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3

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3

#### 4 **Abstract**

5 Situated at the crossroads of Africa and Eurasia, the Levant is a crucial region for  
6 understanding the origins and spread of Upper Paleolithic (UP) traditions associated  
7 with the spread of modern humans. Of the two local Early Upper Paleolithic (EUP)  
8 technocomplexes, the Ahmarian and the Levantine Aurignacian, the latter appears to  
9 be unique in the endemic UP sequence, exhibiting greater similarity to the West  
10 European 'classic' Aurignacian than to the local preceding and proceeding UP  
11 entities. Previous publications have mostly focused on the similarities between the  
12 two lithic industries, and less on studies conducted on Levantine Aurignacian bone  
13 tools and ornaments. Here we present an archaeozoological, technological and use-  
14 wear study of ornaments on animal teeth from the Levantine Aurignacian layers at  
15 Manot and Hayonim caves (the Galilee, Israel). The selection of taxa, the choice of  
16 teeth, the mode of modification and the use-wear analysis exhibit clear similarities  
17 with the European Aurignacian. This, with the technology of the osseous raw material  
18 exploitation, the presence of antler simple based-points, and some lithic  
19 typotechnological features, suggests a link between the symbolic spheres of the  
20 Levantine and the European Aurignacian cultural entities. Such similarity also  
21 supports some contribution of European Aurignacians groups to the local cultural  
22 entities, intermingling with the local material culture features.

23

24 **Keywords:** Upper Paleolithic; Levantine Aurignacian; Human symbolic behavior;  
25 Hayonim Cave; Manot Cave

## 26 **1. Introduction**

27 It seems that postdating the modern human ‘out of Africa’ exodus, at least three  
28 discrete dispersal events took place in the early stages of the Upper Paleolithic  
29 (UP)— two from Western Asia to Europe and one from Europe to Western Asia. The  
30 similarities between the Levantine Emiran and European Bohunician, and between  
31 the Levantine Ahmarian and European Proto-Aurignacian have been proposed to  
32 support movement of populations or ideas from the Levant to Europe (e.g., Skrdla,  
33 1996, 2003; Tostevin, 2003; Bar-Yosef and Belfer-Cohen, 2014; but see also  
34 Teyssandier et al., 2010). Conversely, it appears that the similarities between the  
35 European Aurignacian and the Levantine Aurignacian, observed through  
36 comparisons of the technotypological characteristics of the chipped stone  
37 assemblages (e.g., Bar-Yosef, 1970; Goring-Morris, 1987; Shea, 2006, 2007; Shea  
38 and Sisk, 2010), can be explained as evidence of migration in the opposite direction,  
39 i.e., from Europe to the Levant (Bar-Yosef and Belfer-Cohen, 1996, 2010, 2019;  
40 Goring-Morris and Belfer-Cohen, 2006; Zilhão, 2006; Mellars et al., 2013; Belfer-  
41 Cohen and Goring-Morris, 2014, 2017; Barzilai et al., 2016) with recent dating  
42 indicating that the Levantine Aurignacian is younger than its European counterpart  
43 (Bosch et al., 2013, 2015; Douka et al., 2013; Nigst et al., 2014; Stutz et al., 2015;  
44 Alex et al., 2017; Bergman et al., 2017). Within this framework, bone tools have been  
45 considered an important proxy to trace typological similarities (e.g., Belfer-Cohen and  
46 Bar-Yosef, 1981; Bar-Yosef and Belfer-Cohen, 1996); yet the analysis of the  
47 technological aspects of the bone industry has been rather scarce (Belfer-Cohen and  
48 Bar-Yosef, 1981; Newcomer and Watson, 1984; Bergman, 1987; Coinman, 1996).

49 Recent studies have highlighted the importance of ornaments, be they perforated  
50 shells, or bone and teeth beads/pendants (Kuhn et al., 2001; Stiner et al., 2013; Bar-  
51 Yosef Mayer, 2015). It is now a given that understanding technological behaviors  
52 reflected in bone-implement and ornament manufacture can greatly contribute to the  
53 study of the emergence and diffusion of Eurasian UP technocultural entities as well  
54 as their intra-actions and interactions, locally and globally (Tejero et al., 2016, 2018;  
55 Yeshurun et al., 2018).

56 Two cultural entities are recognized in the Levantine Early Upper Paleolithic  
57 (EUP), the Ahmarian and the Levantine Aurignacian. The latter constitutes a unique  
58 phenomenon in the local UP sequence, showing greater similarity to the West  
59 European 'classic' Aurignacian than to the local Levantine archaeological entities  
60 preceding and following it (Gilead, 1981, 1991; Bar-Yosef and Belfer-Cohen, 1996;  
61 Goring-Morris and Belfer-Cohen, 2006; Belfer-Cohen and Goring-Morris, 2007, 2014,  
62 2017; Barzilai et al., 2016). Besides the similarities observed in the technotypological  
63 characteristics—e.g., nosed and frontal carinated items, retouched (Dufour)  
64 bladelets, etc. (Bar-Yosef and Belfer-Cohen, 1996, 2010; Goring-Morris and Belfer-  
65 Cohen, 2006; Belfer-Cohen and Goring-Morris, 2007; Alex et al., 2017)—there are  
66 also similarities in bone and antler processing. Thus, both entities shared similar  
67 complex technical concepts of antler-working as opposed to the simpler bone-  
68 working technical concepts and had in common a recurrent but limited variety of  
69 morphotypes (mainly awls and projectile points; Tejero et al., 2016).

70 It seems that the use of animal raw material such as bone, mollusks and egg  
71 shells for symbolic expressions predates the manipulation of teeth in the Paleolithic.  
72 Besides a single example linked with *Homo erectus* (see Joordens et al., 2015), bone  
73 and shell ornaments are documented in contexts associated with Neanderthals (e.g.,

74 Zilhão et al., 2010; Caron et al., 2011; Romandini et al., 2014; Majkic et al., 2017;  
75 Rodríguez-Hidalgo et al., 2019, but see White, 2001 and Higham et al., 2010 for  
76 criticism concerning the findings from Grotte du Renne). They are also well known,  
77 along with ostrich eggshell beads, among early anatomically modern human (AMH)  
78 populations (e.g., Taborin, 1980; Kuhn et al., 2001; d’Errico et al., 2005; Bar-Yosef  
79 Mayer et al., 2009; Texier et al., 2013 Stiner et al., 2013, Miller and Willoughby,  
80 2014).

81 Perforated teeth pendants are among the earliest symbolic expressions of the  
82 UP of Eurasia (White, 1992, 1993, 2002, 2007; d’Errico et al., 2003; Zilhão et al.,  
83 2007). In the European Aurignacian record, the exploitation of mammal teeth—  
84 including in some cases human teeth (Henry-Gambier and White, 2006)—became a  
85 common practice, probably playing a role in the symbolic sphere of the hunter-  
86 gatherer groups. Various teeth (incisors, canines, premolars and molars) of a large  
87 spectrum of herbivores (e.g., reindeer, red deer, horse, bison, goat) and carnivores  
88 (e.g., bear, wolf, fox) species were selected for the manufacture of ornaments (e.g.,  
89 Barge-Mahieu and Taborin, 1991; Taborin, 2004; Vanhaeren and d’Errico, 2006;  
90 Álvarez Fernández and Jöris, 2008; Moreau and Jöris, 2013; Wolf et al., 2013; Wolf  
91 and Conard 2015). This behavior is well documented all over the European  
92 Aurignacian domain, from the West to the East.

93 Here we present an archaeozoological, technological and use-wear study of  
94 teeth ornaments from two Levantine Aurignacian assemblages, Manot Cave and  
95 Hayonim Cave (Israel), located 10 km apart in the Western Galilee within the  
96 Mediterranean belt. The ornaments were made mainly on the vestigial canines of red  
97 deer (*Cervus elaphus*), by a perforation of the root to be suspended as pendants or  
98 attached to garments. Both the manufacturing marks made during the preparation of

99 the items and the use-wear traces indicate that they were used as personal  
100 ornaments.

101 The selected taxa and teeth, the mode of modification and use wear show  
102 similarities with analogous items from the European Aurignacian, suggesting a link  
103 between the symbolic sphere of the Levantine and European Aurignacian cultural  
104 entities.

105

### 106 *1.1. Hayonim and Manot caves*

#### 107 Hayonim Cave

108 Hayonim Cave is situated on the right bank of Wadi Izhar, about 13 km from the  
109 Mediterranean coast and 50 m above the present wadi channel, in the Western  
110 Galilee, Israel (Figs. 1 and 2; Belfer-Cohen and Bar-Yosef, 1981; Bar-Yosef et al.,  
111 2017). The Levantine Aurignacian occupation (Stratum D, comprising three  
112 consecutive layers, D4, D3, and D1–2) is quite small in extent (15 m<sup>2</sup>) but rich in  
113 material culture remains, including hearths, ash spots, evidence of ocher use,  
114 chipped stone artifacts and an impressive faunal assemblage.

115 The faunal assemblage was first studied by Davis (Davis, 1981, 1982) and  
116 later by Rabinovich, with special attention to the human mode of exploitation  
117 (Rabinovich et al., 1997; Rabinovich, 1998a, b). The distribution of species (number  
118 of identified specimens [NISP] layer D4 = 1479; D3 = 7012; D1–2 = 5077), is very  
119 similar in all occupation levels with mountain gazelle (*Gazella gazella*) the most  
120 common species (more than 80% of NISP), followed by Persian fallow deer (*Dama*  
121 *mesopotamica*, 5–6%), while other species are represented by several bones only:  
122 red deer (*Cervus elaphus*), wild goat (*Capra aegagrus*), wild boar (*Sus scrofa*),



123 aurochs (*Bos primigenius*), roe deer (*Capreolus capreolus*) and hartebeest  
124 (*Alcelaphus buselaphus*); Rabinovich et al., 1997; Rabinovich, 1998a, b).

125         Regarding the flint assemblage, on the one hand there is great  
126 technotypological similarity between the flint assemblages of the three sublayers of  
127 Layer D. On the other hand, there is pronounced heterogeneity in the overall  
128 typological components of the whole lithic assemblage (Belfer-Cohen and Bar-Yosef,  
129 1981). Flakes are dominant among the debitage items (including 'core trimming  
130 elements' and 'primary elements'). Within the tool categories the picture is different,  
131 and tools were modified on blade/bladelet and on flake blanks equally (Belfer-Cohen  
132 and Bar-Yosef, 1981: Table 2). The character of the debitage is quite irregular. The  
133 number of cores is relatively high (Belfer-Cohen and Bar-Yosef, 1981: Table 1); still,  
134 judging from the frequencies and types of debitage items it seems that a large  
135 number of tools were made elsewhere, while some of the items produced at Hayonim  
136 were taken away.

137         Typologically, the Aurignacian assemblage of Hayonim Stratum D is  
138 dominated by the end-scraper category including the Aurignacian variety, i.e., nosed,  
139 shouldered and lateral carinated items. The second large category is the burin group.  
140 Both categories constitute more than half of the total number of tools in Layer D.  
141 Borers and backed pieces are scarce while denticulates and notches are relatively  
142 well represented. El-Wad points are quite scarce (0.71%) and there is a moderate  
143 presence of bladelets, both in debitage and among the tools (i.e., Dufour bladelets;  
144 Belfer-Cohen and Bar-Yosef, 1981: Table 2).

145         Another interesting phenomenon is the high percentage of tools with double  
146 patina. It is more pronounced in certain tool groups, i.e., end-scrapers, burins,

147 denticulates and notches. Most of the double-patinated artifacts clearly derive from  
148 the preceding Mousterian levels exhibiting Levallois-technique characteristics  
149 including faceted striking platforms. Most probably these Mousterian items were  
150 available on the surface of the cave and the terrace due to post-Mousterian erosion  
151 (see Belfer-Cohen and Bar-Yosef, 1981; Belfer-Cohen and Bar-Yosef, 2015).

## 152 Manot Cave

153 Manot Cave consists of an elongated main hall (80 m long, 10–25 m wide) with two  
154 lower chambers connected from the north and the south (Figs. 1 and 2). Rock falls  
155 and colluvium apparently blocked the original entrance to the cave ca. 30 ka cal BP  
156 (Barzilai et al., 2016). During nine seasons (2010–2018), twelve areas were  
157 excavated, labeled A to L (Hershkovitz et al., 2015; Barzilai et al., 2016; Marder et  
158 al., 2017, 2018). Areas C and E yielded well-preserved UP assemblages. Both areas  
159 display thick stratigraphic profiles and are extremely rich in finds, including flint  
160 artifacts, animal bones, bone and antler tools, shells, and a little charcoal (Barzilai et  
161 al., 2016; Tejero et al., 2016; Alex et al., 2017; Abulafia et al., 2019; Marder et al.,  
162 2019; Yeshurun et al., 2019).

163 Area E is located at the western end of the cave, on top of the talus, at the  
164 location of the original entrance. A sequence of nine distinct archaeological horizons  
165 (Layers I–IX) was exposed, including a series of well-preserved combustion features.  
166 Based on preliminary analyses of the material culture remains, a division of the  
167 sequence into at least two phases was recently suggested (Marder et al., 2019): an  
168 early phase (Layers VIII–IV), presenting ‘classic’ Levantine Aurignacian affinities, and  
169 a later phase (Layers III–I), which demonstrates a change in focus in lithic tool  
170 typology alongside a scant osseous industry and a decrease in mollusk frequencies.

171 This phase is temporarily referred to as 'post-Levantine Aurignacian' (Marder et al.,  
172 2019). Layer IX, at the bottom of the sequence might represent another UP variant,  
173 different from the Levantine Aurignacian, as preliminary observations indicated an  
174 increased dominance of laminar components within the flint assemblage as well as  
175 lack of marine shells and a poor bone industry. However, this layer is yet to be  
176 thoroughly studied to obtain a more concrete definition.

177 The Levantine Aurignacian phase of the sequence (Layers VIII–IV) displays  
178 dense archaeological assemblages rich in flint artifacts, bone tools, animal bones  
179 and shells. Based on a sample from Layer V, the lithic assemblages comprise typical  
180 Levantine Aurignacian tools, such as nosed and carinated scrapers as well as blades  
181 displaying Aurignacian retouch. Notably, el-Wad points are missing in the analyzed  
182 sample (Marder et al., 2019). The shell assemblages include mostly *Patella*, while  
183 various specimens of the scaphopod *Antalis* were also found (Marder et al., 2019).

184 Area C represents secondary accumulation sediments and archaeological  
185 material at the base of the western talus. The stratigraphy, based on  
186 sedimentological criteria, is divided into eight units. Following a technotypological  
187 analysis of the lithic assemblage, two cultural units were defined, the Levantine  
188 Aurignacian (Units 3, 4 and upper Unit 5), and the Early Ahmarian (consisting of the  
189 lower part of Unit 6 and Unit 7). The lower part of Unit 5 and the upper section of Unit  
190 6 contain a mixed assemblage comprising both Levantine Aurignacian and Early  
191 Ahmarian artifacts (Abulafia et al., 2019). Alongside radiocarbon chronology, these  
192 suggest that chronocultural distinctions can be defined (Alex et al., 2017; Abulafia et  
193 al., 2019). The archaeological assemblage from the Levantine Aurignacian cultural  
194 units (ca. 1.5 m thick) is dominated by an Aurignacian lithic component similar to that  
195 described for Area E, as well as projectile points made on antler.

196 The rich and well-preserved faunal assemblages in Manot Cave are quite  
197 similar to those of the nearby Hayonim Cave. An archaeofaunal sequence of both  
198 Ahmarian and Levantine Aurignacian levels was studied in Area C (Yeshurun et al.,  
199 2019). The Levantine Aurignacian therein is rich in mountain gazelle remains and to  
200 a lesser extent, in Persian fallow deer. Red and roe deer, boar and aurochs are all  
201 present in small numbers. Bird hunting played some role, and tortoises and small  
202 mammals were sporadically exploited. Age and sex information on gazelles  
203 cautiously suggest that they were hunted in the summer and autumn (Yeshurun et  
204 al., 2019).

205 The shell assemblages from the Area C Aurignacian included *Columbella*  
206 *rustica* and *Nassarius gibbosulus*, which might have been used for personal  
207 ornamentation, and *Patella* sp., which was probably consumed as food (Bar-Yosef  
208 Mayer, 2019).

209 The Aurignacian sequence at Manot is currently dated between ~38 and 34 ka cal  
210 BP (the dates were determined through samples deriving from both talus material  
211 and a secure Aurignacian context in Area E), with a more constrained timeframe of  
212 ~37–35 ka cal BP suggested based on Bayesian models (Alex et al., 2017).

213

#### 214 1.2. Bone tools of the Levantine Aurignacian

215 The bone and antler assemblages from Hayonim D and Manot Cave (mainly  
216 Areas E–C) are unique in their number of tools—almost 300 specimens—and their  
217 variety, and are comparable only to the Aurignacian assemblage of Ksâr ‘Akil  
218 (Newcomer, 1974; Bergman, 1987; Tejero et al., 2016, 2018; Yeshurun et al., 2018;  
219 Marder et al., 2019).

220 Both in Hayonim and Manot caves, the majority of items are bone awls and antler  
221 simple/massive base projectile points. There are also several items, both bone and  
222 antler that were most probably used in indirect percussion (namely as chisels), as  
223 has been demonstrated through both technological and experimental studies (Tartar,  
224 2009; Tejero et al., 2012). We have also documented several retouchers, which are  
225 currently not represented in other UP Levantine sites (Yeshurun et al., 2018). Indeed,  
226 a renewed technological study of the bone tool production technology from both  
227 Levantine Aurignacian assemblages is underway, with some of it already published,  
228 e.g., the notched and incised ('decorated') bones from Hayonim (Tejero et al., 2018)  
229 as well as the preliminary study of bone tools from the ongoing excavations of Manot  
230 (Tejero et al., 2016).

231 Technical features of the production processes are identical in both sites. The  
232 tools shaped from bones were modified using a single, simple technique—scraping.  
233 On the other hand, antler was exploited using a combination of techniques, following  
234 a process defined by Averbouh (2000) implying a complex operational sequence.  
235 Working the antler by longitudinal splitting of antler beam fragments, typical of the  
236 European Early Aurignacian (Tejero et al., 2012) was employed by Hayonim and  
237 Manot's inhabitants, as demonstrated by the blanks and waste products  
238 characteristic of this process (Tejero et al., 2016).

239 Whenever the base of the antler projectile point is preserved, it is a  
240 simple/massive point, of the variety defined as 'elongated objects with a pointed  
241 distal tip, a variable cross-section (mostly elliptical) and a simple hafting system'  
242 (e.g., Hahn, 1988). Except for one split-based point from Kebara (Bar-Yosef et al.,  
243 1992, see also claims for yet another specimen, from Hayonim Cave; Belfer-Cohen  
244 and Goring-Morris, 2014), all projectile points from the Levantine Aurignacian are

245 simple/massive points. The known assemblage comprises ca. 150 samples so far, of  
246 which Hayonim and Manot caves have provided almost two thirds (31 and 49  
247 specimens respectively). The rest of the projectile points were reported from Ksâr  
248 'Akil, Sefunim and Yabroud II (Newcomer, 1974; Belfer-Cohen and Bar-Yosef, 1981;  
249 Bergman, 1987; Gilead, 1991; Tejero et al., 2016; Shimelmitz et al., 2018).

250 The typological and technological features, as well as the dichotomy observed  
251 between the bone and antler production in both Hayonim and Manot caves, are also  
252 observed in the Early Aurignacian sites/assemblages in Europe (see the descriptions  
253 in Tartar, 2009; Liolios, 1999; Tartar and White, 2013; Tejero, 2013, 2014; Tejero and  
254 Grimaldi, 2015).

255

## 256 **2. Materials and methods**

257 The studied material is housed at the National Natural History Collections of  
258 the Hebrew University of Jerusalem and the Israel Antiquities Authority (IAA),  
259 Jerusalem (Table 1). The taxonomic identification of the items is based on the  
260 comparative osteological collections of the National Natural History Collections, The  
261 Hebrew University of Jerusalem and the University of Haifa. Most of the studied  
262 items were made on red deer teeth. Published criteria were also consulted for  
263 taxonomic identification, e.g., Brown and Chapman (1991) for red deer and Brown  
264 and Chapman (1990) for fallow deer.

265 The distinct sexual dimorphism of red deer (Larson and Knapp, 1971; Goss, 1983), is  
266 also expressed in the shape and size of their canines (Chapman and Chapman,  
267 1997; Fig. 3). Over the evolution of the family Cervidae, hornless ancestors predated  
268 the antlered ruminants. The size of the tusk-like upper canine teeth has tended to be

269 inversely correlated with the size of the antlers, as if 'holding on' to the former  
270 compensated for the lack of the latter. As the antlers became longer, the canines  
271 became shorter, eventually disappearing. In most cervids, they have been lost while  
272 some species like red deer (*Cervus elaphus*) still have vestigial canines (e.g., Goss,  
273 1983).

274         As changes occur through life in the shape, root and size of the canines, the  
275 specimens were examined for age and sex, following the methods of d'Errico and  
276 Vanhaeren (2002). Apparently, male vestigial canines are broader than those of the  
277 females and with wear, the fully grown shape in young males becomes triangular.  
278 Conversely, crowns of young females are pointed, and those of older specimens are  
279 rectangular. The roots of vestigial male canines are square or trapezoid while those  
280 of females are rectangular or V-shaped.

281         We recorded morphometric variables for each canine. Morphological variables  
282 include occlusal wear stages, stages of root development, state of closure of the pulp  
283 cavity, and wear removal of the distolinguocervical lobe. Metric variables include  
284 crown width, length and thickness, width and length of the occlusal wear facet,  
285 maximum width, apex width, root thickness and root length (Fig. 4).

286         For the description of the specimens' modification we followed the  
287 methodology of Barge-Mahieu and Taborin (1991), White (1993, 2007), Vanhaeren  
288 (2002) and d'Errico and Rigaud (2011), among others. We described the perforation  
289 process, dimensions, location, preparation modes and perforation techniques (e.g.,  
290 diameter, shape, the distance between tooth buccal and lingual edges, distance  
291 between the perforation and the root base; Fig. 4).

292 Technological and use-wear analyses were conducted using both a  
293 stereomicroscope (magnification: 10–40×) and a scanning electron microscope. The  
294 scanning electron microscopy images (the XPS Laboratory, the Unit for  
295 Nanocharacterisation, the Harvey M. Krueger Center for Nanoscience and  
296 Nanotechnology, the Hebrew University of Jerusalem) were obtained using a FEI  
297 Quanta 200 ESEM in low-vacuum mode without preliminary treatment and with a  
298 chamber pressure of 0.38 Torr and acceleration voltages of 15–20 kV. The elemental  
299 analyses of the particles—for ocher identification—were done by Energy Dispersive  
300 X-ray spectroscopy (EDS) using EDAX detector.

301

### 302 **3. Results**

#### 303 *3.1. Taxonomic and sexual identification, preservation, and stratigraphic origin*

304 The assemblage of personal ornaments recovered from Hayonim and Manot  
305 caves consists of a total of 10 perforated teeth and an unfinished pendant or preform  
306 (a tooth with an unfinished perforation; Figs. 5 and 6). Nine are vestigial canines of  
307 red deer (specimens H11, H35, H53, H157, H179, and H226 [the unfinished item]  
308 from Hayonim Cave, and specimens 105, 131, and 132 from Manot Cave); two teeth  
309 are upper incisors of a large bovid (*Bos*; specimens H152 from Hayonim and 130  
310 from Manot). Among the red deer vestigial canines, five are left, and four are right  
311 (Table 1). It should to be noted that a previous publication mentioned the presence of  
312 a horse incisor in Layer D at Hayonim (Belfer-Cohen and Bar-Yosef, 1991), which  
313 after re-examination is actually a bovid incisor (H152). A fox (*Vulpes vulpes*)  
314 perforated canine was reported from an Aurignacian context (Belfer-Cohen and Bar-  
315 Yosef, 1981) yet it derives from an area dug-in by the Natufians, and there are many



316 of these pieces in secure Natufian contexts. For this reason, we have decided to  
317 discard it from this study. Conversely, no bovid incisors were reported from the  
318 Natufian occupation levels.

319         The Hayonim pendants were found in Layers D1–2 (two items), Layer D3 and  
320 D4 (one element in each layer) and in the D sequence without exact provenience  
321 (three items). The items from Manot Cave derive from Area C, upper Unit 6 (one  
322 item), and Area E (three pieces). One of the pendants from Area E was found in  
323 Layer V (Fig. 2). Two other pieces from this area were retrieved, together with a bone  
324 awl and an incised ('decorated') bone, from a sounding pit, thus they lack a precise  
325 stratigraphic affiliation. Still, all of the above items fit technotypologically into the  
326 Levantine Aurignacian tradition (Belfer-Cohen and Bar-Yosef, 1981; Tejero et al.,  
327 2016, 2018; Marder et al., 2019).

328         Preservation of most of the pendants is good. Some display sediment  
329 concretion, exfoliations and desiccation fissures. Four of the Hayonim pendants have  
330 been subjected to a combustion process. In Layers D1–2 at Hayonim, isolated  
331 patches of white ash suggested that somewhere, not far away, there was a fireplace  
332 (Belfer-Cohen and Bar-Yosef, 1981). One of the pendants derived from Square H21,  
333 where there was clearly a hearth. The surface of these specimens was burned. The  
334 homogenous color and patina (dark brown and soft brown) of their surface might  
335 suggest a specific treatment rather than just having been tossed in the hearth. In one  
336 of the Manot items (M131) concretion partially covers the perforation. Except for two  
337 specimens from Manot and one from Hayonim, all the others are complete. Based on  
338 the size ratio (Table 2) and shape, the perforated red deer canines of the Hayonim  
339 and Manot belong to males.

340 To what extent worked teeth come from hunted animals, or were recovered  
341 through scavenging, remains unknown. Nevertheless, as noted by several authors,  
342 vestigial deer canines disperse quickly after death as they detach easily from the  
343 maxilla (d'Errico and Rigaud, 2011). This makes it more likely that the vestigial  
344 canines originate from hunted animals. Six of the teeth display incisions at the  
345 vestibular face in the junction between the crown and the root (the base of the  
346 distolinguocervical lobe). Incisions are short and thin, oblique and perpendicular,  
347 relative to the main axis of the piece. We interpret them as cut-marks to extract the  
348 canine from the alveolar cavity, which reinforces the assumption that teeth were  
349 removed from a fresh carcass.

350 The wear signs of Paleolithic personal ornaments indicate long-term use (see  
351 below), which makes it challenging to determine whether they were produced on site  
352 or brought in as finished products from the outside. A high degree of mobility is  
353 assumed for Paleolithic personal ornaments tied in with the mobility of their owners  
354 (d'Errico, 1993). Assessing their lifespan and tracking their movement through a  
355 given territory is indeed rather a speculative exercise. However, the presence of a  
356 preform in Hayonim, abandoned or lost before the perforation was made (Fig. 7),  
357 implies onsite production of at least some of the teeth ornaments. Moreover, the in  
358 situ working of animal raw material (bone and antler) is demonstrated by the  
359 presence, at both sites, of blanks and waste associated with the production of bone  
360 awls and projectile antler points (Tejero et al., 2016).

361

362 *3.2. Description of the tooth pendants and their production techniques*

363 All the perforations are located along the roots of the tooth. In some items (four  
364 canines and the two bovid incisors) the root surfaces were scraped prior to  
365 perforation. The manufacturing sequence is evidenced by the overlapping of the  
366 perforation marks over the scraping ones (Fig. 8B). Preparation scraping might have  
367 been done in order to clean the root and smooth the surface at the starting point of  
368 the hole. The root of the two bovid incisors was entirely scraped, while the deer  
369 canines were scraped over a small part of the root surface (Table 3).

370 Once the surface was prepared, the holes were made by one single technique  
371 in six cases and a combination of two techniques for the other five items. The four  
372 pendants from Manot, both the incisor and the canines, were perforated by bifacial  
373 gouging. The Hayonim items display a slightly different technical behavior, i.e.,  
374 bifacial rotation in two cases, and a combination of bifacial gouging with bifacial  
375 rotation to finish the hole in five pieces (including the preform; Fig. 8A–D).

376 While it is tempting to argue for a particular technical behavior vis-a-vis the  
377 manufacture of the teeth pendants at each site, we should be cautious since the  
378 sample is quite small. Such a difference could be due to intra-Aurignacian  
379 chronological differences. Indeed, while high-resolution radiocarbon chronology for  
380 Manot Cave exists, the dating of Hayonim is questionable since it was done by older  
381 techniques and should be refined (Goring-Morris and Belfer-Cohen, 2002). Still, one  
382 can consider the difference observed as similar to the differences discerned in the  
383 European Aurignacian assemblages which portray flexibility in the techniques  
384 employed in ornament production (White, 2007). We can thus assume that on the  
385 whole, while sharing the selection of taxon and tooth type, the Levantine  
386 Aurignacians could have employed different techniques for the manufacture of the  
387 pendants.

388 Most of the perforations have a circular or subcircular shape, while two  
389 specimens have elliptical holes (Fig. 8; Table 3). These perforation forms are  
390 determined by the techniques employed. Nevertheless, some of the original circular  
391 holes seem to be slightly modified, most likely through use (see below), resulting in a  
392 subcircular form (Fig. 8A, D). The cross-section of the perforations is conical in  
393 almost all the items since they were pierced from both faces of the teeth. Perforation  
394 diameter values are quite regular in all specimens, varying between 2 and 4 mm.  
395 Holes are located at the root centered from the edges and the root distal part (the  
396 apex of the teeth). The distance from the lateral edge is also regular in all pendants.  
397 The hole is at the same range of distance from both edges (between 2 and 5 mm),  
398 and equidistant between the end of the root and the beginning of the crown. This  
399 location was likely chosen to avoid accidents during the perforation process and to  
400 ensure the solidity of the teeth against traction forces, whichever way they were used  
401 (as beads in a necklace, bracelet, attached to clothes, or other).

402 Four of the items from both sites bear ochre stains inside and outside of the  
403 perforation on the buccal and vestibular faces (Fig. 9; Table 4). Presence of ochre  
404 per se in the archaeological remains as well as the presence of modified ochre  
405 fragments have been considered as proof of symbolic behavior during the African  
406 Middle Stone Age (e.g., Henshilwood et al., 2009; Rosso et al., 2016, 2017), and the  
407 European and Levantine Middle Paleolithic (e.g., Hovers et al., 2003; Zilhão et al.,  
408 2010). Exponential growth in scope and quantity is observed from the beginning of  
409 the UP onward (e.g., d'Errico et al., 2003; Zilhão, 2007). In the current study, the  
410 presence of ochre also on the unfinished pendant, covering part of the uncompleted  
411 hole, can indicate that it was used for its abrasive properties, at least in Hayonim, to  
412 facilitate hole perforation. Indeed, combined with a small amount of water, ochre is

413 very useful in increasing the penetration power of the lithic tool used to make the  
414 hole. Still, this mineral could also have been used for decorative purposes, directly  
415 penetrating the pendants themselves or the clothes to which they were attached.  
416 One of the authors (J.-M.T.) experimentally perforated several mammal teeth,  
417 including red deer vestigial canines, by diverse techniques, in some cases using  
418 ocher (Fig. 10). Although this experiment was a didactic test rather than real testing  
419 under an experimental protocol, we have recorded interesting data. Perforating the  
420 teeth, both red deer canines and bovid incisors, using ocher as an abrasive  
421 increases the efficiency—defined as the (often measurable) ability to avoid wasting  
422 materials, energy and efforts in producing a desired result—of carrying out the task at  
423 hand. It allows us to avoid to a great extent sliding of the tool point on the teeth root  
424 surface, thus minimizing the risk of breakages; also, it shortens the time needed to  
425 perforate the tooth, ca. 10–15 minutes against 25–30 minutes without using ocher.  
426 We mention these data while being aware that the modern concept of efficient time  
427 management seems to be absent in hunter-gatherer societies, whether Paleolithic or  
428 recent (i.e., Shina et al., 2008; Polcaro, 2013).

429

### 430 *3.3. Use-wear*

431 Similar use-wear marks were observed on four deer canines and one of the  
432 bovid incisors. The marks consist of polish around the edge of the hole located in the  
433 distal part of the root (the surface closer to the root apex) producing a slight  
434 modification of the original perforation shape. In the area where polish is present, the  
435 striations generated during perforation by rotation were erased, while still visible  
436 along the rest of the perforation (Fig. 8A, D; Table 4).

437           Although it is commonly assumed that the perforated teeth were used as  
438 personal ornaments, the specifics of their use are far from clear. The ethnographic  
439 record provides us with numerous examples of variegated utilization of suspended or  
440 attached objects, not as body ornaments but rather as clothing appendages, basket  
441 and bag accessories, etc. (White, 2007). In the absence of a precise context (for  
442 instance a burial) associated with the teeth pendants of Hayonim and Manot caves,  
443 we must be prudent when considering the functional interpretation of the items.  
444 Nevertheless, technological studies of UP specimens in the European record (e.g.,  
445 White, 1993; Vanhaeren, 2002; White, 2007; d’Errico and Rigaud, 2011), as well as  
446 experimental work (d’Errico, 1993; Cristiani et al., 2014b), advocate the hypothesis  
447 that the perforated teeth of Hayonim and Manot caves are indeed pendants (namely  
448 personal ornaments). Accrue ment of polish inside the holes of the pendants, which  
449 had modified the original shape of the hole, suggests that the piece was worn,  
450 suspended or sewn on clothing. Indeed, a relatively long wear of at least several  
451 months seems to have been needed to produce such a polish (d’Errico, 1993).  
452 Intensive use of the pendants indicates that they had a ‘long life’ and we can thus  
453 assume that such symbolic elements must have been of value to their owners.

454

#### 455 **4. Discussion and conclusion**

456           The study of the two assemblages in conjunction is most beneficial for the  
457 research of the pertinent issue detailed in the present paper. While the Hayonim  
458 specimens enforce the cultural affiliation of the findings discussed herein, the Manot  
459 specimens, especially the one from Area E layer 5 provide a more secure date for  
460 the occurrence of those ornaments.

461           Based on the faunal assemblages, the Aurignacians of Hayonim and Manot  
462 caves could have produced pendants on bones of any of the exploited species.  
463 Nonetheless, they decided to choose exclusively two teeth of two of the largest-  
464 bodied and least consumed species. Contrary to other symbolic expressions of the  
465 Levantine Aurignacians, which highlighted their close relationship with a particular  
466 animal, the gazelle, and whose bones were chosen to be 'decorated' by notches  
467 (Tejero et al., 2018), gazelle teeth do not seem to have been invested with symbolic  
468 meaning. White (2007) noted for the Aurignacian of southwestern Europe that dietary  
469 importance and symbolic significance seem to have been mutually exclusive.

470           The Aurignacian (European and Levantine) symbolic manifestations, namely  
471 personal ornaments as well as graphic, mobile and stationary art, exhibit a broad  
472 similarity. However, at the same time, region-specific characteristics of Aurignacian  
473 groups do occur (Bourrillon et al., 2017) and there is a significant variability on a  
474 continental scale (Vanhaeren and d'Errico, 2006; Wolf and Conard, 2015). The  
475 particularities of each such group are vital in order to understand the dynamics of  
476 intergroup relationships, whether reflecting kinship ties or diachronic trends (Tejero et  
477 al., 2018), as they all belong to the Aurignacian technocomplex *sensu lato*. Recent  
478 research on bone and antler tools suggests similar but also particular features *vis-a-*  
479 *vis* the typological and technical aspects of the exploitation of animal raw materials  
480 (Tejero et al., 2016; Yeshurun et al., 2018). Apparently, the European and Levantine  
481 Aurignacian symbolic items utilizing animal raw material exhibit such variations as  
482 well (Tejero et al., 2018).

483           The techniques employed to modify the Levantine Aurignacian pendants are  
484 similar to those documented in the European Aurignacian (e.g., White, 1993, 2007;  
485 Vercoutère, 2004; d'Errico and Rigaud, 2011). However, while in the Levant the ways

486 to perforate a tooth are limited, the methods employed by the European Aurignacians  
487 were varied, showing technical flexibility with gouging and rotation extensively  
488 documented (White, 2007).

489         The preference of one taxon and a particular tooth, namely the red deer  
490 vestigial canines, to make personal ornaments is a behavior shared by European and  
491 Levantine Aurignacians. Though the European Aurignacian hunter-gatherers  
492 exploited a large variety of teeth from diverse mammals, it appears that pierced red  
493 deer teeth were of importance and were worn by individuals travelling over long  
494 distances (Gravel-Miguel, 2009; Fig. 11). The apparent dissociation between  
495 consumed animals and animals whose teeth were used for ornaments is particularly  
496 marked in the case of this species. The geographic distribution of red deer pendants  
497 in the European UP does not reflect the animals' geographic distribution, since the  
498 pendants seem to have moved beyond the extent of the red deer habitat (Gravel-  
499 Miguel, 2009).

500         In the Levant, red deer were present during the Early UP in the Mediterranean  
501 realm, both in human-generated assemblages and in hyena den accumulations  
502 (Rabinovich, 2017; Orbach and Yeshurun, 2019; Yeshurun et al., 2019). Although  
503 this species was part of the diet of the Levantine Aurignacians, its share in that diet is  
504 anecdotal compared to that of gazelles and, to a lesser extent, Persian fallow deer.  
505 Indeed, in Area C at Manot, red deer specimens represent 1.5% of the identified  
506 species of ungulates. In Hayonim the frequencies of red deer are similar, and  
507 comprise ca. 2% of the NISP in each sublayer (D4: 27 [1.83%]; D3: 97 [1.38%]; D1–  
508 2: 112 [2.21%]). At Hayonim cave *Cervus elaphus* is represented by various body  
509 parts including both upper and lower teeth, either isolated or socketed: seven teeth  
510 (26%) out of 27 elements from Layer D4; 15 teeth (15%) out of 97 elements from



511 Layer D3; and 33 teeth (29%) out of 112 items from Layer D1-2. Among the teeth, no  
512 canines other than the perforated specimens were identified (Rabinovich et al., 1997;  
513 Rabinovich, 1998a, b). In Manot Cave Area C sample, there are two red deer  
514 specimens in the Ahmarian (astragalus and intermediate phalanx) and three red deer  
515 specimens in the Aurignacian (intermediate phalanx, humerus and unmodified  
516 incisor; Yeshurun et al., 2019).

517         As a rule, prehistoric European societies in general had a strong preference  
518 for the use of red deer canines as personal ornaments. Their presence in many  
519 prehistoric settlements, in different contexts, including single burials with dozens of  
520 them—e.g., in ethnographic examples (Binford, 1971), in the UP (Giacobini, 1999),  
521 and in the Mesolithic (Cristiani et al., 2014a, b)—suggests that they possessed  
522 symbolic value for both Paleolithic and post-Paleolithic societies. This could be  
523 explained by the tooth's particular shape—rounded—as well as its luster and its  
524 tactile qualities (White, 2007). Similar reasons have been alleged for other raw  
525 materials like ivory, amber and shells (Taborin, 1993, 2004; Stiner, 2014; Bar-Yosef  
526 Mayer, 2015). Indeed, deer canines were at times imitated in different raw materials  
527 (bone and antler) by Paleolithic hunter-gatherer groups in Europe and the Levant  
528 (White, 1989; Vanhaeren and d'Errico, 2006; Shaham, 2014).

529         Personal ornaments can come in the form of necklaces, pendants, or dress  
530 decorations (Kuhn and Stiner, 2007). The use-wear of the Aurignacian Levantine  
531 pierced teeth suggests usage similar to that observed for the European Aurignacians.  
532 An exchange of tooth pendants between groups from different regions is possible in  
533 light of the shared concepts and it could also explain the adoption of similar symbolic  
534 practices for the Aurignacians groups of both Europe and the Levant. The latter is

535 reinforced by the in situ production of the pendants that is demonstrated for some of  
536 the Hayonim items.

537         While the precise meaning of the message transmitted by such objects is lost  
538 to us, we can nevertheless assess its significance in a particular regional context. In  
539 this regard, it is interesting to note that as in the Levantine Aurignacian, in other  
540 regions and material cultures a few specific types of raw materials with standardized  
541 shapes were selected as personal ornaments. One example is the choice of  
542 particular shells —*Nassarius*—to fabricate pendants in the African Middle Stone Age  
543 and in the beginning of the UP in both the Levant and Europe (Kuhn and Stiner,  
544 2007; Bar-Yosef Mayer, 2015). Another example is the particular shape of the so-  
545 called ‘basket beads’ made mostly of ivory, characteristic of the Early Aurignacian in  
546 southwestern France (White, 1992; Heckel, 2017).

547         An essential feature of the use of symbols is that their meaning is assigned by  
548 arbitrary, socially constructed conventions, allowing the storage and visualization of  
549 information externally (e.g., Henshilwood and Marean, 2003; Hovers et al., 2003;  
550 Langley, 2015; Belfer-Cohen and Hovers, 2020). The objects imbued with symbolic  
551 meaning reflect their use to link the individual or population to their cultural identity,  
552 material culture and environment (Henshilwood and Marean, 2003).

553         As the development of UP technotypological traditions following the dispersal  
554 of AMH in Eurasia, is among the most hotly debated topics, it seems essential to  
555 examine and evaluate the variability among human groups, as regards both  
556 differences and commonalities. Such studies are of great help in identifying the  
557 directions and trajectories of dispersals and the establishment of regional territories  
558 (Bar-Yosef and Belfer-Cohen, 2013). Human groups differ (Binford, 2001;

559 Norenzayan, 2011) and, unquestionably, the differences observed stem not only from  
560 varying external environmental circumstances (Banks et al., 2013) but also from  
561 intra- and intergroup social rules, customs, and relationships (Gelfand et al., 2011).  
562 Thus, variability in ritual and symbolic behavior undoubtedly played an important role  
563 and is a critical aspect among Pleistocene groups and/or archaeological cultures.  
564 Beyond technological skills, variability in social and spiritual dynamics lies at the core  
565 of human self-definition as a group, society, or 'cultural entity' (Bar-Yosef and Belfer-  
566 Cohen, 2013; Belfer-Cohen and Hovers, 2020).

567         The Levantine Aurignacians shared with their European counterparts some  
568 similarities in various spheres (technical, economic, social, symbolic) involving bone  
569 and antler production. For example, they shared similar complex technical concepts  
570 of antler working as opposed to simpler ones for bone-working and had in common a  
571 recurrent but limited variety of bone-tool morphotypes (mainly awls and projectile  
572 points; Tejero et al., 2016). However, they differed in other particulars of their  
573 material culture, i.e., both the bone/antler industries and the lithic ones (e.g., Bar-  
574 Yosef and Belfer-Cohen, 1996, 2010; Goring-Morris and Belfer-Cohen, 2006; Belfer-  
575 Cohen and Goring-Morris, 2007, 2014, 2017; Barzilai et al., 2016; Marder et al.,  
576 2017; Marder et al., 2019). Such is also the case for some symbolic elements, e.g.,  
577 the notched gazelle scapulae and hyoid, which seem to have had special  
578 significance for Levantine Aurignacians (Tejero et al., 2018).

579         The similarity in the symbolic representations of the European and Levantine  
580 Aurignacian is especially striking when the 'symbolic' record of other UP cultures in  
581 the Levant is considered. The other EUP entity of the Levant, the Ahmarian, is  
582 commonly perceived as a local tradition, predating the Levantine Aurignacian and  
583 more extensively distributed in space and time. Symbolic expressions, including

584 pendants, do exist in the Ahmarian, but exclusively in the form of mollusk-shell  
585 ornaments (Bar-Yosef Mayer, 2005; Stiner, 2014). Also, the exploitation of antler, so  
586 typical of the Levantine Aurignacian, is missing from secure Ahmarian contexts,  
587 which display very few bone tools in general. It thus seems that the two EUP entities  
588 in the Levant, utilizing the same environment and having access to the same natural  
589 resources (e.g., Yeshurun et al., 2019), expressed their aesthetic or symbolic needs  
590 in distinct ways. The Levantine Aurignacian symbolic ‘package’ is truly a very distinct  
591 cultural phenomenon that is well constrained in time and space. This lends support to  
592 the notion of the Levantine Aurignacian being an incursion from the north as opposed  
593 to the locally rooted Ahmarian technocomplex (e.g., Goring-Morris and Belfer-Cohen  
594 2006; Bar-Yosef and Belfer-Cohen, 2010, 2014; Belfer-Cohen and Goring-Morris  
595 2014; Barzilai et al., 2016). It does not support an independent development because  
596 of the very particular nature of the material component (Tejero et al., 2018).

597         The significant similarities observed between the Levantine Aurignacian of  
598 Manot Cave and Hayonim Cave are manifested through various aspects of the  
599 material culture, including typotechnological aspects of the lithic component, diet, the  
600 bone industry and the mollusk remains (Marder et al., 2019). Both sites share similar  
601 practices of iconic behavior using gazelle bones as blanks for notched items (Tejero  
602 et al., 2018). We add here yet another aspect to the symbolic sphere of Hayonim and  
603 Manot Aurignacians dwellers—the manufacture of pendants mainly on male red deer  
604 canines. This could imply the existence of cultural bonds between the two sites as  
605 well as between the Levantine and the European Aurignacian, considering the  
606 widespread of this behavior all over Europe.

607

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629

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1091       **Figure captions**

1092       **Figure 1.** Location of the sites mentioned in the text: 1 = Yabroud-II; 2 = Ksâr ‘Akil; 3  
1093       = Manot Cave; 4 = Hayonim Cave; 5 = Sefunim; 6 = Kebara; 7 = El Quseir. Image  
1094       courtesy of NASA/JPL/NIMA.



1095 **Figure 2.** On the left, spatial distribution (A) and stratigraphic location (B–D) of  
1096 perforated teeth from Hayonim Cave (red deer canines = yellow circles; bovid incisor  
1097 = yellow triangle) plotted over the West–East sections of Stratum D. The Aurignacian  
1098 area is shown in soft gray and hearths in dark gray in the cave plan (modified from  
1099 Stiner et al., 2001: Fig. 1). On the right, the Manot Cave, general plan (E) and cross-  
1100 section (F), with the location of the excavation areas and schematic composite  
1101 section of the occupation layers in Area E. Based on the northwestern excavation  
1102 sections.

1103 **Figure 3.** Red deer vestigial canines of female (left) and male (right). Note the  
1104 different morphology of both the root and crown.

1105 **Figure 4.** Red deer vestigial canines: recorded morphometric variables (after d’Errico  
1106 and Vanhaeren, 2002): A = perforation; B = distance between tooth buccal and  
1107 lingual edges; C = distance between the perforation and the root base.

1108 **Figure 5.** Red deer canines (A, B; specimens M105, M131) and bovid incisor (C;  
1109 specimen M130) of Manot Cave (1, 2, 3).

1110 **Figure 6.** Red deer canines (A–C; specimens H11, H53, H157) and bovid incisor (D;  
1111 specimen H152) of Hayonim Cave (1–4). Image courtesy of Assaf Uzan  
1112 (photographer).

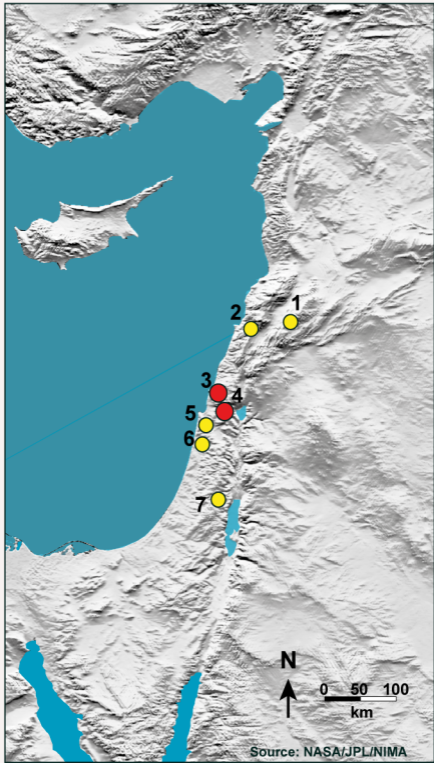
1113 **Figure 7.** Preform of perforated red deer vestigial canine (H226) from Hayonim  
1114 Cave. On the left, detail of the surface preparation by scraping (encircled in magenta  
1115 line) and the unfinished perforation by gouging combined with rotational scraping  
1116 (encircled in blue line; magnification 20×).

1117 **Figure 8.** Detailed scanning electron microscopy photographs of perforated red deer  
1118 canines. A, B, G, H) Area of the perforation: rotation marks (in magenta) and use-  
1119 wear polish (in blue). Use-wear polish masks the rotation striations (H11, H53). C, D)  
1120 Marks of scraping (in brown) outside the hole to prepare the perforation zone. Note  
1121 that scraping striations were cut by the perforation, showing the operational  
1122 sequence, namely first preparation of the root and then perforation of the tooth  
1123 (H157). E, F) Striations due to rotation action to perforate the tooth (H35).  
1124 Magnifications: 32–100×.

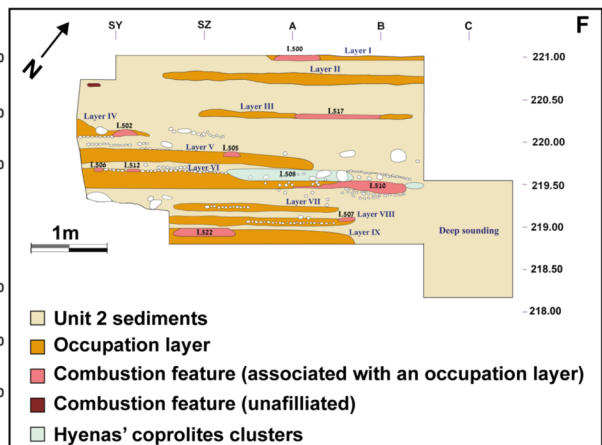
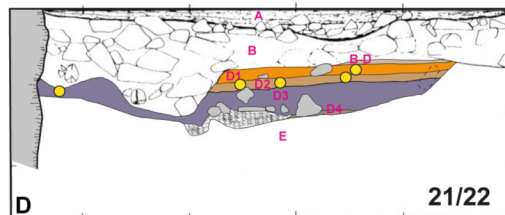
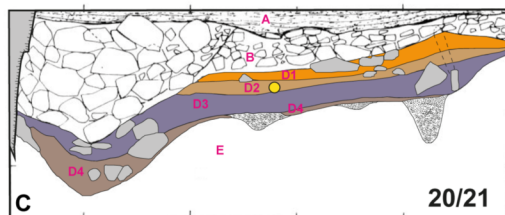
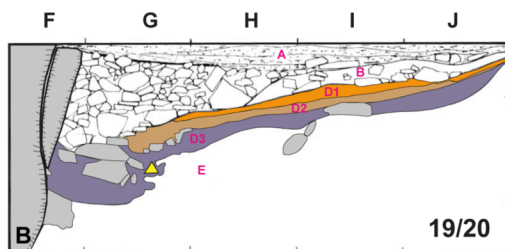
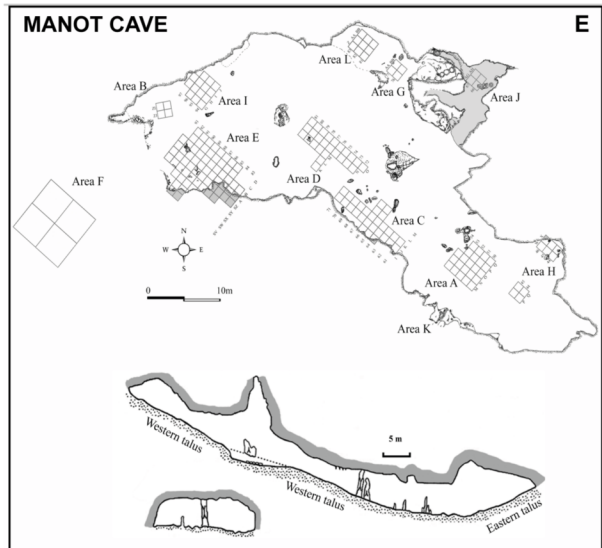
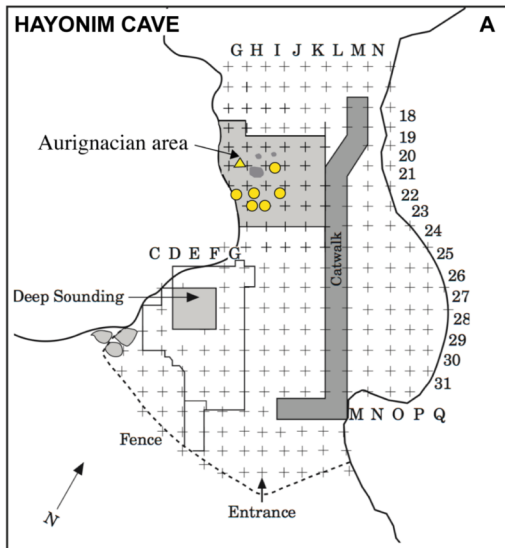
1125 **Figure 9.** Detailed scanning electron microscopy photograph of an ocher stain on  
1126 one of the red deer canines (H35) on top. The analysis shows the elements of the  
1127 ocher stain composition on the bottom. Magnification: 1000×.

1128 **Figure 10.** Red deer canine perforated experimentally using ocher to increase the  
1129 penetration of the lithic tool (A). Detailed microscopy photograph of the holes in  
1130 lower (B) and upper (C) faces of the canine root showing the scraping striations and  
1131 the ocher stains inside the perforations (detail scale 1 mm; magnification 15×).

1132 **Figure 11.** Map with the location of Eurasian Aurignacian sites with worked red deer  
1133 (*Cervus elaphus*) vestigial canines: 1 = Manot Cave; 2 = Hayonim Cave (Israel); 3 =  
1134 Istallöske (Hungary); 4 = Sandalja (Croatia); 5 = Fossellone (Italy); 6 = Hohle Fels; 7  
1135 = Vogelherd (Germany); 8 = Spy; 9 = Princesse; 10 = Goyet; 11 = Trou Magrit  
1136 (Belgium); 12 = Saint Césaire; 13 = La Quina; 14 = Rois; 15 = La Ferrassie; 16 =  
1137 Castanet; 17 = Le Piage; 18 = Balauziere; 19 = Pecheurs (France); 20 = Reclau  
1138 Viver (Spain); 21 = Tuto de Camalhot; 22 = Grotte des Hyenes; 23 = Gatzarria; 24 =  
1139 Isturitz (France); 25 = Covalejos; 26 = Cueva Morín (Spain). Image courtesy of  
1140 NASA/JPL/NIMA.

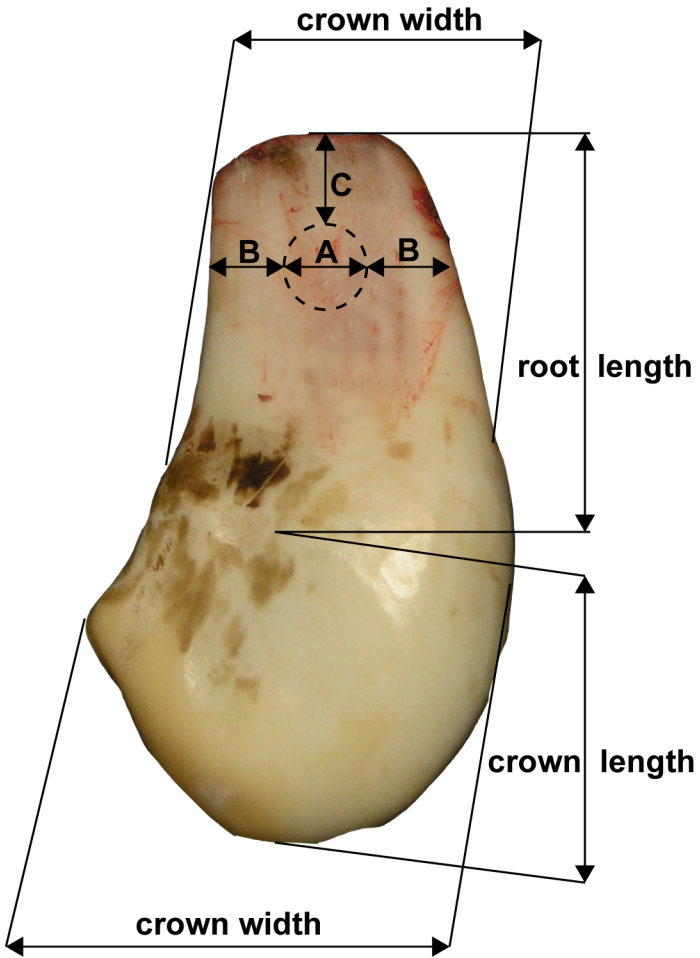


Source: NASA/JPL/NIMA





2 cm



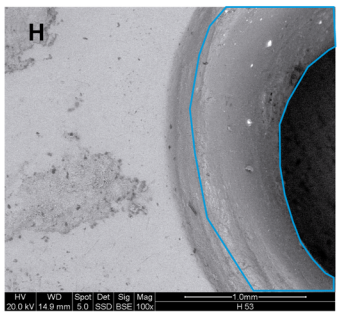
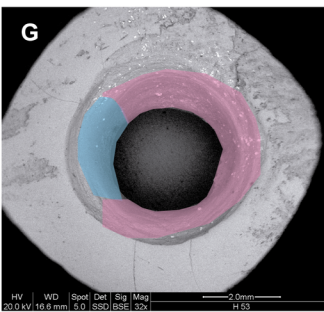
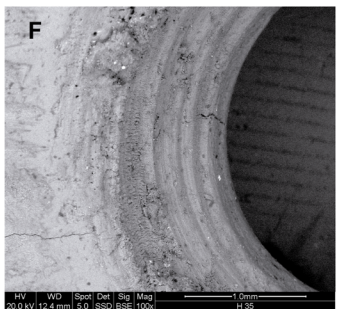
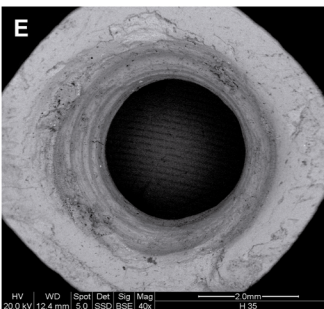
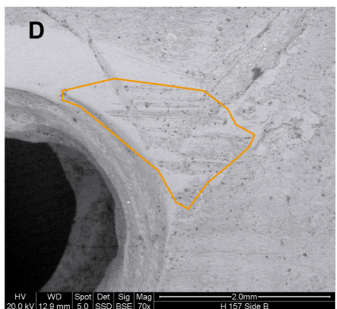
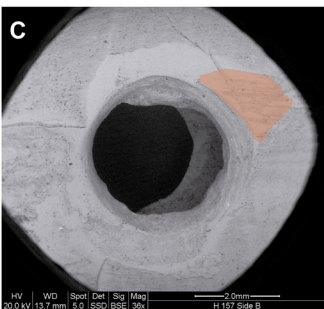
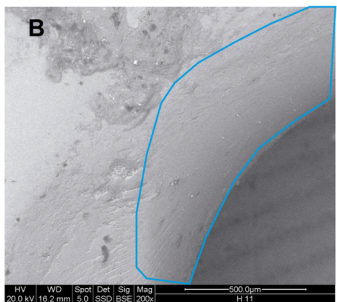
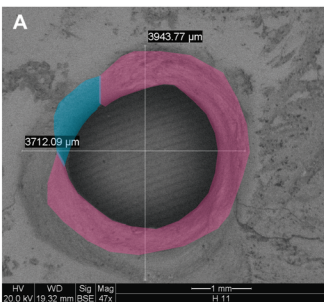
10 mm

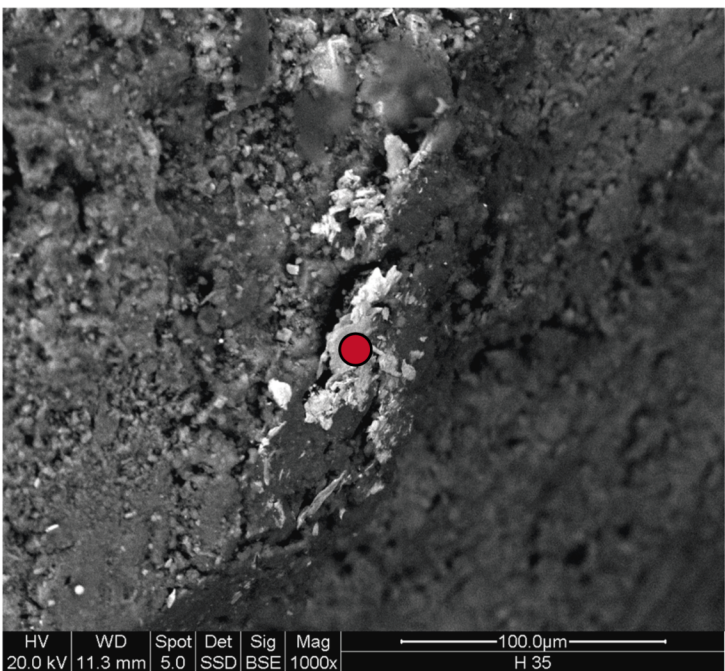
**A****M105****2 mm****B****M131****C****M130**



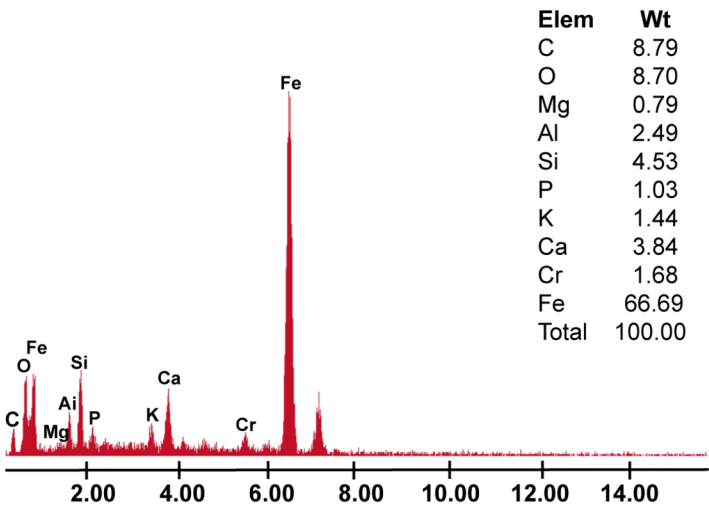


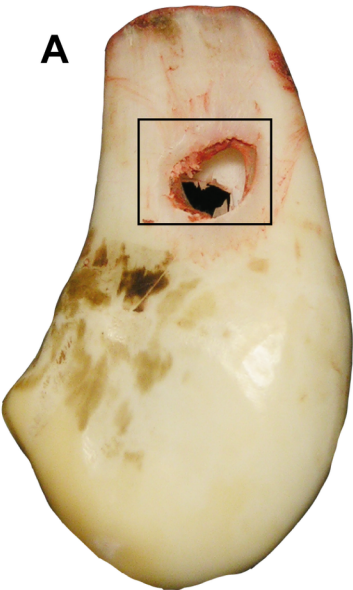




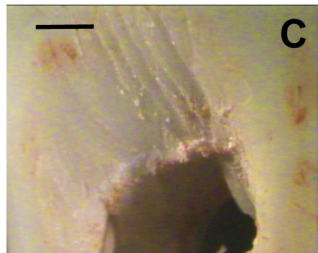
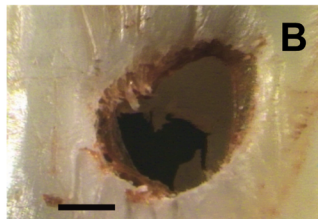


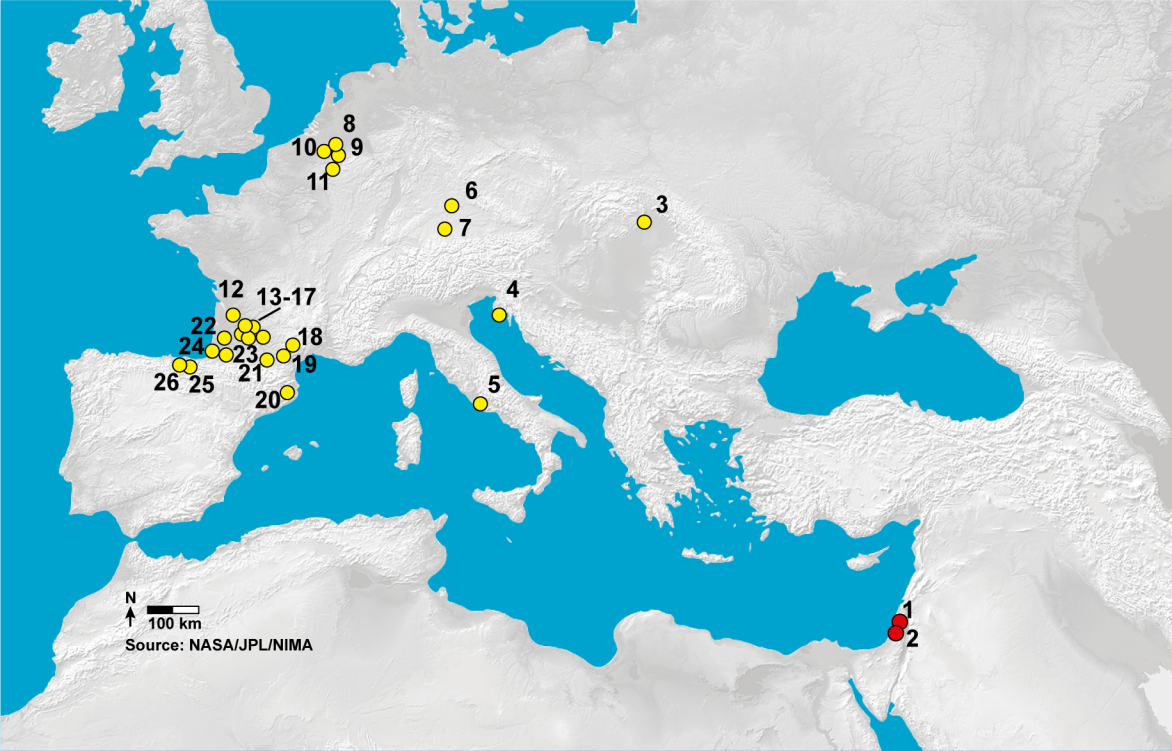
Label A: H35



**A**

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N  
↑  
100 km

Source: NASA/JPL/NIMA

**Table 1**

Pendants from Hayonim and Manot caves.

Site	Number	Area	Unit	Layer	Square	Species	Tooth	Sex	Side
Hayonim cave	H11	—		D	H22/I22	<i>Cervus elaphus</i>	vestigial canine	male	righth
Hayonim cave	H35	—		D	H21a	<i>Cervus elaphus</i>	vestigial canine	male	left
Hayonim cave	H53	—		D	H22d	<i>Cervus elaphus</i>	vestigial canine	male	righth
Hayonim cave	H157	—		D1-2	I22d	<i>Cervus elaphus</i>	vestigial canine	male	left
Hayonim cave	H179	—		D	F22	<i>Cervus elaphus</i>	vestigial canine	male	left
Hayonim cave	H226	—		D2	H22	<i>Cervus elaphus</i>	vestigial canine	male?	righth
Hayonim cave	H152 <sup>a</sup>	—		D4	G20	<i>Bos primigenius</i>	incisor	—	
Manot cave	105	E	2	5	SY89b	<i>Cervus elaphus</i>	vestigial canine	male	righth
Manot cave	130	C	6	—	j66d	Bos	incisor	—	
Manot cave	131	E	test pit	—	c87	<i>Cervus elaphus</i>	vestigial canine	male	left
Manot cave	132	E	test pit	—	c86	<i>Cervus elaphus</i>	vestigial canine	male	left

<sup>a</sup> This specimen was first described as a horse tooth (Belfer-Cohen and Bar-Yosef, 1981)

**Table 2**

Red deer vestigial canines pendants morphometry (d'Errico and Vanhaeren, 2002; see Fig. 4).

Number	Root length	Root width	Root apex width	Root thickness	Ratio L/T	Crown L	Crown W	Crown T	Length of occlusal surface	Width of occlusal surface	Wear stage of occlusal surface	Root apex	Pulp cavity	Distolingual lobe
H11	17	11	8	5	3.4	12	15	8	17	8	highly	closed	not visible	absent
H35	15	12	8	5	3	—	12	—	—	—	—	just closed	not visible	-
H53	17	11	8	5	3.4	9	10	8	20	10	highly	closed	not visible	absent
H157	15	8.5	7	4	2.2	12	12	7	12	6	affected	open	visible	present
H179	15	8	5	4	3.7	8	10	5	12	6	affected	closed	not visible	present
H226	10	8	5	5	2	8.5	7	5	6	3	highly	closed	not visible	absent

105	9	12	8	4	3	13	—	9	6	4	affected	closed?	visible?	present
131	11	12	8	5	2.2	11	11	8	11	8	affected	closed?	not visible?	present
132	11	8	5	4	2.7	9	10	6	10	7	affected	closed	not visible	present

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Abbreviations: L = length; W = width; T = thickness.



**Table 3**

Detail description of the pendants perforation of Hayonim and Manot Caves.

Number	Type	Preparation of the surface	Perforation procedure	Perforation shape	Diameter (mm)	Distance between tooth buccal and lingual edges (mm)	Distance between the perforation and the root base (mm)
H11	perforation	scraping	bifacial gouging + rotational scraping	subcircular	4 × 3.8	3.5/4	4
H35	perforation	scraping	bifacial gouging + rotational scraping	circular	4 × 4	5/5	8
H53	perforation	—	bifacial rotational scraping	circular	4 × 4	3.5/4	6
H157	perforation	scraping	bifacial gouging + rotational scraping	subcircular	3 × 3.5	2.5/3	8
H179	perforation	—	bifacial rotational scraping	circular	3 × 3	2/2	6
H226	unfinished perforation	scraping	—	—	—	—	—

H152	perforation	scraping	bifacial gouging + rotational scraping	subcircular	4 × 5	2/2	15
105	perforation	—	bifacial gouging	subcircular	2 × 2.5	3.5/3.5	3
130	perforation	scraping	bifacial gouging	oval	5 × 3	3/3	6
131	perforation	—	bifacial gouging	oval	4 × 2	3/4	3
132	perforation	—	bifacial gouging	subcircular	2 × 2.5	2/3	2

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**Table 4**

Use-wear marks and ocher stains (see Fig. 9).

Number	Use wear marks	Use-wear marks location	Ochre stains	Ocher stains location
H11	polish	Upper (distal) part of perforation	no	—
H35	no	—	no	—
H53	polish	Upper (distal) part of perforation	yes	root and crown bucal face
H157	polish	Upper (distal) part of perforation	no	—
H179	no	—	no	—
H226	—	—	yes	root (bucal and vestibular faces)
H152	no	—	no	—
105	polish	Upper (distal) part of perforation	no	—
130	polish?	Upper (distal) part of perforation	no	—
131	—	—	yes	root and crown bucal and vestibular faces
132	polish?	Upper (distal) part of perforation	yes	inside the perforation