Journal of the Israel Prehistoric Society 47 (2017), 5–32

An Extensive Neolithic/Chalcolithic Axe and Adze Workshop Found within a Paleolithic Extraction Complex at Mt. Reihan, Northeastern Galilee, Israel

Meir Finkel[1], Avi Gopher[2], Erez Ben-Yosef[3] and Ran Barkai[4]

[1] Department of Archaeology and Ancient Near Eastern Cultures, Tel Aviv University, Tel Aviv, Israel. finkel2010@gmail.com
[2] Department of Archaeology and Ancient Near Eastern Cultures, Tel Aviv University, Tel Aviv, Israel. agopher@post.tau.ac.il
[3] Department of Archaeology and Ancient Near Eastern Cultures, Tel Aviv University, Tel Aviv, Israel. ebenyose@post.tau.ac.il
[4] Department of Archaeology and Ancient Near Eastern Cultures, Tel Aviv University, Tel Aviv, Israel. barkaran@post.tau.ac.il

ABSTRACT

Bifacial tools, primarily axes and adzes, played a significant role in the adaptation and development of new socio-economic systems in Neolithic and Chalcolithic communities of the Levant. However, raw material extraction localities and workshops for their production are rare, and in most cases they are not associated with earlier (Paleolithic) extraction and reduction complexes. Here we report on a newly discovered, extensive bifacial workshop site at Mt. Reihan in northern Israel, which is situated within a large scale Paleolithic flint extraction and reduction complex. Based on the new finds, the production process of bifacial tools is reconstructed. The size and intensity of this workshop reflect the centrality of bifacial tools and the scale of investment in their production in Neolithic/Chalcolithic societies. Moreover, while several south Levantine axe production workshops have been found and studied, adze manufacturing workshops are a rare phenomenon. The infrequent re-use of Paleolithic landscapes for extraction by Neolithic/Chalcolithic communities is also considered.

KEYWORDS: Flint extraction, Workshop, Neolithic, Chalcolithic, Paleolithic, Axe, Adze

INTRODUCTION

During the Neolithic and Chalcolithic periods in the Levant (11,600–5,500 Cal BP), human societies underwent major socio-economic transformations, including the establishment of village life and agriculture. During the Pre-Pottery Neolithic (henceforth PPN) period, bifacial tools became an important component in the human toolkit. Neolithic and Chalcolithic bifacial tools are primarily associated with tree felling and the handling and processing of wood (*e.g.* Barkai 2005; Barkai and Yerkes 2008; Keeley 1983; Yerkes *et al.* 2003, 2012; Yerkes and Barkai 2013).

Barkai (2005: 80) divided Neolithic and Chalcolithic bifacial tools into three types: axes, adzes and chisels. Axes and adzes, according to Barkai (2011), not only had functional importance but were recognized as cultural markers with symbolic features within the newly developed socio-economic system.

The technological aspects of the manufacturing process of Neolithic/Chalcolithic bifacial tools have been widely discussed (*e.g.* Barkai 2005). Generally, the manufacturing process, following the procurement and transportation of the appropriate stone, consists of three main stages: 1) roughing-out, or pre-forming; 2) shaping and thinning the biface, and 3) an optional stage of a transversal blow or polish for shaping the working edge of the tool. The life history of the tool includes maintenance and resharpening stages (Barkai 1999).

The Reihania Adze and Axe workshop (RAW)

Below we introduce a new, large scale Neolithic/Chalcolithic bifacial workshop found recently in northern Israel along with the results of our study of the first two stages of bifacial production as represented by the new finds. In addition, we discuss the workshop's regional significance and its unique location within the extensive Paleolithic extraction and reduction complex of the entire Dishon area (Finkel *et al.* 2016).

The newly discovered site of the Reihania adze and axe workshop (henceforth RAW) is the first found in the southern Levant to contain intensive adze production and one of three axe/adze workshops found within a Paleolithic flint extraction site in the north of Israel. The extensive workshop provides a unique opportunity to study the early stages of the *chaîne opératoire* of Chalcolithic and Neolithic bifaces, when their use was particularly intense. RAW is the only axe/adze workshop that has been found to date in the Upper Galilee, Hula Valley and Golan Heights. It is situated 40 km northeast of the Lower Galilee Giv'at Rabi East, a Neolithic bifacial workshop that has been considered the northernmost one in Israel (Barzilai and Milevski 2015). In RAW we found two types of flint procurement activities: the exploitation of exposed nodules in the open space (henceforth: surface workshop) and the extraction of nodules embedded in limestone karrens, which creates tailing piles composed of broken pieces of limestone and flint reduction *debitage* (for details regarding the tailing pile phenomenon, see Gopher and Barkai 2011a; 2014). Tailing piles appear in many forms and sizes (see Finkel *et al.* 2016).

Goals and methodology of the study

The goals of this study are fourfold: 1) to describe the RAW workshop, focusing on the reduction stages of Neolithic/Chalcolithic bifacial tools; 2) to calculate the number of end-products transported from the workshop; 3) to compare the intensity of the two types of flint procurement activities found within the workshop area; 4) by means of geochemical analysis, to correlate the finds from the workshop with bifacial tools from a few Neolithic/Chalcolithic sites in northeast Israel.

In accordance with these goals, we employed a set of methods: 1) analysis of the multiple reduction stages by dividing the bifacial tools into four reduction stages (see below) and comparing them with those found at archaeological sites in the region; 2) calculating the ratio between rejected items found in the workshop and the end products transported from the site; 3) assessing the density of bifacial tools and total weight of the assemblages found in the two types of procurement activities sampled in the workshop (surface versus embedded nodules); 4) data collection regarding bifacial tools found in Neolithic/Chalcolithic sites in the Galilee, the Hula Valley and the Golan Height, in an attempt to correlate these with the finds from the workshop according to the basic type of flint (*i.e.* Eocene, Cenomanian, Turonian, *etc.*) and employ correlative geochemical analysis with two sites (Hagoshrim and Beisamoun) where bifacial tools were found in abundance.

Neolithic and Chalcolithic bifacial workshops in the Levant

The intensive use of bifacial tools during the Neolithic/Chalcolithic periods required systematic processes of flint procurement, mostly by quarrying (*e.g.* Barkai *et al.* 2007; Gopher and Barkai 2011b; Schyle 2007; Taute 1994) and specialized workshops for the production and maintenance of bifacial tools. However, it should be stressed that bifacial tools were also produced and maintained at almost every Neolithic and Chalcolithic site in the Mediterranean zone of the southern Levant (Barkai 2005).

Few Neolithic bifacial workshops were found in the Levant, and those that were found were mostly related to nearby flint sources. At Nahal Lavan 109 a ~3,500 m^2 PPN workshop was found that includes axes, axes in preparation and evidence for the maintenance and resharpening of axes. All items were deformed or damaged rejects (Barkai 2005: 122–127; Burian *et al.* 1976, 1999); most probably, successful products had already been transported elsewhere. At Mt. Carmel, Neolithic workshops were found within flint procurement locations (Point 355 Z [Ronen and Davis 1970]; Giv'at Mikhal [Wreschner 1963]; and Daliyat el-Carmel 3 [Barkai *et al.* 2006; Olami 1984: 147; Rosenberg *et al.*

2009]). A Neolithic workshop was also found at Metzad Mazal, near the Dead Sea. The focus there was on the production of axes as well as blades. This workshop, 3,000 m^2 in size, relied on a supply from the extensive flint extraction complex of Ramat Tamar (Barkai *et al.* 2007; Schyle 2007; Taute 1985, 1994). Another workshop was found at Tell Abu Hamid, Jordan, where bifacial tools were produced (Barberan 1997). Other bifacial tool workshops were recorded in Lebanon, near Beirut (Cauvin 1968: 246–253, 299–319), in the Nahal Besor area in the western Negev (Rosen 1987; Roshwalb 1981), in Kaizer Hill, central Israel (Grosman and Goren-Inbar 2010; Herzlinger *et al.* 2013) and Triangulation Point Q-1 in the Lower Galilee (Oshri *et al.* 1999). A Late Neolithic/Chalcolithic basanite quarry and axe workshop were found at Giv'at Kipod (Rosenberg *et al.* 2008; Rosenberg and Gluhak 2016; Shimelmitz and Rosenberg 2016). In Giv'at Rabi East, Neolithic workshops and refuse pits were discovered on top of flint outcrops (Barzilai and Milevski 2015). These pits contain the waste of bidirectional and unidirectional blade cores and a number of bifacial tools, mostly finished and unfinished cortical axes and adzes, attributed to the PPN.

Chalcolithic bifacial workshops for adze production are rare. One possible case is Khirbet Yoah (Lower Galilee, Shimelmitz and Mendel 2008) and another is the larnite quarry and workshop site at Har Parsa, Judean Desert, which covers ~10,000 m^2 and contains mostly larnite bifacial adzes (Vardi 2012, 2013, 2015). The RAW site described here is a combination of the more common Neolithic axe workshop and the relatively rare Chalcolithic adze workshop, as significant numbers of both axes and adzes in the process of being produced were retrieved.

To sum up, while Neolithic bifacial tool production in the region is known, Chalcolithic adze production is still obscure. Besides being a rare Chalcolithic flint adze manufacturing site, RAW is also significant in size (~40,000 m^2). A third unique feature of RAW is its location within a much wider late Lower/Middle Paleolithic extraction and reduction complex (Finkel *et al.* 2016).

Location and setting of RAW

RAW is located on a plateau above the Dishon Stream in the eastern Upper Galilee, northern Israel (Fig. 1). The Dishon flows east for 32 km, from Mt. Meron to the Hula Valley. The mountainous area includes several prominent erosion surfaces (plateaus) at altitudes of 650–750 m above sea level (asl), with peaks up to 830 m asl between them (Fig. 2). Geologically, the study area is dominated by Eocene limestone and chalk, mostly of the 400 m thick Lower Eocene Timrat formation, which is characterized by karrens containing large amounts of flint nodules (Levitte and Sneh 2013).

There is a perennial stream in the Dishon Valley with a few additional springs along its course. The Dishon Stream curves sharply to the east due to a Late Pliocene–Early Pleistocene tectonic shift (Yair 1962: 128). The Neolithic/Chalcolithic extraction and reduction activity took place within a wider Paleolithic complex. It is significant that the Lower and Middle Paleolithic surface, especially on the plateaus, is assumed to have been similar to the Holocene surface (following Brosh and Ohel 1981: 25; Ohel 1991: 161), although the incision of the Dishon Valley and its tributaries must have been shallower. The plateau topography is the main explanation for the lack of post depositional processes on the entire complex. We assume that climate conditions in the research area during interglacial phases were basically similar to those observed today (Brosh and Ohel 1981: 28–29; Ohel 1986: 30–31).

Previous archaeological studies of the Paleolithic period in the Dishon central basin include the biface "factory" site of the Baram Plateau (Turville-Petre *et al.* 1927), several Acheulean sites (Ohel 1986, 1990, 1991; Ronen *et al.* 1974 and see also Ronen 1991, 2006), and extensive late Lower Paleolithic/Middle Paleolithic flint extraction and reduction complex (Barkai *et al.* 2006; Finkel *et al.* 2016 and references therein; Gopher and Barkai 2006).

Earlier archeological studies regarding the Neolithic/Chalcolithic periods in the Nahal Dishon central basin include:

1. Ein-Miri/Khirbet Kharruba Epipaleolithic and Neolithic site (Prausnitz 1959; Shimelmitz *et al.* 2004) situated in the Dishon Valley bottom, two km southwest of RAW. The Neolithic finds at this site include 14 axes, three adzes and four chisels (Yerkes and Barkai 2013).
2. Neolithic flint extraction sites located in karstic cavities at the Dishon Valley bottom (Gopher and

Barkai 2006), 300–400 m from the site of Ein Miri.

3. Neolithic/Chalcolithic open-air sites on the Yiron Plateau (Fig. 2), where adzes and chisels were found (Khalaily *et al.* 2000), and Nahalit Chalcolithic cave site, located 1 km north of the Yiron Plateau (Frankel *et al.* 2001: 41–42, 96–97).

RAW is located in an extensive Lower/Middle Paleolithic flint extraction and reduction complex, which was divided for research purposes into eight localities (Finkel *et al.* 2016). Lithic assemblages from eight tailing piles (out of thousands of such piles, one from each extraction and reduction locality) were documented in a field survey and indicate mostly late Lower Paleolithic/Middle Paleolithic affinities and rarely Neolithic/Chalcolithic stray finds. The Paleolithic evidence indicates intensive extraction and reduction of large amounts of flint, far beyond what was probably needed for immediate local consumption (Finkel *et al.* 2016). It is interesting to note that an old man from the Circassian village of Reihania, 1.5 km east of RAW (Fig. 2), said that locals called the RAW area "*Kurum a-sawan*" in Arabic (the vineyard of flint), and that until the early 20th century

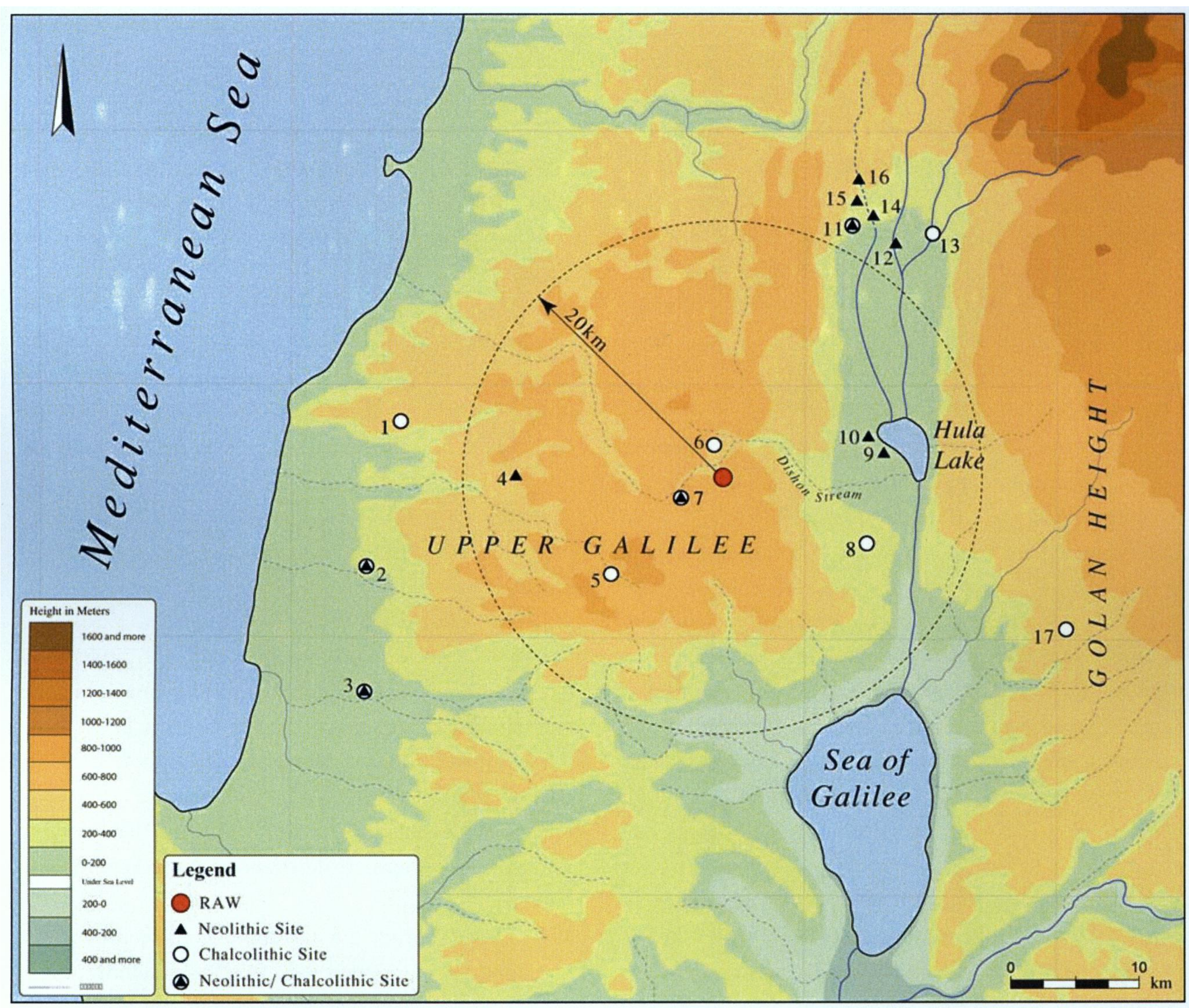


Figure 1. RAW and excavated/surveyed Neolithic/Chalcolithic occupation sites in its vicinity (for details see Table 1). **Upper Galilee**: 1) Sites in the area of Kibbutz Hanita ('En Eder, Biq'at Shefa); 2) Tel Kabri; 3) H. 'Uza; 4) H. Galil; 5) Peqi'in (burial site) ; 6) Mizpe Yiron; 7) Ein Miri/H. Kharruba; **Hula Valley**: 8) Tel Mashav; 9) Tel Te'o; 10) Beisamoun; 11) 'Ain Rawakhina-Kfar Gil'adi; 12) Hagoshrim; 13) Tel Turmus; 14) Qat/Kat; 15) 'Ein ha-Shomer; 16) Tannour/Hatanur; **Golan Heights**: 17) Rasem Harbush.

the flint was used for the manufacture of gunflint.

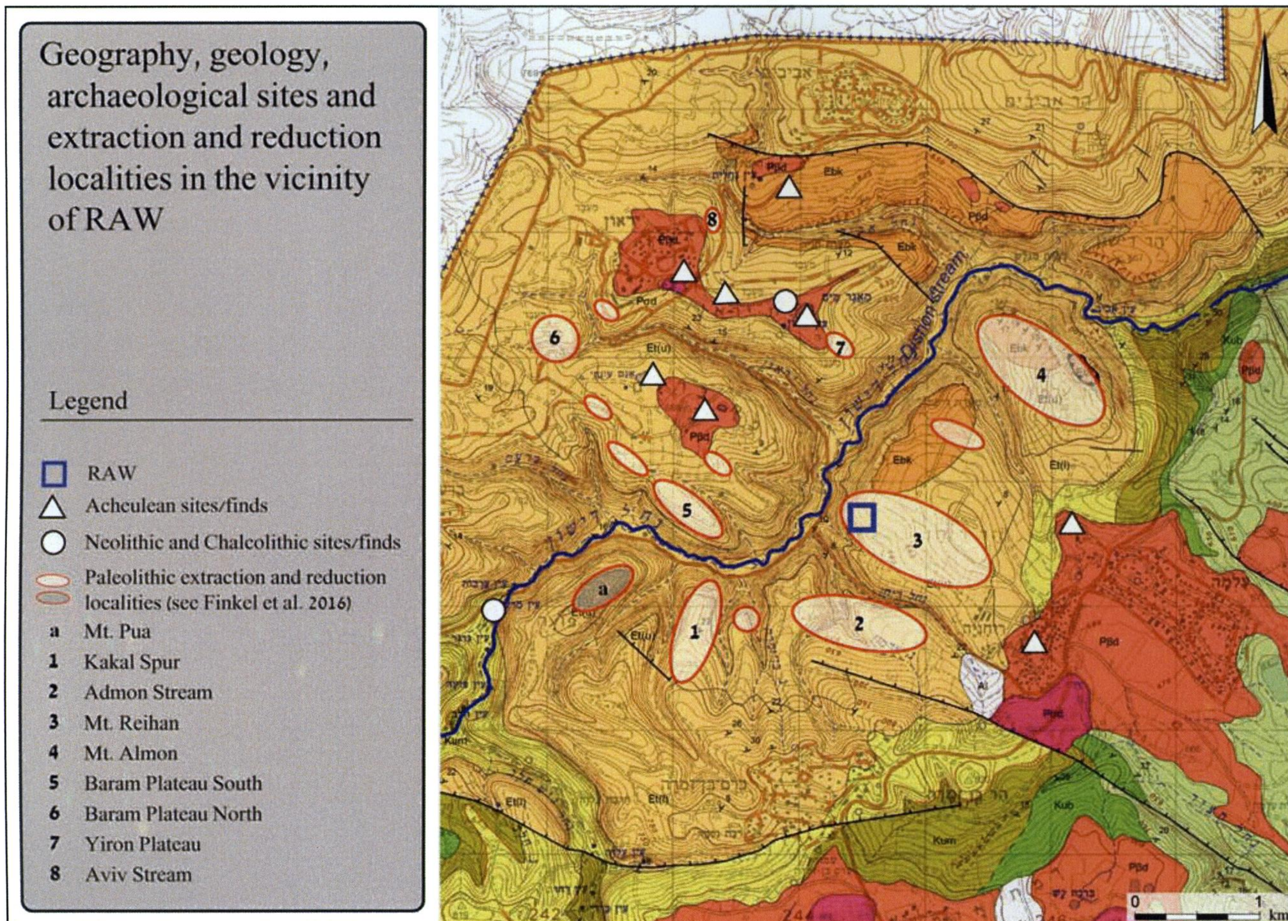
RAW was found in a survey conducted in 2014. Walking northwest of the Paleolithic extraction and reduction tailing piles (Finkel *et al.* 2016, locality 3) dozens of adze and axe roughouts were detected scattered on the ground unrelated to any specific tailing pile. Five piles containing Paleolithic and Neolithic/Chalcolithic finds were found farther to the north and west. Those initial observations triggered the field work described in this paper. The observation that both Paleolithic and Neolithic/Chalcolithic extraction and reduction activities took place in the same area also motivated this study, as this is a rare phenomenon in the Levant and elsewhere (see below).

Neolithic and Chalcolithic sites in Northern Israel—The potential distribution area of items produced at RAW

Aside from the nearby sites mentioned above, the most northern parts of Israel—the Upper Galilee, Hula Valley and Golan Heights to the east—host many Neolithic/Chalcolithic sites characterized by the presence of bifacial tools (see Fig. 1 and Table 1). In the Hula Valley, at the Neolithic/Chalcolithic Hagoshrim site (20 km from RAW) 6,854 bifacial tools were collected (Barkai 2005: 76) and more were recovered during excavations (Rosenberg *et al.* 2008, 2010). At the Neolithic site Beisamoun (12 km from RAW) 5,894 bifacial tools were collected from the surface (Barkai 2005; Bocquentin *et*

No	Site	Period	Flint axe/adze	Source
1	Sites around Kibbutz Hanita ('En Eder, Biq'at Shefa, and more)	PPN? PN? Chal, L. Chal	79 axes and adzes	Ronen 1968
2	Tel Kabri	PPN, PN, E. Chal, Chal	23 axes, 2 adzes	Marder *et al.* 2002: 303
3	H. 'Uza	PPN, PN, E. Chal, Chal, L. Chal	7 adzes, 3 axes/chisels in stratum 16–18, C7-C8	Getzov *et al.* 2009: 88
4	H. Galil	PPN	Few axes	Gopher 1997
5	Peqi'in (burial site)	E. Chal, L. Chal	17 adzes,1 axe	Getzov 2013
6	Mizpe Yiron	E. Chal, L. Chal	Few adzes	Khalaily *et al.* 2000
7	Ein Miri (H. Kharruba)	PPN, PN, (E. Chal, Chal, L. Chal)	14 axes, 3 adzes	Yerkes and Barkai 2013; Prausnitz 1959
8	Tel Mashav	PPN, PN	6 axes	Stefanski 1993
9	Tel Te'o	PPN, PN, Chal	17 adzes, 18 axes/chisels	Gopher and Rosen 2001: 52
10	Beisamoun	PPNB, PN	5,894 (4,895 axes, 162 adzes, 551 chisels	Barkai, 2005: 76; Khalaily *et al.* 2015
11	'Ain Rawakhina – Kfar Gil'adi	PN, E. Chal	Few adzes	Kaplan 1966
12	Hagoshrim	PPNB, PN, Chal	6,854 axes and adzes	Barkai 2005: 76
13	Tel Turmus	Chal	Few adzes	Dayan 1969; Marder *et al.* 1988
14	Qat/Kat	N	13 axes	Lechevallier and Dollfus 1973
15	'Ein ha-Shomer		7 axes	
16	Tannour/Hatanur		79 axes	
17	Golan sites mainly in Rasem Harbush	Chal	66 adzes, 12 axes	Noy 1998: 284

Table 1. Excavated/surveyed Neolithic/Chalcolithic occupation sites in the Upper Galilee, Hula Valley and Golan Heights.



STRATIGRAPHY סטרטיגרפיה

SYSTEM תקופה		SERIES - STAGE סדרה - דרגה	SYMBOL סימן	THICK. m עובי מ'	LITHOLOGY מסלע	LITHOSTRATIGRAPHY ליתוסטרטיגרפיה: MAPPING UNITS יחידות מיפוי		GROUP חבורה
QUATERNARY קוורטר		HOLOCENE הולוקן	Al	2+		Alluvium, colluvium, soil אלוביום, קולוביום, קרקע		
TERTIARY טרציאר	NEOGENE ניאוגן	PLIOCENE פליוקן	Pτsd			Dalton Scoria & Tuff סקוריה וטוף דלתון		
			Pβd			Dalton Basalt בזלת דלתון		
	PALEOGENE פליאוגן	EOCENE אאוקן	Ebk	100+		Bar Kokhba Formation תצורת בר כוכבא		AVEDAT עבדת
			Et(u)	100-150		Timrat Formation Upper Memeber תצורת תמרת פרט עליון		
			Et(l)	100-200		Timrat Formation Lower Memeber תצורת תמרת פרט תחתון		
		PALEOCENE פלאוקן	KTmgt	42-110		Mishash (chalk), Ghareb & Taqiye fms. תצ. מישאש (קירטון), ע'רב וטקייה		MOUNT SCOPUS הר הצופים
		SENONIAN סנון	Kum: Kuma	61		Menuha Fm. תצורת מנוחה	Ahihud Mbr. (incl. Kabri Marl)	
			Kum: Kumh				Har Zefat Mbr.	
		TURONIAN טורון	Kub	0-30		Bina Formation תצורת בענה		
			Kuyi	0-20		Yirka Formation תצורת ירכא		
			Kuy	0-40		Yanuh Formation תצ. ינוח		
			Kusa	142		Sakhnin Formation תצורת סחנין		

Figure 2. RAW area in its geographical, geological and archaeological context (geological map: Levitte and Sneh 2013).

al. 2011; Lechevallier 1978). These very large numbers of bifacial tools collected from two sites in the Hula Valley reflect intensive tree felling and woodworking activities during Neolithic/Chalcolithic times (Barkai 2005). Other Neolithic/Chalcolithic sites known from the Hula Valley are Tel Turmus, Tel Te'o, Kefar Gil'adi, Tannour/Hatanur, Qat/Kat, 'Ein ha-Shomer (see Fig. 1 and Table 1), Tel Ro'im West (Nadel and Nadler-Uziel 2011), and at several of these sites bifacial tools appear in the dozens. Farther to the east are the Golan Heights Chalcolithic sites (adzes were found mainly in Rasem Harbush, Noy 1998: 270–271). To the west and south, Neolithic/Chalcolithic sites containing bifacial tools include Hanita (Ronen 1968), Peqi'in Cave (Getzov 2013), Horvat 'Uza (Getzov *et al.* 2009: 88), Tel Kabri (Marder *et al.* 2002: 303) (see Fig. 1 and Table 1) and more (Frankel *et al.* 2001). It is interesting to note here the presence of adzes at the Chalcolithic burial site of Peqi'in and the possibility that they might have been ritually "destroyed" (Barkai 2005: 268–271; Getzov 2013), highlighting the symbolic and social significance of bifacial tools in Chalcolithic societies.

All these sites are potential destinations for the large scale distribution system of bifacial tools originating from RAW, which is the only Neolithic/Chalcolithic workshop found to date on the Eocene strip running north to south in the eastern Galilee. Relatively small patches of Eocene limestone and chalk formations are found in the northern Golan Heights and in the western Upper Galilee, but no significant extraction and reduction activities have yet been noticed there.

METHODS

The field work described here was conducted during May, 2015, and focused on Neolithic/Chalcolithic extraction activities. The workshop area, defined by the presence of bifacial roughouts, is about 40,000 m^2 (Fig. 3a, marked in black). The area includes two types of Neolithic/Chalcolithic flint procurement activities: 1) a surface workshop where knappers exploited the loose nodules naturally exposed and available on the plateau's surface (Figs. 3d, 4a); and 2) designated and focused procurement activity characterized by the formation of tailing piles of extraction debris, on which flint knapping took place (tailing piles, Figs. 3c, 4c). In this research we applied a similar collection methodology of items to both types of procurement activities (see below). A 900 m^2 area was randomly selected for surface collection (out of 40,000 m^2). The tailing pile selected for field work, designated as RAW 100, is one of five such piles within the workshop and is relatively large. In the area north of the RAW (see Fig. 3a), unused large flint nodules (up to 40 kg) can still be seen on the surface (Fig. 5).

Collection of items from the surface workshop (RAW 1–9)

Artifact collection from four 10 × 10 m squares, marked 1, 2, 4, 5 (Fig. 3b), was conducted by two persons in each square for one hour. All knapped items found on the surface were collected. However, the recovery was biased towards relatively large items (>2 cm). All participants in this survey were advanced students experienced in studying knapped stone industries.

The items found were divided into categories following accepted standards in lithic typology. In addition to the systematic recovery from the four squares, a collection focused solely on bifacial roughouts was conducted in five additional 10 × 10 m squares (Fig. 3b, marked as 3, 6–8 and 9) for a duration of half an hour by two persons in each square. In order to detect earlier use of raw material, special attention was paid to handaxes and Levallois cores collected from those squares. Altogether, 900 m^2 were surveyed and collected (which is approximately 2.5% of the workshop's total area).

Collection of items from tailing pile RAW 100

The pile, which measured 12.3 × 18.0 m (Fig. 3b, c), is rich in knapped flint items. We systematically collected knapped items from a 2 × 2 m square at the center of the pile (Fig. 4c) for 20 minutes by four people of the same group. Only relatively large items (>2 cm) that were visible on the surface were collected. Following the designated collection of the selected 2 × 2 m square, nine people conducted a 15 minute selective survey of bifacial roughouts and Levallois cores on the rest of the pile surface.

Analysis of the reduction stages of bifacial tools

All recovered bifacial items were classified as roughouts (following Barkai 2005: 10–11, 80) and divided into four categories: axe roughouts, adze roughouts, general roughouts (*i.e.* undefinable as adze or axe, all definitions following Barkai 2005: 80) and Lower Paleolithic handaxes and/or handaxe roughouts. The axe and adze early-stage roughouts, which were made on flakes, were put aside in separated groups, since they demonstrate limited bifacial flaking only and thus could not be fully categorized as axes or adzes. The differentiation between adzes and axes was based on the cross section of the items. Axes have "lenticular cross section while adzes are characterized by plano-convex cross section" (Barkai 2005: 80, following Cauvin 1968: 138, and see the

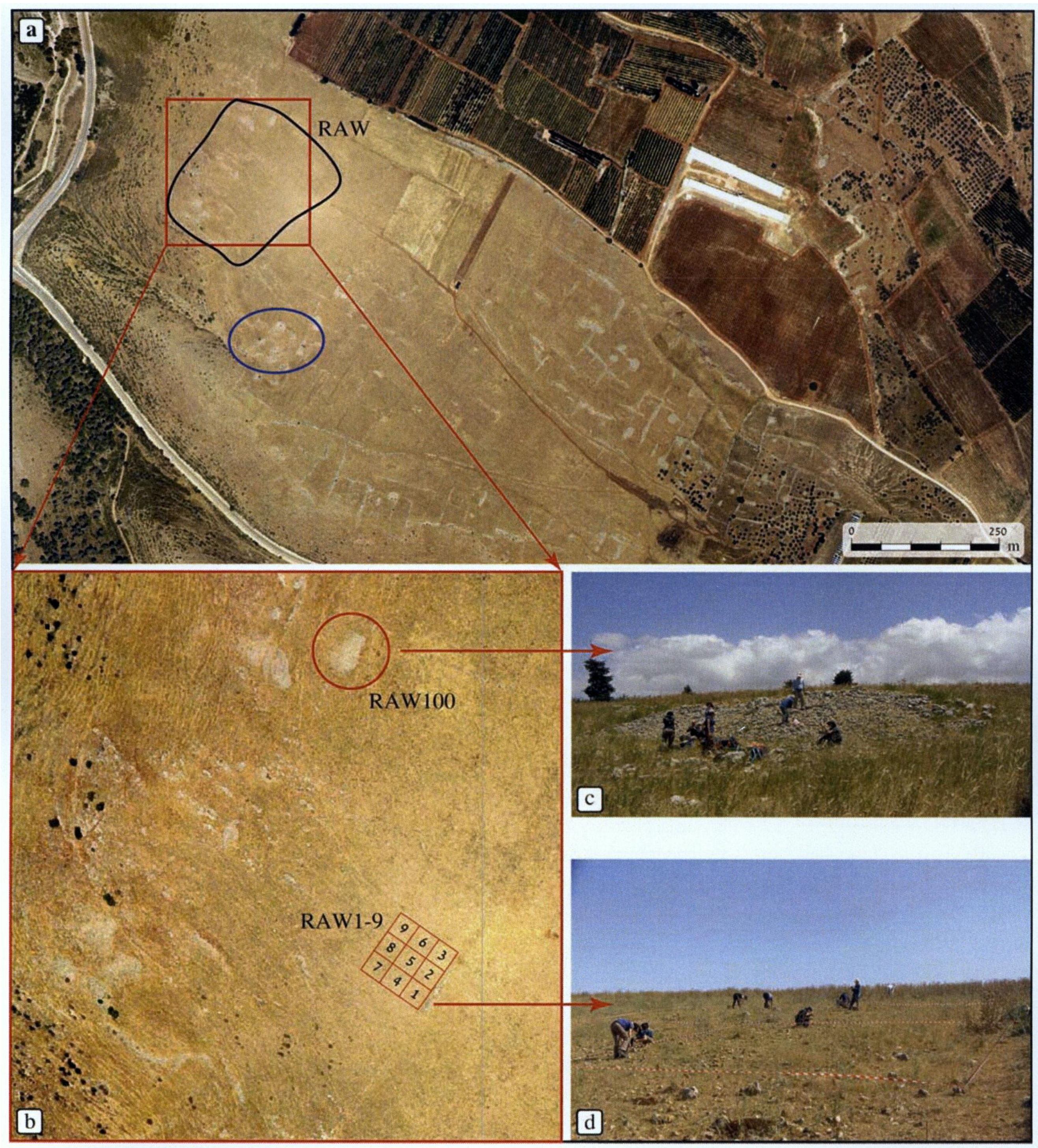


Figure 3. RAW research area. a) Aerial view of Mt. Reihan extraction and reduction locality. The black line marks the total area of RAW, the blue line marks Paleolithic extraction and reduction piles; b) RAW 1–9 surveyed squares (bottom) and RAW 100 tailing pile (top); c) RAW 100; d) RAW 1–9.

discussion of the history of these definitions therein). Due to the initial stage of reduction, in many cases the designation of roughouts as adzes or axes was not straightforward and those items were classified as best fitted the definition.

The bulk of the bifacially worked roughouts were divided according to four stages of the reduction and shaping process. These are based on Beck *et al.'s* (2002) roughout stages (henceforth **RO**) as follows:

RO1 is the first reduction stage, with relatively rough, large and coarse flaking scars. These are mostly massive items, some with large cortical surfaces. At this early stage the volume of the item is designed and the two flaking surfaces and bifacial ridges are initiated.

RO2 exhibits rough but smaller flaking scars, mostly de-corticated items with initial treatment of the shape of the biface and the relations between its two faces and working edge.

RO3 is an advanced stage of shaping the volume, surfaces and edges of the biface. Most of the items were relatively refined with precise removals aimed at adjusting the shape and other properties of the biface, most likely to enable polishing the working edge and facilitate hafting.

RO4 represents seemingly finished bifacial tools, almost ready to be polished. However, in most cases further modification and refinement was still required.

It should be noted that no biface with polished surfaces

Figure 4. a) Work at RAW 4 (front), 3 and 5 (back); b) Flint assemblage collected from RAW 4; c) 2 × 2 m square at RAW 100.

was recovered, and we assume that the finishing stage by polish was not conducted at the workshop. Most probably all of the bifaces described are rejects discarded at the workshop, while successfully designed bifaces were transported elsewhere. This is similar to the finds at Metzad Mazal, where only seven out of 111 roughouts were defined as fully shaped (yet unpolished) tools (Barkai 2005: 171) and most items were probably taken to the major habitation sites or to a place where running water was available for the polishing process (Barkai 2005: 18–20). Each item was weighed and measured for its length, width and thickness, number of scars and cortex coverage. Averages and standard deviations were calculated for each of the above mentioned parameters. We photographed five items from each reduction stage.

Geochemical analysis

In order to explore possible connections between RAW and Neolithic/Chalcolithic sites in the region we compared the geochemical composition of samples of 10 flint flakes from RAW 100 to 20 samples of knapped flint items from two occupation sites in the region—Beisamoun (10 broken axes) and Hagoshrim (10 small adzes) (*cf.* Fig. 1). The RAW 100 items were chosen according to two criteria: the absence of cortex and a minimal weight of 50 gr. The Beisamoun and Hagoshrim samples were selected based on visual attributes (beige color and a relatively smooth texture) which are common in flint in the entire Dishon area. We assumed they originated from Eocene formations following the work by Ekshtain *et al.* (2016) at Amud Cave.

All samples were analyzed geochemically, using Inductively Coupled Plasma Mass Spectrometer (ICP-MS, Agilent 7500Cx) at the geochemical laboratory of the Institute of Earth Sciences, Hebrew University of Jerusalem. For homogenizing the samples, each artifact was ground using Jaw Crusher (Retch BB100, tungsten components) and then Vibratory Disc Mill (Retch RS200, 700 rpm for one minute, tungsten components). The pulverized material went through a routine treatment of dissolution by HNO_3 and HF. The results (see below) were normalized according to Chondrite norms (values according to Piper and Bau 2013) and compared to data from other flint sources in the Galilee (Nathan *et al.* 1999).

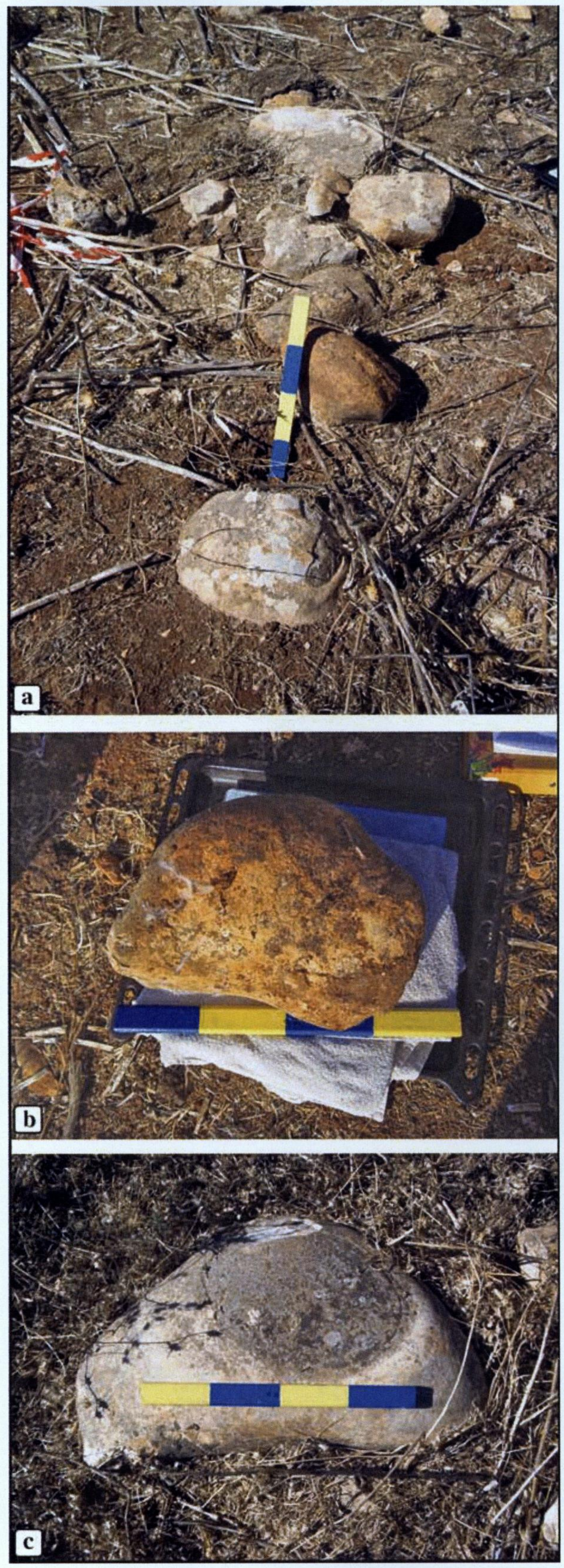


Figure 5. a–c) A few large flint nodules from the area 150 m north of RAW 1–9 (scale = 40 cm).

RESULTS

Items from the surface workshop (RAW 1–9)

RAW Squares 1, 2, 4, and 5 (comprehensively collected) yielded 2,272 knapped flint items including 80 bifacial roughouts, two handaxes and 15 Levallois cores (Tables 2 and 3). RAW Squares 3, 6, 7, 8 and 9 (selectively collected) yielded 80 bifacial roughouts and eight Levallois cores (Table 4). The total number of bifacial roughouts collected from nine RAW squares (1–9) was 162. These were divided into adze roughouts, axe roughouts, general roughouts and possibly Paleolithic roughouts (Table 5).

The artifacts retrieved from RAW 1–9 included:

Adzes roughouts: eighty one adze roughouts recovered from RAW Squares 1–9 (Fig. 6). Nineteen were made on flakes and two were broken. The 60 remaining roughouts were divided according to the four reduction stages (Fig. 7) and measured. Results show decreases in weight and width, length, thickness and cortex coverage along the reduction stages (Fig. 8: A–E). A slight increase is seen in the number of scars (Fig. 8: F).

Axe roughouts: Of the 56 axe roughouts recovered from RAW Squares 1–9 (Fig. 9), eight were made on flakes. The remaining 48 were divided according to the four reduction stages (Fig. 10). Results show decreases in weight, width, length, thickness and cortex coverage along the stages (Fig. 11: A–E). A slight increase is seen in the number of scars (Fig. 11: F). Axe roughouts on flakes are presented in Figure 12.

General roughouts: Seventeen (including six on flakes).

Levallois cores: Altogether 23 Levallois cores were collected (Fig. 13: 3, 4).

Handaxes: Altogether eight handaxes and handaxe roughouts were found exhibiting a combination of bifacial reduction, pointed ends and a rather oval form, compared to the typical elongated form of the axes and adzes (Fig. 13: 1, 2). Moreover, these items exhibit much more severe taphonomic damage (abrasion, patina, etc.) than the rest of the bifaces and resemble the Paleolithic artifacts found at Mt. Pua (Barkai and Gopher 2011).

Category of items	RAW 1	%	RAW 2	%	RAW 4	%	RAW 5	%	Total	%
Core *(Levallois core)*	49*(5)*	7.6	25*(4)*	5.5	30*(4)*	4.2	35*(2)*	7.8	139*(15)*	6.1
Large flake (10 cm and larger)	183	28.2	256	56.3	157	21.8	145	32.1	741	32.6
Flake (smaller than 10 cm)	171	26.4	71	15.6	400	55.7	192	42.6	834	36.7
Blade	20	3.0	30	6.6	25	3.5	32	7.1	107	4.7
Tool*	194	30.0	49	10.7	71	9.9	37	8.2	351	15.5
Chunk†	31	4.8	24	5.3	35	4.9	10	2.2	100	4.4
Total	**648**	**100.0**	**455**	**100.0**	**718**	**100.0**	**451**	**100.0**	**2,272**	**100.0**

Table 2. Items collected from RAW 1, 2, 4, 5.
* including two possible Paleolithic handaxes (see Fig. 13), † including core trimming elements, special spalls and recycled items.

Category of items	RAW 1	%	RAW 2	%	RAW 4	%	RAW 5	%	Total	%
Retouched large flake	84	43.3	31	63.3	20	28.1	11	29.7	146	41.6
Retouched flake	89	45.9			30	42.3	4	10.8	123	35.0
Bifacial roughout*	21	10.8	18	36.7	21	29.6	22	59.5	82	23.4
Total	**194**	**100.0**	**49**	**100.0**	**71**	**100.0**	**37**	**100.0**	**351**	**100.0**

Table 3. Tools collected from RAW 1, 2, 4, 5.
* including two possible Paleolithic handaxes (see Fig. 13).

RAW Square	1	2	3	4	5	6	7	8	9	Total
Axe (on flake)	5(1)	8	3	9	5(2)	3(1)	4(1)	3(3)	8	56
Adze (on flake) [broken]	6(4)	6(2)	3(4)	8(3)	10[1]	3(2)	10	9(1)	6(3)[1]	81
General roughout (on flake)	2(3)	1	2	(1)	2	2(1)	2		(1)	17
Paleolithic roughout*		1	1		2	1		2	1	8
Total	**21**	**18**	**13**	**21**	**22**	**13**	**17**	**18**	**20**	**162**
Levallois core	5	4		4	2	1	4		3	23

Table 4. Bifacial roughouts and Levallois cores collected from RAW 1–9.
* including possible Paleolithic handaxes.

	Adze roughouts				Axe roughouts			
Stage of reduction	**RO1**	**RO2**	**RO3**	**RO4**	**RO1**	**RO2**	**RO3**	**RO4**
N	25	17	11	7	14	16	11	7
Average weight (gr)	814.3	436.3	282.0	281.1	589.6	481.7	337.1	256.4
Average length (cm)	16.4	14.3	12.9	12.4	15.2	14.6	13.1	12.9
Average width (cm)	8.4	6.5	5.7	5.8	8.8	8.1	7.0	5.9
Average thickness (cm)	6.0	4.8	3.8	3.7	5.7	4.6	4.0	3.3
Average cortex coverage (%)	12.1	8.6	4.5	0.7	25.3	3.2	1.2	0.7
Average no. of scars	16.0	14.9	18.7	19.7	13.6	16.9	17.9	22.4

Table 5. Adze and axe roughouts from RAW 1–9, arranged according to stages RO1–4.

Figure 6. Adze roughouts from RAW 1–9.

Figure 7. Adze roughout reduction stages from RAW 1–9. 1) RO1; 2) RO2; 3) RO3; 4) RO4.

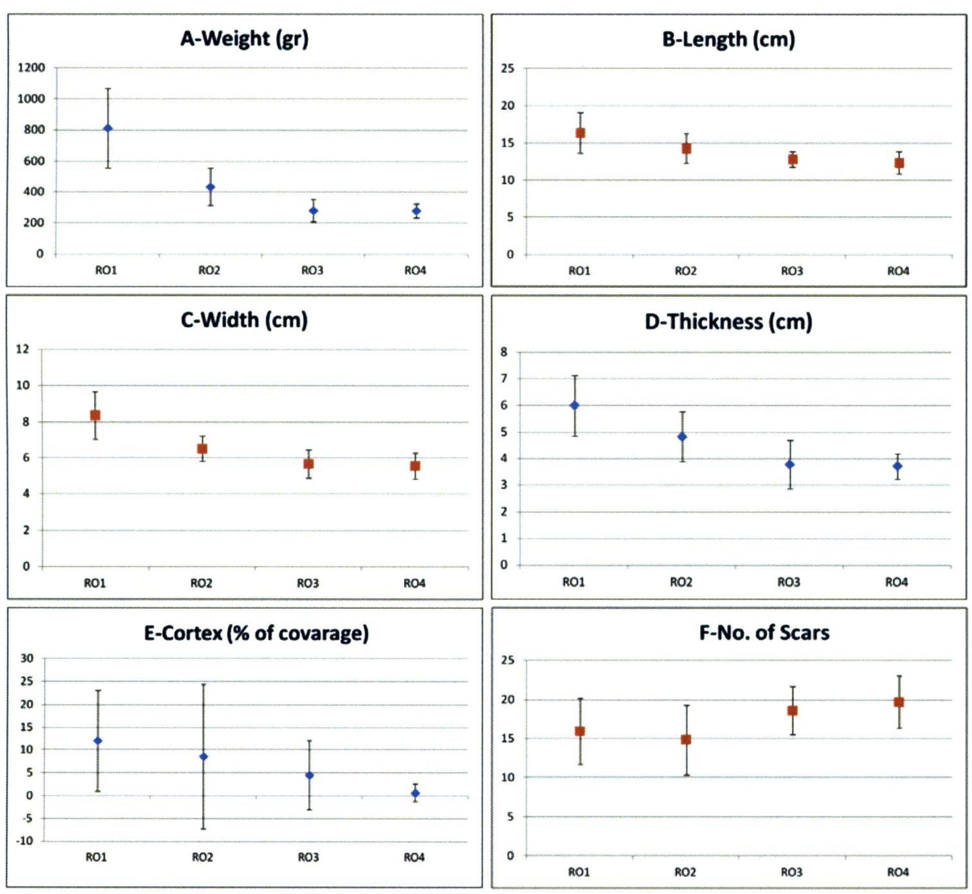


Figure 8. A–F) Mean value and standard deviation of adze roughout parameters.

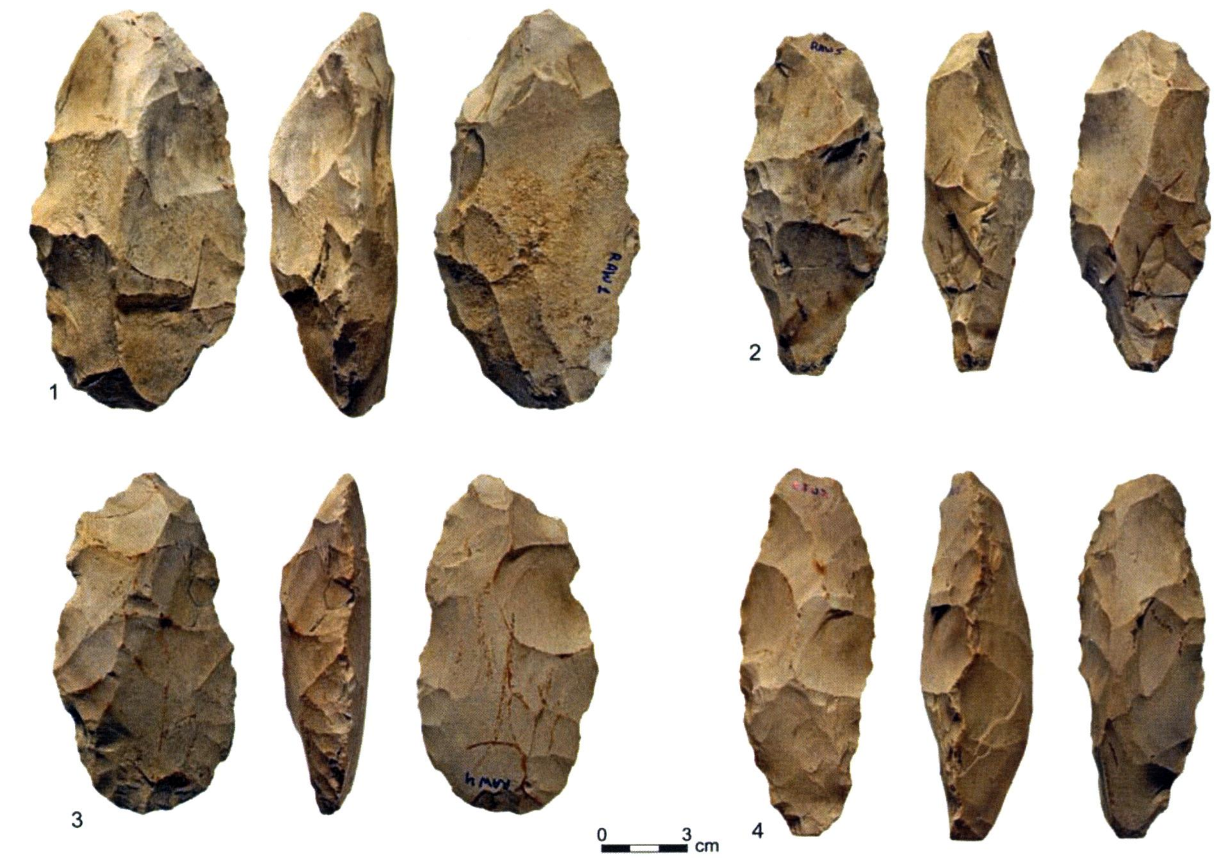


Figure 9. Axe roughouts from RAW 1–9.

Figure 10. Axe roughout reduction stages from RAW 1–9. 1) RO1; 2) RO2; 3) RO3; 4) RO4.

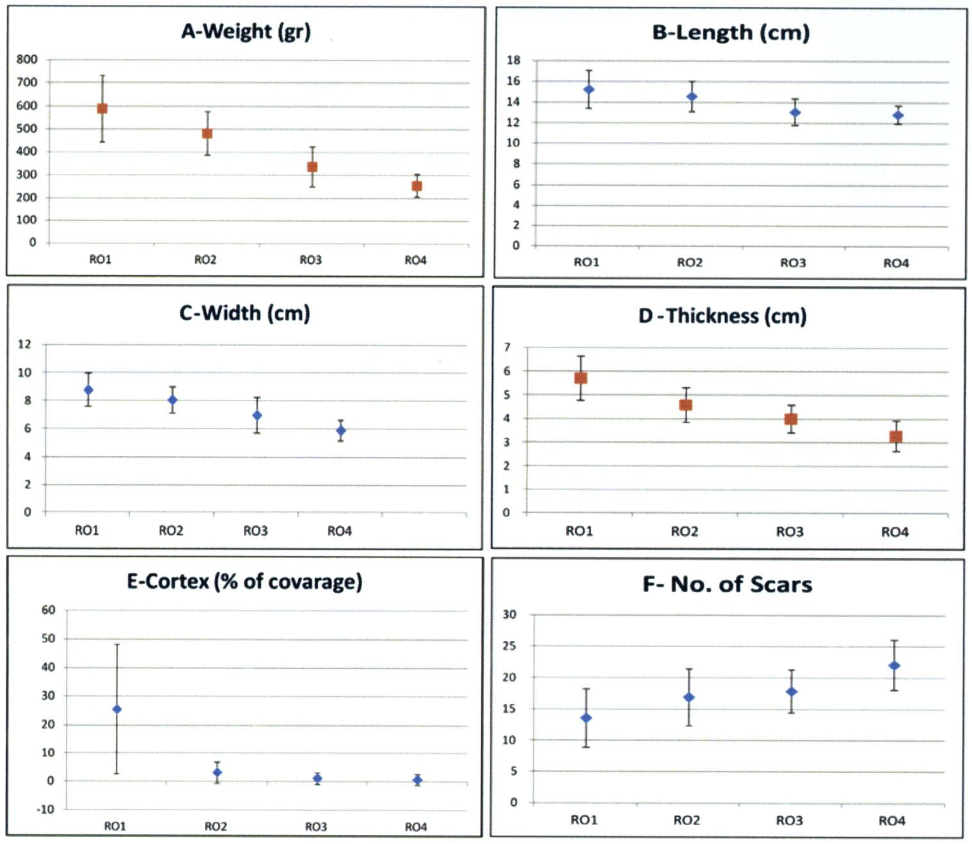


Figure 11. A–F) Mean value and standard deviation of axe roughout parameters.

Figure 12. Axe roughouts on flakes.

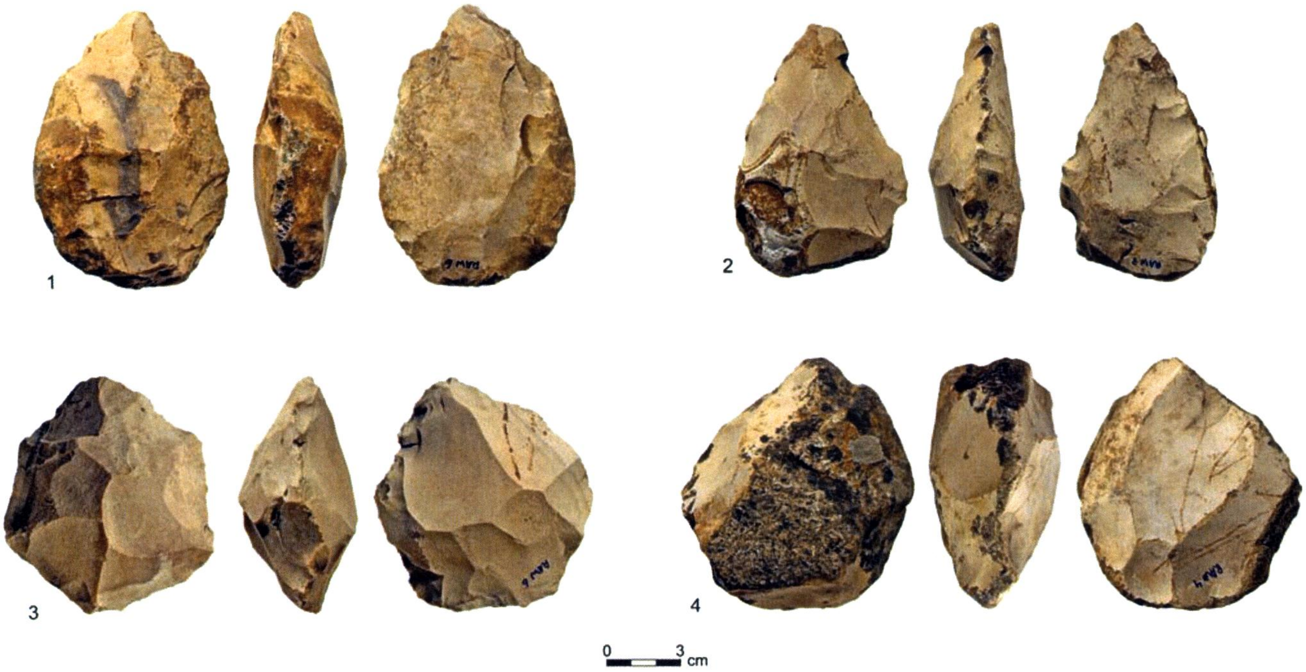


Figure 13. 1–2) two handaxes from RAW 1–9; 3–4) two Levallois cores from RAW 1–9.

Items from tailing pile RAW 100

The lithic collection from RAW 100 2 × 2 m square yielded 324 knapped flint items including nine bifacial roughouts (Table 6). The finds from the remaining surface of the pile include 29 bifacial roughouts (Fig. 14) and seven Levallois cores (Fig. 15). The 38 roughouts were divided into four categories: 17 adze roughouts, 16 axe roughouts, one general roughout and four early roughouts. The number of items in each reduction stage was too small for quantitative analysis (out of 17 adzes, RO1: 5; RO2: 6; RO3: 3; RO4: 0; 3 on flake; out of 16 axes, RO1: 6; RO2: 8; RO3: 1; RO4: 0; 1 on flake).

Extraction intensity differences between RAW 1, 2, 4, 5 and RAW 100

In order to compare extraction and reduction intensity between RAW 1, 2, 4, 5 and RAW 100, we weighed the collected knapped flint (debitage, tools and roughouts) in all locations. Then we compared the ratio of knapped flint weight per 1 m^2 between locations. The results (Table 7) show that extraction and reduction intensity in pile RAW 100 is ~6.5 times higher than in RAW 1, 2, 4, 5. A comparison of the total number of flint items between the same locations shows a ratio of 14.3:1. A comparison of the Paleolithic and later Neolithic/Chalcolithic RAW 100 extraction and reduction pile to three other Paleolithic extraction and reduction piles in the entire Dishon complex (Table 8) demonstrates a significant difference in intensity.

Both the surface workshop and the tailing pile include an interesting distinctive Paleolithic component of Levallois cores. RAW 1–9 and RAW 100 show a similar density of Levallois cores (average density of Levallois cores for RAW 1–9 is 2.55/100 m^2 [Table 4] and for

All knapped items		
Category	**Number**	**%**
Core	12	3.7
Large flake (10 cm and larger)	48	14.8
Flake (< 10 cm)	182	56.2
Blade	16	4.9
Tool	53	16.3
Chunk	13	4.1
Total	**324**	**100.0**
Tools		
Retouched large flake	5	9.4
Retouched flake	39	73.6
Bifacial roughout	9	17.0
Total	**53**	**100.0**

Table 6. Knapped items and tools collected from 2 × 2 m in the center of RAW 100.

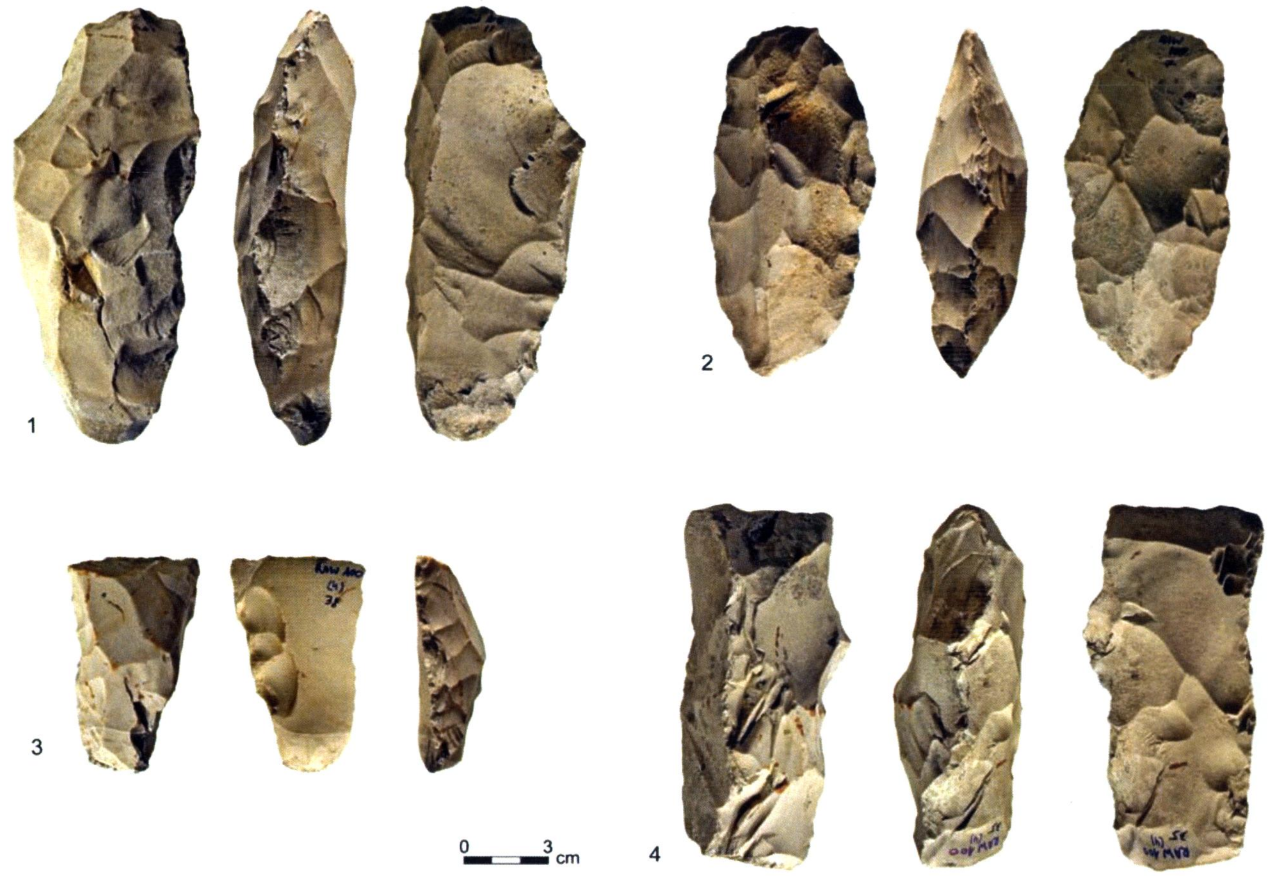


Figure 14. Axe and adze roughouts from RAW 100.

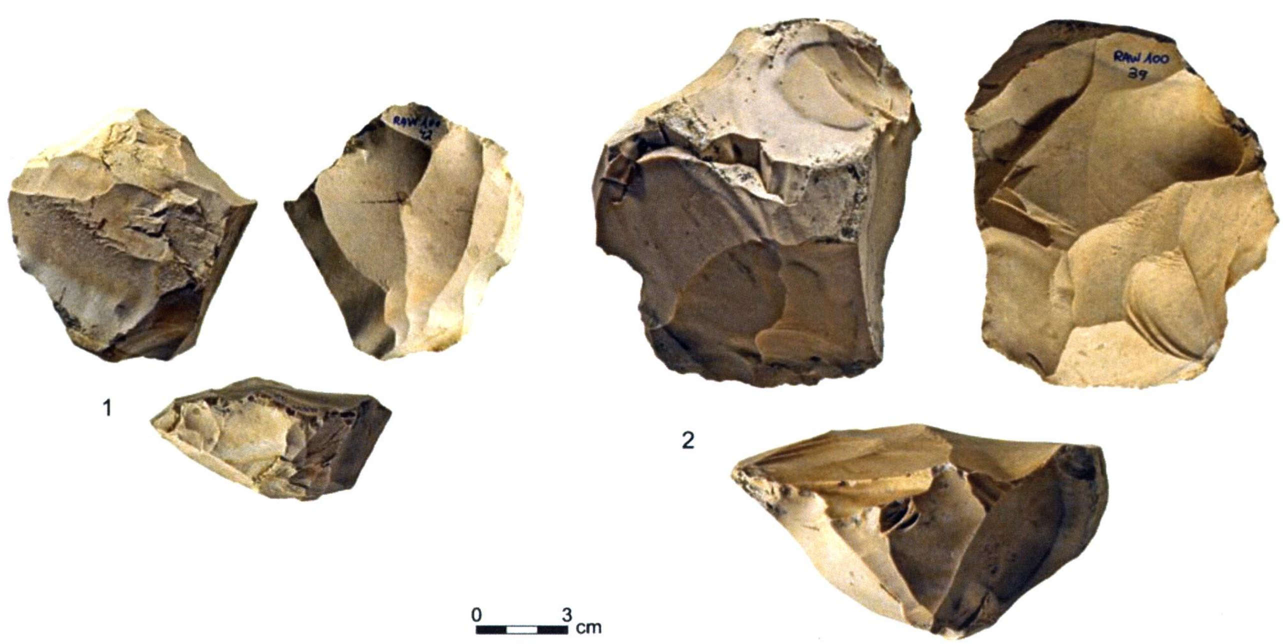


Figure 15. Levallois cores from RAW 100.

	RAW 1 (100 m^2)	RAW2 (100 m^2)	RAW 4 (100 m^2)	RAW 5 (100 m^2)	RAW 1, 2, 4, 5 Average (100 m^2)	RAW 100 (4 m^2)	RAW 100 normalized to 100 m^2	RAW 100/ RAW 1, 2, 4, 5
Knapped flint in kg	134.4	118	142.1	95.6	122.5	32.1	802.5	6.5
Knapped flint items	648	455	718	451	568	324	8,100	14.3

Table 7. Comparison of knapped flint weight and number of items between squares 1, 2, 4, 5 and RAW 100.

	RAW 100 (4 m^2)	Pile in Dishon locality 5 (Fig.2)(4 m^2)	Pile in Dishon locality 6 (Fig.2)(4 m^2)	PW3—Square G 24 (Mt. Pua) [Barkai and Gopher 2011] (4 m^2)
Knapped flint in kg	32.1	23.7	24	-
Knapped flint items	324	195	128	149

Table 8. Comparison of knapped flint weight and number of items (all retrieved from 4 m^2 of surface collection) between RAW 100 and three Paleolithic extraction and reduction piles in the entire Dishon complex.

RAW 100 is 3.5/100 m^2). Early bifacial roughouts were identified only at the surface workshop of RAW 1–9.

Geochemical analysis

The data presented in Fig. 16 show a difference in the Rare Earth Elements (REE) pattern between Eocene flint (Timrat formation) of the Dishon basin and the Western Galilee, and other non-Eocene flints, thus present a clear geochemical fingerprint of the Timrat formation. The data demonstrate the geochemical similarity between bifacial flint items from the Neolithic site of Beisamoun, the Chalcolithic/late PN site of Hagoshrim, and the flint reduction debitage at RAW. Combining these data with the abundance of bifacial tools at those sites suggests that RAW was, most probably, one of their major sources.

DISCUSSION

In the following discussion we will briefly touch on the reduction sequence/stages of bifacial tools and the intensity difference between RAW 1, 2, 4, 5 and RAW 100. We will then focus on the implications of the number of exported items from RAW. We will use a geochemical based correlation between the workshop and relevant archaeological sites in the Hula Valley to evaluate the probable extent of the area to which items from RAW were distributed. Finally, we will discuss two unique characteristics of RAW: 1) its location within a larger Paleolithic extraction and reduction complex; and 2) the use of exposed flint nodules rather than "freshly" extracted flint. When considered together, we suggest that these attributes reflect the important role of RAW as a major flint source for bifacial tools during the Neolithic/Chalcolithic periods in Northern Israel (as defined above).

The axe/adze reduction processes at RAW

We hereby discuss the reduction stages found at RAW compared to bifacial tools found at occupation sites. The last reduction stage we defined at RAW (RO4) is characterized by an average roughout weight of 281 gr and a thickness of 3.7 cm for adzes and 256 gr and a thickness of 3.3 for axes. Thickness was measured at the mid-length of the bifacial item. Equivalent measures at a few sites in the Hula Valley and Upper Galilee show lower values: at Beisamoun PPNB the average axe weight was 161 gr and thickness was 2.7 cm (Barkai 2005: 157–158); at Peqi'in burial cave the average adze weight is 145 gr and thickness is 2.5 cm (Barkai 2005: 270–271). Those values are still higher than the average of ten sites in Israel. PPNA axes: 37 gr and thickness of 1.5 cm; PPNB axes: 120 gr and thickness of 2.3 cm (see Barkai 2005: 313–316, and see details regarding the sites therein); Chalcolithic adzes: 96 gr and thickness of 2.4 cm (Barkai 2005: 334–338). We can conclude that in the case of RAW, although "rocks are heavy" (Beck *et al.* 2002), the roughouts transported from RAW were still 2–3 times heavier than the final end products and much heavier than the on-site discarded bifacial tools after a few cycles of use, resharpening, reuse, etc. From those numbers we can determine that a substantial amount of work awaited the knappers at the habitation sites, where they would be shaping the roughouts transported from RAW. While axe reduction processes in the Levant have already been documented (*e.g.* Barkai 2005 and references therein), here we briefly document the first adze reduction process.

Extraction intensity differences between RAW 1, 2, 4, 5 and RAW 100

The comparison of extraction and reduction intensity between the two types of procurement activity locales found at RAW raises a question. In the one hand, the comparison between bifacial roughouts per 100 m^2 is basically similar at both RAW 100 (38/218 m^2 = 19/100 m^2) and RAW 1–9 (18/100 m^2). On the other hand, the nine roughouts found in the 2 × 2 m square at RAW 100 add up to an extrapolated number of 225 roughouts per 100 m^2, more than ten times the number of roughouts found in a 100 m^2 of the surface workshop. This ratio is also demonstrated when comparing the weight of knapped flint in kg (6.5) or the total number of knapped flint items (14.3) (Table 7).

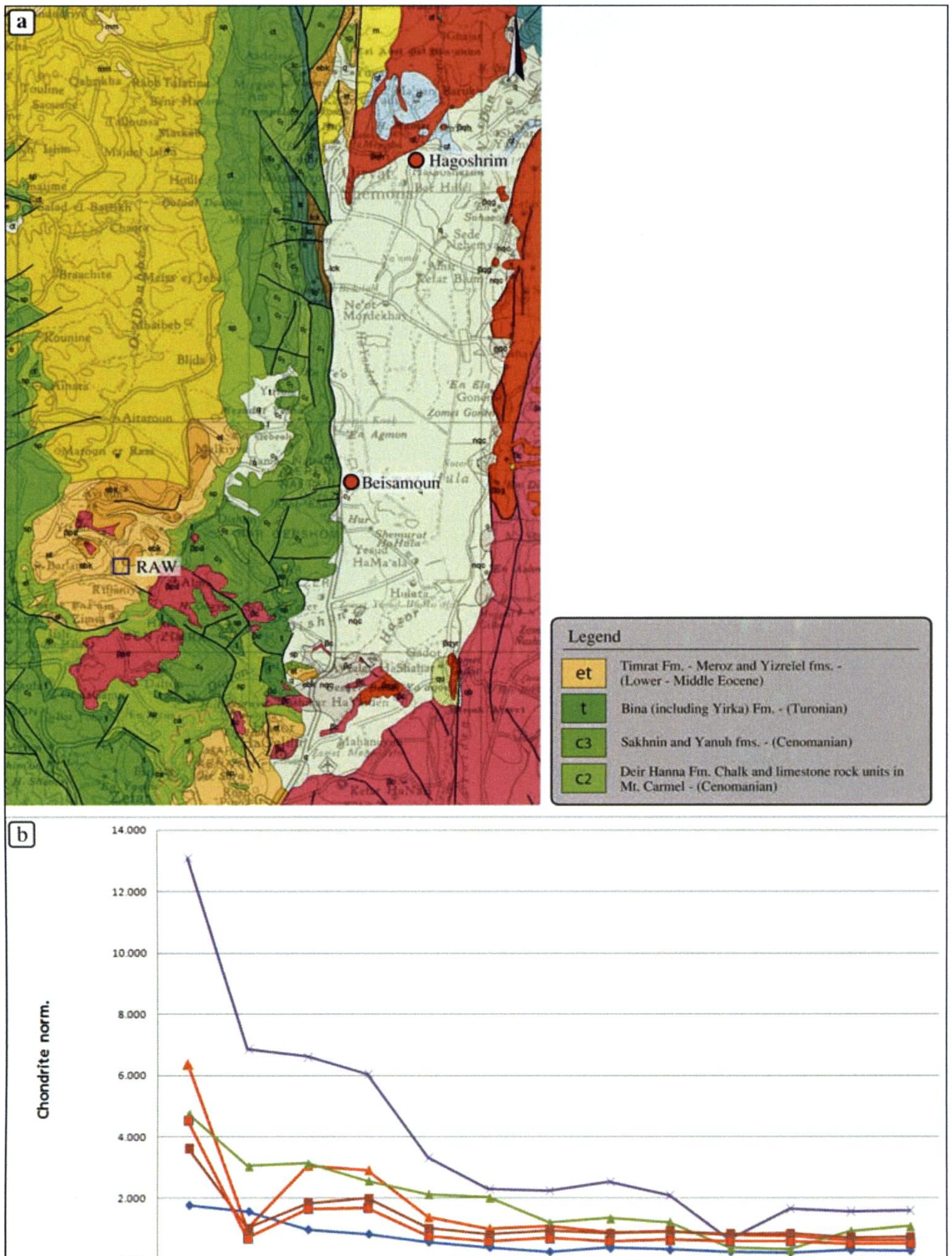
The significant differences in the average density of roughouts between the two types of procurement activities could be explained by a much higher knapping intensity on the pile RAW 100 than in the surface workshop, which suggests that the pile may have been the focus of knapping activity because of a concentrated extraction activity. In other words, the extraction area represented by the accumulation of the tailing pile supplied larger quantities of flint nodules than the nodules available at the surface workshop. Another possible reason for the higher number of knapped items found in the 2 × 2 m square at the pile (but not roughouts) might be the fact that the pile was more intensively used not only during the Neolithic/Chalcolithic but during Paleolithic times as well, thus accumulating large numbers of knapped items.

The amount of exported items from RAW

The Neolithic/Chalcolithic site of RAW covers an area of ~ 40,000 m^2, making it the largest known bifacial extraction and workshop site in Israel. For estimating the number of tools exported from RAW, we followed Schyle's (2007: 93–109) calculations for the Ramat Tamar Neolithic bifacial extraction and reduction complex.

Based on refitting studies, Schyle calculated that the ratio of waste weight/total raw material weight was 3:1 (75% waste). Then, by using the total weight of flint waste produced during the extraction and reduction processes, the number of abandoned axe roughouts and the weight of the roughouts ready to be exported (found to be very similar to ours: 275 gr in Ramat Tamar vs. ~256 gr for axes and ~281 gr for adzes [Table 5, RO4] in RAW), he calculated the exported roughouts to be between 50% to 64% of the total number of roughouts, a very low ratio in his view. In our case, 75% of an average waste weight of 122.5 kg/100 m^2 at RAW 1, 2, 4, 5 (Table 7) should provide 30 kg of roughouts; we found 20 roughouts/100 m^2 (Table 4) weighing ~10 kg (Table 5, average of 0.5 kg per roughout when including all RO stages), estimating ~20 kg for exported roughouts. This results in an average of ~70 roughouts (weighing ~275 gr [256–281] for exported roughouts) per 100 m^2. That means that the ratio of exports/rejects is 70/20 (or 77%), closer to Schyle's higher estimation of 64%. With an average of 18 bifacial roughouts per 100 m^2 (in RAW 1–9) and with the basic assumption that for every unsuccessful rejected roughout discarded at the workshop, 2–3 successful preforms were actually transported to their destination to become usable axes and adzes, we can estimate that the number of axes and adzes exported from RAW was in the thousands.

Based on the presumed large numbers of exported roughouts and the many Neolithic/Chalcolithic settlements in this region (presented above, see Fig. 1 and Table 1), and supported by our geochemical data (Fig. 16), we suggest that RAW was a main flint source for Neolithic/Chalcolithic communities in northern Israel. We cannot however rule out the use of other contemporary sources of Eocene flint since, for the time being, it is impossible to distinguish geochemically between different Eocene flint outcrops of the same formation. The intensity of extraction at RAW may be explained by both the high quality of the Eocene Timrat formation flint and the large number of Neolithic/Chalcolithic settlements in this region.



	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
RAW (Eocene)	6.375	1.031	3.057	2.920	1.394	1.022	1.118	0.904	0.924	0.801	0.785	0.652	0.648
Deir Hanna	1.781	1.578	1.000	0.842	0.571	0.405	0.258	0.392	0.333	0.270	0.238	0.313	0.278
Yanuh	4.750	3.056	3.154	2.579	2.143	2.027	1.226	1.373	1.233	0.405	0.333	0.938	1.111
Yirka	13.094	6.867	6.615	6.035	3.333	2.297	2.258	2.549	2.100	0.676	1.667	1.563	1.611
Hagoshrim	3.636	1.045	1.847	1.998	1.044	0.835	0.967	0.865	0.933	0.855	0.872	0.740	0.756
Beisamoun	4.520	0.718	1.665	1.693	0.791	0.616	0.712	0.608	0.657	0.609	0.623	0.526	0.536

Figure 16. a) Geological map with the RAW site, Beisamoun and Hagoshrim locations. Flint is found in the Eocene Timrat formation (designated as "et" on the map); Deir Hanna (C2 on the map) and Yanuh (C3 on the map) formations belong to the Cenomanian Age; Yirka formation (C1 on the map) belongs to the Turonian Age. b) A chondrite normalization based comparison between geological flint from different flint-bearing limestone formations in the Galilee, mentioned in a (data according to Nathan *et al.* 1999), flint from RAW site (Eocene flint), flint axes from Beisamoun and adzes from Hagoshrim. The Ce depletion and Pr rise pattern is also characteristic of the Eocene formation of the Amud Cave area, near the Sea of Galilee (Ekshtain *et al.* 2016).

The suggested distribution model of bifacial flint items from RAW to the Hula Valley in the eastern and the western Upper Galilee to the west may be supported by Shalem *et al.*'s (2013: Fig. 5) proposal that the Chalcolithic Hula ware was introduced to the western Upper Galilee through the Dishon Valley. Regarding Tel Te'o (Fig. 1), Gopher and Rosen (2001: 49) write, "We have no data concerning the sources of flint, but it is fair to assume that these lay to the west of the site in the mountainous region of the Eastern Upper Galilee," which is exactly the Dishon area. Regarding Beisamoun (Fig. 1), Khalaily *et al.* (2015: 12) suggested that "The immediate vicinity of the site offers various flint sources, mainly from the Eocene formation in the Naftali Hills. Most of the flint originates from these sources." The Naftali Hills are west of Beisamoun and have no Eocene formations. The Dishon area, 10 km to the west of the Naftali Hills, is the closest Eocene formation.

Based on geochemical analysis, Rosenberg and Gluhak (2016) attempted to correlate Miocene basanite sources from the Jezreel Valley (and specifically from the Giv'at Kipod quarry) and Miocene basanite bifacials from Neolithic sites in Israel.

They write:

> "Bifacial tools from Hagoshrim (Hag13) and Hatanur (HatA5) in the northern Hula Valley, and from Kabri (Kab1) and Yiftahel (Yif138) in the Galilee, were most probably derived from a single extraction site. Similarly, the bifacial tools from Beisamoun (BeisA36 and BeisA35) and Tel Turmus (TelTV3) in the Hula Valley also have a common source (fig. 7)". (Rosenberg and Gluhak 2016: 58).

We suggest that the idea of a central basanite extraction site is relevant in our case, too, with RAW as the central flint extraction site, although we do not ignore the option of other secondary sources.

It is worth noting that Eocene flint is mentioned as the source for the bifacial tools of the Golan Heights Chalcolithic (mainly from Rasem Harbush, Noy 1998: 270–271), as well as for the Neolithic bifacials at Hanita (Ronen 1968: 12), Neolithic Horbat 'Uza (Getzov 2009: 16–17), and the Neolithic of Tel Kabri (Marder *et al.* 2002) (see all in Fig. 1 and Table 1). The assignment is based on visual attributes of the flint, which the current study has demonstrated to be valid (see Fig. 16). In addition, Delage (2007) describes the Eocene formations as the most suitable flint source in the Galilee (in terms of quality, density and extraction accessibility). Thus, the preferable flint for Neolithic/Chalcolithic bifacial production in Northern Israel—from the Mediterranean Sea in the west, along the Upper Galilee to the Hula Valley and Golan Heights in the east—seems to be Eocene flint. With this preference in mind, and in light of the fact that RAW is the only Neolithic/Chalcolithic axe and adze extraction and workshop site known in these areas to date, the extensive extraction and reduction phenomena observed at RAW are easier explained.

Neolithic/Chalcolithic flint extraction and reduction activities within a Paleolithic extraction and reduction complex

The few large-scale (1 square km and above) Paleolithic stone extraction and reduction complexes known worldwide (in Libya, the Arabian Peninsula and South Africa) for the most part do not demonstrate later extraction and reduction activities. At Messak, Libya, Foley and Lahr (2015) indicate the "absence of significant evidence for Upper Palaeolithic or Later Stone Age occupation in the area." At Dawadmi, Arabian Peninsula, Jennings *et al.* (2015), note the very low post-Acheulean lithics. At Upper Karoo Acheulian quarries, South Africa, Sampson notes that "the paucity of younger, less patinated debris is puzzling" (Sampson 2006: 80). Post-Paleolithic extraction and reduction activity was not found at Isampur Acheulean quarry in India either (Petraglia *et al.* 1999).

This phenomenon of spatial separation or discontinuity in flint extraction and reduction is also reflected in the Holocene workshops of the Levant. Paleolithic extraction and reduction activities have not been found in any Neolithic/Chalcolithic Levantine sites, with the exception of the two sites listed in our introduction. The site of Giv'at Rabi East in the Lower Galilee has a combination of a Neolithic workshop (Barzilai and Milevski 2015) located close to a Middle Paleolithic workshop (Ekshtain *et al.* 2011; Yaroshevich *et al.* 2017). Daliyat el-Carmel 3 on Mt. Carmel, although quite disturbed by modern works, also exhibits a combination of Neolithic reduction activity focused on axe production within a Lower/ Middle Paleolithic extraction and reduction complex (Barkai *et al.* 2006 but see also Rosenberg *et al.* 2009). The site of Nahal Galim and Nahal Ornit on Mt. Carmel is another example of a late use (Epipaleolithic in this case) of an early Middle Paleolithic workshop (Rosenberg and Nadel 2009).

Topping's (2010) work on Neolithic mines and workshops in England presents data from ten Neolithic quarries, none of which present evidence of earlier Paleolithic extraction and reduction activities. Teather gives an explanation for this:

> "Prior to the Neolithic, surface outcrops and secondary deposits of flint and other hard rocks provided the raw material for stone tool production (Care 1979). However, from the start of the Neolithic a new approach was taken to extract flint through mining." (Teather 2011: 231).

Taking into account the most probable rise in human population densities in the Neolithic/Chalcolithic compared to the Lower Middle Paleolithic, and the fact that the Dishon area was populated in the course of this very long time span, we assume that the demand for good stone was a constant concern in the region for hundreds of thousands of years. We thus presume that the need for lithic raw materials during Neolithic/Chalcolithic times reached new heights. We also believe that Neolithic/Chalcolithic communities were familiar with the available flint sources as well as with the early (Paleolithic) extraction and reduction complexes in the region that were quite conspicuous and visible due to their topographical positions, and they indeed visited these ancient extraction sites, leaving behind stray evidence in the form of single bifacial tools (Finkel *et al.* 2016; Gopher and Barkai 2006). However, apart from these sporadic items, there is no evidence of substantial Neolithic/Chalcolithic exploitation of the ancient Paleolithic lithic sources, except in the case of RAW.

Given the available data worldwide, we cannot reject the hypothesis that the separation between Paleolithic and later Neolithic/Chalcolithic extraction and reduction operations was based on a decision of Holocene communities to avoid earlier extraction complexes for reasons that escape us at the moment. The rare case presented by RAW may be explained by the intensive Paleolithic extraction activities of the very high quality Eocene flint source (leaving only modest "virgin" outcrops in the entire region), and its proximity to the Hula Valley sites.

The use of exposed flint nodules vs. the use of freshly extracted flint

A second interesting aspect of RAW is the wide use of exposed nodules found on the Reihan Plateau (see Fig. 5). Exposed nodules (totally loose and resting on the ground) are found in the Dishon area in other extraction and reduction localities like Kakal spur, Baram north, and Mt. Pua (Fig. 2) but remained untouched, lying beside extensive extraction and reduction tailing piles bearing Paleolithic finds. It also seems that for Paleolithic knappers in the Dishon area, exposed nodules were better left untouched, while in the specific case of RAW, Neolithic/Chalcolithic knappers thought otherwise.

The mining of fresh flint rather than extracting surface pebbles/nodules (Topping 2010) in Neolithic England is supported by ethnographies from Australia. Binford and O'Connell (2007) describe observations on extraction work as follows:

> "He pointed to the weathering cracks and noted that the stone was "rotten," so that it broke with a "mind of its own." The cores that littered the surface of the quarry had all been weathered; they were thus considered unsuitable for making tools". (Binford and O'Connell 2007: 410).

Gould and Saggers (1985) describe four lithic sources found within the 24 km radius of Puntutjarpa Rock shelter at the Warburton Ranges:

> "At these localities, the Aborigines did not collect any of the white chert exposed in nodules on the surface, but dug into the ground to depths of less than one meter with digging-sticks to obtain lumps of unweathered chert. In 1966-1967 Aborigines were also observed collecting and using white chert from the hill near Mulyangiril Well, although there only surface material was taken". (Gould and Saggers 1985: 128). Burton (1984: 242) describes a similar phenomenon in Papua New-Guinea.

As far as we can tell, Neolithic communities in the Levant invested great efforts in extracting fresh flint nodules from primary bedrock contexts, as in the cases of Ramat Tamar (Schyle 2007; Taute 1985, 1994), Giv'at Rabi East (Barzilai and Milevski 2015), Mt. Gevim (Gopher and Barkai 2011b), 'Ain Ghazal (Quintero 1996) and Wadi el- Sheikh (Koehler *et al.* 2017; Weisgerber 1987).

Why then do we see in RAW an extensive use of surface nodules? Our suggestion is that the extensive Lower and Middle Paleolithic extraction exhausted the near-surface flint bearing karrens in the Dishon area. Today, only a few places show flint nodules (usually small ones) embedded within the limestone karrens in the Dishon extraction and reduction area (Finkel *et al.* 2016), yet fair numbers of nodules of various sizes can still be found on the surface. The need for relatively large nodules for the production of bifacial tools and the nearly exhausted resource of hard to get primary "fresh" large nodules may be the reason for the re-use of earlier exploited sites where natural nodules were found in abundance on the surface and the uncommon phenomenon of using exposed nodules at RAW could thus be explained. However, we should reiterate that exposed nodules are found in several other Paleolithic extraction and reduction localities in the area, and the choice of Mt. Reihan specifically as an extensive Neolithic/Chalcolithic workshop site is still to be understood.

CONCLUSIONS

This paper reports a newly discovered extensive Neolithic/Chalcolithic axe and adze workshop—RAW, located on the Mt. Reihan Plateau in northern Israel. The area contains high quality Eocene flint and is part of a large scale Paleolithic flint extraction and reduction complex. The production processes of bifacial tools can be traced from the complete nodule to the almost finished axe or adze. As in previously studied Neolithic extraction and reduction sites in the Levant, the size and intensity of the workshop found at RAW reflects both the centrality of the site in the bifacial production system of the region, the scale of investment in the production of these tools and the important role of bifacial tools in these societies. Thus, this paper contributes towards understanding the early stages of adze and axe production in the region while considering the rare case of re-using Paleolithic extraction sites by later Neolithic/Chalcolithic communities. As mentioned, the location of RAW makes it the only Neolithic/Chalcolithic axe and adze extraction and workshop site known to date in the Upper Galilee, Hula Valley and Golan Heights, in which many occupation sites from those periods are documented. This, together with new geochemical data and other considerations raised in this paper, suggests that RAW was a main source of Eocene flint for the entire region, and possibly part of a well-organized procurement and distribution system.

ACKNOWLEDGMENTS

The items from Beisamoun and Hagoshrim were generously provided by the Israel Antiquities Authority (IAA), and geochemically analyzed with the aid of Y. Erel and O. Tirosh of the Hebrew University of Jerusalem. We want to thank P. Shrago for the studio photography, I. Ben-Ezra for the graphics and B. Efrati for her wholehearted assistance in working on the figures.

REFERENCES

Barberan C.N.I. 1997. Troisateliers de taille de silex à Abu Hamid (Jordanie). In: Gebel H.G.K., Kafafi Z. and Rollefson G.O. (eds.), *The Prehistory of Jordan II. Perspectives from 1997. Studies in Early Near Eastern Production, Subsistence and Environment 4,* pp. 383–393. Berlin: Ex Oriente.

Barkai R. 1999. Resharpening and recycling of flint bifacial tools from the Southern Levant Neolithic and Chalcolithic. *Proceedings of the Prehistoric Society* 65: 303–318.

Barkai R. 2005. *Flint and Stone Axes as Cultural Markers: Socio-Economic Changes as Reflected in Holocene Flint Tool Industries of the Southern Levan, Studies in Early Near Eastern Production, Subsistence, and Environment Volume* 11. Berlin: Ex Oriente.

Barkai R. 2011. The evolution of Neolithic and Chalcolithic woodworking tools and the intensification of human production: axes, adzes, and chisels from the Southern Levant. In: Davis V. and Edmonds M. (eds.), *Stone Axe Studies III*, pp. 39–54. Oxford: Oxbow.

Barkai R. and Gopher A. 2011. Two flint caches from a Lower–Middle Paleolithic flint extraction and workshop complex at Mount Pua, Israel. In: Diaz del Rio P. (ed.), *2nd International Conference of the UISPP Commission on Flint Mining in Pre- and Protohistoric Times* (BAR International Series, 2260), pp. 265–274. Oxford: Archaeopress.

Barkai R., Gopher A. and LaPorta C. 2006. Middle Pleistocene landscape of extraction: Quarry and workshop complexes in northern Israel. In: Goren-Inbar N. and Sharon G. (eds.), *Axe Age – Acheulian Tool Making from Quarry to Discard*, pp. 7–44. London: Equinox.

Barkai R., Gopher A. and Weiner J. 2007. Quarrying flint at Neolithic Ramat Tamar: an experiment. In: Astruc L., Binder D. and Briois F. (eds.), *Technical systems and Near Eastern PPN Communities*, pp. 25–32. Antibes: Éditions APDCA.

Barkai R. and Yerkes R.W. 2008. Stone axes as cultural markers: technological, functional and symbolic changes in bifacial tools during the transition from hunter-gatherers to sedentary agriculturalists in the Southern Levant. *Prehistoric Technology* 40: 159–167.

Barzilai O. and Milevski I. 2015. Neolithic flint workshops at Giv'at Rabi East in the Lower Galilee. *Atiqot* 82: 1–21.

Beck C., Taylor A.K., Jones G.T., Fadem C.M., Cook C.R. and Millward S.A. 2002. Rocks are heavy: Transport costs and Paleoarchaic quarry behavior in the Great Basin. *Journal of Anthropological Archaeology* 21: 481–507.

Binford L.R. and O'Connell J.F. 1984. An Alyawara day: The stone quarry. *Journal of Anthropological Research* 40(3): 406–432.

Bocquentin F., Barzilai O., Khalaily H. and Kolska Horwitz L. 2011. The PPNB site of Beisamoun (Hula Basin): present and past research. In: Healey E., Campbell S. and Maeda O. (eds.), *The state of the stone: Terminologies, Continuities and Contexts in Near Eastern Lithics* (Studies in Early Near Eastern Production, Subsistence, and Environment 13), pp. 197–211. Berlin: Ex Oriente.

Brosh A. and Ohel M. 1981. Factors of habitat selection of Acheulean sites at Ramat Yiron, Israel. *Paléorient* 7(1): 23–31.

Burian F., Friedman E. and Mintz-Docter E. 1976. An early PPNB site in Nahal Lavan region. Site No. 109. *Mitekufat Haeven* 14: 50–60 (Hebrew with English summary).

Burian F., Friedman E. and Mintz-Docter E. 1999. Nahal Lavan 109 – A Pre-Pottery Neolithic site in the Western Negev, Israel. *Festschrift für Günter Smolla. Materialienzur Vor-und Frühgeschichte von Hessen* 8: 95–120.

Burton J. 1984. Quarrying in tribal societies. *World Archaeology* 16(2): 234–247.

Cauvin J. 1968. *Les Outillages Neolithiques de Byblos et du Littoral Libanais* (Fouilles de Byblos 4). Paris: Maisonneuve.

Dayan Y. 1969. Tell Turmus in the Huleh Valley. *Israel Exploration Journal* 19: 65–78.

Delage C. 2007. Chert availability in Israel and Palestine: A general assessment based on data from the Galilee. In: Delage C. (ed.), *Chert Availability and Prehistoric Exploitation in the Near East* (BAR International Series 1615), pp. 29–54. Oxford.

Eisenberg E., Gopher A. and Greenberg R. 2001. *Tel Te'o. A Neolithic, Chalcolithic and Early Bronze Age Site in the Hula Valley* (IAA Reports 13). Jerusalem: Israel Antiquities Authority.

Ekshtain R., Barzilai O., Inbar M., Milevski I. and Ullman M. 2012. Giv'at Rabi East, a new Middle Paleolithic knapping site in the Lower Galilee (Israel). *Paléorient* 37(2): 107–122.

Ekshtain R., Ilani S., Segal I. and Hovers E. 2016. Local and nonlocal procurement of raw material in the Amud Cave, Israel: The complex mobility of Late Middle Paleolithic groups. *Geoarchaeology*: doi.10.1002/gea.21585.

Finkel M., Gopher A. and Barkai R. 2016. Extensive Paleolithic flint extraction and reduction complexes in the Nahal Dishon central basin, Upper Galilee, Israel. *Journal of World Prehistory* 29: 217–266. doi.10.1007/s10963-016-9097-9.

Foley R.A. and Lahr M.M. 2015. Lithic Landscapes: Early human impact from stone tool production on the Central Saharan environment. *PloS ONE* 10(3): e0116482.

Frankel R., Getzov N., Aviam M. and Degani A. 2001. *Settlement Dynamics and regional Diversity in Ancient Upper Galilee – Archaeological Survey of Upper Galilee.* Jerusalem: Israel Antiquities Authority.

Getzov N. 2009. Strata 21–15, C8–C6: The Neolithic and Chalcolithic periods. *Horbat 'Uza: The 1991 Excavations. I: the Early Periods*. Jerusalem (IAA Reports 41), pp. 7–105. Jerusalem: Israel Antiquities Authority.

Getzov N. 2013. Flint assemblage. In: Shalem D., Gal Z. and Smithline H. (eds.), *Peqi'in – A late Chalcolithic Burial site, Upper Galilee, Israel*, pp. 293–315. Land of Galilee 2. Kinneret Academic Collage. Institute for Galilean Archeology. Ostracon.

Gluhak T.M. and Rosenberg D. 2013. Geochemical discrimination of basaltic sources as a tool for provenance analyses of bifacial tools in the southern Levant: first results from the Jezreel Valley, Israel. *Journal of Archaeological Science* 40(3): 1611–1622.

Gopher A. 1997. Horvat Galil-An Early PPNB site in the Upper Galilee, Israel. *Tel Aviv* 24: 183–222.

Gopher A. and Barkai R. 2006. Flint extraction sites and workshops in prehistoric Galilee, Israel. In: Körlin G. And Weisgerber G. (eds.), *Stone Age—Mining Age,* pp. 91–98. Bochum: Deutsches Bergbau-Museum Bochum.

Gopher A. and Barkai R. 2011a. Sitting on the tailing piles: Creating extraction landscapes in Middle Pleistocene quarry complexes in the Levant. *World Archaeology* 43(2): 211–229.

Gopher A. and Barkai R. 2011b. A new Neolithic quarry complex at Har Gevim, Israel: An introduction. In: *Proceedings of the 2nd International Conference of the UISPP Commission on Flint Mining in Pre-and Proto-historic Times* (Madrid, 14–17 October 2009) (BAR International Series Vol. 2260), pp. 275–282. Oxford.

Gopher A. and Barkai R. 2014. Middle Paleolithic open-air industrial areas in the Galilee, Israel: The challenging study of flint extraction and reduction complexes. *Quaternary International* 331: 95–102.

Gopher A. and Rosen S. 2001. Lithics of strata XIII-III. The Pre Pottery Neolithic - Early Bronze Age. In: Eisenberg E., Gopher A. and Greenberg R. (eds.), *Tel Te'o. A Neolithic, Chalcolithic and Early Bronze Age Site in the Hula Valley*, pp. 49–82 (IAA Reports 13). Jerusalem: Israel Antiquities Authority.

Grosman L. and Goren-Inbar N. 2010. Evidence in rock – A Neolithic quarry at Kaizer Hill, Modi'in. In: Amit D., Peleg-Barkat O. and Stiebel G. (eds.), *New Studies in the Archaeology of Jerusalem and its Region*, pp. 40–53. Jerusalem: Institute of Archaeology, Hebrew University of Jerusalem (in Hebrew).

Gould R.A. and Saggers S. 1985. Lithic procurement in Central Australia: A closer look at Binford's idea of embeddedness in archaeology. *American Antiquity* 50 (1): 117–136.

Herzlinger G., Grosman L. and Goren-Inbar N. 2013. The PPNA quarry of Kaizer Hill, Modi'in, Israel– The waste piles. In: Borrell F., Ibáñez J.J. and Molist M. (eds.), *Stone Tools in Transition: From Hunter-Gatherers to Farming Societies in the Near East,* pp. 395–406. Bellaterra (Barcelona): Universitat Autònoma de Barcelona. Servei de Publicacions.

Jennings P.R., Shipton C., Breeze P., Cuthbertson P., Bernal M., Oshan Wedage W.M.C., Drake N., White A.T.S., Groucutt H.S., Parton A., Clark-Balzan L., Stimpson C., al Omari A-A., Alsharekh A. and Petraglia M.D. 2015. Multi-scale Acheulean landscape survey in the Arabian Desert. *Quaternary International* 382: 58–81.

Kaplan J. 1966. Kfar Gil'adi. *Israel Exploration Journal* 16(4): 272–273.

Keeley L.H. 1983. Microscopic examination of adzes. In: Kenyon K.M. and Holland T. A. (eds.), *Excavations at Jericho V: The Pottery Phases of the Tell and Other Finds.* p. 759. London: British School of Archaeology in Jerusalem.

Khalaily H., Marder O. and Shaked I. 2000. Ramat Yiron Survey. *Hadashot Arkheologiyot* 111: 1.

Khalaily H., Kuperman T., Marom N., Milevski Y. and Yegorov D. 2015. Beisamoun: an early Pottery Neolithic site in the Hula Basin. *Atiqot* 82: 1–61.

Koehler E.C., Hart E. and Klaunzer M. 2017. Wadi el-Sheikh: A new archaeological investigation of ancient Egyptian chert mines. *PLoS ONE* 12(2): e0170840. doi:10.1371/journal.pone.0170840.

Lechevallier M. and Dollfus G. 1973. Nouveaux sites du Vie millénaire en Haute-Galilée. *Eretz Israel* 11: 9–21.

Lechevallier M. 1978. *Abou Gosh et Beisamoun.* Deux gisements du VIIe millenaire avant l'ere chretienne en Israel. Memoires et Travaux du Centre de Resherches Prehistoriques Francais de Jerusalem 2. Paris: Association Paléorient.

Levitte D. and Sneh A. 2013. *Geological map of Israel, Zefat Sheet 2-III.* Jerusalem: Geological Survey of Israel.

Marder O., Smithline H. and Covello-Paran K. 1998. Tel Turmus. *Hadashot Arkheologiyot*. http://www.jstor.org/stable/23474155.

Marder O., Prausnits M.W., Khalaily H. and Bankirer R.Y. 2002. Kabri 1975: the flint assemblage from area A. In: Kempinski A. (ed.), *Tel Kabri: the 1968-1993 excavation seasons*, pp. 299–306. Tel Aviv: Emery and Claire Yass Publications in Archeology.

Nadel D. and Nadler-Uziel M. 2011. Is the PPNC really different? The flint assemblages from three layers at Tel Roim West, Hula Basin. In: Healey E., Campbell S. and Maeda O. (eds.), *The State of the Stone: Terminologies, Continuities and Contexts in Near Eastern Lithics Studies in Early Near Eastern Production, Subsistence, and Environment* 13, pp. 243–255. Berlin: Ex Oriente.

Nathan Y., Segal I. and Delage C. 1999. Geochemical characterization of cherts from northern Israel (western Galilee). *Israel Journal of Earth Science* 48: 235–245.

Noy T. 1998. The flint artifacts. In: Epstein C. *The Chalcolithic culture of the Golan* (IAA Reports 4), pp. 269–332. Jerusalem: Israel Antiquities Authority.

Ohel M. 1986. *The Acheulian industries of Yiron, Israel* (BAR International Series 307). Oxford.

Ohel M. 1990. *Lithic analysis of Acheulian assemblages from the Avivim sites, Israel* (BAR International Series 562). Oxford.

Ohel M. 1991. *Prehistory of the Baram Plateau, Israel.* Haifa: Department of Sociology and Anthropology, University of Haifa.

Olami Y. 1984. *Prehistoric Carmel.* Jerusalem: Israel Exploration Society.

Oshri A., Khalaily H., Milevski I. and Marder O. 1999. Yiftah'el (Northeast; Triangulation Point Q-1). *Hadashot Arkheologiyot – Excavations and Surveys in Israel*: 110: 89.

Petraglia M.D., LaPorta P. and Paddayya K. 1999. The first Acheulian quarry in India: Stone tool manufacture, biface morphology and behaviors. *Journal of Anthropological Research* 55: 39–70.

Piper D.Z. and Bau M. 2013. Normalized Rare Earth Elements in water, sediments, and wine: Identifying sources and environmental redox conditions. *American Journal of Analytical Chemistry* 4: 69–83.

Prausnitz M.W. 1959. The first agricultural settlements in Galilee. *Israel Exploration Journal* 9(3): 166–174.

Quintero L. 1996. Flint mining in the Pre-Pottery Neolithic: Preliminary report on the exploitation of flint at Neolithic 'Ain Ghazal in Highland Jordan. In: Kozlowski S.K. and Gebel H.G. (eds.), *Neolithic Chipped Stone Industries of the Fertile Crescent and their Contemporaries in Adjacent Regions*, Proceedings of the Second Workshop on PPN Chipped Lithic Industries. pp. 233–242. Berlin: Ex Orient.

Ronen A. 1968. *Flint implements in the Museum of Hanita.* Museum of Hanita, Publication No. 2. (Hebrew).

Ronen A. 1991. The Yiron-gravel lithic assemblage artifacts older than 2.4 My in Israel. *Archäologisches Korrespondenzblatt* 21(2): 159–164.

Ronen A. 2006. The oldest human groups in the Levant. *Comptes Rendus Palevol* 5(1): 343–351.

Ronen A. and Davis M. 1970. Un atelier de taille Neolithique au Mt. Carmel – Le point 355 Z. *L'Anthropologie* 74: 161–194.

Ronen A., Gilead I., Bruder G. and Meller P. 1974. Notes on the Pleistocene geology and prehistory of the Central Dishon Valley, Upper Galilee, Israel. *Quartär* 25: 13–23.

Rosen S.A. 1987. The potentials of lithic analysis in the Chalcolithic of the Northern Negev:In: Levy T.E. (ed.), *Shiqmim I* (BAR International Series 356I), pp. 295–312. Oxford.

Rosenberg D., Assaf A., Getzov N. and Gopher A. 2008. Flaked stone discs of the Neolithic and Chalcolithic periods in the southern Levant. *Paléorient*: 137–151.

Rosenberg D., Etzion N., Kaufman D. and Ronen A. 2009. Daliyat el-Carmel 3. A flint bifacial tools workshop on Mount Carmel. Preliminary account. *Neo-Lithics* 2/09: 31–35.

Rosenberg D. and Nadel D. 2009. Prehistoric flint quarries and workshops in Mount Carmel – The Nahal Galim/Nahal Ornit complex. *The Quarry* 4(2): 5–12.

Rosenberg D., Getzov N. and Assaf A. 2010. New light on long distance ties in the Late Neolithic/Early Chalcolithic Near East. *Current Anthropology* 51(2): 281–293.

Rosenberg D. and Gluhak T. 2016. Trade me an axe? Interpretive challenges of the distribution and provenance of Neolithic basaltic bifacial tools in Israel. *Antiquity* 90(349): 48–63.

Roshwalb A. 1981. *Protohistory in the Wadi Ghazzeh: A typological and technological study based on Macdonald excavations.* Unpublished Ph.D. Dissertation. University of London, London.

Sampson G. 2006. Acheulean quarries at hornfels outcrops in the Upper Karoo region of South Africa. In: Goren-Inbar N. and Sharon G. (eds.), *Axe Age, Acheulian Toolmaking from Quarry to Discard*, pp. 75–107. London: Equinox.

Schyle D. 2007. *Ramat Tamar and Metzad Mazal. The Economy of Neolithic Flint Mining and Production of Bifacials Southwest of the Dead Sea.* Berlin: Ex Oriente.

Shalem D. 2008. The Upper and Lower Galilee in the Late Chalcolithic period. In: Bar S. (ed.), *The Hill-Country, and in the Shephelah, and in the Arabah: Studies and Researches Presented to Adam Zertal in the Thirtieth Anniversary of the Manasseh Hill-Country Survey.* pp. 99–110. Jerusalem: Ariel Publishing House.

Shalem D., Gal Z. and Smithline H. (eds.) 2013. *Peqi'in – A late Chalcolithic Burial Site Upper Galilee, Israel.* Land of Galilee 2. Kinneret Academic College. Institute for Galilean Archeology. Ostracon.

Shimelmitz R., Barkai R. and Gopher A. 2004. The Geometric Kebaran microlithic assemblage of Ain Miri, northern Israel. *Paléorient* 30(2): 127–140.

Shimelmitz R. and Mendel S. 2008. A Chalcolithic workshop for the production of blades and bi-facial tools at Khirbet Yoah, the Manasseh Hills. *Journal of the Israel Prehistoric Society* 38: 229–256.

Shimelmitz R. and Rosenberg D. 2016. The organization of basanite bifacial production at Giv'at Kipod Quarry, Israel: Towards an 'Alyawara Day' model of extraction. *Journal of Lithic Studies* 3(3): doi:10.2218/jls.v3i3.1643.

Sneh A., Bartov Y. and Rosensaft M. 1997.*Geological map of Israel, 1:200,000 Sheet 1.* Jerusalem: Geological Survey of Israel.

Stefanski Y. 1993. *The Rosh Pina Survey Map.* Israel Antiquities Authority Website: http://www.antiquities.org.il/survey/new/default_en.aspx.

Taute W. 1985. Mesad Mazzal, ein Siedlungsplatz des präkeramischen Neolithikums südlich des Toten Meeres (Vorbericht). In: Frey W. and Uerpmann H.P. (eds.), *Beiträge zur Umweltgeschichte des Vorderen Orients. Beiheftezum Tübinger Atlas des Vorderen Orients, Reihe A (Naturwissenschaften) 8*, pp. 236–256. Wiesbaden: Ludwig Reichert.

Taute W. 1994. Pre-Pottery Neolithic flint mining and flint workshop activities Southwest of the Dead Sea, Israel. In: Gebel H.G. and Kozlowski S.K. (eds.), *Neolithic Chipped Stone Industries of the Fertile Crescent.* (Proceedings of the First Workshop on PPN Chipped Lithic Industries), pp. 495–510. Berlin: Ex Oriente.

Teather A. 2011. Interpreting hidden chalk art in southern British Neolithic flint mines. *World Archaeology* 43 (2): 230–251.

Topping P. 2010. Neolithic axe quarries and flint mines: Towards an ethnography of prehistoric extraction In: Field D., Burke A.L. and Brewer-LaPorta M. (eds.), *Ancient Mines and Quarries: A Trans-Atlantic Perspective*, pp 22–32. Oxford: Oxbow.

Turville-Petre F., Bate A.J., Baynes C. and Keith A. 1927. *Researches in Prehistoric Galilee, 1925–1926.* London: Council of the British School of Archaeology in Jerusalem.

Vardi J. 2013. Large-scale larnite quarries and production sites for bifacial tools in the southern Judean desert. In: Borrell F., Ibáñez J.J. and Molist M. (eds.), *Stone Tools in Transition: From Hunter–Gatherers to Farming Societies in the Near East: 7th Conference on PPN Chipped and Ground Stone Industries of the Fertile Crescent,* pp. 87–101. Barcelona: Universitat Autònoma de Barcelona, Servei de Publicacions.

Vardi J. 2015. Larnite-bearing rock—the discovery of a new source of raw material in the production of Neolithic and Chalcolithic bifacial tools. *Archaeometry* 57: 20–35.

Vardi J. and Cohen-Sasson E. 2012. Har-Parsa: A large-scale larnite quarry and bifacial tool production site in the Judean Desert, Israel. *Antiquity* 86(332). http://antiquity.ac.uk/projgall/vardi332.

Weisgerber G. 1987. The ancient flint mines at Wadi el-Sheikh (Egypt). In: de G. Sieveking G. and Newcomer M.H. (eds.), *The Human Uses of Flint and Chert* IV. (Internationales Feuerstein-Symposium

Brighton 1983/2), pp. 165–171. Cambridge: Cambridge University Press.

Wreschner E. 1963. Unatélier de taille dit Giv'at Mikhal. *Bulletin Société Belge d'Anthropologie et de Préhistoire* 73: 197–211.

Yair A. 1962. *The Morphology of Nahal Dishon.* Unpublished M.A. Thesis. The Hebrew University, Jerusalem (Hebrew with English summary).

Yaroshevich A., Shemer M., Porat N. and Roskin J. 2017. Flint workshop affiliation: Chronology, technology and site-formation processes at Giv'at Rabbi East, Lower Galilee, Israel. *Quaternary International*: doi.org/10.1016/j.quaint.2017.03.001.

Yerkes R.W., Barkai R., Gopher A. and Bar-Yosef O. 2003. Microwear analysis of early Neolithic (PPNA) axes and bifacial tools from Netiv Hagdud in the Jordan Valley, Israel. *Journal of Archaeological Science* 30: 1051–1066.

Yerkes R.W., Khalaily H. and Barkai R. 2012. Form and function of early Neolithic bifacial stone tools reflects changes in land use practices during the Neolithization process in the Levant, *PloS ONE* 7(8): e42442.

Yerkes R.W. and Barkai R. 2013. Tree-felling, woodworking, and changing perceptions of the landscape during the Neolithic and Chalcolithic periods in the Southern Levant. *Current Anthropology* 54(2): 222–231.