

## NEW <sup>14</sup>C DATES FOR THE EARLY NATUFIAN OF EL-WAD TERRACE, MOUNT CARMEL, ISRAEL

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**ABSTRACT.** The Natufian culture of the southern Levant played an integral role in the transition from simple hunter-gatherers to food-producing societies of the Neolithic, but the major Natufian hamlets are currently poorly dated. Moreover, none of these complex, continuously occupied base camps have delivered an adequate number of dates to enable an in-depth delineation of intra-Natufian developments. This paper presents the first results of our dating program at el-Wad terrace, Mount Carmel (Israel), one of the major Natufian hamlets of the “core area” of this culture. Thirteen accelerator mass spectrometry (AMS) radiocarbon age determinations were obtained from 46 bone (both ungulate and human) and charcoal samples, originating in Early Natufian living surfaces, dwellings, and burials. The obtained dates are largely in agreement with the cultural affiliation of the samples (13–15 kyr cal BP). Two series of dates from different locations show good agreement with the stratigraphy. The ages of the burials clearly point to their being younger than the living surfaces seemingly associated with them. Presently, no burials may be linked with the major architectural phase of Early Natufian el-Wad. Our ongoing dating program and the processing of additional samples from refined contexts will help shed important light on the initial phases of the Natufian culture, habitation duration, intensity, and continuity, as well as the relationships between site features and stratigraphy.

### INTRODUCTION

The Natufian culture of the southern Levant played an integral role in the transition from simple hunter-gatherers to food-producing societies of the Neolithic (e.g. Garrod 1957; Henry 1995; Belfer-Cohen and Bar-Yosef 2000; Bar-Yosef 2002). In spite of its pivotal place in the prehistory of the Levant, sites of the Natufian culture are currently poorly dated (Weinstein-Evron 1998; Stutz 2004; Blockley and Pinhasi 2011; Maher et al. 2011). Moreover, the relatively scarce dates are derived from various sites and none of the complex, continuous base-camp sequences have delivered an adequate number of dates to enable an in-depth delineation of intra-Natufian developments. In this paper, we present the first results of our dating program at el-Wad terrace, Mount Carmel (Israel), one of the major Natufian hamlets of the “core area” of this culture. Based on its long Natufian sequence, encompassing all main stages of the culture, the rich material culture, architectural remains, and numerous and varied burials, el-Wad has long been regarded as one of the key Natufian sites since its first excavation in the early 20th century (Garrod and Bate 1937; Weinstein-Evron 2009).

Today, following extensive archaeological and archival research, the site appears much more complex than previously thought, both chronologically and spatially. However, we still lack detailed information about the sequence of occupations, their nature, organization of space, permanency of settlement, and subsistence strategies and how they all may have changed through time, and need to establish the chronological framework for these changes. We expect our dating program to generate a more comprehensive portrayal of the settlement at this particular site and of the Natufian in general and to yield a new understanding of increasing sedentism and societal complexity at the threshold of the “Agricultural Revolution.”

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## **EL-WAD: THE SITE AND EXCAVATION**

El-Wad is a large Natufian site in Mount Carmel, well known for its elaborate architectural features and numerous graves and high density of finds. The site (a large cave and adjacent terrace; Figure 1) contains a long and rich Early to Late/Final Natufian sequence. It was first investigated by C Lambert in 1928, but became well-known as a result of the 1929–1933 excavation campaign of D A E Garrod (Garrod and Bate 1937; see also Weinstein-Evron 2009). The site was later excavated by F Valla and O Bar-Yosef (Valla et al. 1986), by M Weinstein-Evron (1998), and recently by M Weinstein-Evron, D Kaufman, and R Yeshurun (Weinstein-Evron et al. 2007; in press; Yeshurun et al., in press). As documented previously (e.g. Garrod and Bate 1937; Garrod 1957), the Early Natufian layer is much thicker and richer than the Late Natufian. In recent years, during the renewed excavations on the northeastern part of the el-Wad terrace, the later phases of the Early Natufian have been exposed in an area of ~70 m<sup>2</sup>. Throughout the site, this is the phase displaying substantial stone architecture, as previously documented by Lambert and Garrod (Weinstein-Evron 2009; Weinstein-Evron et al., in press; Figure 1b). A well-built curvilinear wall (Wall I), minimally 9 m in diameter, is the most prominent feature of the current excavation on the terrace (Figure 1). This wall partially abuts a natural bedrock step in a manner similar to the “terrace wall” unearthed by Garrod (Garrod and Bate 1937: Plate V1-2). Wall I could have been used for leveling the naturally steep bedrock terrace and/or for demarcating a large structure. In the area enclosed by Wall I, several partially preserved stone structures and stone-rich “living floors” (which are not always clearly associated with walls) have been excavated. Among the former, Structure II (Figures 1, 2) is the best preserved example of a medium-sized dwelling in the area enclosed by Wall I. Three successive stone-laid pavements were unearthed in it to date, thereby attesting to the repeated use of the structure. The density of finds in the Early Natufian layer is extremely high, but human remains are almost absent; so far, only 1 burial has been exposed. The stone structures, numerous living floors, density and diversity of finds, and the near-complete absence of burials indicate that this part of the site was used primarily for habitation and daily activities in the Late Early Natufian (LEN) (Weinstein-Evron et al., in press; Yeshurun et al., in press).

To date, 3 radiocarbon dates have been obtained for the bottom, middle, and upper parts of the relatively shallow Natufian layer in the inner part of the cave (Weinstein-Evron 1991, 1998, and see below), bracketing the (Early) Natufian layer roughly between 16,000–12,400 cal BP. As part of the renewed excavation in the NE terrace, we launched a dating program in order to gain important insights into the duration and intensity of site occupation and its subphases, which will enable the testing of hypotheses pertaining to Natufian sedentism and the impact of abrupt environmental changes in the terminal Pleistocene.

### **Provenience and Sampling**

During the renewed excavations at el-Wad terrace, a series of samples for <sup>14</sup>C dating were collected from distinct proveniences covering a significant part of the attained Early Natufian sequence, mostly in the West Area of the excavation (Figure 1). In this part of the site, a thick Natufian sequence has been exposed, containing extensive Early Natufian stone architecture, overlain by Early Natufian levels with some living surfaces and stone installations, subsequently overlain by relatively thin Late/Final Natufian sediments with no built features. A group of Late/Final Natufian burials terminates the Natufian sequence at the NE terrace (Weinstein-Evron et al. 2007, in press; Yeshurun et al., in press).

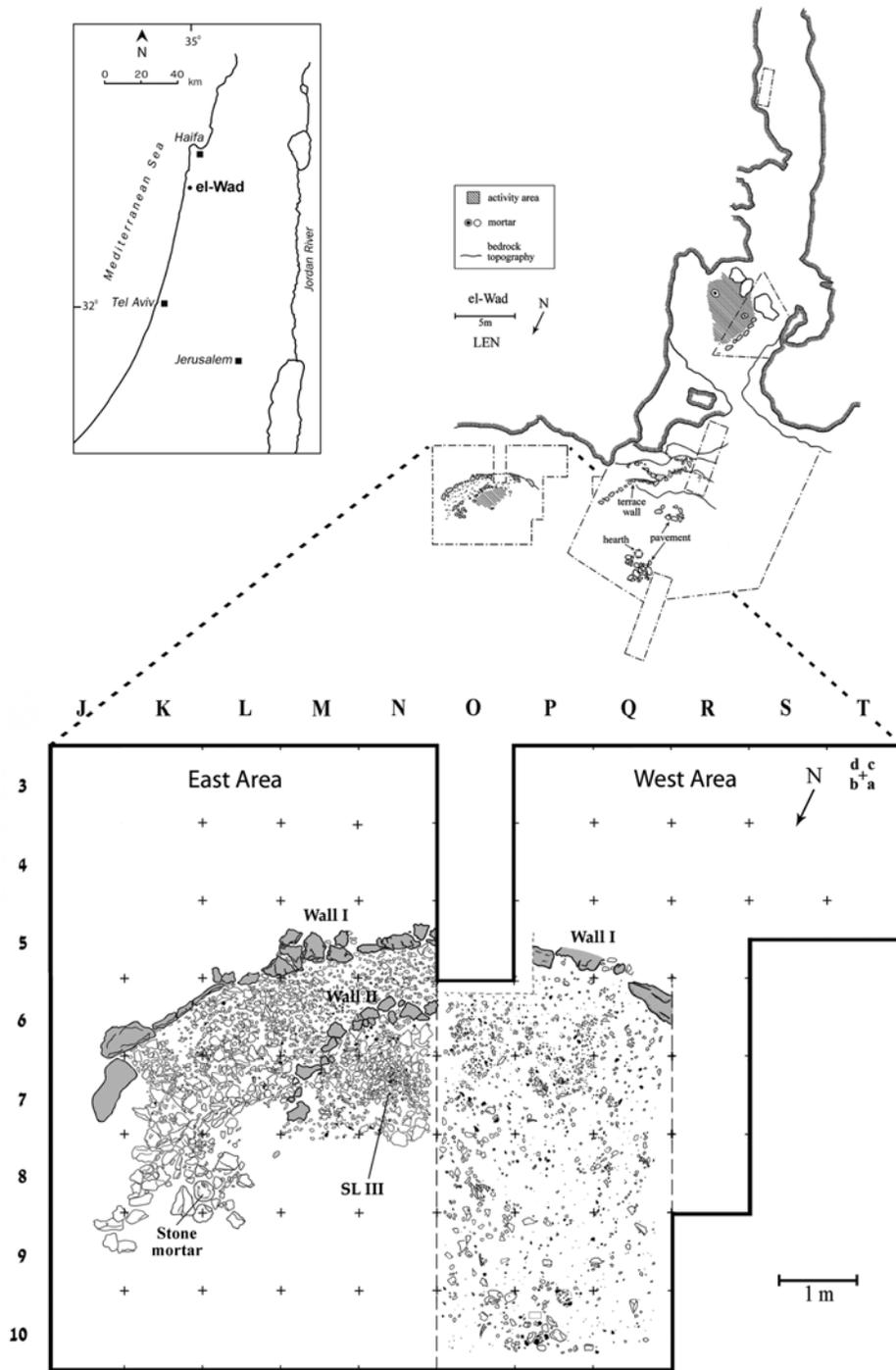


Figure 1 Map showing the location of el-Wad, a general plan of the site, and a plan of the renewed terrace excavation showing the Late Early Natufian (LEN) layer. The architectural complex of Wall I (large “terrace wall”) delimits numerous living levels, of which a portion of Structure II (Wall II) is shown in the East Area of the excavation and a rich living surface overlying it is depicted in the West Area.

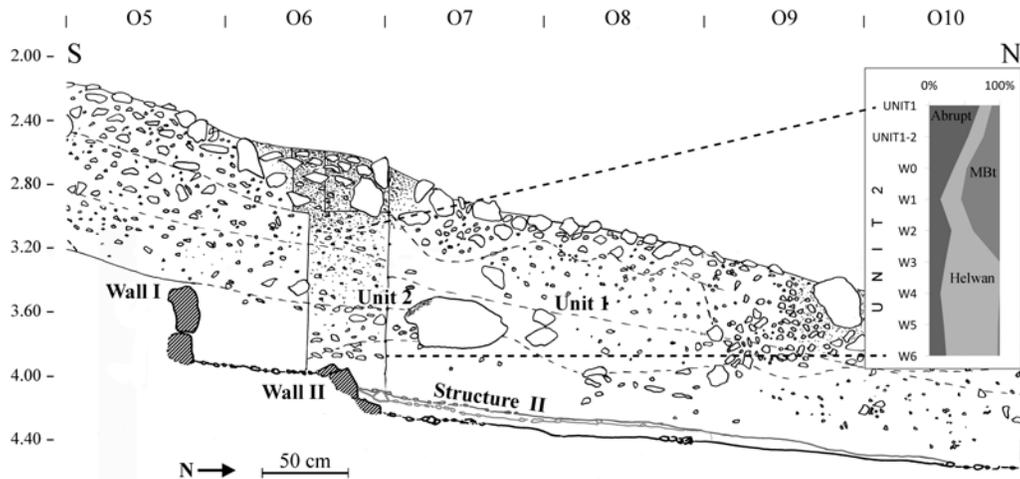


Figure 2 Section presenting the general stratigraphy of the terrace (marked as the N-O line in Figure 1). The lithic-based cultural division is depicted in the inset, showing the proportions of Helwan-retouched and abruptly retouched lunates, as well as microburins.

The samples (bone and charcoal) are derived from living floors, installations, and burials. Table 1 lists the provenience details for each sample (season of excavation, grid square and basket, “locus” if applicable, and elevations below the excavation datum). Note that as the layers dip NE (Figure 2), the elevation data can be safely correlated only within specific grid subsquares. Next, the table lists a short stratigraphic and contextual description of the samples. All of the samples come from the Natufian Unit 2, which is the main archaeological entity of the terrace. This layer, which correlates with Garrod’s layer B, contains a series of Natufian occupations exhibiting architectural features, graves, numerous finds, and virtually no signs of later intrusions. Unit 2 is provisionally divided into phases based on the intra-Natufian architectural stratigraphy. Phases W-0 through W-4 contain rich levels with a few built installations. Phase W-5 includes well-preserved occupation levels, while phases W-6 and W-7 display massive stone architecture including walls, numerous stony floors, and installations. Preliminary sorting of the lithics (Figure 2) points to the uppermost phase/s of Unit 2 and the bottom of Unit 1 as being of Late/Final Natufian age (dominated by short, abruptly retouched lunates and many microburins) and the rest of Unit 2 as belonging to the Early Natufian (dominance of Helwan-retouched lunates, abruptly retouched lunates being longer, and microburins are very rare). The excavation of the Natufian layers is still ongoing. We have attained the bottom of the Early Natufian layer in 2 small soundings, where only sterile earth and bedrock underlie it, similar to Garrod’s descriptions (Weinstein-Evron 2009; Weinstein-Evron et al., in press).

Altogether, 46 samples (34 bones and 12 charcoals) were selected for dating, but only 11 (5 bones and 6 charcoals) were finally processed and yielded ages. A strict prescreening selection has been applied to determine the quality of the sample material (Eckmeier et al., these proceedings). Most  $^{14}\text{C}$  samples are derived from uninterrupted living surfaces, from the central (lines 6–7) and northern (lines 8–9) parts of the West Area of the excavation (Figure 1), from above, inside, and outside Structure II. A single sample was collected from a living surface in the East Area of the excavation. Additionally, 2 human burials were sampled: the femur of the newly unearthed Early Natufian Homo 132 (RTT-6114) and a charcoal piece (RTT-6116) from the burial of Homo 101 (a young male adult; Weinstein-Evron et al. 2007; Bachrach et al., in press). While the latter was attributed to a Late Natufian burial ground, its location within a cavity in the bedrock south of Wall I and its burial mode raise the possibility that it may belong to the Early Natufian (Weinstein-Evron et al. 2007).

Table 1 Description of the archaeological context and <sup>14</sup>C ages for the el-Wad terrace samples. Calibration using OxCal v 4.1.5 (Bronk Ramsey et al. 2001; Bronk Ramsey 2009) and the IntCal09 calibration curve data (Reimer et al. 2009).

Lab # (RTT-)	Material	Year	Sq. Bas. Locus	Elevation below datum (cm)	Unit phase level, Excavation area	Remarks	Age BP	Cal age BP (1 $\sigma$ )	Cal age BP (2 $\sigma$ )
6095-2	Charcoal	2004	Q7d 50	314–319	Unit 2 W-1 or W-2 Center	Associated with a few stone installations	11,610 $\pm$ 80	13,570–13,350	13,660–13,280
5786	Bone	2007	O6b 32	345–350	Unit 2 W-3, Center	Associated with a few stone installations	11,370 $\pm$ 115	13,340–13,120	13,450–13,000
5790	Bone	2007	O7c 40	353–355	Unit 2 W-4, Center	Associated with a few stone installations	11,965 $\pm$ 125	13,980–13,710	14,150–13,500
6096-2	Charcoal	2007	P6b 66	348–353	Unit 2 W-5, level I, Center	Well-preserved level with stone built features	12,340 $\pm$ 85	14,560–14,080	14,800–14,000
6098-2	Charcoal	2008	Q6a 94 loc46	355–361	Unit 2 W-6 level IV, Center	Stone with adhering charcoal, in a stony living floor, probably in-side structure	12,430 $\pm$ 80	14,660–14,220	14,950–14,100
6097-2	Charcoal	2009	O6c 84 loc55	383–388	Unit 2 W-6 level VII, Center	Stony living floor, probably in-side structure	14,150 $\pm$ 140	17,200–16,550	17,550–16,350
6106	Bone	2006	Q8c 37	343–347	Unit 2 W-3, North	Well-preserved level with stone-built features	11,840 $\pm$ 100	13,820–13,580	13,910–13,440
6105	Bone	2008	O9d 20	396–400	Unit 2 W-5 level II, North	Well-preserved level with stone-built features	11,935 $\pm$ 100	13,920–13,690	14,030–13,560
6107	Bone	2009	Q8d 85 loc58	392–393	Unit 2 W-6 level VII, North	Concentration of artifacts and small stones with concretions, above burial H132	12,350 $\pm$ 100	14,590–14,100	14,900–14,000
6117-2	Charcoal	2009	Q9a 54	408–408	Unit 2 W-7 level VIII, North	Just above a large pile of stones and flint artifacts (loc. 63)	12,300 $\pm$ 70	14,350–14,030	14,700–13,950
6115	Bone	2007	M8c 96	442–446	Unit 2 W-7 level IX, East	Well-preserved level with architecture	11,570 $\pm$ 75	13,490–13,300	13,620–13,260
6114	Bone	2009	Q7b 124 H132	397–397	Unit 2 W-6, Burial	Burial H132, human femur	11,570 $\pm$ 75	13,490–13,300	13,620–13,260
6116	Charcoal	1997	N4b 25 H101	321–329	Unit 2 indet., Burial	Associated with burial H.101	11,640 $\pm$ 70	13,590–13,390	13,680–13,320

## METHODS

A collaborative effort was made by all authors to sample good archaeological contexts, assess their depositional environment, and increase precision and accuracy of the associated  $^{14}\text{C}$  dates. Bone samples were prepared using the procedure given in Yizhaq et al. (2005), while charcoal samples were prepared using a modified procedure with an additional water step before the acid-base-acid procedure (see Eckmeier et al., these proceedings). The detailed description of the analytical procedures is given in Eckmeier et al. (these proceedings). Infrared spectroscopy of sediments and  $^{14}\text{C}$  samples, micromorphology of bones, prescreening methods of material quality control of  $^{14}\text{C}$  samples, and an alternative pretreatment procedure for charcoal samples were applied.

## RESULTS

Thirteen AMS  $^{14}\text{C}$  age determinations were obtained from 46 bone (both ungulate and human) and charcoal samples from the renewed excavation. The ages and calibrated ages (68.2% and 95.4% probability) are given in Table 1 and ordered stratigraphically in Figure 3. Two more samples, RTT-5786 and -5790, were dated in an earlier exercise and they are included in this paper, but they did not go through the same material characterization.

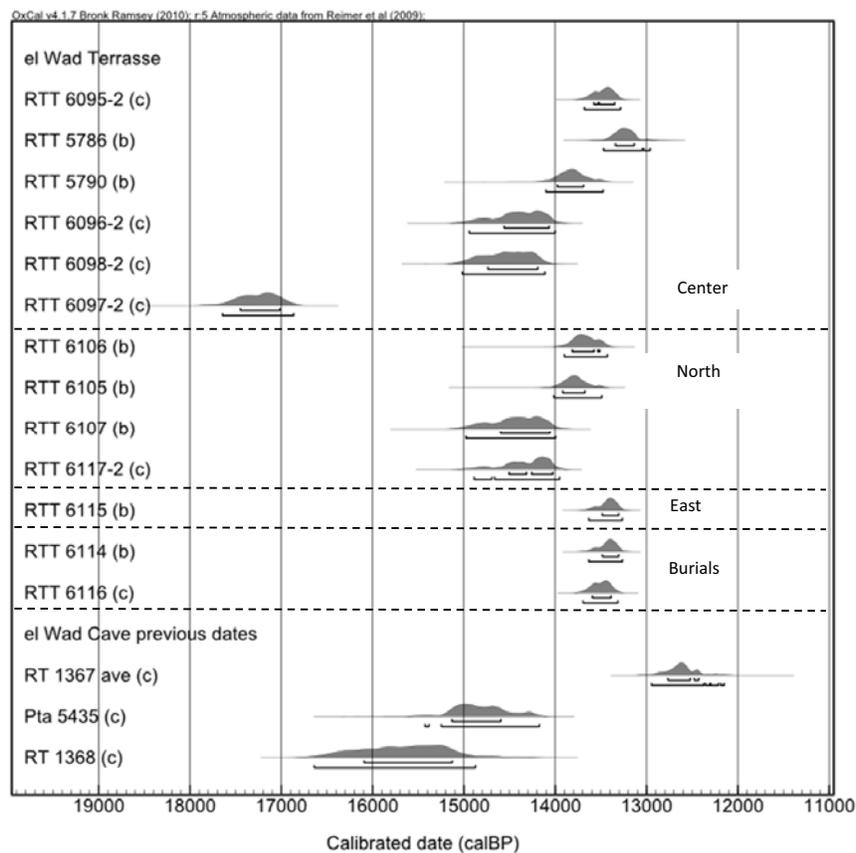


Figure 3 The calibrated dates presented in stratigraphic order, grouped by the central sequence (squares O-Q/6-7) and the northern sequence (squares O-Q/8-9). The single date from the East Area and the 2 ages coming from burial contexts are also shown. The 3  $^{14}\text{C}$  dates made in the 1980s are shown at the bottom of the figure. The samples are marked (b) for bones and (c) for charcoal.

Table 2 Description of the archaeological context and <sup>14</sup>C ages for the el-Wad Cave samples (Weinstein-Evron 1991, recalibration using OxCal v 4.1.5, Bronk Ramsey et al. 2001; Bronk Ramsey 2009; atmospheric data from Reimer et al. 2009).

Lab #	Material	Year	Square	Elevation below datum (cm)	Remarks	<sup>14</sup> C age year BP	Cal age BP (1 $\sigma$ )	Cal age BP (2 $\sigma$ )
RT-1368	Charcoal	1988–1989	I41	165	Bottom of the Natufian sequence in Chamber III	12,950 $\pm$ 200	16,090–15,130	16,640–14,875
Pta-5435	Charcoal	1988–1989	I41	150	Middle part of the Natufian sequence in Chamber III	12,620 $\pm$ 110	15,130–14,595	15,250–14,175
RT-1367a	Charcoal	1988–1989	I41	130	Upper part of the Natufian sequence in Chamber III	10,680 $\pm$ 190		
RT-1367b	Charcoal					10,740 $\pm$ 200		
RT-1367						10,710 $\pm$ 140	12,760–12,520	12,945–12,375
AVERAGE							61.4% 12,475–12,430	6.8% 12,355–12,155

To augment the emerging chronological scheme for the Natufian of el-Wad, we present here 3 decay-counting method dates (RT-1367, RT-1368 Rehovot Laboratory; Pta-5435 Pretoria Laboratory) obtained in the 1980s on samples from chamber III of the cave (Table 2, also presented in Figure 3). These 3 determinations are not used in the stratigraphic model since they did not go through the same prescreening procedure as the samples dated in this work (Eckmeier et al., these proceedings).

## DISCUSSION

The obtained dates are largely in agreement with the Early Natufian (EN) cultural affiliation of the samples (13–15 kyr cal BP) and with the few available dates from other EN sites (reviewed in Weinstein-Evron 1998; see also Valla et al. 2007). They also accord with those derived previously from el-Wad (Figure 3). Two series of dates, from within living surfaces and from outside the structures, show a general good agreement with stratigraphy. While we have not reached the base of the Natufian layer on the terrace, the date derived from the base of the Natufian layer in the cave may provide some point of reference for the unresolved question of the initial Natufian.

Two dates require further consideration. The first is the date derived from the East part of the excavation (RTT-6115, bone), which is younger than expected from its stratigraphic position (phase W7) compared to the older dates obtained for the overlying and corresponding living surfaces (W4–W7). It corresponds better with the dates obtained for the more recent part of the sequence (phases W1 or W2). No explanation can be provided at this stage, but continuous excavation and additional dates from the layers below phase W7 may help resolve this apparent discrepancy. The second is the charcoal date (RTT-6097-2), the oldest for the series obtained for the central part of Structure II (Figure 3;  $14,150 \pm 140$   $^{14}\text{C}$  yr BP;  $\pm 1\sigma$  17,200–16,550 cal BP;  $\pm 2\sigma$  17,550–16,350 cal BP). While the date represents the deepest sample in the discussed series, it is clearly too old for its stratigraphic position within the Natufian. It is also too old relative to the date obtained from the bottom of the Natufian layer in the cave (Figure 3), which may correspond with the initial Natufian phase recently suggested for the Natufian hamlet at el-Wad (Weinstein-Evron 2009; Weinstein-Evron et al., in press); the date is certainly older than the identified Natufian range and its problematic state cannot be presently resolved. Significantly, layers of the earlier Epipaleolithic cultures (Kebaran or Geometric Kebaran), the possible candidates for such an early date, have not been unearthed at el-Wad to date. This sample was also prepared (RTT-6097-1) with an alternative procedure that excluded the first acid step in the  $^{14}\text{C}$  preparation (Eckmeier et al., these proceedings). The date obtained ( $13,085 \pm 105$   $^{14}\text{C}$  yr BP;  $\pm 1\sigma$  15,660–15,250 cal BP;  $\pm 2\sigma$  15,900–15,100 cal BP) with this procedure fits the other dates in the stratigraphy. Since the alternative procedure is not yet proven to be accurate for  $^{14}\text{C}$  dating, we do not incorporate this date in our suggested chronology.

The dates for the upper part of the sequence (RTT-6095-2, -5786, -5790) are derived from a segment in the section that roughly represents the transition to the Late Natufian, that can be put either between levels W3 and W2 based on the appearance of the microburin technique (MBt) (RTT-6095-2) or, rather at the passage between W2 and W-1 (RTT-5790, -5786), if the rise in abruptly retouched lunates is considered (Figure 2). The substantiation of one of these possibilities requires additional  $^{14}\text{C}$  determinations.

Significantly, the 2 dates derived from burials (RTT-6114, -6116) that were dug into previous habitation layers are among the youngest of the series and suggest that they belong to the later stages of the Early Natufian. The direct dating of H132's femur indicates that the skeleton is younger than the determinations for the architectural remains of phases W6–7. This agrees with our suggestion that no burials may thus far be associated with the major architectural phase at el-Wad (the LEN; Weinstein-

Evron et al., in press). The date for H101's burial (RTT-6116) is somewhat enigmatic, since it was obtained from a charcoal piece that constitutes part of the grave fill that may have contained older material than the buried young male himself. Even though the date supports our notion that H101 may have been Early Natufian, further dates, this time obtained directly from the skeleton, will help untangle this enigma.

## CONCLUSION

The new set of dates from the el-Wad terrace has been performed on charcoal and on animal and human bones. The strict stratigraphic and quality control on the material dated has provided a consistent chronology exhibited by samples derived from different parts of the terrace. Our ongoing dating program and the processing of additional samples from refined contexts, whether from the same levels or deeper, will help shed important light on some of the salient questions regarding the Natufian, such as the initial phases of the culture, habitation duration and continuity, as well as the relationships between site features and stratigraphy. The Natufian occupations at el-Wad were numerous and variable, resulting in a rich and complex archaeological sequence requiring additional chronological data for further refinement.

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