



Early and Middle Pleistocene Faunal and Hominins Dispersals through Southwestern Asia

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1 **Early and Middle Pleistocene Faunal and Hominins Dispersals through**
2 **Southwestern Asia**

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12 **Abstract**

13 This review summarizes the paleoecology of the Early and Middle Pleistocene of
14 southwestern Asia, based on both flora and fauna, retrieved from a series of ‘windows’
15 provided by the excavated sites. The incomplete chrono-stratigraphy of this vast region
16 does not allow to accept the direct chronological correlation between the available sites
17 and events of faunal and hominin dispersals from Africa. It also demonstrates that
18 hominins survived in a mixed landscape of open parkland with forested surrounding hills.
19 In addition, the prevailing environmental conditions are not sufficient to explain the
20 differences between ‘core and flake’ and the Acheulian industries that probably reflect
21 the learned traditions of different groups of hominins successful adaptations to new
22 ecological niches away from the African savanna. The current distribution of lithic
23 industries across Eurasia is undoubtedly incomplete due to lack of cultural continuities as
24 well as paucity of field research in several sub-regions. This observation supports the
25 contention that what we view as a constant stream of migrants was actually interrupted
26 many times. The continuous occupation of southwestern Asia by the makers of the
27 Acheulian is in contrast with neighboring regions such as the Iranian plateau and Eastern
28 Europe. A more complex model is required to explain the Eurasian archaeological-
29 cultural mosaic recorded in Eurasia.

30

30 **Introduction**

31 The effect of climate change on the tempo and mode of early hominids dispersals
32 from Africa during the Early and Middle Pleistocene is one of the main interests in
33 paleoanthropology and Paleolithic archaeology (Behrensmeyer, 2006). It has been
34 suggested that the expansion of savanna environments during the Early Pleistocene
35 allowed for the first ‘Out of Africa I’ dispersal (Dennell, 2004; Martínez-Navarro, 2004)
36 and that humans dispersed into Western Europe during warmer periods and that the
37 dispersal was highly influenced by climate rather than culture, which played only a minor
38 role (Agustí et al., 2009a). However, these theories assume as a working hypotheses that
39 the presence of hominins and faunal present in the paleontological and archaeological
40 record is continuous. Here we would like to focus on southwestern Asia that served as the
41 main corridor for hominin dispersal during the Early and Middle Pleistocene and address
42 the assertion that we can test hominids co-dispersed with other taxa and the extent of the
43 response to climatic forcing. We will propose that there is no correlation between
44 hominid and faunal dispersals and suggest that early *Homo* dispersals were not directly
45 controlled by climatic forcing.

46 Geological and archaeological investigations in southwestern Asia produced a
47 few “windows” into the geological sequence of the Early and Middle Pleistocene. Most
48 of these “windows” are known from excavations of archaeological sites. Hence, in order
49 to provide a continuous narrative of hominin and faunal dispersals we need to combine
50 the chronologically patchy information with the physiographic variability of this vast
51 region, as well as the incomplete paleo-climatic conditions that determined the
52 distribution of resources in each sub-region.

53 The sub-regions of southwestern Asia are commonly identified from north to
54 south and west to east as follows: Anatolia, the southern Caucasus, The Zagros
55 mountains and the Iranian plateau, the Levant and the Arabian peninsula. Among these,
56 due to many years of field and laboratory research, the better known is the Levant. It also
57 has the advantage that researchers from various schools and institutions conducted
58 surveys of Quaternary deposits, drilling boreholes for water and pollen, and
59 archaeological excavations of Lower Paleolithic occupations. Thus the accumulated
60 information creates an imbalance between the areas, some of which like the Iranian and
61 the Anatolian plateaus are of larger area than the Levant but yet poorly known. We are
62 therefore forced to base our review on the Levantine sequence and touch upon, in a more
63 cursory fashion, the other sub-regions.

64 The Levant is a unique biogeographic entity within southwestern Asia. It lies at
65 the crossroads of Africa and Eurasia and has more lush environments compared to the
66 alternative dispersal corridor on the southern fringes of the Arabian Peninsula. This land
67 bridge emerged during the Miocene as a continuous terrestrial belt that allowed various
68 plants and animal taxa to migrate through in either direction (Thomas, 1985; Tchernov,
69 1988; Bar-Yosef, 1994,1998a). The southern path through the margins of the Arabian
70 Peninsula could be crossed at the Bab el-Mandeb straits during low sea level stands,
71 and along the area that receives the summer Indian Ocean monsoon to be followed by a
72 passageway through the Hormuz straits into the southern coast of Iran (Fig. 1), and a
73 northern path via the Nile river and the Sinai Peninsula.

74 During the Middle Pleistocene both land and sea bridges were potential dispersal
75 routes for hominins (Derricourt, 2006). However, the available archaeological evidence

76 was retrieved only from the Levant with a few indications from the southern route
77 (Amirkhanov, 1991). During the Late Pliocene and Early Pleistocene there is no evidence
78 for a land bridge over the Bab el Mandeb straits. Indeed, during this time period,
79 dispersals of most animal and plants seem to have been limited to the terrestrial Northern
80 corridor of the Levant.

81 It is well-known that dispersals of early *Homo ergaster/etectus* from Africa across
82 Eurasia during the Early and Middle Pleistocene are interpolated from isolated
83 archaeological and fossil sites (e.g., Gabunia and Vekua, 1995; Larick and Ciochon,
84 1996; Bar-Yosef, 1998a; Potts, 1998; Arribas and Palmqvist, 1999; Bar-Yosef and
85 Belfer-Cohen, 2001; Potts, 2002; Antón and Swisher, 2004; Martínez-Navarro, 2004;
86 Lordkipanidze et al., 2007). The reasons for these long-range migrations, whether in a
87 form of “leap frog” expansions or gradual diffusion, are formulated as plausible
88 hypotheses, open to alternative interpretations. Moreover, the advantages for leaving
89 Africa are not easily testable (e.g., Bar-Yosef and Belfer-Cohen, 2001). One may use the
90 biogeographic ranges outside Africa, from the Iberian peninsula to East and Southeast
91 Asia, occupied by early hominins, to calculate the rate of movements and the chance for
92 long term survival of early mobile hunter-gatherers. Currently it seems that it took ca. 0.5
93 Ma to reach Western Europe by ca. 1.3 Ma (Agustí et al., 2000) and much less time to get
94 to ca. 1.66-1.7 Ma to East and Southeast Asia (Zhu et al., 2003; Antón and Swisher,
95 2004). One of the major questions is how African species adapted to the ecological
96 variability in Eurasia and the role the ‘culture’, as recorded in the stone tools, assisted (or
97 not) in the survival of lineages in the new territories.

98 For the purpose of making the most parsimonious explanations about hominin
99 adaptations, and indicating where and when continuity is interrupted, probably by the
100 demise of some groups, we provide a brief review of current climatic and vegetation
101 conditions, a survey of the main Lower Paleolithic sites, followed by a summary of the
102 vegetation and faunal records as a basis for environmental reconstruction and long
103 distance correlations with known climatic events, and evaluation of hominin dispersals
104 through this region.

105

106 **Current Climatic Conditions**

107 The dominant physiographic feature of southwestern Asia is the combination of
108 mountains, plateaus, alluvial plains and desert landscapes including oases. The Anatolia
109 plateau is surrounded by mountains ranges in the north and the south where the Taurus
110 Mountains arching eastward into the Zagros Mountains. The Levant, along the eastern
111 Mediterranean coast has several parallel features. The narrow coastal plain in the north
112 widens in the south, the mountain ranges create the main watershed of this sub-region,
113 the Anuq-Beqa'a-Jordan Rift Valley stretches from north to south, and the Trans-
114 Jordanian or Syro-Arabia desert plateau descends eastward and southward. The
115 Euphrates and the Tigris rivers and their tributaries cross the Mesopotamian plain, which
116 is bordered by the Zagros Mountains and the Iranian plateau. The latter was and is mainly
117 desert strewn by oases.

118 Today's climate of the region is dominated by cold winters with the precipitation
119 brought by the westerlies. Snow falls only in the higher mountains, and in particular in
120 eastern Turkey and the northwestern Zagros. Summers are hot and dry. There is a wide

121 range of variation across the region. Thus, winter temperatures are milder in the coastal
122 belts and more severe inland or at higher elevations and precipitation is affected by
123 distance from the Mediterranean Sea and the local sub-regional altitude.

124 The East Mediterranean region is located between the more temperate European
125 climatic zone in the north and the hyper arid regions of the Saharo-Arabian desert belt in
126 the south. Since the synoptic hydrological conditions may affect the entire southwestern
127 Asia, the question is whether and how warm to cold and humid to dry oscillations
128 affected the Levant since the Early Pleistocene (Frumkin and Stein, 2004).

129 Models of Pleistocene climates attempted to explain the paleoclimatic record of
130 the Levant. Earlier Butzer (1958) suggested a high correlation between the local
131 intensification of the westerly circulation of the Mediterranean during glacial periods and
132 the deep Cyprus Lows that would explain the increase in rainfall during glacial times.
133 Similar views were expressed by others (e.g., Horowitz, 1979). Recently, the extent the
134 increase of annual precipitation during North Hemispheric glaciations affected the
135 Levant, and whether it extended into the currently dry desert belt in the south has been a
136 topic of debate (Enzel et al., 2008 and references therein).

137 The climatic conditions and physiographic conditions determined the distribution
138 of the phytogeographic belts (Zohary, 1973; Danin, 1988), and the most frequently
139 encountered mammals in each region (e.g., Harrison and Bates, 1991; Harrison, 1972):

140 1. The Pontic province – the ‘Euro-Siberian’ region corresponds to the Palearctic
141 deciduous and coniferous forests. It stretches from the southern edge of the Black Sea in
142 northern Turkey as well as relict enclaves in south in the Anti-Taurus Mountains, the
143 Syrian Amanus range and northern Lebanon. Part of the Pontic includes the Hyrcanian

144 province of the coastal mountains of the southern Caspian Sea that descends into Iraqi-
145 Kurdistan and northern Syria. It included deciduous species of maple (*Acer*), birch
146 (*Bitula*), hazelnut (*Corylus*), beech (*Fagus*), ash (*Fraxinus*), lime (*Tilia*) and elm (*Ulmus*)
147 that have a clear Arcto-Tertiary origin. Other evergreen species that occur in southern
148 Europe are present such as the boxwood (*Buxus sempervirens*), holly (*Ilex aquifolium*)
149 and yew (*Taxus baccata*).

150 2. Irano-Turanian province – covers the sub-regions of the Anatolian plateau, the
151 Syrian Desert, the Iranian plateau, and stretches into central Asia and the Gobi Desert.
152 The climate here is dominated by extremely cold winters and very hot summers with little
153 to no rain fall in the winter. It is dominated by dwarf scrubland and steppes vegetation.

154 3. The Saharo-Arabian province stretches south of the Mediterranean basin and
155 extends from Mauritania to the Red Sea incorporating the Sahara desert. This vegetation
156 is open xeromorphc dwarf scrubland and desert plant associations.

157 4. The Mediterranean province spreads around the Mediterranean Sea and
158 includes a combination of *maquis* and forests dominated by oak (*Quercus*), Olive (*Olea*)
159 and almonds (*Amgydalus communis*).

160 5. The Sudano-Zambesian province is confined to the Jordan Valley and preserves
161 relicts of typical African subtropical savanna species such as the acacias.

162 Southwestern Asia was frequented by fauna from three biogeographic provinces:
163 Palaeartic, Oriental and Ethiopian in different proportions. Here we include a
164 description of extant fauna, all species dating to the early Holocene that predates the
165 effects of agriculture, horticulture and hunting. Thus most of the data comes from
166 archaeological excavations.

167 Many taxa are similar over two or more provinces giving the entire Near East a
168 coherent faunal community (Harrison and Bate, 1992). Two main regions can be
169 observed: The first includes the Mediterranean, Pontic and Iranian plateau provinces with
170 Palearctic taxa, and the second includes the mesic Mediterranean, Arabian provinces with
171 Ethiopian elements. Taxa common to all regions include *Hyaena hyaena*, *Felis silvestris*,
172 *Felis chaus*, *Panthera pardus*, *Acinonyx jubatus*, *Lepus capensis*, *Hystrix indica*, *Rattus*
173 *rattus*, *Rattus norvegicus*, *Mus macedonicus*. Palearctic fauna which are found in the
174 Mesic regions of the Mediterranean, the Pontic and much of the Iranian plateau include
175 *Dama mesopotamica*, *Capreolus capreolus*, *Cervus elaphus*, *Sus scrofa*, *Canis aureus*,
176 *Canis lupus*, *Vulpes vulpes*, *Panthera pardus*, *Ursus arctos*, *Martes foina*, *Vormela*
177 *peregusna*, *Mustela nivalis*, *Meles meles*, *Lutra lutra*, *Sciurus anomalus*, *Spalax*
178 *leucodon*, *Apodemus mystacinus*, *Apodemus sylvaticus*, *Cricetulus migratorius*, *Meriones*
179 *tristrami* and *Microtus guentheri*. The Ethiopian taxa unique to the Arabian region are
180 *Vulpes rueppellii*, *Vulpes cana* and *Vulpes zerda*, *Mellivora capensis*, *Genetta felina*,
181 *Felis margarita*, *Caracal caracal*, *Procavia capensis*, *Acomys cahirinus*, *Eliomys*
182 *melanurus*, *Gerbillus nanus*, *Gerbillus dayurus*, *Sekeetamys calurus*, and *Psammomys*
183 *obesus*.

184 Nonetheless, while some genera are common throughout the entire region, the
185 species within each genus differ across the provinces. Thus, the unique species that
186 appear in each province give its unique affinities. For example, the caprine in the
187 Caucasus is *Capra caucasica* while the dominant *Capra* in the Iranian plateau is *Capra*
188 *aegagrus* and in the Mediterranean and Arabia is *Capra ibex*. The gazelle in the semi arid
189 regions of the Mediterranean is *Gazella gazelle*, in Arabia it is *Gazella dorcas* and in the

190 Iranian plateau is *Gazella subgotarossa*. Furthermore, other species are unique to each
191 region. For example, species unique to the Pontic region are *Lynx Lynx*, *Apodemus*
192 *flavicollis*, and *Mesocricetus auratus*. Species unique to the Iranian plateau are the *Ovis*
193 *ammon*, *Allactaga euphratica*, *Dryomys nitedula*, *Calomyscus bailwardi*, *Meriones*
194 *persicus* and *Ellobius fuscocapllius*. Species unique to Arabia are *Oryx leucoryx*,
195 *Tragelaphus imbris*, *Jaculus jaculus*, *Arvicanthis niloticus* and *Gerbillus gerbillus*.

196 However, it is most important to remember that the home ranges of the species is
197 fluid rather than static, and are constantly changing dependant on climatic and
198 environmental changes and inter and intra species competition. Therefore, the presence-
199 absence of faunal elements correspond to the vegetation conditions, and disperse when
200 resources diminish during worsening climatic conditions that could also result in
201 extinction (Bennett, 1997). Thus in the following sections, we will discuss the changes in
202 the distribution of botanical and faunal compositions across the Early and Middle
203 Pleistocene in relation to the biogeographic provinces of southwestern Asia.

204

205 **Lower and Middle Pleistocene sites in Southwestern Asia**

206 The series of sites briefly described below form the isolated windows we have in
207 southwestern Asia into this long period of the Early and Middle Pleistocene. In the
208 absence of radiometric dating and/or paleomagnetic information the ages of several of the
209 localities rely on faunal correlations within the region including long distance
210 comparisons with European sites. Indeed, most of the Pleistocene data was acquired
211 through archaeological excavations while the number of assemblages derived from
212 natural accumulations is limited to a few Pliocene sites in the Caucasus region such as

213 Kvabebi (Vekua and Lordkipadinze, 2008; Agustí et al., 2009b) and Bethlehem in the
214 Levant (see below).

215 There are special localities in the Levant that were thought to provide evidence
216 for early presence of hominins, but a close examination do not stand up to the
217 geochronological criteria. The mammalian fauna of Bethlehem is the oldest Plio-
218 Pleistocene assemblage known from the Levant. This was an animal bone accumulation
219 incorporated in a deposit of flint fragments and clay discovered when a local farmer was
220 digging a well (Gardner and Bate, 1937). The small collection of flints was originally
221 thought to include human artifacts but they have since been shown to be natural (Hooijer,
222 1958; Clark, 1961).

223 Another claim for an Early Pleistocene site named Yiron where core and flakes
224 have been retrieved from the gravels in a major crevice. Unfortunately the Yiron basalt
225 on the plateau did not cover this location and thus the date of the lava flow of 2.4 Ma
226 (Ronen et al., 1980; Ronen, 1991a), is unrelated to the human made lithics.

227 The ‘Erq el Ahmar Formation (Horowitz, 1979) is located about 14 km south of
228 the Sea of Galilee, in the Jordan Valley and accumulated prior to the ‘Ubeidiya Formation.
229 The polarity sequence is correlated with late Gauss and early Matuyuma chrons, within
230 which the Olduvai subchron was identified (Ron and Levi, 2001). Unfortunately the
231 artifacts mentioned in the different papers were found on the surface, except for a few
232 retrieved from a fluvial conglomerate of an unknown stratigraphic position (Tchernov,
233 1995). Hence, the attribution of these to the Olduvai subchron is only tentative and
234 cannot serve as a well-established evidence for hominin presence prior to Dmanisi (Bar-
235 Yosef, 1998a).

236 The subsequent analysis of faunal turnovers in the Levant and the Caucasian
237 region is reported in relation to the cultural definitions, and supplemented by the
238 information from dated archaeological contexts (Table 1). It is followed by information
239 from the more poorly known regions of Anatolia, the Iranian plateau and the Arabian
240 Peninsula; For the sake of clarity, we briefly present the major sites that contain
241 archaeological remains and their cultural attributions in the Caucasian and the Levant
242 regions according to their accepted chronology and regardless of their geographic
243 location (Fig. 1). Numerous prehistoric occurrences were assigned to the Early and
244 Middle Pleistocene that did not yield fossil bones or datable substances or deposits
245 amenable to paleomagnetic readings. On morphological grounds the collected or
246 excavated artifacts were attributed to the Acheulian sequence such as the Early Acheulian
247 occurrences at Nahal Zihor in the Negev (Ginat et al., 2003) or the Late Acheulian in
248 Ma'ayan Baruch in the Upper Jordan Valley. In summarizing the archaeological
249 information we do not describe the faunal and floral remains found in each site in this
250 section, as they will be discussed in length in the following one. The condensed
251 information will allow us to demonstrate below that the assumptions concerning
252 continuous hominin dispersals into Eurasia relies on a series of speculations and that the
253 proposed timing of prehistoric migration is not well tied with the transitions among the
254 faunal assemblages.

255

256 **Dmanisi**

257 The site of Dmanisi is located on a basaltic block bordered by two tributaries of
258 the larger Kura River. The prehistoric deposits were target for systematic excavations

259 (Vekua, 1987; Dzaparidze et al., 1989; Gabunia and Vekua, 1990, 1995; Liubin and
260 Bosinski, 1995; Liubin and Bosinski, 1995; Lordkipanidze et al., 2007; Jöris, 2008;
261 Rightmire et al., 2006). The geoarchaeological study concluded that entire sequence at
262 Dmanisi could be dated to the Olduvai subchron and immediately after as shown by the
263 normal polarity of the lower lava flow (1.8 ± 0.1 Ma) and the infillings of the upper
264 deposit that date to 1.77 Ma. Several human skulls and postcranial bones are attributed to
265 *Homo erectus/ergaster* (Gabunia and Vekua, 1995; Rightmire et al., 2006; Lordkipanidze
266 et al., 2007). The lithics of Dmanisi are identified as core and flake industry sometimes
267 called “pre-Oldowan” or Mode 1 (de Lumley et al., 2005; Jöris, 2008). The Dmanisi core
268 and flake industry marks the presence of hominins that did not practice the production of
269 handaxes (bifaces). It indicates that handaxes were not a necessity for the colonization of
270 Eurasia. The Dmanisi faunal assemblage is earlier than the faunas of S n ze and Le
271 Coupet, and thus also earlier than ‘Ubeidiya (Tchernov, 1987).

272

273 **‘Ubeidiya**

274 ‘Ubeidiya is situated on the edge of the western escarpment of the Jordan Rift
275 Valley and its geological structure was uncovered through a series of excavations
276 (already reported in details) an anticline with several undulations disturbed by a few
277 faults (Bar-Yosef and Tchernov, 1972; Bar-Yosef and Goren-Inbar, 1993). The exposed
278 tilted layers were numbered from those observed as the earliest to the latest over a total
279 thickness of 154m. The sequence was subdivided into four cycles: two mostly limnic (Li
280 and Lu) and two essentially terrestrial (Fi and Fu).

281 The raw materials used for manufacturing artifacts were lava (basalt), flint, and

282 limestone. The basalt nodules occurred as pebbles, cobbles, boulders, and scree
283 components; the limestone was available as much more sparse cobbles within the beach
284 and wadi deposits; and the flint is found in the same environments as small pebbles and
285 cobbles. The 'Ubeidiya hominins employed each type of rock to shape a different type of
286 object (Bar-Yosef and Goren-Inbar, 1993). Core-choppers and light-duty tools were made
287 of flint, spheroids mainly of limestone, and the handaxe group from basalt, with a few of
288 flint and limestone. There is a direct correlation between the size of the tool-category and
289 the type of raw material. Although basalt is the most common rock and found in every
290 lithological facies at 'Ubeidiya the most abundant object is the core-chopper, which is
291 made of flint and its detached pieces (flakes). It seems that the lithic assemblages from
292 the lower most layers in the sequence (K/III-12, III-20-22, II-23-24) contain an
293 abundance of core-choppers, polyhedrons and spheroids but lack bifaces, except for one
294 trihedral. The samples are large enough to suggest that they may indicate the presence of
295 an early group of hominins that did not produce bifaces. The overlying assemblages
296 contain bifaces in varying frequencies and can be called Early Acheulian (Bar-Yosef and
297 Goren-Inbar, 1993). As the presence or absence of bifaces is taken to designate different
298 groups of hominins one may speculate that as in Dmanisi, the first hominins to arrive at
299 'Ubeidiya, were not the bearers of the Acheulian.

300 Among the so-called formal categories the frequencies of bifaces are abundant in
301 gravelly layer K-30 although the underlying layer K-29 of the same wadi fill produced
302 very few bifaces. It seems that certain activities were carried in the hilly-forested areas
303 from which the more abraded assemblage of K-30 was derived. The almost total
304 disappearance of bifaces in the later assemblages at 'Ubeidiya is noticeable and as yet

305 unexplained.

306 Estimated dates for the fossil-bearing strata of the ‘Ubeidiya Formation are
307 between ca. 1.6 - 1.2 Ma. Paleomagnetic analysis of the ‘Ubeidiya Formation indicated a
308 reversed polarity suggesting that it predates the Brunhes - Matuyama reversal (Opdyke et
309 al., 1983; Braun et al., 1991; Verosub and Tchernov, 1991). Two short, normal
310 paleomagnetic episodes have been found in the Fi member layers II-33 and II 23-24.
311 Layer II-33 has been assigned to the Cobb Mt. (1.215 - 1.190 Ma) and layer II 23-24 has
312 been assigned to the Gilsa (1.575-1.567 Ma) (Sagi, 2005). This correlation fits well with
313 an ESR date of ca. 1.2 Ma for the stratum I 26 which immediately overlays stratum II 33
314 (Rink et al., 2007).

315 The dating of these short polarity events was also corroborated by local faunal
316 turnovers (Belmaker, 2009). The ‘Ubeidiya fauna (Table 1) can be assigned to a local
317 mammalian fauna biozone older than the assemblages of Bitzat Ruhama, Evron-Quarry
318 and Latamne (Belmaker, 2009). All these sites have been dated to ca. 1.0-1.2 Ma
319 suggesting that the ‘Ubeidiya normal polarity events in strata II 23-24 and II-33 should
320 both predate the Jaramillo (0.99-1.07 Ma). Further corroboration by long-range
321 biochronological correlations indicates that the large mammalian assemblage of
322 ‘Ubeidiya is similar to the Farneta faunal unit (the sites of Selvella and Pietrafitta, Italy)
323 (Belmaker, 2006; Martínez-Navarro et al., 2009), which has been dated to ca. 1.6-1.2 Ma
324 (Caloi and Palombo, 1997 and references therein). Employing similar approach of long
325 distance comparisons to the lithics of ‘Ubeidiya suggests that the assemblages are similar
326 to those from upper Bed II at Olduvai dated to ca. 1.53-1.27 Ma (Bar-Yosef and Goren-
327 Inbar, 1993; Cerling and Hay, 1986).

328

329 **Evron-Quarry**

330 The excavations at Evron-Quarry, located in the coastal plain of the Western
331 Galilee, exposed a sequence of alternating deposits of sandstone (*kurkar*), sometimes up
332 to three meters thick, and red-brown loams (*hamra*), either as isolated lenses or layers up
333 to about one to four m thick (Ronen, 1991b). The layer that contained the Acheulian
334 industry had two distinct horizons of calcareous concretions, occasional artifacts, and
335 sandy clay lenses with pebbles (two to three meter thick) separated from the dark brown-
336 black clay (two m thick) that contained Late Acheulian artifacts and a few animal bones.
337 The artifacts within the archaeological horizon had a vertical distribution of 15-25 cm
338 deep, a phenomenon interpreted as the result of repeated occupations.

339 The archaeological assemblage contained small pebbles of quartz, limestone, and
340 flint, with most of the artifacts made of the latter raw material. No bifaces were found in
341 the excavated areas probably due to their small surface but earlier searches in the quarry
342 dumps recovered twenty handaxes. These are of large size (140-220 mm in length) and
343 demonstrate a relatively crude workmanship that resembles that of the Latamne site
344 (Ronen, 1991b). Large cobbles from which the bifaces were made were recovered
345 together with a group of hard calcite geodes, the heaviest of which was 580g, were
346 brought to the site by the occupants from about 5 km away.

347 Chronologically, the context of Evron-Quarry is assigned to a post-'Ubeidiya age,
348 and is perhaps contemporaneous with the Latamne site in Syria (ca 1.0-0.8 Ma).
349 Paleomagnetic and ESR studies of the archaeological bearing strata have suggested a date
350 ca. 1.0 Ma (Porat and Ronen, 2002; Ron et al., 2003).

351

352 **Bizat Ruhama**

353 The site of Bizat Ruhama is situated in the southern coastal plain and the
354 archaeological horizon is incorporated in a paludine deposit (Ronen et al., 1998; Zaidner,
355 2003a, b; Zaidner et al., 2003). The retrieved rich lithic industry, generally made of small
356 flint pebbles, falls within the category of “core and flake” assemblage with intensively
357 retouched flakes (small borers, notches and denticulates, etc.) No bifaces were found.
358 Paleomagnetic information and TL dates places the site at 0.99 to 0.85 Ma (Laukhin et
359 al., 2001; Ron and Gvirtzman, 2001).

360

361 **Latamne**

362 The site of Latamne was excavated by D. Clark (1967) and additional fieldwork
363 was conducted by Sanlaville and his associates (1993). The archaeological horizon of
364 Latamne lay in the mid-sequence of the Latamne Formation. It contained the Latamne
365 “occupation floor,” a silt layer only a few centimeters thick (up to 10cm) capped by
366 sandy-silty bedding with traces of rootlets. The sequence was interrupted by erosion and
367 was overlaid by a fluvial sandy deposit, capped by a lacustrine layer (Sanlaville et al.,
368 1993).

369 Geomorphological observations indicate that the archaeological horizon of
370 Latamne resulted from a low energy water flow responsible for the deposition of the
371 artifacts and their pattern of spatial distribution. About one-third of the total recorded
372 artifacts, made from local available flint, limestone and basalt, were slightly abraded or
373 fully abraded. Tool classes can be roughly divided into a collection of bifaces, light duty

374 scrapers, heavy-duty tools, and a few limestone and basalt spheroids. Several handaxes
375 are trihedral picks similar to those found at 'Ubeidiya.

376 Water activity caused leaching of the sediments as well as diagenesis that
377 destroyed most of the bones. Most of the well-preserved identifiable bones were collected
378 from the gravels underneath the archaeological site (Hooijer, 1962; Guérin et al., 1993).
379 The entire assemblage reflect a great similarity between the faunas from Latamne and
380 'Ubeidiya. Originally, the date of the site was estimated as ca. 0.7 Ma based on faunal
381 correlations (Guérin et al., 1993) but the presence of the arvicolid *Lagurodon arankae*
382 and typo-technological affinities of the lithic assemblage suggest a date ca. 1.0 Ma
383 (Tchernov, 1994). However, a single TL date of 560 ka for the Latamne Formation led to
384 the conclusion that the site is 700-500 ka years old (Sanlaville, 1988; Sanlaville et al.,
385 1993) which seem untenable.

386

387 **Dursunlu**

388 The quarry of Dursunlu is 75 km northwest of Konya, western Turkey. It
389 comprises Early Pleistocene lucustrine limestones, marls and clay with lignites.
390 Paleomagnetic analysis has suggested a reverse polarity punctuated by three episodes of
391 normal polarity, consistent with an Early Pleistocene age. A more detailed analysis of the
392 drilled cores suggested that the artifacts were derived from two layers between the
393 Jaramillo and MBB, i.e., 0.99 and 0.78 Ma (Güleç et al., 2009). Most of the small lithic
394 assemblage was made of quartz with rare pieces of flint and an igneous rock. The
395 assemblage falls under the category of core and flake industry and provides a unique
396 point in the presence of early hominins in Anatolia.

397

398 **Gesher Benot Ya'aqov**

399 The site of Gesher Benot Ya'aqov (GBY) lies in the Jordan Valley, at the eastern
400 edge of a vast, basalt-covered area. The excavations in the 1930s by M. Stekelis, and
401 recently by Goren-Inbar and her associates (Goren-Inbar et al., 1991, 1992a, b, 2000,
402 2004; Goren-Inbar and Saragusti, 1996; Alperson-Afil et al., 2007) provided an African-
403 type assemblage of cleavers and bifaces that is unlike any of the other known 200
404 Acheulian occurrences in southwestern Asia including both surface and excavated
405 occurrences (e.g., Hours, 1975, 1981; Bar-Yosef, 1987; Goren-Inbar, 1995; Liubin, 2002;
406 Taskiran, 1998). The nature of the deposits and the malacological assemblages,
407 dominated by *Viviparus apameae*, indicate that the archaeological assemblages
408 accumulated on the shores of an expanding lake that flooded the gorge (Horowitz, 1979;
409 Goren-Inbar et al., 1991, 1992a, b; Goren-Inbar and Saragusti, 1996; Feibel, 2004).

410 The complex stratigraphic sequence, first partially exposed by M. Stekelis (1960)
411 and more recently by systematic excavations conducted by N. Goren-Inbar (Goren-Inbar
412 et al., 2004; Feibel, 2004) contains early layers with Acheulian industry dominated by the
413 production of cleavers and bifaces from basalt, as well as flint and limestone objects.
414 Some of the cleavers were fabricated by the Kumbewa technique. Although lava flows
415 cover the area, on both sides of the parts of Jordan River and in particular the large area
416 of the Hauran-Golan no other Acheulian sites with basalt industry were located. On the
417 contrary, in most cases flint nodules derived from isolated limestone and chalky outcrops,
418 often of Eocene age, served as raw material for fabricating handaxes (e.g., Goren, 1979;
419 Goren-Inbar, 1985; Ohel, 1991).

420 The archaeological horizons of GBY are embedded in a depositional sequence
421 that accumulated above a lava flow with normal polarity. The lava flow, designated as the
422 Yarda Basalt, was first K/Ar dated to 0.68 ± 0.12 Ma (Horowitz, 1979) and later to
423 0.9 ± 0.15 Ma (Goren-Inbar et al., 1992a). However, the paleomagnetic sequence within
424 the excavated deposits demonstrated that the Matuyama Brunhes Boundary (MBB) was
425 located within the series of deposits and the accumulation of the entire sequence took
426 place during ca. 100,000 years (Feibel, 2004).

427

428 **Holon**

429 The site of Holon is embedded in marshy deposits overlying an abraded kurkar
430 ridge dated by Horowitz (1979) to around 500-400 ka. The site contained more than one
431 level (Chazan and Kolska-Horwitz, 2007). ESR and luminescence dating (Porat et al.,
432 2002) suggested for the archaeological horizon an average date of ca 205 ka based on
433 ESR and TL dates and suggested that is comparable to the ESR readings from teeth from
434 Tabun layer E of Garrod's excavations (the Acheulo-Yabrudian industry). However, TL
435 dates of burnt flint pieces from Tabun E indicate an age older of 270 ka, considered as the
436 onset of the Mousterian (Mercier et al., 1995) dated also in other sites around 220-250
437 ka. Unfortunately the dates for Holon were retrieved from another geological exposure as
438 the area of the original site lies below a major factory.

439 The bifaces of Holon are mostly of pointed and rounded aspects; the flake
440 industry contains side scrapers, denticulates, and notches, along with cores and debitage
441 products This lithic assemblage has been attributed to the Late Acheulean (Chazan and
442 Kolska-Horwitz, 2007) and if the dates are accepted it would mean that either the Holon

443 Acheulian was contemporary with the early Mousterian, which is untenable, or that there
444 is a systematic difference between the luminescence dates of quartz grains that were
445 retrieved from another location although near the location of the original excavation.

446

447 **Qesem**

448 Qesem Cave is located 12 km east of Tel Aviv, Israel. Excavation in the cave
449 revealed several meters of deposits with abundant lithic and faunal assemblages and
450 plenty of evidence for systematic use of fire (Karkans et al., 2007). Uranium series dates
451 have suggested an age bracket of 0.4 - 0.2 Ma (Barkai et al., 2003). The rich lithic
452 assemblages, dominated by the production of blades, were assigned to the Amudian
453 culture (Gopher et al., 2005; Barkai et al., 2006; Lemorini et al., 2006).

454

455 **Revadim**

456 Revadim Quarry is located on the southern coastal plain of Israel, north of
457 Kibbutz Revadim. Paleomagnetic dates suggest a normal polarity indicating an age
458 younger than 0.78 Ma. OSL dates suggest a minimum age bracket of 0.3-0.2 Ma.
459 (Gvirtzman et al., 1999; Marder et al., 1999). The lithic assemblage at the site suggests a
460 high frequency of flake tools and the presence of handaxes. The typo-technological
461 characteristics of the bifacial tools have suggested that it may be attributed to the Late
462 Acheulean culture (Marder et al., 1999, 2006).

463

464 **Oumm Zinat**

465 The site of Oumm Zinat is situated 500 m east of Kibbutz Evron and was first
466 excavated by Prof. Stekelis in 1950. Subsequent excavations by Gilead and Ronen in
467 1977 revealed a small to medium size assemblage dominated by hand axes
468 contemporaneous with Late Acheulean such as Oum Qatafa D1 and Tabun E/F (Kolska-
469 Horwitz and Tchernov, 1989)

470

471 **Tabun E**

472 Tabun Cave in location on the Southwest flanks of Mount Carmel, Israel on the
473 banks of Wadi el Mughara (Nahal Me'arot). The excavation of the cave began in 1930's
474 under Bate and Garrod and continued with Jelinek (1970-1972) and recently A. Ronen
475 since the 1990's. Layer E consists of slightly abraded flint over an area of 1.0X1.3 m.
476 The lithic assemblage was characterized as Late Acheulean (Garrod and Bate, 1937).

477 The TL dates for Tabun Ed to D suggested that they were deposited during MOIS
478 9 through 8 (Mercier et al., 1995), more recent dates by Mercier and colleagues (2000)
479 suggest that Tabun F and E were deposited during MOIS 9 between 350 ± 30 and 330 ± 30
480 ka. However, ESR dates for Tabun E by Grün et al., (1991) and Grün and Stinger (2000)
481 suggested a date of only 200 ka.

482

483 **Oumm Qatafa**

484 Oumm Qatafa is situated on the left bank of Wadi Khareteitun in the Judean
485 Desert, ca. 15 km west of the Dead Sea. The site was excavated by R. Neuville between
486 1928-1949 (Neuville, 1951) where he identified a sequence which spans the chacolithic

487 through the Lower Paleolithic. The Upper Acheulian level in D2 is characterized by
488 broad, ovate discoidal and cordiform bifaces. Recent ESR dates obtained from level
489 D2 indicate an upper date of 213 ± 26 ka and thus an end for the late Lower Paleolithic
490 (Porat et al., 2002).

491

492 **Early and Late Acheulian in the Levant**

493 Surveys along the Levantine coast located a few occurrences that appear to be of
494 Early Pleistocene age although dating, in most cases, is rather tenuous due to lack of
495 datable substances. Shorelines were dated on the basis of their elevation above sea level,
496 while the known relative ages of foraminifera and marine shell assemblages were also
497 incorporated into these figures along the western mountainous range along the Levantine
498 coast, a few artifacts were found on terraces as high as 120 m above sea level. We
499 therefore choose to summarize those sites where systematic excavations or surveys were
500 conducted and their dates depend of the geological stratigraphy and its suggested
501 correlation with sea level chronology. Here we add some brief information about the
502 main occurrences, and for a full survey see the available summaries (e.g., Hours 1975,
503 1981; Muhesen, 1985, 1993; Sanlaville et al., 1993; Bar-Yosef, 1998a).

504 One of the distinctive sites is Kefar Menachem, situated in the interior part of the
505 coastal plain and was excavated twice (Gilead and Israel, 1975; Barzilai, 2006). The
506 lithic industry is embedded in red loam of an Early Pleistocene age (Horovitz, 1979). The
507 lithic assemblages of both excavated areas are comprised of numerous core and flake
508 products, a few flake-tools (classified as end-scrapers, side scrapers, burins, notches, and
509 denticulates). The use of direct hard hammer percussion is dominant. To date, the rare

510 bifaces have been found only on the surface and their attribution to the excavated
511 collections is doubtful. These bifaces are described as irregular ovates, picks, long
512 lanceolates, and backed bifaces (Gilead and Israel, 1975) who tentatively related this
513 surface assemblage to the Early Acheulian.

514 Most of what is known from the areas of Lebanon and Syria was obtained through
515 the study of the terraces of Nahr el Kebir, the Orontes, and the Middle Euphrates. The
516 majority of the collections were classified as Early and “Middle Acheulian” first on the
517 basis of stratigraphic grounds and later upon consideration of their typological
518 characteristics. Rare finds were retrieved and in several localities in the Beqa’a Valley.

519 Lithic studies of the so-called “Middle Acheulian” assemblages identified two
520 geographic facies. The sites along the coast, such as Berzine and Ouadi Aabet, contain
521 essentially amygdaloid and oval bifaces, while the inland sites (Joub Jannine II and
522 Latamne) have more lanceolates and trihedral picks, and along the Nizip river (Minzoni-
523 Déroche and Sanlaville, 1988), a tributary of the Euphrates in Turkey, recognized a
524 similar distribution of the “Middle Acheulian” artifacts.

525 The general technological tendency among the Acheulian sites is toward a greater
526 use of soft hammer percussion and the sporadic appearance of the Levallois technique
527 (Copeland and Hours, 1981). Typologically, the almost total disappearance of core-
528 choppers is noticeable. The cordiform and amygdaloid bifaces outnumber the ovates. The
529 length of the handaxes decreases in general, a tendency that was already noted by D.
530 Gilead (1970) for the southern Levantine samples.

531 The sites of Hummal and Nadaouiyeh I were discovered in El-Kowm basin
532 (Hours et al., 1983; Le Tensorer et al., 1993), and exposed several occupational horizons.

533 Nadaouiyeh I comprised of an accumulation of alternating clayey layers and by sandy
534 layers near an artesian spring. The stratigraphy is a complex one, marked by slumping
535 and erosion. The systematic excavations demonstrated the presence of *in situ* Acheulian
536 assemblages. The bifaces, generally amygdaloid, were accompanied by a rich flake
537 industry in every one of the six tested layers. The presence of the Levallois technique was
538 noted in low frequencies. In addition, the both Hummal where a much longer depositional
539 sequence was revealed and Nadaouiyeh contain Yabrudian or Acheiulo-Yabrudian
540 capped by Hummalian (an early Mousterian industry) contexts (LeTensorer 2004).

541 Subdividing the Late (or Upper Acheulian) into phases or “facies” was and still is
542 not an easy task. On the basis of technological and morphological considerations Gilead
543 (1970) subdivided the Late Acheulian into several groups as follows:

544 A. The Ma’ayan Barukh group (MB), mostly from open-air sites, is characterized
545 by the dominance of the cordiform aspect (including amygdaloids, cordiforms and
546 subtriangulars) with fewer ovate and a few pointed bifaces and rare cleavers. The
547 assemblage from the excavations of Umm Qatafa D2 is included in this group.

548 B. The Evron-Kissufim group (EK) is, on the basis of stratigraphic evidence,
549 later than the MB group. It contains a richer flake tool component, up to 30-60%, with
550 clear evidence for the manipulation of the Levallois technique. The bifaces show a
551 decrease in rounded aspects (ovates and discoids) and a slight increase in the pointed
552 forms.

553 C. The Sahel el-Khoussin-Yiron group (SY) are those assemblages mostly surface
554 collected in the hilly areas and flanks. The bifaces are somewhat cruder than those of the
555 other groups with an occasional dominance of the rounded aspect over the cordiform

556 aspect (Yiron, Beith Uziel, Baqaa-Rafaim etc.). As in the EK group, the Levallois
557 technique was practiced in some sites. It is worth noting that despite the hilly distribution,
558 these assemblages are not present in the three caves where Late Acheulian layers were
559 uncovered (Tabun F, Abu Sif, Umm Qatafa D).

560 The frequency of refinement index (thickness/breadth x 100) demonstrates the
561 differences among the sites. The same is probably true when the mean length among Late
562 Acheulian sites is considered. Wherever large cobbles were available, there was a
563 tendency towards larger bifaces. However, a general tendency for decrease in biface
564 length could indicate increasing efficiency of resharpening (perhaps longer curation?)
565 during the Late Acheulian.

566 The flake industry of most of the Late Acheulian occurrences is not very well
567 known. In some places, the number of flakes cannot account for their manufacture. For
568 instance, the thousands of bifaces found in Ma'ayan Barukh may have been produced in
569 an area further north near the Litani River. The flakes collected from the same surface
570 clusters could indicate some resharpening (although small flakes and chips are not easy to
571 retrieve in the deep red soil of these hills). It seems that the concentration of bifaces near
572 the Hula Lake shores on the interfluves of freshwater creeks may represent repeated
573 butchering activities in a pristine environment.

574 A unique Late Acheulian site, embedded between a lava flow dated to 233 ± 3 ka
575 and an older lava flow dated to 800 ka, was excavated on the edge of the crater lake
576 known as Berekhat Ram on the Golan plateau (Goren-Inbar, 1985). The rich assemblage
577 contains several thousands of artifacts, mostly in mint condition, with about four hundred
578 of retouched pieces including eight small bifaces. The makers of the industry employed

579 the Levallois centripetal (radial) technique. A special find is a human figurine (Goren-
580 Inbar, 1986) that recently received much attention in the debate concerning the capacities
581 of Archaic *Homo sapiens* or late *Homo erectus* (e.g., Marshack, 1997; D'Errico, 2000).
582 The actual date of the site is unknown but given the current TL dates of the Acheulo-
583 Yabrudian, it should be placed during the time span of 350-450 ka.

584 In general, Late Acheulian sites can be found across the southwestern Asia in
585 every environment including the coastal plain, hilly areas, inter-montane valleys, and
586 oases and in desert landscapes. The best example to date from an oasis situation is the
587 series of Late Acheulian assemblages which is characterized by high frequencies of
588 bifacial cleavers, uncovered in the Azraq basin (Copeland and Hours, 1989; Rollefson,
589 1997). Among these, the sounding at Lion Spring provided stratified lithic assemblages
590 that are characterized by ovate, amygdaloid, and cordiform bifaces, with a rich flake
591 industry. In the absence of precise dating and on the basis of comparisons with the
592 occupations in other location it seems that some Late Acheulian occupations should be
593 correlated with periods of wetter conditions during the time span of ca. 600-400/350 ka.

594

595 **The Acheulo-Yabrudian**

596 The Acheulo-Yabrudian, was renamed as the Mugharan Tradition by Jelinek
597 (1981, 1982a, b), and has a definite geographic distribution from the Taurus foothills to
598 the central Levant (Bar-Yosef, 1998b). It is generally dated to 400/350- 250/220 Ka, and
599 is found stratigraphically always under the Early Mousterian (e.g., Tabun, Hayonim,
600 Misliyeh caves; Garrod and Bate, 1937; Weinstein-Evron et al., 2003). We stress that in
601 spite of intensive surveys, none of the typical artifacts by which this entity is defined

602 were found in the Negev and Sinai or in the desert region of southern Jordan. Three
603 facies that sometimes considered as independent industries were identified on the basis of
604 quantitative studies, as follows (Jelinek, 1982a, b; Copeland and Hours, 1983):

605 1. The Yabrudian facies contains numerous side-scrapers, often made on thick
606 flakes including canted ones, thus resulting in relatively high frequencies of Quina and
607 demi-Quina retouch with a few Late Paleolithic tools and rare blades. Although
608 typologically, Levallois-type products have sometimes been mentioned, the
609 reconstruction of operational sequences has not yielded a well-identified Levallois
610 method.

611 2. The Acheulian facies is considered by Jelinek (1982a, b) to consist of up to 15
612 percent bifaces, with numerous scrapers fashioned in the same manner (Quina type scalar
613 retouch) as the Yabrudian ones.

614 3. The Amudian facies is characterized by end scrapers, burins, backed knives,
615 and rare bifaces and was therefore originally called ‘Pre-Aurignacian’ in the sense of
616 being blade dominated. Not surprisingly, until the 1940s the term Aurignacian was used
617 to refer to all early Upper Paleolithic industries in Western Eurasia. The Amudian facies,
618 following the Tabun excavations, seems to be closer typologically to the Acheulian than
619 to the Yabrudian and contains evidence for limited practice of the Levallois technique
620 (Jelinek, 1982a, b). The “Pre-Aurignacian” in Yabrud I and Abri Zumoffen are richer in
621 “Upper Paleolithic” elements. The excavations at Qesem cave produced rich assemblages
622 of blades and plenty of evidence for the use of fire (Gopher et al., 2005; Barkai et al.,
623 2006; Karkans et al., 2007) and a faunal assemblage dominated by Fallow deer (Stiner et
624 al., 2004).

625

626 **The Lower Paleolithic of Iraq, Iran and the Caucasian region**

627 The vast geographic area summarized here is generally poorly known. The scant
628 evidence from Turkey on one end of the region and India on the other, including a few
629 recorded find spots from Iran (Smith, 1986) and from the Arabian Peninsula (Zarins et
630 al., 1979, 1980, 1982; Whalen et al., 1983, 1984; Abdul Nayeem, 1990), indicate that
631 bifaces can be found everywhere. The distribution toward the northern edges of the Near
632 East has implications for the reexamination of the “Movius line”.

633 In Iraq, little is known beyond the site of Barda Balka, located in the Chemchemal
634 valley in Kurdistan, which was collected and excavated by Howe (Braidwood and Howe,
635 1960). This predominantly flake assemblage may be of Middle Paleolithic age. Iranian
636 finds are also few and are far apart. In Khorasan, on the edge of a dried-up lake, quartzite
637 and andesite core-choppers were collected (Ariai and Thibault, 1975/77). In the absence
638 of dates, the investigators related the assemblage to the Late Pliocene on typological
639 grounds. Isolated bifaces have been collected in various places in Iran (Smith, 1986). The
640 Ladizian industry in Baluchistan (Hume, 1976) to the east should be mentioned briefly. It
641 is defined on the basis of scatters of lithics on old river terraces and it is a core-chopper
642 industry with retouched pieces but no bifaces. Hume (1976) has proposed a late Middle
643 Pleistocene age for the Ladizian.

644 Early and Late Acheulian sites in Georgia were either surface collected or
645 excavated (Liubin and Bosinski, 1995; Liubin, 2002). Among the surface sites, some of
646 the interesting collections were done in Cikiani, near Paravani in southern Georgia, where
647 cleavers and handaxes were found (Kikodze, 1986). The bifaces were made of andesite

648 but most of the cores were made of obsidian. Persati, another surface site, which is yet
649 unpublished, is located on top of a volcanic plateau that is apparently the continuation of
650 the Dzavacheti range in southern Georgia, about 2100m above sea level (Kikodze,
651 personal communication). The artifacts were found at the edge of lacustrine sediments,
652 dated to the Neogene. One of the find spots seems to be eroding from these lake deposits,
653 but radiometric dates are not available.

654 Acheulian industries were uncovered in four excavated caves: Azych, Kudaro I
655 and III, and Tsona. The lithic industry in Azych, located 800 m above sea level, is
656 subdivided on the basis of the observed stratigraphy into several phases of the Acheulian.
657 The earliest levels produced a few core-choppers but they are without clear attribution to
658 a prehistoric entity (Liubin and Boskinski, 1995; Liubin 2002). The richest assemblages
659 were uncovered in layers VI and V, including mainly Late Acheulian bifaces with distinct
660 use of the Levallois technique. In layer V, a fragment of a hominid mandible was found.

661 Kudaro I is situated 1600 m above sea level. Layer 5 contained Acheulian
662 artifacts made from local raw material. The entire assemblage is characterized by a high
663 frequency of retouched pieces including numerous side scrapers. Core-choppers and
664 bifaces, mostly of elongated shapes, assign this assemblage to the Late Acheulian. The
665 presence of flake cleavers was noted by the excavator. Three human teeth were also
666 found in this context. Dates suggest a range of 250-300 ka. TL readings indicate a
667 slightly earlier time, 360 ± 90 Ka and 350 ± 70 ka. However, a reversed paleomagnetic
668 situation identified in level 6 immediately below the Acheulian, with the fauna of several
669 Galerian elements, hints that the Acheulian in layer 5 is perhaps of an older age (Liubin
670 and Bosinski, 1995).

671 Kudaro III produced a more restricted Acheulian collection in layers 6-8 with
672 bifaces and flake tools. A TL date of level 8a was 560 ± 112 ka, while layer 5 produced
673 dates of 252 ± 51 ka and 245 ± 49 ka (Liubin, 2002).

674 Tsona Cave, at an altitude of 2150 m above sea level, and just about 5-6 km south
675 of Kudaro, is a very large cave. The Acheulian industries were derived from layers 6-7a.
676 Preliminary reports indicate that the lower assemblages (layer 7) that were originally
677 considered as Early Acheulian produced only a small sample. The assemblage of layer 6
678 assigned to the Late Acheulian contained about 100 artifacts, including 29 bifaces made
679 from local raw material, mostly retrieved in the form of pebbles. The chronological
680 position of this Acheulian is not well-known, however it seems that this cave, like others
681 at high altitudes, could have been occupied only during interglacial times and in most
682 cases were possibly only seasonal hunting camps. At least two other cave sites on the
683 northern flanks of the Caucasus are known to contain Late Acheulian remains.

684 In sum, the distribution of the Acheulian industries in Western Asia is essentially
685 limited mainly to the Levant with decreasing abundance in the Caucasian region and
686 eastern Anatolia. In spite of the paucity of information from Iran, as mentioned above,
687 there is no evidence for continued distribution of the Acheulian into India. Thus, the
688 “Movius Line,” which distinguishes between the Acheulian and the non-biface industries,
689 separates Anatolia from Eastern Europe and the Iranian plateau and Baluchistan from the
690 Levant.

691

692 **Human remains**

693 While the lithic stratigraphy in the region is rather complete, the hominin remains

694 are woefully underrepresented. The Lower Paleolithic sequence of Western Asia, apart
695 from Dmanisi, is very poor in human fossils. Dmanisi, as mentioned above, contained
696 several skulls and postcranial bones, demonstrating a large range of morphological
697 variability (Gabunia and Vekua, 1995; Braüer and Schultz, 1996; Gabunia et al., 2000a;
698 Gabunia et al., 2002; Lordkipanidze et al., 2007; Rightmire et al., 2006).

699 The available human remains from this long period are scanty, and a few are
700 surface finds. The extensive excavations at ‘Ubeidiya (1959-1999) have revealed
701 numerous lithics which attest to hominid presence in the Southern Levant during the
702 Early Pleistocene. Several cranial fragments (UB 1703, 1704, 1705 and 1706), an incisor
703 (UB 1700) and a molar (UB 1701) have been assigned to *Homo* indet. (Tobias, 1966a,
704 1966b) and as *Homo cf. erectus* (Tchernov and Volokita, 1986). Belmaker et al., (2002)
705 described a new right lateral hominid incisor (UB 335) from stratum I-26a and which was
706 assigns to *Homo cf. eragster*. However, the antiquity of the previous finds has been
707 contested, and UB 335 is the only one that can be securely assigned to the Early
708 Pleistocene deposits.

709 Two broken femora from GBY (Geraads and Tchernov, 1983), attributed to
710 *Homo erectus*, were identified in the collections of animal bones made at the site when
711 the deepening of the Jordan River channel took place.

712 A broken femur was uncovered in Tabun cave layer E (McCown and Keith, 1939)
713 within the Acheulo-Yabrudian assemblage. It thus occupies the same stratigraphic and
714 chronological position as the fragmentary skull from Zuttiyeh (Gisis and Bar-Yosef,
715 1974). The latter is considered as an example of an Archaic *Homo sapiens*
716 (Vandermeersch, 1995) and could have been one of the potential ancestors of the later

717 Qafzeh-Skhul group. Recently, this fragmentary skull has been compared to the
718 Zhoukoudian human remains and interpreted as belonging to a generalized Middle
719 Pleistocene Asian population (Sohn and Wolpoff, 1993).

720 Only after MOIS 5 do hominin remains (both of Anatomically modern humans
721 and Neanderthals) become more common in the region and allow to fully discuss aspect
722 of biological adaptability vis á vis both environment and culture.

723

724 **Early-Middle Pleistocene Environmental changes**

725

726 The unique geological-climatological position of the Levant in conjunction with a
727 highly fragmented habitat contributes to creating an extremely varied and complex biotic
728 picture. The great diversity of the Southern Asian biota, both in number of species and in
729 biogeographic origin (Palearctic, Palearctic and Saharo-Arabian), is primarily the
730 product of the Afro-Eurasian biotic interchanges over the past 25 million years (Miocene
731 through Quaternary).

732 Since the beginning of the Miocene Southwestern Asia has been situated at the
733 crossroad between African and the Eurasian continent thus forming a wide land bridge
734 between the two regions. During different time periods, tectonic, climatic and sea level
735 changes altered the “permeability” of this land bridge. At times the region would allow
736 for animals to disperse in opposite directions and in other times the land bridge served as
737 a barrier. The Messinian event at the end of the Miocene represents a period of long
738 distance reciprocal biotic exchange due to the dramatic lowering of the Mediterranean
739 Sea level. However, since then the developing Red Sea finally limited this geographic

740 corridor to the Levant and the southern Arabian Peninsula. Indeed, these two passages
741 functioned as a selective filter for most organisms, through which only specific species
742 could spread or pass (Tchernov, 1988; Tchernov and Belmaker, 2004).

743 The onset of the Pliocene is marked by an abrupt transgression of the
744 Mediterranean and reestablishment of the barrier between Africa and Eurasia. Thus,
745 Africa became considerably isolated from the rest of the world by the Saharo-Arabian
746 arid belt. North Africa was even further isolated from both sub-Saharan Africa and the
747 eastern Mediterranean region (Thomas, 1985). During this period, the main biotic
748 influences in the region were Asiatic, primarily from the Irano-Turanic region. These are
749 recorded mainly in Anatolian sites, which include many forest dwellers such as the
750 Cervids. The Taurus-Zagros Mountains and the Saharo-Arabian developing desert belt
751 eventually became a biogeographic barrier, particularly for laurophyllous (evergreen
752 broad-leaved) plant species (Jacobs et al., 1999), forest dwellers (Cervidae, Castoridae,
753 Gliridae and Ursidae) and aquatic animals. Hence, the transgression of the Mediterranean
754 increased the isolation of the Southwestern Asia

755 Towards the end of the Pliocene and in the Early Pleistocene, the regression of the
756 Mediterranean terminated the quasi-isolation of the region and the increase glacial-
757 interglacial cycles had their impact on the region under discussion.

758

759 *Vegetation and pollen*

760 The bimodal Mediterranean climate has been shown to appear in Southwest Asia
761 during the late Pliocene ca. 3.2 Ma as part of a global cooling trend and was fully
762 established by 2.8 Ma (Suc, 1984). Unfortunately, long pollen cores that would allow for

763 a continuous paleobotanical reconstruction throughout the Early and Middle Pleistocene
764 are rare in Western Asia in comparison to marine cores in central from the Western
765 Mediterranean Sea and the Aegean. Nonetheless, these provide a scale to which we can
766 compare results from smaller cores obtained in the region.

767 A succession scheme has been developed for the Mediterranean vegetation for
768 glacial- interglacial cycles such that glacial steppe vegetation in replaced by
769 sclerophyllous woodland (dominated by *Quercus*, *Pinus*, *Betula* and *Juniperus*) and then
770 by deciduous forests (deciduous *Quercus*, *Carpinus*, *Ostrya* and later on *Abies* and
771 *Fagus*), followed by a regressive phase of open woodland. Specific regional pattern
772 reflects local climatic conditions but pollen analysis in the Mediterranean basin has
773 shown that the vegetation succession follows the processional insolation cycles
774 (Tzedakis, 2007). Thus during the Early Pleistocene, while the glacial- interglacial cycles
775 were dominated by the obliquity 41 ka cycles, the succession of floral communities
776 followed a cycle roughly every 23 ka.

777 A long pollen core in Teneghi Philippon, Greece, that spans the last 1.35 million
778 years, allows us to test general trends in vegetation in relation to orbital forcing. Flora
779 reconstruction for the glacial periods were based on the minima of the AP percentage and
780 are reflected during MOIS 22, 16, 12, 10, 8 and 6 with 16 (0.65 Ma) being the most
781 extensive during the past 1.35 Ma. In early periods such as MOIS 38, 40 and 42,
782 *Artemisia* levels were over 90% indicating extreme aridity, however these conditions
783 were not sustained over a period longer than 10ka (Tzedakis et al., 2006).

784 The majority of pollen data is derived from late Pleistocene and Holocene
785 sediments and post date the period discussed in this study. A playnostraigraphy of the

786 Jordan Valley (Horowitz, 2001) provides a generalized Quaternary sequence for the
787 Levant, but unfortunately is not well dated. The sequence records alternations between
788 wet and dry Mediterranean flora. The interglacial flora was poor in arboreal pollen in
789 comparison to modern day conditions. A north – south gradient indicated 3- 5% arboreal
790 pollen in the north associated with steppe elements while southern cores indicate no
791 arboreal pollen but proliferation of desert plants. In comparison, the pluvial periods or the
792 glacial flora was dominated by arboreal pollen, and of interest is the increase of pollen
793 the winter deciduous oak *Quercus ithaburensis* (Horowitz, 1988).

794 Pollen from archaeological sites, in spite of the time gaps, provides another angle
795 to landscape reconstructions, and the conditions that faced the early hominins. A study in
796 Dmanisi indicated a forested area with *Abias*, *Pinus*, *Fagus*, *Alnus*, *Castanea*, *Tilia*,
797 *Betula*, *Caprinus* and rarely *Ulmus* and *Salix*. Bushes and shrubs are represented by
798 rhododendron, *Corylus* and myrtle and the herbaceous vegetation is dominated by
799 Cyperaceae, Germinae and Polygonaceae (Dzaparidze et al., 1992) consistent with the
800 humid thermophilous broad leaf forest zone which is similar in the region today in the
801 western Caucasus (Zazanashvili et al., 2000).

802 Only few botanical remains have been retrieved from ‘Ubeidiya, all from the Li
803 cycle. Macrofloral remains of fossilized leaves were discovered in the limnic laminated
804 layer III- 19. These have been identified as *Pistacia lentiscus*, *Rhus tripartita* and
805 *Myriophyllum* sp. (Lorch, 1966). Pollen spectrum was extracted from layer III-12,
806 analyzed by A. Horowitz (Bar-Yosef and Tchernov, 1972) indicating 82% arboreal
807 species of which the overwhelming majorities are *Quercus* sp. followed by *Juniperus* sp.
808 and *Olea* sp. Non-arboreal families include Gramineae, Cruciferae and Compositae.

809 Cyperaceae comprise 8.4% of the pollen and attest to the water habitat present at the site
810 suggesting a period more humid than today.

811 There is a small pollen spectrum from Bitzat Ruhama ($n=114$) reflecting
812 relatively high frequencies of arboreal pollen including *Quercus*, *Pinus*, *Olea* and *Cedrus*.
813 (Zaidner, 2003b). Among the non-arboreal pollen we encounter *Chenopodiaceae*, *Palmae*,
814 *Poaceae* and *Liliaceae*. The presence of cedar is indicative of a colder environment in the
815 region than the present (Zaidner, 2003b).

816 A pollen sample from the Latamne formation indicates that mountain slopes near
817 the site were forested by board leaf trees such as *Quercus*, *Caprnius*, *Tilia*, *Juglans*,
818 *Ulmuss*, *Corylus* and *Betula* and coniferous species such as *Pinus* and *Cupressus*
819 (Dodonov et al., 1993).

820 The wood remains of GBY suggest the presence of Mediterranean wood and plant
821 species and that the climate in the Hula valley at the time of deposition resembled the
822 seasonal Mediterranean pattern seen today. Among the dominant species are oak
823 (*Quercus* sp.), wild pistachio (*Pistacia atlantica*), wild olive (*Olea europaea*), plum
824 (*Prunus* sp.), and jujube (*Ziziphus spina-christi*) (Goren-Inbar et al., 2004; Werker, 2006).
825 Immersed or floating freshwater plants are common at the site and include species such as
826 *Euryale ferox*, *Najas foveolata*, *Nymphoides* cf. *peltata*, *Potamogeton*
827 *coloratus/polygonifolius*, the extinct *Stratiotes intermedius*, *Trapa natans* and apparently
828 *Sagittaria sagittifolia*. Bank forest taxa include wild grape (*Vitis sylvestris*) and ash
829 (*Fraxinus syriaca*).

830 Pollen analysis from this site (van Zeist and Bottema, 2009) supports the general
831 landscape reconstruction derived from wood identification specifically the presence of

832 *Quercus ithaburensis* – *Pistacia atlantica* woodland land or park-forest. Above 400-
833 500m to the west of the valley, this Tabor Oak woodland species was replaced by
834 *Pistacia atlantica*- *Amgdalus korschinskii* woodland. The overall pattern indicates that
835 the upper Jordan Valley did not undergo any significant vegetation changes as a results of
836 the glacial- interglacial periods as we see in higher latitudes and the overall vegetation as
837 observed in the wood remains as in the pollen reflects comparable environs to those of
838 today. However, oxygen and carbon stable isotope evidence derived from gastropods and
839 ostracods at GBY as well as evidence from mollusk ecology indicate a climatic shift
840 (Rosenfeld et al., 2004; Ashkenazi et al., 2009; Spiro et al., 2009) inline with global
841 climatic forcing throughout the sequence across the MBB, the paleoecological
842 reconstructions based on vegetations (pollen, wood) indicated that climatic forcing may
843 have had a stronger effect on the local hydrological regime and aquatic fauna than on the
844 terrestrial ecosystem and most notably fauna (see Kingston, 2007, for further discussion
845 of this phenomenon).

846

847 *Faunal turnovers and dispersal from Africa*

848 The paucity of sites from the Early and Middle Pleistocene does not allow to
849 track both inter and intra variability within each of the sub-regions during this long
850 period. There are far less sites that preserve well-dated faunal assemblages than lithic
851 localities that can be used for paleontological and paleoecological analysis. The
852 observations made on the basis of fossiliferous sites are generally correlated with the
853 European and South African sequences (Belmaker, 2009). While the actual species
854 composition within each region is different the tempo and mode of change are similar

855 across the region and point to a secular trend of cooling through time. Data for this
856 analysis is derived from archaeological sites (see previous section for detailed description
857 of the sites) as well as a several paleontological site that yielded only faunal material.

858 The Late Pliocene is well recorded in the Caucasus such in Kvabebi, (Georgia)
859 which yielded a large assemblages indicative of a marshy and riverine habitat (Vekua,
860 1995) surrounded by open woodland environment (Agustí et al, 2009b). Similarly, the
861 Bethlehem fauna with the small assemblage of 11 mammalian species can be identified
862 as representing a humid and temperate woodland environment (Gardner and Bate, 1937;
863 Hooijer, 1958). The presence of *Giraffa* sp. uncovered in Bethlehem suggests an African
864 dispersal during the Late Pliocene although the poor preservation of the specimen
865 precludes identification to species (Robinson and Belmaker, in press). The presence of
866 the three-toed horse *Hipparion* (Hooijer, 1958) would indicate a date ca. 2.5 Ma. During
867 this time period, the Jordan rift had not formed in its current state (Horowitz, 2001),
868 which may have hindered a large dispersal from Africa. Furthermore, as previously
869 mentioned, the absence of sites prior to Bethlehem does not allow us to pinpoint the
870 precise date of this dispersal which may have occurred any time prior to that.

871 The transition from the Late Pliocene to Early Pleistocene, similarly to the
872 Olduvai dry event, indicates a shift from a more humid and wet environment to a more
873 open, partially dry and somewhat cooler conditions. The change is attested when the
874 faunal assemblages of Bethlehem and Kabevebi are compared to Dmanisi (1.8 – 1.77
875 Ma) (Gabunia et al., 2000; Agustí et al, 2009b), Kotsakhuri (1.63 – 1.83 Ma) and Tsalka
876 (Vekua and Lordkipandize, 2008). While the fauna from these sites is characteristic of
877 Mediterranean temperate woodland indicated by a high proportion of cervids, an

878 ecological shift to a more open habitat is marked by the first appearance of several taxa
879 such as the Mammoth (*Mammuthus meridionalis*) and the large Stenoid horse (*Equus*
880 *stenonis*).

881 A local faunal turnover can be observed between the Early Pleistocene fauna
882 dated to ca. 1.8 – 1.7 Ma as represented by Dmanisi, Kostakhuri and Tsalka, and the
883 younger site of ‘Ubeidiya (1.6 – 1.2 Ma). While all sites have many taxa in common, the
884 older sites exhibit a more archaic suite of species including *Canis etruscus*, *Cervus*
885 *perrieri* and *Eucladoceros* sp. replaced by the younger *Canis mosbachensis* and late
886 Villafranchian cervids *Praemegaceros obscurus- verticornis* at ‘Ubeidiya. ‘Ubeidiya
887 possibly represents a long sequence spanning ca. 400 Ka and its landscape was
888 essentially Mediterranean woodland similar to that of Dmanisi as shown by the great
889 abundance of cervids and other Eurasian taxa (Belmaker, 2009). However, several new
890 taxa that appear in ‘Ubeidiya are not present in the previous Late Pliocene deposit of
891 Bethlehem (ca. 2.5 Ma) and the Early Pleistocene sites in the Caucasus. These include the
892 unique suite of African taxa such as *Pelorovis oldwayensis*, *Kolpochoerus olduvaiensis*
893 and Cercopithecinae cf. *Theropithecus* sp. (Belmaker, 2010), which coincides with the
894 Aullan dispersal event dated to 1.8 Ma (Arribas and Palmqvist, 1999). This indicates that
895 a dispersal route from East Africa to Eurasia became available during this time or
896 immediately prior to that date.

897 The comparison between ‘Ubeidiya and Dmanisi is particularly informative. With
898 the exception of the genus *Homo*, the Early Pleistocene sites of the Caucasus are devoid
899 of African taxa (Tappen, 2009 but see Martínez-Navarro and Palmqvist, 1995), and have
900 a high proportion of endemic species such as *Bison georgicus* and *Struthio dmanisiensis*.

901 This suggests that during the Late Pliocene the Caucasus was isolated and this situation
902 allowed for the evolution of endemic species. However, ‘Ubeidiya and the Georgian sites
903 share several taxa and specifically the jird, *Parameriones obiediensis*. This species was
904 identified as an endemic to ‘Ubeidiya and subsequently found in Dmanisi indicating that
905 the biogeographic route connecting the two regions was open. In addition the path from
906 East Africa into the Levant was also open and led to the influx of African taxa into the
907 latter.

908 The Epivillafranchian fauna is represented by the sites of Bizat Ruhama, Evron
909 Quarry and Daquara, Latamne in the Levant, Dursunlu in Anatolia and Akhalkalaki in
910 Georgia. The archaic nature of this fauna is maintained by the presence *Hipopotamus*
911 *behemoth* in Latamne. However, a novel dispersal from Africa is attested by the arrival
912 of the suid *Kolpochoerus evronensis* in Evron Quarry and by *Giraffa camelopardalis* at
913 Latamne (Robinson and Belmaker, in press). Furthermore, the appearance of modern
914 taxa such as *Dama mesopotamica* and *Cervus elaphus* indicates a new and more modern
915 faunal composition.

916 The increased shift towards a more open, arid habitat, compared to earlier sites
917 dominated by cervids and woodland taxa, is evidenced by the increasing dominance of
918 equids and the steppe mammoth (*Mammuthus trogontherii*). The small faunal assemblage
919 of Bizat Ruhama (ca. 1.0 Ma) in the southern coastal plain has only bovid, equid and
920 hippo remains (Ronen et al., 1998). Evron - Quarry (ca. 1.0 Ma) although situated at the
921 western margins of the Galilee where rainfall is higher than in the south, the cervid
922 sample comprises only of four among a total of 36 (11%) identified specimens, while
923 bovinds are represented only by 11 specimens (30%) (Tchernov et al., 1994).

924 Akhalkalaki (0.9-0.8 Ma) in central Georgia is dominated by megacerids,
925 *Stephanorhinus etruscus*, *Mammuthus trogontherii*, *Equus suessenbornensis* and *E.*
926 *altidens* (Vekua, 1986, 1987; Hemmer et al., 2001; Tappen et al., 2002) and Dursunlu in
927 the generally more arid central Anatolia (1.0-0.78 Ma) is characterized by the high
928 frequency of *Equus caballus mosbachensis* and *E. altidens* (Güleç et al., 1999).

929 A later large faunal turnover is observed between the Epivillafranchian and the
930 Galerian faunas and is date dated to the Matuyama-Brunhes Boundary ca. 0.78 Ma. The
931 best record is derived from GBY. This dated to MOIS 18, is assigned to a wet and humid
932 stage apparent in the high frequency of cervids (*Dama* sp., *Cervus* cf. *Cervus elaphus* and
933 *Megalocerni* sp.) (Rabinovich et al., 2008). A small contribution of African taxa includes
934 *Bos buiaensis* (Martínez Navarro et al., 2009)

935 The sites of Denizli and Emirkaya-2 in Anatolia and Bear's cave, Tel Hesi and
936 'Ain Soda in the Levant are dated to the early part of the Middle Pleistocene roughly
937 between 0.5-0.43 Ma (Sen et al., 1991; Tchernov and Tsoukala, 1997; Dirks, 1998; Erten
938 et al., 2005). Taxa that appear in the region for the first time include *Panthera leo*, several
939 megacerines and *Capreolus* aff. *sussenborensis* while the continuation of archaic taxa
940 from earlier time periods include large taxa such as *Stephanorhinus hemitoechus* and *Bos*
941 *primigenius*. Unfortunately the taphonomic history of these sites precludes a detailed
942 paleoecological analysis. Bear's cave as its name implies is a carnivore den and presents
943 high frequencies of carnivore taxa and a minimal appearance of herbivore taxa, which
944 precludes an environmental reconstruction. The other sites have only scant remains.

945 Not surprisingly the assemblage of Yarimburgaz cave, situated in Thrace, the
946 European portion of modern Turkey, includes faunal elements from the Russian plains

947 such as *Lagurus transiens* and *Ochotona pusilla* which suggest the expansion of steppe
948 environment in the southern Balkans, consistent with a cold and dry OIS 8 (von
949 Koenigswald, 1998).

950 The sites of Qesem cave, Revadim and Holon, Hayonim cave layer E, Tabun cave
951 layer E in the southern Levant are dated to the later part of the Middle Pleistocene
952 between 0.43-0.13 Ma and provide a rich faunal assemblage for MOIS 8-6. The layers
953 which dated to the earlier phase of the sequence (MOIS 7) are dominated by cervids most
954 notably *Dama mesopotamica* whereas from MOIS 6, the increase in the mountain
955 gazelle is noted. It has been hypothesized that the increasing frequencies of gazelle may
956 indicate a climatically driven dispersal of an African arid species into the region (Stiner et
957 al., 2004, 2009), which is supported by the presence of a single specimen of *Lycaon*
958 *pictus* in Hayonim E (Stiner et al., 2001). However, isotopic analysis of teeth of both
959 fallow deer and gazelles from the Mediterranean region from both Middle and Late
960 Pleistocene sites of Qesem, Hayonim and Meged sites did not indicate any significant
961 change in niche utilization between the ungulates, suggesting that the change in
962 abundance may be due to human hunting preferences (Rowland, 2006). During this
963 period there is no sound evidence for an additional dispersal from Africa following the
964 Mid-Brunhes event of 0.43 Ma, represented by extinction of the larger fauna (Belmaker,
965 2009).

966 The modern terrestrial ecological signature of both the flora and the fauna of the
967 region developed early in the Pleistocene. While the exact composition of species may
968 have changed throughout the last 2.5 Million years, but the overall biome structure as a
969 Mediterranean region surrounded by a more arid region in the South and East and

970 temperate region in the north did not alter significantly. The locations and extent of the
971 borders between the sub-regions may have changed emphasizing the importance of
972 understanding the role of ecotones in the region.

973

974 **Discussion - faunal and hominins dispersals**

975 Several trends can be observed in the paleoecological sequence of Western Asia
976 during the Early and Middle Pleistocene. Within this long sequence, four major
977 observations are recognized: 1. None of the environmental changes, and particularly in
978 the Levant, were as dramatic as those recognized in higher latitudes (e.g., temperate
979 Europe); 2. The climate changed gradually from more humid and closed habitats to more
980 dry and open ones, through minor fluctuations generally correlated with the marine
981 isotope data; 3. Punctuated faunal turnovers occurred in rough correlations with Western
982 and Eastern Europe faunal units and 4. Hominin dispersals at the current state of research
983 are not positively correlated with faunal turnovers (Table 2).

984 The evidence presented in this paper indicates that a few faunal dispersals
985 between African and Eurasia occurred throughout the Late Pliocene through the Middle
986 Pleistocene. There is a general agreement among scholars that these events were
987 generally coincident with global climate changes. The main difficulty is attributing each
988 dispersal event to the time when it took place. The reason is that the known sites and
989 assemblages, described and discussed above, do not necessarily date these events. We
990 tend to forget that the discovery of Lower Paleolithic sites is accidental and they cannot
991 be considered as a continuous chronological sequence. Not surprisingly this is the nature
992 of windows into the remote past, and one can argue that the dispersals of large mammals

993 occurred long before their bones were uncovered in the excavated sites. Relating the
994 dispersal events to the known or conjectured age of an archaeological site may result in
995 erroneous conclusions.

996 It should be stressed that the southwestern Asian fauna was established in this
997 vast region since the Miocene and consisted of characteristic Palaeartic Eurasian
998 element. The earliest dispersal from Africa of the generally woodland browser species
999 (n=2) took place sometimes during the late Pliocene. It is recorded in the undated site of
1000 Bethlehem. The next migration was during the Early Pleistocene by several species
1001 marked by their adaptation to open grasslands (n=5). Their representation in the
1002 ‘Ubeidiya assemblages does not necessarily indicate the date of the first arrival of these
1003 taxa. A few additional browsers arrived at the time of the Jaramillo Event (n=2), and an
1004 additional grassland species at the Brunhes-Matuyama (n=1) as well as one taxon in the
1005 Mid-Brunhes (ca. 0.43 Ma; Belmaker, 2009).

1006 The attempt to use the evidence from large mammals as a backdrop to
1007 understanding the tempo and mode of early hominin dispersals is generally unsuccessful.
1008 Contrary to what has been suggested (Martínez-Navarro et al, 2007, in press; Agustí et
1009 al., 2009a) it becomes apparent that hominin migrations into this region do not correlate
1010 with the arrivals of large mammals or specific climatic regimes. The earliest dated
1011 hominin dispersal is at the time of the Dmanisi (ca. 1.77 Ma) by bearers of a core and
1012 flake industry. The second, as no other Early Acheulian site was found and dated in
1013 southwestern Asia, is at ‘Ubeidiya (1.6-1.2 Ma).

1014 During the Epivillafranchian, ca. 1.1 Ma, large mammalian fauna arrived in the
1015 Levant from Africa as attested by the fauna of Evron and Latamne. However, the lithic

1016 industry of these sites does not differ from other Early Acheulian assemblages, and in the
1017 lack of specific tool-types or new knapping techniques, we see no evidence for additional
1018 migration of African hominins into southwestern Asia.

1019 The site of GBY is interpreted to be the archaeological remains of a group of
1020 hominids that migrated from Africa (Bar-Yosef, 1987; Goren-Inbar and Saragusti, 1996).
1021 The lithic industry at GBY bears an African stamp and is still a rare occurrence in the
1022 Levant in spite of large surveys (e.g. Hours, 1981). The hominins had a definite
1023 preference for employing basalt as the main raw material although flint and limestone
1024 were present in the immediate vicinity. This choice, clearly expressed in high frequencies
1025 of cleavers, indicates the African origins of this group. It has been suggested (Bar-Yosef,
1026 1994, 1995) that this move was triggered by environmental change in East Africa that
1027 occurred around the Jaramillo subchron or the BMM. Interestingly, the makers of the
1028 GBY industry, either passed away after a time span of several dozens of millennia, or
1029 simply adopted the making of bifaces from flint with similar shapes to the common ones
1030 in the Levant.

1031 Human migrations occurred along the “Levantine Corridor” as defined by the
1032 paleontologists (e.g., Thomas, 1985). The Lower Paleolithic assemblages from el-
1033 Abassieh in Cairo (Bovier-Lapierre, 1926) may indicate that the Nile Valley was a
1034 possible segment of this route. The interior of the Arabian Peninsula was not an option
1035 due to the existence of the Saharan desert belt, since the end of the Miocene. Under
1036 interglacial conditions the northern penetration of the monsoonal system drastically
1037 changed the potentials for increasing amounts of resources in eastern Sahara (e.g.,

1038 Neumann, 1989) and could have facilitated an alternative path for hominins and later
1039 Archaic *Homo sapiens* groups along the western shores of the Red Sea.

1040 Thus, the absence of correlation between hominin and faunal dispersals is
1041 apparent and points to different underlying mechanisms for the two phenomenon. To
1042 reiterate the point we can discuss the situation in Arabia, which is beyond the scope of
1043 this paper. Regional surveys in the Arabian Peninsula have led to the identification of
1044 find spots and the collection of lithic assemblages with and without bifaces. Bifaces are
1045 reported solely from the western margins where they are made on a variety of raw
1046 materials such as flint, basalt, and metamorphic rocks. No bifaces have yet been found in
1047 the eastern Arabia that borders the Persian Gulf. Of special interest are the reports
1048 concerning sites or find spots along the Red Sea, another potential route of hominins. The
1049 excavation at Saffaqah (Whalen et al., 1983, 1984) provided a rich Acheulian assemblage
1050 made primarily of andesite with bifaces, cleavers, and numerous flakes. The depth of the
1051 deposits that contain artifacts (ca. 0.90m) probably reflects repeated occupations. Farther
1052 south in Yemen, excavations of open-air sites embedded in Pleistocene formations, many
1053 of which are rich in gravels or angular rock fragments, unearthed several series of core
1054 and flake assemblages and bifaces without animal bones (Amirkhanov, 1991). In
1055 addition, surface collections clearly indicate the presence of Late Acheulian industry. If
1056 no lithics remains are found in the anterior of Arabia during the Lower Paleolithic
1057 suggesting hominin migration into this region, then the site of An Nafud (Thomas et al.,
1058 1998) dated to the Early Pleistocene exhibits many of the African taxa present in the
1059 Southern Levant (*Crocota crocuta*; *Pelorovis* cf. *oldowayensis*; *Oryx* sp.) as well
1060 additional African alcelephines and bovids whereas Palaeartic species such as cervids

1061 are notably absent. This would suggest that Africa fauna could disperse where early
1062 *Homo* could or would not. Further confirming the disjunct between the two dispersal
1063 patterns.

1064 We should therefore return to the question concerning the nature of long distance
1065 migrations of hominins, whether it was based on “leapfrog” bursts of movements or
1066 gradual spreading out of small groups. Several scholars proposed that climatic changes
1067 determined the timing, mode and motivation for the out of Africa of early *Homo*
1068 *erectus/ergaster* (Potts, 1998; Dennell, 2004). It has been suggested that the expansion of
1069 grassland habitats into higher latitudes (30°N), during the Late Pliocene and Early
1070 Pleistocene climatic amelioration provided the favorite habitats that facilitated human
1071 survival (Vrba, 1988, 1995; Wynn, 2004). As the paleo-climatic information reflects
1072 alternating drier and wetter intervals it could have determined the closing and opening of
1073 natural corridors and thereby allowing *Homo* and other taxa to move from one region to
1074 the next (Vaks et al., 2002; Raia et al., 2006).

1075 Indeed, the Aullan dispersal event (ca. 1.8 Ma) was associated with favor
1076 ecological conditions permitting hominins and a few African taxa to reach Eurasia.
1077 However, the paleoecology of the Early Pleistocene sites across southwestern Asia
1078 (Dmanisi, ‘Ubeidiya, GBY) based on both flora and fauna indicates that the hominins
1079 survived in a mixed landscape of open parkland with forested surrounding hills (van Zeist
1080 and Bottema, 2009; Belmaker, 2009; Tappen, 2009; Belmaker, in press). Moreover, the
1081 prevailing environmental conditions are not sufficient to explain the differences between
1082 the lithic industries, whether ‘core and flake’ in the Caucasus region or the Early
1083 Acheulian in the Jordan Valley. Probably these two particular industries reflect the

1084 activities of different groups of hominins who by their traditional learning employed
1085 different stone artifacts.

1086 Successful adaptations to new ecological niches away from the savanna
1087 environment had its price. Probably more than one of the hominin lineages has
1088 disappeared i.e., simply died out, when they had too few members to keep a viable
1089 mating and reproductive system. Such local and temporal extinctions are possibly one of
1090 the reasons, together with low archaeological visibility, why the number of Lower
1091 Paleolithic sites, even in well-researched areas, is still so small. Therefore the current
1092 distribution of lithic industries across Eurasia is undoubtedly incomplete due to paucity of
1093 field research in several regions, indicating that there is no real cultural continuity and
1094 that what we view as a constant stream of migrants, was actually interrupted many times
1095 (e.g., Dennell, in press).

1096 Chronologically, the earliest hominins reaching southwestern Asia after leaving
1097 Africa were the makers of ‘core and flake’ industries, and is probably why this kind of
1098 simple way of obtaining sharp edges spread across Asia and Eastern Europe. It is not
1099 impossible that even migrants in later time (such as the makers of the Karari industry)
1100 carried the ‘core and flake’ production into the same areas. This would explain why the
1101 Acheulian contexts dated to 1.5 Ma to 0.25 Ma demonstrate interstratifications with those
1102 who manufactured cores and flakes (sometimes with additional types such as spheroids).

1103 The continuous occupation of southwestern Asia by the makers of the Acheulian
1104 industry needs to be stressed. The contrast with the neighboring regions is striking. No
1105 Acheulian sites are known from Iran, but plenty were recorded in Southern Asia (e.g.
1106 Petraglia, 1998). A few sites with bifaces are known in China beyond the “Movius line”

1107 (e.g., Hou et al, 2000). Between the Zagros and the western margins of the Indus valley
1108 there are suitable raw materials for making bifaces, but those who needed and knew how
1109 to make these tool-types were not present in these region. Natural boundaries such as the
1110 mountain ranges of the Caucasus limited early hominin moves as shown by the
1111 decreasing numbers of Acheulian handaxes (Liubin, 2002).

1112 In brief, we have no persuasive explanation why the Acheulian is not represented
1113 in the vast area between the Zagros and Baluchistan. A similar observation concerns
1114 Eastern Europe where only ‘core and flake’ industries were found and stand in marked
1115 difference with the proliferation of handaxes in Western Europe.

1116 While we agree that technological innovations and their social role are also
1117 considered as an important adaptation for dispersal (Carbonell et al., 1995; Larick and
1118 Ciochon, 1996), we wonder how exactly the technological innovations assisted in the
1119 survival or organization of those early hominin groups, and in particular given the lack of
1120 correlation between lithic technology, typology and environment. Detaching a few flakes
1121 from a nodule can be done in different ways, as it often depends of the fracture
1122 mechanics of the raw material, its size, shape and volume (Hovers and Braun, 2009 and
1123 papers therein).

1124 Therefore, if we accept the notion that adaptation to a specific environment during
1125 Lower Paleolithic times, did not influence the way stone tools were shaped, we have to
1126 adopt the position that it was due to the intrinsic behavioral capacities, unique to
1127 hominins, that facilitated the moves from Africa into new territories. It should be
1128 remembered that the initial dispersal of hominins has been attributed to both
1129 morphological and behavioral characteristics such as the capacity for long distance

1130 walking (Steudel, 1994), endurance running (Bramble and Lieberman, 2004), heat
1131 adaptation (Walker and Leakey, 1993), greater brain capacity (Aiello, 1993; Aiello and
1132 Wheeler, 1995) and social structure (Kroll, 1994). Even the release from tropical diseases
1133 that allowed for an increase in population size in higher latitudes (Bar Yosef and Belfer-
1134 Cohen, 2001), does not explain what happened to the various groups in Asia.

1135 The variability selection hypothesis states that the adaptability of hominins to a
1136 wide range of habitats and specifically to a variable climate in Africa may have provided
1137 a pre-adaptation to survival in novel environments (Potts, 1998, 2002). While we agree
1138 that the presence of hominins in a wide range of environments in Eurasia supports this
1139 hypothesis, however, this explanation is valid for the “longue durée” when a period of
1140 one million years or more is considered. In addition, hypothesizing what may constitute
1141 the pre-adaptability traits is rather intriguing. These may include an increase of resource
1142 exploitation by using of stone tools, wooden tools that did not survive, and fire. For the
1143 latter there is hardly any solid evidence prior to 0.8 Ma in GBY (Goren-Inbar et al., 2004;
1144 Alperson-Afil and Goren-Inbar, 2007; Alperson-Afil, 2008). Additional pre-adaptations
1145 would have been the importance of high-energy foods such as meat, tubers or other
1146 vegetal sources during the initial dispersal. The increase in body and brain size required a
1147 better quality diet and often the contribution of protein seems to have been the main
1148 source (Aiello and Wheeler, 1995; Cordain et al., 2000; Aiello et al., 2001; Cordain et al.,
1149 2001; Aiello and Wells, 2002). Hence, hominins evolved to become more active hunters
1150 and gatherers when compared to their ancestors, and these capacities required larger
1151 territories (Walker and Shipman, 1996). Specifically, a high proportion of meat in the diet
1152 was seen as a critical for the success of hominins and this proposition was supported,

1153 according to various authors, by the taphonomic analyses of faunal remains
1154 (Brantingham, 1998; Hemmer, 2000; Domínguez-Rodrigo et al., 2002; Domínguez-
1155 Rodrigo, 2002; Domínguez-Rodrigo and Pickering, 2003). The colonization of the
1156 temperate Europe after 0.7 Ma is thought as facilitated by a decrease in the number of
1157 carnivore competitors and the ability of hominins to acquire larger quantities of meat
1158 (Palombo and Mussi, 2006), although the role of large game hunting could signal more a
1159 social expression than the need for meat (J.D.Speth, personal communication).

1160 In sum, this paper provides an overview of the environmental conditions that
1161 prevailed during the Lower and Middle Pleistocene in southwestern Asia indicating that
1162 regional topographic configuration played a primary role in shaping the effects of
1163 climatic amplitude on the biotic responses of flora and fauna. The emphasis on climatic
1164 shifts and regional ecological variability is commonly seen as the sound background for
1165 the archaeological contexts and therefore facilitating the understanding hominin
1166 population dynamics. Hominins were able to disperse into regions that were beyond the
1167 their sub-tropical and tropical African homeland (Bosinski, 2006; Dennell 2009) and in
1168 routes, times and into environments unrelated to other large African taxa both carnivore
1169 and herbivore suggesting a unique biological, behavioral and cultural suite of characters
1170 which allowed them to do so. However, without a better understanding the reasons for
1171 success and failure of survival of various hominin migrant groups, and whether it
1172 depended on their ability to keep their mating and reproductive systems, we will need to
1173 resort to oversimplifications of the “human success”.

1174

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1765 **Figure legends**

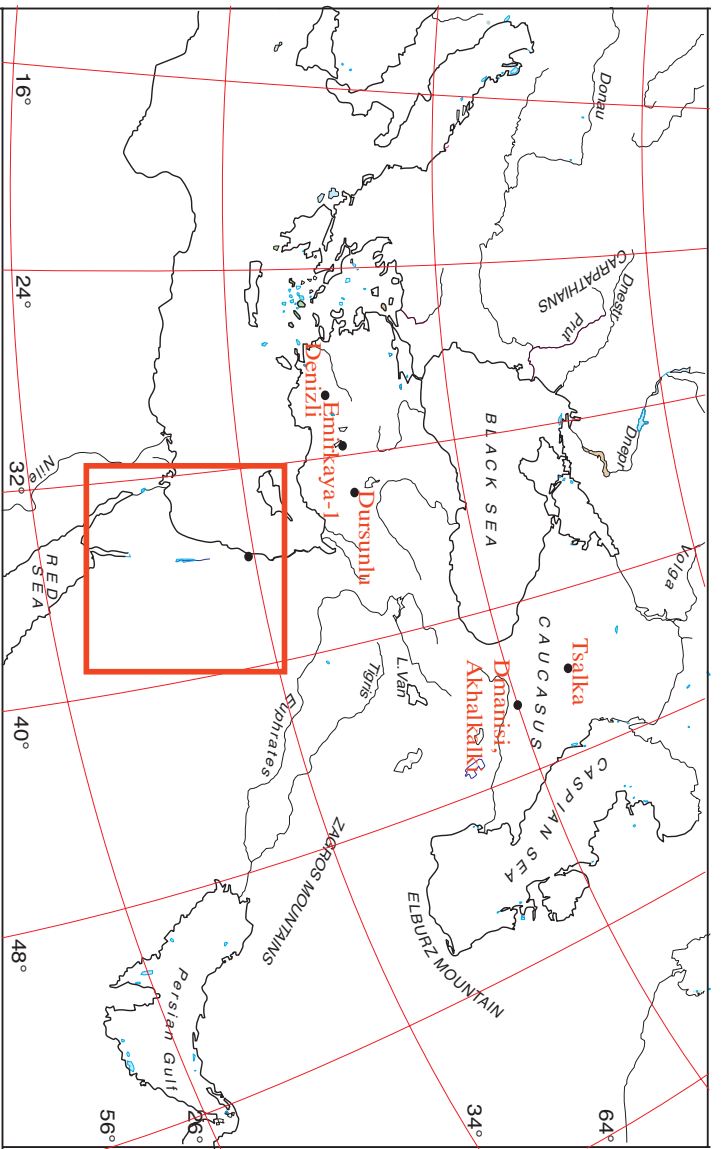
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1767 Figure 1: Location of major sites mentioned in the texts. Subfigure A includes the near east.

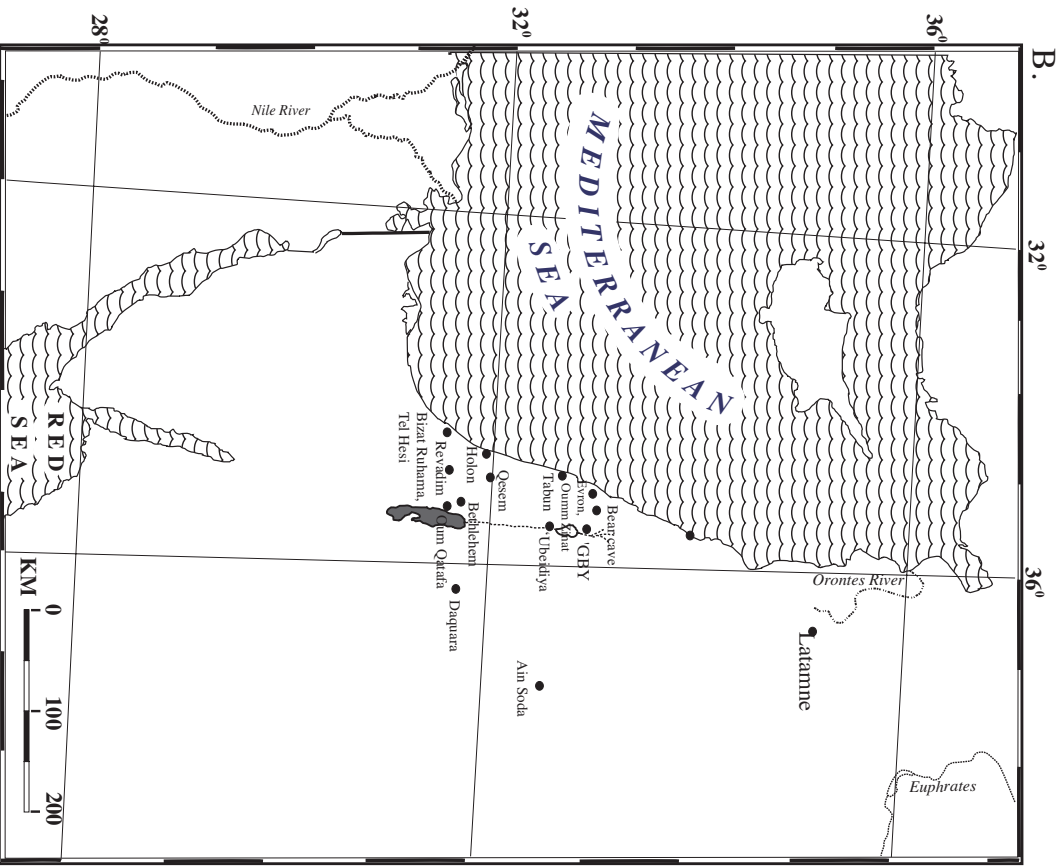
1768 Subfigure B includes the Levant and is denoted in the box within subfigure A.

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1770



A.



B.

Table 1a: A summary of the distribution of the main carnivores in the Early to Middle Pleistocene of the Near East. References are mentioned in the texts. X denoted presence.

		Dmanisi Tsalka	Gilsa	'Ubeidiya	Cobb Mt.	Evron Latmane	Jaramillo	Dursunlu Akhalkalaki	BMB	GBY	Bear cave Emirkaya - 2	Mid brunhes	Holon Hayonim E
		1.8 – 1.6		1.6 – 1.2		1.2 – 1.0		1.0 – 0.8		0.8 – 0.5	0.5 – 0.3		0.3 – 0.1
Canidae	<i>Canis etruscus</i>	X											
	<i>Canis mosbachensis</i>			X				X					
	<i>Canis lupus</i>										X		
	<i>Lycaon lycaonoides</i>			X				X					
	<i>Lycaon pictus</i>												X
	<i>Canis aureus</i>					X							X
	<i>Vulpes</i> cf. <i>V. praeglacialis</i>			X									
	<i>Vulpes vulpes</i>										X		X
Ursidae	<i>Ursus etruscus</i>	X		X									
	<i>Ursus</i> sp.	X						X		X			
	<i>Ursus</i> sp. small												
	<i>Ursus deningeri</i>										X		X
	<i>Ursus arctos</i>												X
Mustelidae	<i>Martes</i> sp.	X						X					X
	<i>Meles meles</i>										X		
	<i>Lutra simplicidens</i>			X									
	<i>Lutra</i> sp.							X					
	<i>Mellivora</i> sp.			X									
	<i>Pannonictis pilgrimi</i>			X									
Viverridae	<i>Herpestes</i> sp.			X									
	<i>Vormela</i> cf. <i>peregusna</i>			X				X					X
Hyaenidae	<i>Pachycrocuta perrieri</i>	X											
	<i>Pachycrocuta brevirostris</i>							X					
	<i>Crocuta crocuta</i>			X		X					X		
	<i>Hyaena hyaena</i>												
Felidae	<i>Lynx issiodorensis</i>	X		X									
	<i>Felis</i> sp. size of <i>F. silvestris</i>			X				X					X
	<i>Felis chaus</i>												X
	<i>Acinonyx pardinensis</i>	X											
	<i>Megantereon</i> cf. <i>whitei</i>	X		X				X					
	<i>Homoherium crenatidens</i>	X											
	<i>Panthera pardus</i>										X		X

<i>Panthera leo</i>									X	
<i>Panthera gombaszoegensis</i>	X		X							

	<i>Giraffa</i> sp.		X						
	<i>Giraffa camelopardalis</i>			X					
Bovidae	<i>Bison georgicus</i>	X							
	<i>Leptobos</i> sp.		X						
	<i>Bison</i> sp.			X	X	X	X		
	<i>Bos primigenius</i>			X	X	X	X		X
	<i>Gallogoral meneghini</i>	X							
	<i>Pelorovis oldowayensis</i>		X						
	<i>Bos buiaensis</i>					X			
	? <i>Sinoreas</i> sp.				X				
	<i>Capra</i> sp.					X			
	<i>Capra ibex</i>						X		X
	<i>Capra aegagrus</i>								X
	<i>Capra dalii</i>	X							
	<i>Caprini</i> indet.					X			
	<i>Ovibovini</i> indet.	X				X			
	<i>Pontoceros</i> sp.	X	X	X					
	Antilopini indet.	X	X						
	<i>Gazella</i> sp.		X	X		X			
	<i>Gazella</i> cf. <i>gazella</i>						X		X
	<i>Oryx</i> cf. <i>gazella</i>		X						
	<i>Alcelaphus buselaphus</i>			X					X
Camelidae	<i>Camelus</i> sp.	X	X	X					
Suidae	<i>Kolpochoerus olduvaiensis</i>		X						
	<i>Kolpochoerus evronensis</i>			X					
	<i>Sus strozzi</i>		X						
	<i>Sus scrofa</i>					X	X		X
Hippopotamidae	<i>Hippopotamus georgicus</i>	X?			X				
	<i>Hippopotamus behemoth</i>		X	X					
	<i>Hippopotamus gorgops</i>		X						
	<i>Hippopotamus antiquus</i>			X		X			X
Primates	<i>Macaca sylvanus</i>		X						
	Cercopithecidae cf. <i>Theropithecus</i>		X						

Table 2: Faunal and hominin dispersal from Africa to Eurasia in different biozones

Date (Ma)	MOIS	Mammalian zone	Caucasus	Anatolia	Levant	African Dispersal ¹	Hominin dispersals	Cultural entities
2.5		Early Villafranchian	Kvebebi		Bethlehem	N=2		
1.8		Middle Villafranchian	Dmanisi, Tsalka				Dispersal event	Core and flake
1.6 – 1.2		Late Villafranchian			‘Ubeidiya	N=5	Dispersal event	Early Acheulian
1.1 – 1.0		Epi-villafranchian	Akhalkalaki Takshe	Dursunlu	Daquara, Latamne, Evron,	N=2		
0.8	19	Gallerian			GBY	N=1	Dispersal event	Acheulian
0.5				Danizli, Emirkaya -2, Bear Cave,	Revadim Holon, Ein Soda, Tel Hesi			
0.4 – 0.3	8-9	Auralian			Qesem, Revadim Tabun E			Achelo-Yaburidian
0.3 – 0.13	7-6				Hayonim E, Misliya			Early Mousterian

¹ Number of species that left Africa

