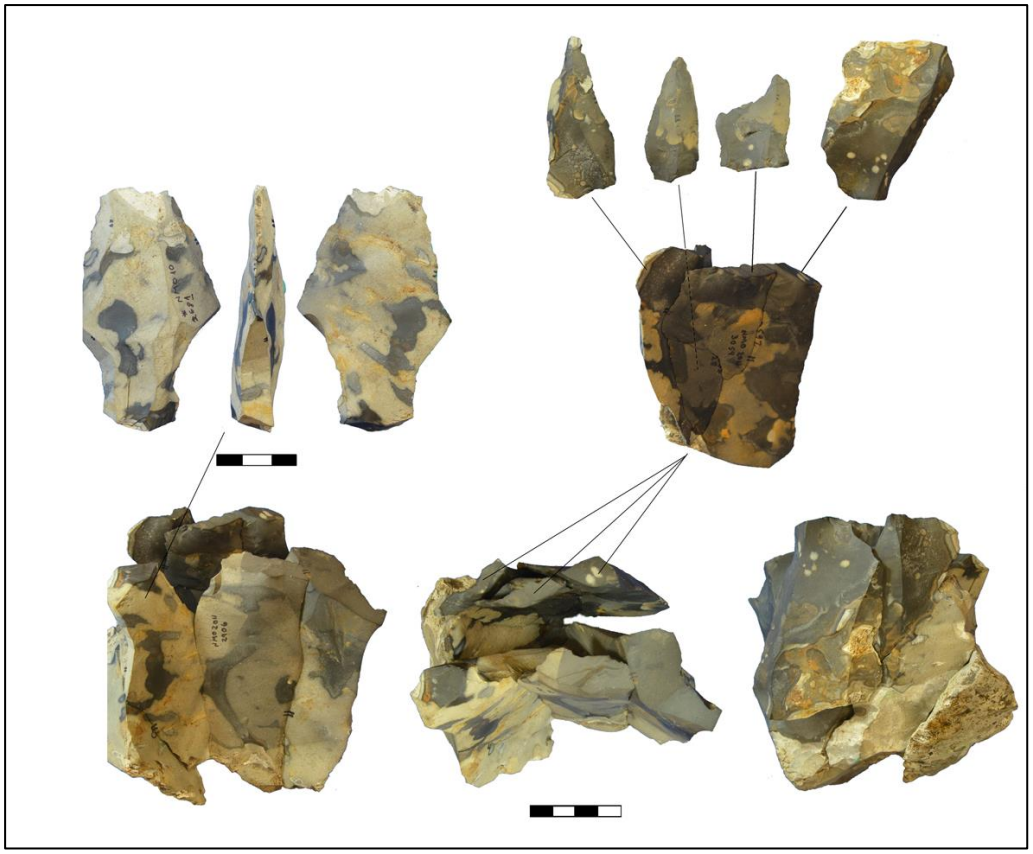

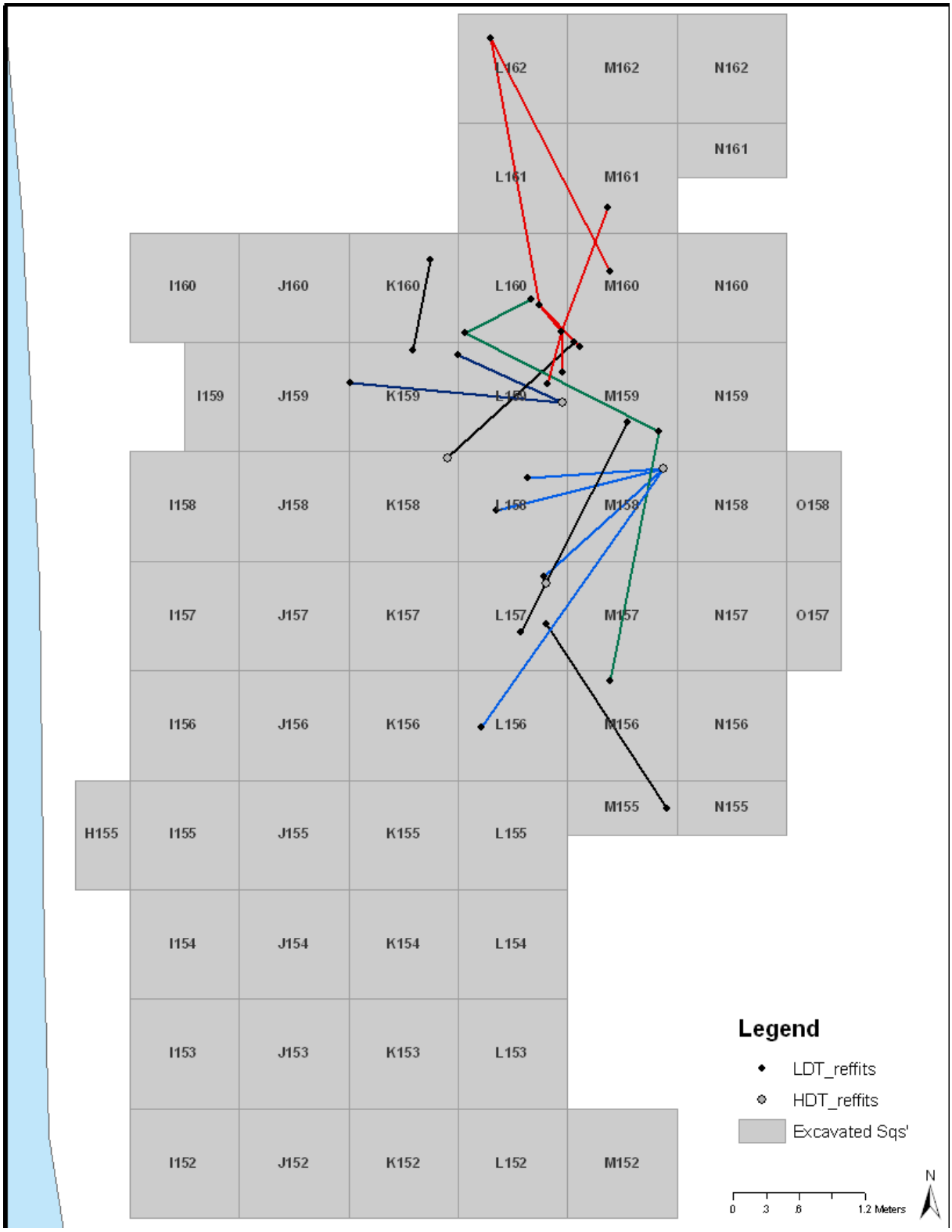
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שחזור חברת הצומח בפלייסטוקן העליון בעמק החולה על פי ממצא הזרעים והפירות בשטח E באתר המוסטרי בשפך נחל מחניים לירדן (MNO)

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בהנחיית ד"ר גונן שרון, המכללה האקדמית תל חי, וד"ר יואל מלמד, אוניברסיטת בר אילן.

תקציר

עדויות בוטאניות מתקופת הפלייסטוקן הינן ממצא נדיר הטומן בחובו מידע רב אודות אורחות החיים וסביבת העבר. בשטח החפירה E באתר המוסטרי בשפך נחל מחניים (NMO) נמצא שפע ממצאים אורגניים במצב שימור מצוין אשר גילם קדום ל-75,000 שנה לפני זמננו. מחקר זה מתמקד בממצא הזרעים והפירות. מטרת המחקר היא שחזור חברת הצומח בעמק החולה בתקופת הפלייסטוקן העליון. במהלך המחקר נדגם החתך המערבי של שטח החפירה E החוצה מספר שכבות סדימנטריות שונות. מהחתך נלקחו 6 דגימות המייצגות את רצף השכבות. במעבדה, נופו הדגימות דרך סדרת נפות ולאחר מכן מוינו וזוהו מתוכן הזרעים והפירות. בכלל החתך זוהו 610 פרטים המשתייכים ל-45 טקסונים. תוצאות המחקר מצביעות על שליטה מוחלטת של צמחי בית גידול לח (83%) אשר רובם צמחי גדה (72%). כמו כן ניראה כי רוב מיני הצומח (83%) מקורם באזורי תפוצה צפוניים. תוצאות המחקר מעלות כי חברת הצומח בפלייסטוקן דמתה במידה רבה לחברת הצומח שהייתה נפוצה בעמק החולה לפני ייבוש האגם בשנות ה-50. מכאן כי גם האקלים היה דומה לזה השורר כיום. עוד עולה כי יתכן ובתקופת הפלייסטוקן שררו תנאי אקלים קרירים ולחים יותר שאפשרו קיומו של מקור מים קבוע אשר אתר זה שכן לגדותיו. מבין מיני הצומח שזוהו ישנם 9 מינים אכילים. מינים אלה זמינים למאכל בתקופות שונות לאורך השנה ויתכן שהיו חלק מתזונתנו הצמחית של האדם. ממצאי מחקר זה תורמים לניסיון להתחקות אחר השינויים האקולוגיים ואורח חייו של האדם בפלייסטוקן העליון. ומעשירים את הידע הקיים אודות ההיסטוריה האקולוגית והאנושית של עמק החולה.

מבוא

צומח עמק החולה כיום

עמק החולה שוכן בחבל הפיטוגיאוגרפי הים-תיכוני. צמחיית עמק החולה מורכבת ממספר חבורות צומח: (1) שרידים של צמחיית השיא (climax) , (2) מינים של צמחים רודורלים (צמחי מעזבה) וסגטלים (של שדות), (3) צמחי מים ששרדו את ייבוש אגם החולה בשנות ה-50 של המאה הקודמת.

שרידיה של צמחיית השיא הקיימים כיום בעמק החולה כוללת ריכוזים של יער-פארק המורכב מחברת הצומח של אלון תבור- אלה אטלנטית. וכן משרידים של חברת שיזף השיח, הכוללת פרטים של עצים כשיזף מצוי, ושיחים כחרחבינה מכחילה, ברקן סורי, חוח עקוד ועוד. מוצאם של האלה האטלנטית וחברת שיזף השיח היא בצמחייה

אירנו-טורנית קדומה ואילו מוצאו של אלון התבור הוא בצומח הים תיכוני. לכן ניתן לומר כי זיקתה הכללית של החברה היא לתנאי אקלים יובשניים יותר מאשר האקלים הים תיכוני. יש המייחסים מאפיין זה לשינויים אקלימיים בעבר. (ויזל 1989).

את שרידיה של צמחיית המים ניתן למצוא כיום בעיקר בשמורת החולה ועין תאו והיא מורכבת בעיקר מפרטים של גומא הפאפירוס וארכובית מחודדת. לאורך נחלי שניר וחרמון ישנו גם צומח-גדות של חברת הדולב המזרחי. עם זאת חברת הצומח שקדמה לייבוש האגם הייתה עשירה יותר והורכבה מ 3 חגורות צומח המקיפות זו את זו- (1) צמחי גדה המיוצגת ע"י חברת הסמר החד והטיון הדביק אשר הקיפו חגורה של קנה מצוי, גומא הפפירוס וכדורן ענף. (2) צמחים בעלי שורשים ועלים צפים כדוגמת נהרונית צפה, נופר צהוב ונימפאה לבנה. (3) צומח טבול במרכז הביצה המורכב מפרטים של נאדיד המים, קרנן טבול וקרנן טבוע, נהרונית שקופה ועוד (ליפשיץ 1990).

שיחזור צומח העבר בעמק החולה

חומר ממוצא צמחי אינו משתמר היטב לאורך זמן. לכן, ממצאים בוטאניים משמעותיים נדירים ברובם המוחלט של האתרים הארכיאולוגיים בכלל ובאתרים פרהיסטוריים קדומים בפרט. האתרים הפרהיסטוריים במוצאו של נהר הירדן דרומה מאגם החולה מראים תנאי שימור ייחודיים הנובעים מקבורתם בקרקעות רוויות מים. החפירות באתרים אלו העלו שפע של ממצאים בוטאניים כולל עצים, זרעים ופירות וכן אבקת פרחים (pollen) במצב שימור ייחודי (van Zeist & Bottema, 2000.;Goren Inbar, et al. 2002 a) ממצאים בוטאניים המתגלים בחפירות פרהיסטוריות טומנים בחובם מידע רב אודות הצומח בעבר. השילוב בין מידע המתקבל מהממצא הצמחי עם מידע מפורט אודות הכרונולוגיה של האתר, הטופוגרפיה, מאפייני הקרקע, התהליכים הטאפונומים (תהליכי ההרבדה והבתר-הרבדה) והפאונה, שהם תוצאות החפירה, מאפשרים ליצור שחזור מהימן של חברות הצומח והתנאים הסביבתיים שהיוו את הרקע לפעילות האנושית בתקופה המדוברת.

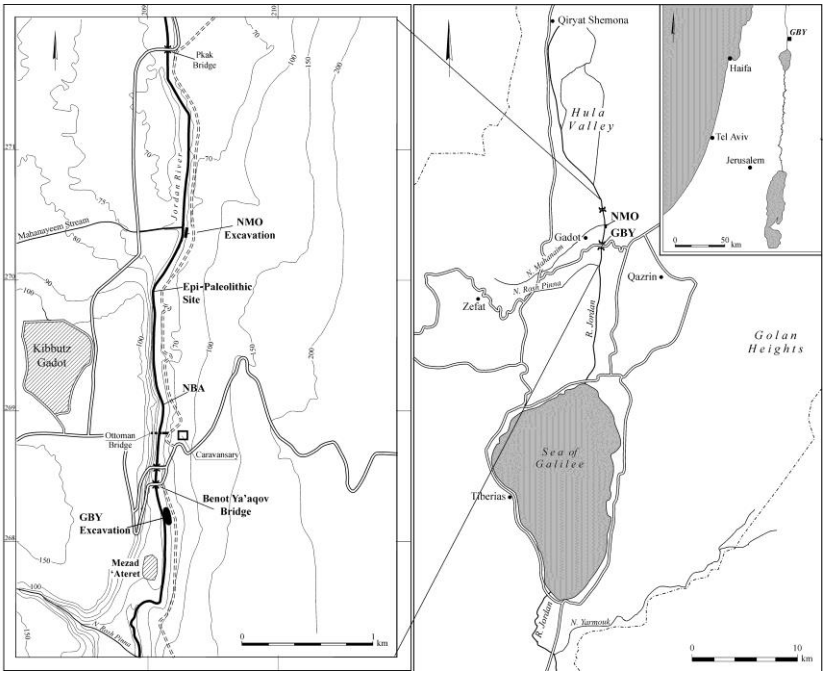
זיהוי מורפולוגי של זרעים ופירות באתרים פרהיסטוריים

חומר בוטאני הכולל ענפים, פירות, זרעים, אבקת פרחים ועוד הנחשף באתרים ארכיאולוגים הוא עדות ישירה וחשובה לחברות הצומח ותנאי הסביבה בעבר. עם זאת, ככול שהאתר עתיק יותר כך פוחת הסיכוי לשימור שרידים בוטאניים בסדימנט. רמת השימור של החומר הבוטאני תלויה מאד בתהליכים הטאפונומים ובסביבת ההרבדה של האתר בו הם נמצאים. מכאן כי באתרים שהורבדו בתנאי יובש קיצוני לאורך זמן, כמו אתרים מדבריים, צפוי מצב שימור החומר האורגני להיות טוב. גם באתרים רוויי מים (waterlogged) מצב השימור של החומר הבוטאני הוא טוב, שכן הם קבורים בסביבה דלת חמצן (Dincauze, 2000). באתרים הפרהיסטוריים לאורך גדת הירדן במוצאו דרומה מעמק החולה, תנאי השימור הייחודיים הביאו לשימור מעולה של שרידים בוטאניים רבים כבר מגיל פלייסטוקן קדום. באתרים אלו נחפר מכלול עשיר של עץ, זרעים ופירות בו מתאפשר זיהוי מורפולוגי של חלקי הצמח השונים. ניתן לזהות את העצים במקרים רבים עד לרמת המין על פי המורפולוגיה של העצה (Goren-Inbar, et al., 2002a) ואת הזרעים והפירות ניתן לזהות במקרים רבים לרמה טקסונומית דומה על פי המורפולוגיה הייחודית של כל מין (Melamed, et al., 2011) . בשיטה זו, יוצרים אוסף משווה של צמחים

רצנטים רלוונטיים לאזור וע"י השוואה מורפולוגית בינם ובין הממצאים מהאתר יוצרים מאגר נתונים אודות הצמחייה שהתקיימה בסביבת האתר בתקופה בה חי בו האדם. שחזור חברת הצומח והשכיחות היחסית בה מופיע כול מין מסייעת לשחזור הסביבה כמו גם לשחזור אורחות החיים והדיאטה של האדם הקדמון באתר (Goren-Inbar, et al., 2002b).

האתר NMO

האתר הארכיאולוגי בשפך נחל מחניים לירדן (NMO-nahal Mahanaim outlet) (תמונה 1) נחפר עד היום במשך 5 עונות מאז סתיו 2007 ועד ספטמבר השנה. האתר מתוארך בשיטת OSL ל ±65,000 שנה לפני זמננו, וכלי הצור שנחפרו באתר משייכים אותו לתקופת הפליאולית התיכון. באתר שטח חפור של כ-60 מ"ר.



איור 1: מיקום האתר NMO, דרום עמק החולה (Sharon, et al., 2011).

בין הממצאים בוטאניים באתר ניתן למצוא שברי עץ בגדלים שונים (החל ממספר מילימטרים וכלה בענף שאורכו 75 ס"מ שנמצא בעונת 2011), זרעים, פירות ואבקת פרחים. מן הממצאים שנותחו עד כה מתגלה מגוון רחב של צומח הן של בית גידול לח והן של יבש (טבלה 1). בין שברי העץ זוהו אלון תולע (*Quercus boissieri*), עץ שגדל היום בגבהים שמעל 500 מ', מילה סורית (*Fraxinus syriaca*) , ערבה (*Salix sp*), ושקד (*Amygdalus*) (Sharon, et al., 2011). הזיהוי נעשה בידי פרופ' אלה וורקר מהאוניברסיטה העברית.

במכלול הזרעים והפירות שנחפר באתר זוהו זרעי אגמון האגם (*Scirpus lacustris*), כשכיחים ביותר. צמח זה מצוי כיום בסביבת מים מתוקים ורדודים נפוץ בגדות נהר הירדן. צמחים נפוצים נוספים הם צמח המים הצף סלביניה צפה (*Salvinia cf. natans*) ועוקץ עקרב (*Heliotropium spicatum*), צמח חד שנתי האופייני גם הוא לבתי גידול לחים. בנוסף נמצאו גם חלקי פרי של טרפה צפה (*Trapa natans*), הידוע גם כערמוני מים, מין

של צמח מים אכיל שנכחד מישראל. כל אלה מצביאים על סביבה של גדת אגם (Sharon, et al., 2011)רוב הממצאים שזוהו עד כה מגיעים משטח החפירה D (איור 2).

טבלה 1: ממצאי הזרעים מהפירות מריבועי חפירה נבחרים בשטח החפירה D (Sharon, et al., 2011).

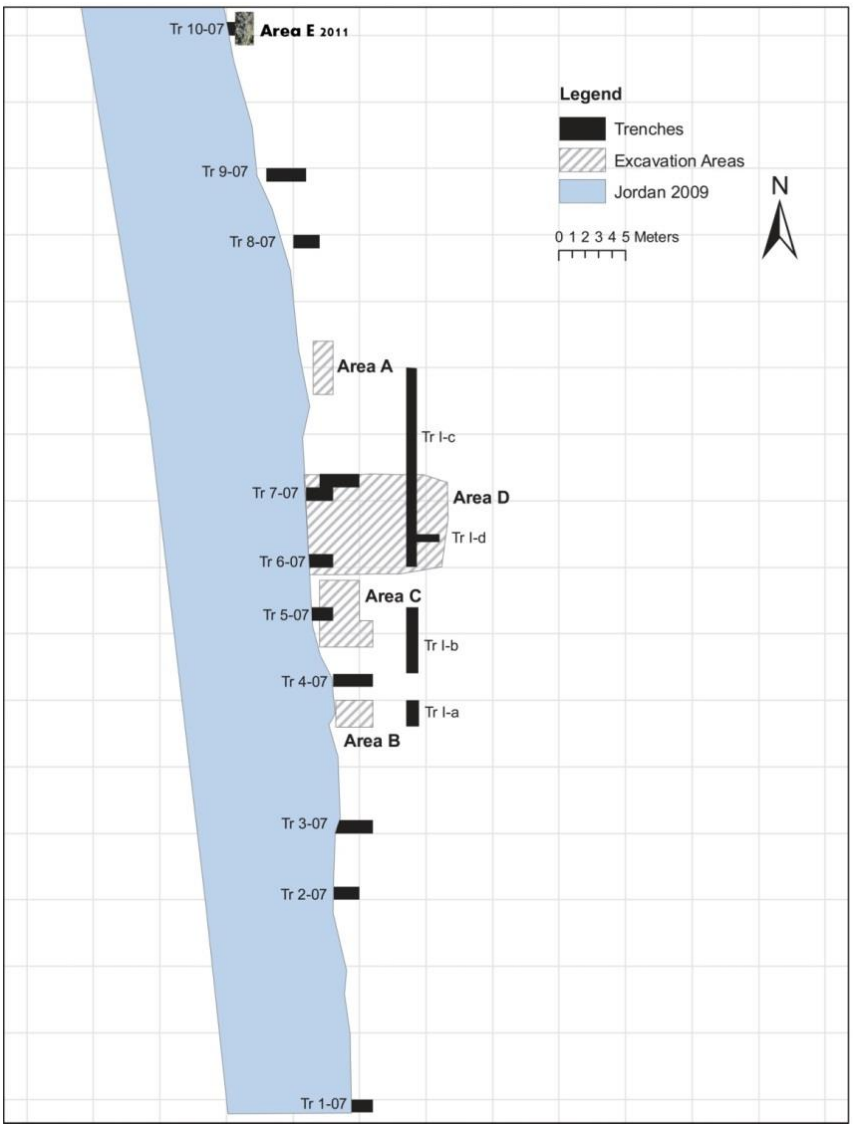
מס' פרטים: (+ = 1-3, ++ = 4-10, +++ = 10<)

		Square and sample volume (cc)				
Plant name	**organ**	**K158d**	**k159 c+d**	**L159c**	**N158d**	**N175b**
		850	**1340**	**300**	**300**	**400**
Emergent plants in shallow water						
Alisma sp.	seed	++	+	++	+	+++
Butomus umbellatus	seed		+			
Cladium mariscus	nutlet	++	++			
Cyperus sp.	nutlet	+	+	+		++
Lycopus europaeus	fruit		++	+	++	++
Polygonum cf. *lapathifolium*	nutlet					++
Scirpus cf. *holoschoenus*	nutlet	+				
Scirpus lacustris	nutlet	+++	+++	+++	+++	+++
Typha sp.	seed					+
Verbena officinalis	fruit	+	+			++
Floating and submerged plants in open water						
Ceratophyllum demersum	nutlet	++	++	+	+	++
Myriophyllum spicatum	fruit		+			+
Potamogeton cf. *crispus*	nutlet	+	++		+	+
Potamogeton cf. *trichoides*	nutlet	+	++	+	+	+
Potamogeton sp.	nutlet	+	++	+	+	+
Ranunculus subgen. *Batrachium*	fruit	+++	++	+++	+	+++
Salvinia cf. *natans*	macrosporangium					+
Plants in Brooks and springs						
Chara sp.	oospore		+	+		
cf. *Mentha* sp.	fruit		+	+		
cf. *Nasturtium officinale*	seed			+		+
Plants in Flooded soils						

Heliotropium supinum	fruit		+			
Ranunculus cf. *scandicinus*	fruit	+	+			
Herbaceous vegetation of dry habitats						
Adonis sp.	fruit				+	
Beta vulgaris	fruit		+			
Chenopodium sp.	Seed	+	+	++	+	+++
cf. *Geranium*	seed		+			
Silybum marianum	fruit	+	+++			
Thymelaea passerina	nutlet	+		+		
Others						
Cruciferae	seed		+++			
cf. *Hypericum*	seed	+				++
Labiatae	fruit			+		
Medicago sp.	fruit	+				
Rumex sp.	nutlet					
Umbelliferae	fruit	+	++	+	+	++

בעונת החפירה האחרונה (ספטמבר 2011) נחפר אזור נוסף באתר שלא נחפר קודם לכן, שטח E (איור 2). מחפירה מקדימה של השטח ניראה כי אזור זה מתאפיין ברמת שימור מצוינת של ממצאים בוטאניים וזואולוגים גם יחד ולכן הוחלט על החפירה בשטח זה. במהלך החפירה נחפר שטח שגודלו 3 מ"ר .

תצפיות פרלימינאריות בשטח העלו כי בשכבת הקוקינה (שכבה המורכבת בעיקרה מקונכיות של רכיכות) ממצאים בוטאניים בשכיחות גבוהה וברמת שימור טובה ביותר. לפיכך, מטרת מחקר זה היא שחזור חברת הצומח לחופו של אגם החולה הקדום בפלייסטוקן העליון כפי שעולה ממצאי הזרעים והפירות בשטח E, ובחינת שונות הממצאים בין השכבות השונות. לשם כך נבחנו פרמטרים של מגוון מינים בכל שכבה.



איור 2 : מפת האתר NMO. בחלקו הצפוני שטח החפירה E בו מתמקד מחקר זה.

שאלות המחקר אשר נבחנו הן:

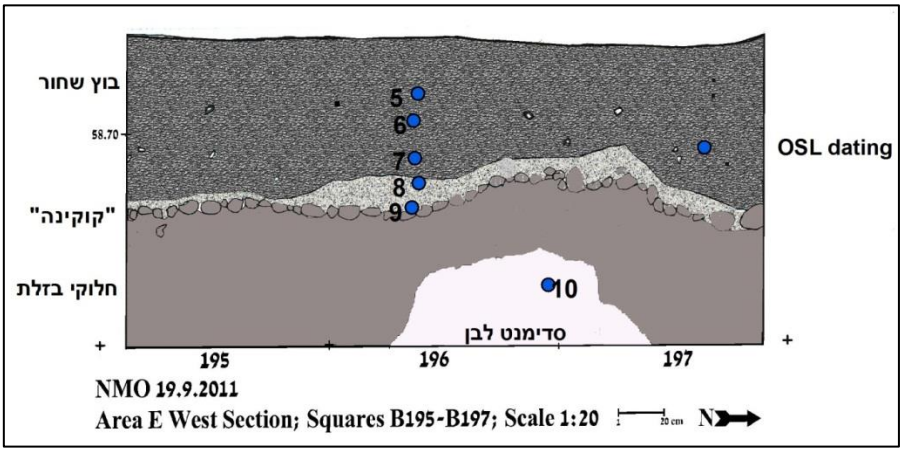
1. מה הייתה חברת הצומח האופיינית לחופו הדרומי של אגם החולה הקדום בתקופת הפלייסטוקן העליון, כפי שעולה מן הממצאים בשטח החפירה E?
2. האם ישנם הבדלים בפיזור הזרעים ושכיחותם לאורך השכבות הסדימנט השונות וכיצד ניתן להסבירם?
3. מה ניתן ללמוד ממצא הזרעים והפירות באתר על פעילות האדם והדיאטה שלו?

המידע הקיים כיום לגבי חברת הצומח בעמק החולה בפרט ובלבנט בכלל בתקופת הפליאולית התיכונה הוא מצומצם ביותר ומחקר זה עתיד להרחיבו.

<u>שיטות וחומרים</u>

בעונת החפירה שהתקיימה בסתיו 2011 נחפר שטח E באתר. תצפיות ראשוניות בשטח העלו כי בחלק זה איכות השימור של הממצאים הבוטאניים והזואולוגים טובה במיוחד. בכדי לבחון תצפית זו לעומק הוחלט על דיגום שיטתי של החתך המערבי באזור זה. חתך זה נבחר בהיותו מייצג את כל סוגי הסדימנט בשטח החפירה E ולכן מאפשר לבחון בצורה טובה את השוני בין השכבות. כמו כן מחתך זה התקבל תיארוך בשיטת OSL ל-74,000±3000 שנים ÓÓÓ (תיארוך ע"י ד"ר נעמי פורת, המכון הגיאולוגי) הממקם את הממצאים שנמצאו בחתך מבחינה כרונולוגית. החתך הנבחר חוצה 4 שכבות סדימנטריות שונות (איור 3) שתיאורן (מלמעלה למטה):

1. שכבת בוץ שחור: מאופיינת בצבע כהה ומרקם דק. עם הירידה בגובה נצפתה שכיחות הולכת ועולה של קונכיות עד לשכבה שמתחתיה.
2. שכבת "קוקינה" – המורכבת בעיקר מקונכיות צדפים של מים מתוקים ובעיקר של הגסטרופוד שחריר הנחלים.
3. שכבת חלוקי בזלת מעוגלים וצפופים, כנראה ממקור פלוביאלי.
4. בחלקה הפנימי של ערימת חלוקי הבזלת נצפו "עדשות" של חומר חרסיתי בהיר בעל מירקם משחתי כנראה ממקור גירני.



איור 3: חתך מערבי בשטח החפירה E, ומיקומי דגימות הקרקע שנבחנו במחקר זה.

מן נחתך נלקחו 6 דגימות המייצגות אופי סדימנטרי שונה. עבור כל דגימה תועד המיקום בשלוש קואורדינטות ואופי הסדימנט. דוגמאות הקרקע אוכסנו בשקית ניילון סגורה על מנת למנוע התייבשות. במעבדה, מכל דגימה נדגם נפח ידוע של סדימנט (טבלה2), אשר נופה בסדרת נפות בגודל חרירים יורד: 2000µm, 1000µ m, 850µ m, 212µ m. החומר המנופה נשמר בכוסיות פלסטיק סגורות כאשר הוא מכוסה במים. דגימה מספר 8 נופתה כולה.

טבלה 2 : מיקום ומאפייני דגימות הסדימנט שנבחנו במחקר זה.

מס' דגימה	מיקום			אופי סדימנט	נפח מנופה (מ"ל)
	E*	N	גובה (מ' מעל פני הים)		
ym/11/5	3001.556	1095.333	58.941	צבע כהה, סילט דק. מעט קונכיות	140
ym/11/6	3001.641	1095.315	58.829	צבע כהה, מרקם דק. יותר קונכיות	140
ym/11/7	3001.604	1095.32	58.674	צבע כהה, מרקם דק. יותר קונכיות	140
ym/11/8	3001.589	1095.336	58.571	"קוקינה"	1580
ym/11/9	3001.624	1095.307	58.469	"קוקינה"	140
ym/11/10	3001.735	1095.873	58.15	צבע בהיר, מרקם משחתי.	140
OSL dating	3000.925	1096.552	58.752	/	/

* הקורדינאטות המצוינות מתייחסות לרשת מקומית של האתר.

הדגימות המנופות מוינו והופרדו מהן הזרעים והפירות בעזרת פינצטה דקה. בכל דגימה נספרו מס' הפירות/ זרעים המינימאלי. עבודת המיון והזיהוי נעשתה תחת בינקולר בהגדלה פי 60 כאשר גם כאן הוקפד כי הממצאים יהיו תמיד תחת מים וזאת על מנת למנוע שינויים במבנה הממצאים העלול להיגרם בתהליך ההתייבשות (Melamed, 1997) . הממצאים זוהו ע"פ המורפולוגיה שלהם בהשוואה לאוסף משווה קיים, ובהנחיית ד"ר יואל מלמד, המעבדה לארכיאו-בוטניקה, אוניברסיטת בר אילן.

תוצאות המחקר נותחו בעזרת תוכנת אקסל . מיפוי החתך ומיקום נעשה בעזרת תוכנת GIS.

<u>תוצאות</u>

תוצאות מיון וזיהוי הזרעים מדגימות הסדימנט בחתך המערבי של שטח החפירה E העלו שפע של זרעים ופירות (טבלה 3) ברמת שימור מצוינת וייחודית אשר אפשרה זיהוי טוב (איור 6). מיקום דגימות החתך ואופי השכבות מציעות גיל של כ- 77 אלף שנים לפני זמננו עבור הממצאים (פלייסטוקן עליון). הממצא כלל סוגים שונים של איברי פרי וזרע: אגוזיות, פרודות, זרעים, זרעונים, מנבג וספלול. מכלל הדגימות זוהו 610 פרטים המתחלקים ל- 45 טקסונים. המין נפוץ ביותר הינו נורית, תת סוג בטרכיום (*Ranunculus subgen. Batrachium*) ממנו נמצאו 223 זרעים אשר הופיעו בכל דגימות החתך. המין השני בשכיחותו הוא סלביניה צפה (*Salvinia cf. natans*) עם 60 נבגים ומנבגים אשר הופיעו בכל הדגימות מלבד דגימה 10.

ממצאי הזרעים ופירות מגיעים מ-6 דוגמאות קרקע שונות באותו חתך ומאופיינות בסדימנט וגובה שונה (טבלה 2). מגוון המינים בכל דגימה איננו אחיד. לאחר בחינת ממצא הזרעים ואופי הסדימנט ניתן לחלק את הדגימות לשלוש קבוצות:

קבוצה 1: כוללת את דגימות 7-5. מאופיינת בסדימנט המורכב מסילט דק ואחיד יחסית עם מעט שבלולים אשר שכיחותם עולה ככל שהדגימה נמוכה יותר. בדגימות מקבוצה זו נמצאו בין- 18 ל-21 פרטים בכל דגימה אשר זוהו כמשתייכים ל 6 עד 9 מינים.

קבוצה 2: כוללת את דגימות 8 ו-9. מאופיינת בסדימנט המורכב ברובו משבלולים, "קוקינה", אשר ביניהם ישנו סילט דק. בשכבה זו נמצא גם שפע רב של ענפים קטנים, פחם, עצמות בע"ח וכלי צור (ר. ביטון: מידע בע"פ). ממצא הזרעים והפירות בשכבה זו עשיר מאד וכלל למעלה ממאה פרטים בכל דוגמא אשר משתייכים ל-24-32 מינים.

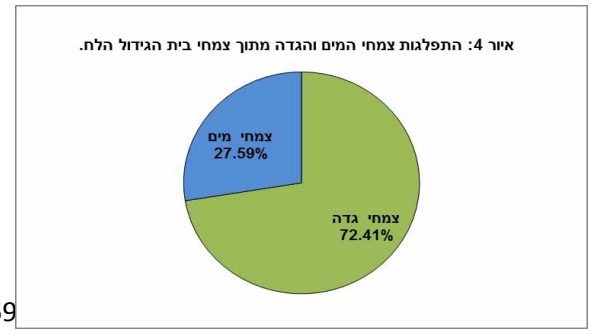
קבוצה 3: כוללת את דגימה 10 בלבד. דגימה זו מתאפיינת בסדימנט בהיר בעל מרקם חרסיתי אשר נמצא בתוך שכבת חלוקי הבזלת בחלקו הנמוך ביותר של החתך . ממצא הזרעים והפירות מדגימה זו עני ביותר וכלל זרע אחד בלבד.

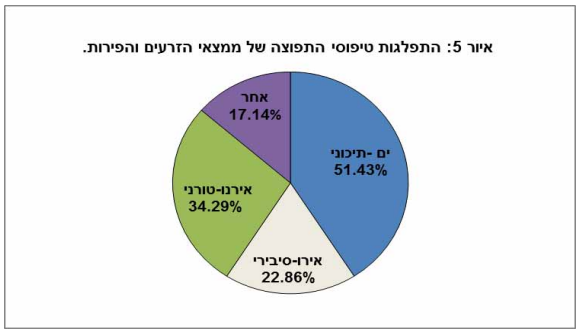
מבחינת ההבדלים בין השכבות נראה כי, ככל הנראה, השוני במגוון וכמות הזרעים אינו תלוי בתנאי השימור של השכבות אלא לאופיין, שכן נוכחות של זרעים נצפית בכולן.

35 מתוך 45 הטקסונים שזוהו ניתן להגדיר לרמת המין. כאשר ידוע מין הצמח ניתן לדעת מהו בית הגידול וטיפוס התפוצה האופייניים לו כיום (טבלה 4). הנחת היסוד היא שהצמחים שמרו על הדרישות האקולוגיות שלהם (Melamed, 1997) ולכן מאפיינים אלה יכולים לרמוז לנו על בית הגידול והתנאים הסביבתיים שהתקיימו באזור עמק החולה בתקופת הפלייסטוקן העליון.

כאשר בוחנים את מאפייני בית הגידול של הממצאים ניראה כי רובם המכריע, כ-83%, מגיעים מבית-גידול לח של מים מתוקים. מתוכם כ-72% הינם צומח של גדות נחלים ואגמים/ביצות והשאר הינם צומח טבול או צף על המים (איור 4). צמחי בית-הגידול היבש, מהווים כ-17% מכלל המינים כאשר מלבד אחד מעוצה, כולם צמחים עשבוניים.

בנוסף, כאשר בוחנים את טיפוסי התפוצה של המינים שזוהו מתגלה מגוון טיפוסים וביניהם האירנו-טורני, האירו-סיבירי, הים-תיכוני, הטרופי ועוד. מבין טיפוסי התפוצה ניראה כי הטיפוס הים-תיכוני הוא השכיח ביותר ואחריו האירנו-טורני, כ-51% ו-34% בהתאמה (איור 5). יחד עם זאת יש לשים לב כי למין מסוים ייתכנו מספר טיפוסי תפוצה אופייניים. יש לציין כי גם בתוך קבוצות המשנה שהוזכרו להלן נשמרו יחסי שכיחויות דומים בין בתי-הגידול ובין טיפוסי התפוצה.





בין הממצאים נמצא מין אחד אשר נכחד ואיננו מצוי בצומח הארץ כיום: חצצון חיצי (*Sagittaria sagittifolia*). החצצון צומח כיום בחצי הצפוני של כדה"א ויתכן והכחדתו קשורה לשינויי אקלים שהתרחשו מאז.

מתוך מיני הצמחים שזוהו ניתן למנות 9 מינים אכילים אשר ייתכן והיוו חלק מתזונת האדם אשר כליו נמצאו באתר: אלון, חצצון חיצי, כף אווז (חלק מהמינים בסוג), נופר צהוב, סוף, פטל קדוש, שומר פשוט, תאנה וגרגר נחלים. בין צמחים אלה ישנם האכילים רק לאחר בישול או קלייה ובכל מקרה יש צורך בהפרדת החלק האכיל בכל צמח שכן לא כולו ראוי למאכל (Melamed, 1997; דפני, 1984).

<u>דיון ומסקנות</u>

ממצאים בוטאניים מתקופת הפלייסטוקן הם עדות נדירה וחשובה בשחזור אורחות החיים וסביבת העבר (Weiss & Kislev, 2008). ממצאי הזרעים והפירות משטח החפירה E מתאפיינים מרמת שימור מצוינת המאפשרת הצצה ייחודית לסביבת העבר בעמק החולה מלפני כ- 75,000 שנה.

שחזור הסביבה והאקלים

בבואנו לשחזר את סביבת העבר ע"פ הממצאים הבוטאניים אנו יוצאים מנקודת הנחה כי תנאי הסביבה בה גדל צמח מסוים כיום הם גם התנאים בהם גדל בעבר. כאשר מין מסוים "משנה" את העדפותיו הסביבתיות הדבר מלווה בד"כ גם בשינויים מורפולוגים אשר למעשה יגדירו אותו כמין חדש/אחר (Melamed, 1997).

אחת המסקנות המרכזיות העולות מממצאי הזרעים והפירות היא כי רובם, מלבד מין אחד, עדיין גדלים כיום בארצנו ורובם התקיימו גם בעמק החולה עד לייבוש האגם בשנות ה-50. תאריכן של השכבות ממקם אותן בתחילתה של תקופת הקרח האחרונה (שלב איזוטופי 4). מכאן כי על פי הממצאים מהאתר ניתן להציע כי האקלים לא היה שונה משמעותית מזה השורר היום בעמק החולה.

עם זאת, כאשר בוחנים את טיפוסי התפוצה של המינים ניראה כי רובם (83%) נפוצים באיזורים הצפוניים של כדה"א המאופיינים באקלים קר וגשום ולכן יתכן שהם מעידים על תקופה בה כמות המשקעים הייתה רבה יותר ואולי אף קרה יותר.

עדות נוספת המאפשרת לנסות ולשחזר את סביבת האתר עולה מאופי הסדימנט בשכבות השונות:

איכות השימור ושפע הממצאים האורגניים, השכוב האחיד של סדימנט דק גרגר (סילט) ונוכחותה של שכבת שבלולים ומעידים על הרבדה מהירה יחסית של השכבות ועל נוכחות רצופה של מים באנרגית זרימה נמוכה. סביבה כזו אופיינית לחוף אגם אשר מפלס המים שלו עולה באיטיות (Goren-Inbar 2002 b).

בנוסף, רובו המכריע של מיני הצומח (82%) אופייני לבית-גידול לח. מתוכם 72% הם צמחי גדה והשאר הינם צמחים הצפים על המים או טבולים בהם.

מאפיין זה מחזק את ההשערה כי מדובר בחופו של אגם החולה הקדום. ייתכן כי הדבר מעיד על כמות משקעים גדולה יותר מאשר בהווה בו האגם הגיע לנקודה פחות דרומית.

מסקנה זו נתמכת על ידי הממצאים הבוטאניים והזואולוגים משטח החפירה D באתר.

ממצאים אלה כוללים עצים של גדות נחלים/אגמים כמילה סורית (*Fraxinus syriaca)* וערבה (*Salix. sp*). וכן עצמות רבות של דו-חיים שהמין הנפוץ שבהם הוא צפרדע הנחלים (*Rana palestina*) האופייינית לאתרים בהם מקורות מים קבועים בלבד.

לפיכך, ניראה כי אופי הסדימנט של החתך הנדגם בשטח E כמו גם מאפייני הממצאים הבוטאניים והזואולוגיים מצביעים על קיומו של מקור מים קבוע בקרבת האתר, אולי אגם החולה הקדום. בנוסף טיפוסי התפוצה של מיני הצומח שזוהו מצביעים על כי יתכן ובתקופת הפלייסטוקן העליון כמות המשקעים הייתה רבה יותר והטמפרטורות היו נמוכות יותר מאשר בזמננו. עם זאת, נראה כי השינוי לא היה דרמטי שכן רוב הצומח שנמצא בשכבות האתר גדל גם כיום בעמק החולה או לפחות גדל עד שינוי בית הגידול הטבעי בייבוש האנתרופוגני בראשית שנות ה-50.

יש לציין עוד כי כל המינים אשר נמצאו בחתך, כולל צמח החצצון החיצי אשר נכחד כיום, נמצאו גם באתר של גשר בנות יעקב (GBY) אשר מתוארך לכ-750,000 שנה לפני זמננו. מכאן עולה השאלה האם מדובר פה ברצף אקלימי שנשמר לאורך מאות אלפי שנים או שמא מדובר בשיקום אוכלוסיית הצומח לאחר תקופות בהן הייתה שונה ותחת תנאים אקלימיים אחרים. שאלה זו אף מתחדדת לאור הימצאותם של בע"ח חיים גדולים כגון פילים (Mega-fauna) ב-GBY הנעדרים ממכלול הפאונה באתר של מוצא נחל מחניים .Rabinovich,et al; (Sharon, et al. 2011 ó2012)

שחזור תזונת האדם

באתר NMO בכלל ובשטח החפירה E בפרט נמצאו כלי צור המעידים על נוכחות האדם ומעורבותו בהיווצרות האתר.

תזונת האדם בפלייסטוקן העליון, הייתה תלויה באפשרויות הליקוט והציד בסביבה בה נמצא (Goren-Inbar 2002 b). לפיכך זמינות צומח אכיל הינה תנאי הכרחי לקיומו.

8 מינים של צמחים אכילים נמצאו בדגימות. לא כל חלקי הצמח ראויים לאכילה, וחלקם זמינים רק בעונות מסוימות עובדה המשפיעה על זמינות המזון לאורך השנה.

במינים חצצון חיצי, נופר צהוב וסוף החלק הנאכל בצמח הינו קנה-השורש או הפקעת והם זמינים לאורך כל השנה. גם עלי גרגר הנחלים זמינים לאכילה במשך רוב חודשי השנה ,טריים או לאחר בישול. לעומתם, בפטל קדוש ובתאנה החלק הנאכל הוא הפרי אשר מבשיל בעונת הקיץ ואילו באלון יהיו הבלוטים טובים למאכל רק בחורף. בשומר פשוט ניתן להיזון הן מעלי הצמח והגבעולים והן מהזרעים ולפיכך יהיה זמין לאכילה החל מהחורף ועד סוף הקיץ.

נוכחות של צמחים אלה אינה מעידה בהכרח כי האדם אכן ניזון מהם אלא על אפשרויות ההזנה שעמדו לרשותו. לפיכך ניראה כי לפחות חלקם של הצמחים היו זמינים למאכל לאורך כל עונות השנה ולכן לא היוו גורם המגביל את שהות האדם באזור זה.

ממצאי הזרעים והפירות אשר נמצאו במחקר זה תורמים לניסיון להתחקות אחר השינויים האקולוגים ואורח חייו של האדם בעמק החולה בתקופת הפלייסטוקן העליון. רמת השימור המצוינת ושפע הממצאים האורגניים והליתיים ובאתרים נוספים בעמק החולה מהווים קרקע פורייה להמשך מחקר, במטרה NMOגם יחד אשר התגלו באתר להעשיר ולבסס את הידע אודות ההיסטוריה האקולוגית והאנושית של עמק החולה.

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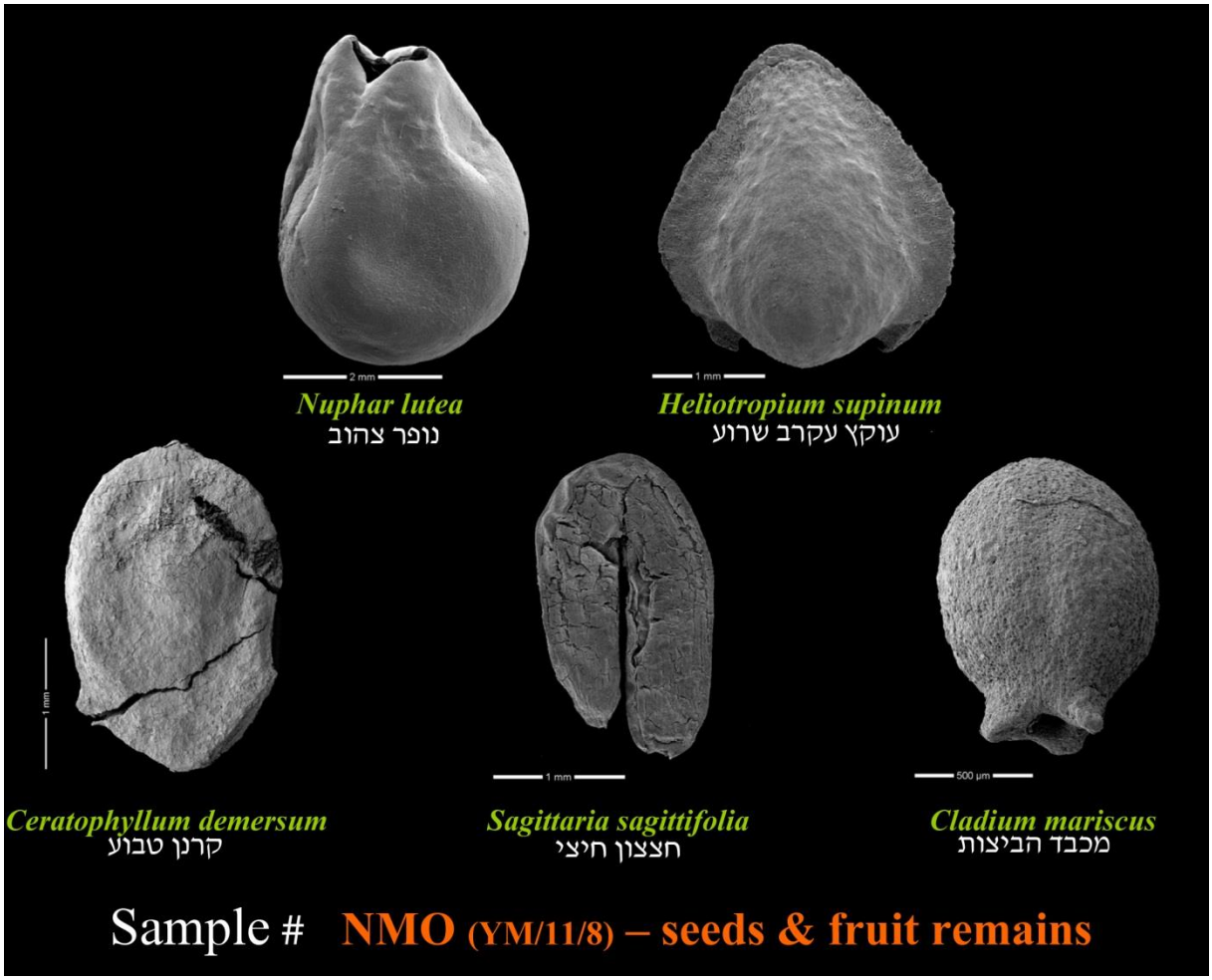
איור 6: ממצאי זרעים ופירות אשר נמצאו בדוגמא מס' 8 :



צילום במיקרוסקופ אלקטרוני (SEM), אוניברסיטת בר אילן.

טבלה 3: ממצאי הפירות והזרעים שנמצאו במחקר זה.

דגימה			ym/11/5	ym/11/6	ym/11/7	ym/11/8	ym/11/9	ym/11/10	סה"כ פירות וזרעים
מין	**specie**	**איבר**							
אגמון	Scirpus sp.	אגוזית			1				1
אגמון ימי/האגם	Scirpus lacustris/maritimus	אגוזית		2		55	10		67
אלון	Quercus sp.	ספלול				1			1
אלף-עלה משובל	Myriophyllum spicatum	אגוזית				8			8
ארכובית	Polygonum sp.	אגוזית				5			5
ארכובית הכתמים	Polygonum cf lapathifolium	אגוזית				6	1		7
גומא	Cyperus sp.	אגוזית				2			2
גומא א	Cyperus sp. a	אגוזית	1						1
גומא הפרקים?	Cyperus cf. articulatus	אגוזית					1		1
גומאיים	Cyperaceae	אגוזית				21	4		25
גרגיר הנחלים	Nasturtium	זרע			1	3	2		6
דמסון כוכבני	Damasonium alisma	זרע				1			1
ולריינית	Valerianella sp.	אגוזית					1		1
ורבנה רפואית	Verbena officinalis	פרודה	1	3		4			8
חלבלוב	Euphorbia sp.	זרע				2	2		4
חצצון חיצי	Sagittaria sagittifolia	פרודה				15	10		25
כדורן ענף	Sparganium erectum	אגוזית				3			3
כף-אווז	Chenopodium sp.	זרע	1			3	1		5
כף-זאב אירופית	Lycopus europaeus	פרודה				7	1		8
כף-צפרדע	Alisma sp.	זרע				8	1		9
כף-צפרדע	Alisma sp.	פרודה			2	11	1		14
מכבד הביצות	Cladium mariscus	אגוזית				3			3
נהרונית	Potamogeton sp.	אגוזית				13	3		16
נופר צהוב	Nuphar lutea	זרע		1		11	1		13
נורית המלל	Ranunculus marginatus	פרודה				1			1
נורית, תת-סוג בטרכיום	Ranunculus subgen. Batrachium	פרודה	1	4	3	175	39	1	223
ניידת החוף	Najas delilei	אגוזית			7	9			16
נימפאה לבנה/צחורה	Nymphaea alba type	זרע				1	1		2
נענע	Mentha	פרודה					9		9
סוככיים	Umbelliferae	זרעון		1		2			3
סולנום	Solanum sp.	זרע				2			2
סוף	Typha sp.	זרע					8		8

דגימה			ym/11/5	ym/11/6	ym/11/7	ym/11/8	ym/11/9	ym/11/10	סה"כ פירות וזרעים
מין	specie	איבר							
סלביניה צפה?	Salvinia cf. natans	מנבג				2	1		3
סלביניה צפה?	Salvinia cf. natans	נבג	9	7	4	33	4		57
סלקיים	Chenopodiaceae	פרי	2						2
ספלילה?	Hydrocotyle?	?				1			1
עוקץ-עקרב שרוע	Heliotropium supinum	פרוד ה				1			1
פטל קדוש	Rubus sanguineus Friv	אגוזית				2	2		4
פרע מסולסל	Hypericum triquetrifolium	זרע					2		2
ציפורניים	Caryophyllaceae	זרע	1						1
קרנן טבוע	Ceratophyllum demersum	אגוזית					1		1
שומר פשוט	Foeniculum vulgare	זרעון	1		2	24	5		32
שפתניים	Labiatae	פרוד ה	1		1	3			5
תאנה	Ficus carica	זרע				2	1		3
תת-בלתי מזוהים	/	/			1		3		4
סה"כ פירות וזרעים	**total seeds & fruits**		**18**	**18**	**21**	**440**	**112**	**1**	**610**
סה"כ טקסונים	**total taxa**		**8**	**6**	**9**	**32**	**24**	**1**	**45**

טבלה 4: בתי הגידול וטיפוסי התפוצה של ממצאי הזרעים והפירות שנמצאו במחקר זה (פינבורן-דותן ודנין, 1991; שמידע, 2005; Melamed, 1997).

דגימה					ym/11/5	ym/11/6	ym/11/7	ym/11/8	ym/11/9	ym/11/10	סה"כ פירות וזרעים
בית גידול		תפוצה	מין	specie							
יבש	עצים	/	אלון	Quercus sp.				1			**1**
יבש	עשבוניים	ים-תיכוני	נורית המלל	Ranunculus marginatus				1			**1**
יבש	עשבוניים	ים תיכוני	חלבלוב	Euphorbia sp.				2	2		**4**
יבש	עשבוניים	ים תיכוני, אירנו-טורני	פרע מסולסל	Hypericum triquetrifolium					2		**2**
יבש	עשבוניים	ים תיכוני, אירנו טורני	שומר פשוט	Foeniculum vulgare	1		2	24	5		**32**
יבש	עשבוניים	/	ולריינית	Valerianella sp.					1		**1**
לח	גדה	אירו-אסיה	ורבנה רפואית	Verbena officinalis	1	3		4			**8**
לח	גדה	טרופי	גומא הפרקים?	Cyperus cf. articulatus					1		**1**
לח	גדה	ים תיכוני ואירנו-טורני	דמסון כוכבני	Damasonium alisma				1			**1**

לח	גדה	ים תיכוני, אירו-סיבירי, אירנו-טורני?	חצצון חיצי	Sagittaria sagittifolia				15	10		**25**
לח	גדה	ים תיכוני, אירנו-טורני	פטל קדוש	Rubus sanguineus Friv				2	2		**4**
לח	גדה	ים תיכוני, אירנו-טורני/אירו-סיבירי	אגמון ימי/האגם	Scirpus lacustris/maritimus		2		55	10		**67**
לח	גדה	ים תיכוני, אירו-סיבירי	עוקץ-עקרב שרוע	Heliotropium supinum				1			**1**
לח	גדה	ים תיכוני, אירנו- טורני	תאנה	Ficus carica				2	1		**3**
לח	גדה	ים תיכוני, אירו-סיבירי, אירנו-טורני	כדורן ענף	Sparganium erectum				3			**3**
לח	גדה	ים תיכוני, אירו-סיבירי, אירנו-טורני	כף-זאב אירופית	Lycopus europaeus				7	1		**8**
לח	גדה	ים תיכוני/ אירו-סיבירי	ארכובית הכתמים	Polygonum cf lapathifolium				6	1		**7**
לח	גדה	צפוני, טרופי	גרגיר הנחלים	Nasturtium			1	3	2		**6**
לח	גדה	רב אזורי, טרופי	מכבד הביצות	Cladium mariscus				3			**3**
לח	גדה	/	אגמון	Scirpus sp.			1				**1**
לח	גדה	/	גומא	Cyperus sp.				2			**2**
לח	גדה	/	גומא א	Cyperus sp. a	1						**1**
לח	גדה	/	נענע	Mentha					9		**9**
לח	גדה	/	סוף	Typha sp.					8		**8**
לח	גדה	/	ספלילה?	Hydrocotyle?				1			**1**
לח	מים	אירו-אסיה וטרופי.	נורית, תת-סוג בטרכיום	Ranunculus subgen. Batrachium	1	4	3	175	39	1	**223**
לח	מים	אירו-סיבירי	סלביניה צפה?	Salvinia cf. natans	9	7	4	35	5		**60**
לח	מים	אירו-סיבירי - ים-תיכוני - אירנו-טורני	אלף-עלה משובל	Myriophyllum spicatum				8			**8**
לח	מים	אירו-סיבירי,ים תיכוני וטרופי	קרנן טבוע	Ceratophyllum demersum					1		**1**
לח	מים	ים תיכוני, אירו-סיבירי	נימפאה לבנה/צחורה	Nymphaea alba type				1	1		**2**
לח	מים	ים תיכוני,אירו-סיבירי,אירנו-טורני	נופר צהוב	Nuphar lutea		1		11	1		**13**
לח	מים	צפוני, טרופי	ניידת החוף	Najas delilei			7	9			**16**

לח	מים	/	נהרונית	Potamogeton sp.				13	3		**16**
סה"כ מינים					**5**	**5**	**7**	**27**	**22**	**1**	**35**
סה"כ ב"ג לח					**4**	**5**	**6**	**23**	**18**	**1**	**29**
סה"כ ב"ג יבש					**1**	**0**	**1**	**4**	**4**	**0**	**6**