

**Fig. 8.** Selected bone surface modifications and bone fracture patterns from Nahal Hesi. Scales are 2 mm: (a) NH-65, cutmarks on an unidentified long-bone shaft fragment of a large ungulate. The butchery marks are overlain by weathering cracks and exfoliated areas; (b) NH-125, cutmarks on an unidentified long-bone shaft fragment of a large ungulate; (c) NH-24, a tibia shaft from a medium ungulate showing a conchoidal notch, probably induced by hammerstone percussion.

Cave (Stiner et al., 2009). The precise trophic level of the hominins in the Northern Negev is difficult to discern without more data, especially concerning the intriguing Early Pleistocene faunal evidence from Bizat Ruhama.

#### *Hominin paleoecology and paleoenvironment of the sites*

The faunal remains of Bizat Ruhama and Nahal Hesi are essentially food debris accumulated by Lower Paleolithic hominins in the Northern Negev region. Thus, these sites directly represent the ecological settings exploited through hominin foraging (e.g., Bar-Yosef, 2004). The macromammalian record may be a coarse-grained measure of environmental changes relative to others (e.g., sedimentological or isotopic studies). However, this measure is highly correlated to hominin ecology, because ungulates served as the resources regularly procured and used by hominin foragers.

The two sites display very similar taxonomic compositions, with dominance of equids and bovines. Both equid species probably attest to a relatively dry climate and an open environment, while the teeth of the spiral-horned antelope (probably *Pontoceros/Spirocerus*) of Bizat Ruhama suggest a browsing diet. Gazelles usually forage on open terrain (Mendelsohn and Yom-Tov, 1999). The large bovines may inhabit dry grassland, but must stay in proximity to a water source. Overall this indicates an open, relatively uniform environment with patchy water sources and trees, much like this semiarid region today.

This species composition is markedly different from Lower Paleolithic sites located just 50–70 km to the north, including Holon (Monchot and Horwitz, 2007a) and Qesem (Gopher et al., 2005). Moreover, this species composition is different from the sites of the Galilee coastal plain and the Jordan Valley, including Evron Quarry (Tchernov et al., 1994), 'Ubeidiya (Tchernov, 1986; Belmaker, 2006),

and Gesher Benot Ya'aqov (Rabinovich et al., 2008) (Fig. 10). Specifically, all of these sites are rich in cervids, while equids are scarce in all sites but 'Ubeidiya, where they amount to about 15% of NISP (Belmaker, 2006). The site of Revadim Quarry, located just 30 km north of the Northern Negev sites, include three cervids species but also many 'open' species (Marder et al., 1998, 2007), raising the possibility that it occupies a niche in between the sites of Northern and Central Israel and the Northern Negev sites. Many sites in this period include proboscidean remains (e.g., 'Ubeidiya, Evron, Gesher Benot Ya'aqov, Revadim and Holon), and remains of amphibious animals such as hippos and turtles (except for Revadim), but no such remains have been confidently identified at either Bizat Ruhama or Nahal Hesi. The faunal remains collected at the Azraq C-Spring in eastern Jordan, which may belong to the Lower Paleolithic, offer a similar array of 'open' ungulate taxa, probably indicating a relatively dry grassland environment (Clutton-Brock, 1989).

The closest parallel to the Lower Paleolithic Northern Negev sites comes from the Middle Paleolithic (Late Pleistocene) of the same region – the open-air site of Far'ah II in the Nahal Besor region, which is dominated by *Equus*, *Bos*, *Alcelaphus* and *Camelus* remains (Gilead and Grigson, 1984). As is the case with the Lower Paleolithic sites, Far'ah II diverges from Middle Paleolithic sites further north which usually display an important cervid component (e.g., Bate, 1937; Davis, 1977; Rabinovich and Hovers, 2004; Rabinovich et al., 2004; Stiner, 2005; Speth and Tchernov, 2007; Yeshurun et al., 2007b). The three faunal assemblages of the Northern Negev, dating to the Early, Middle and Late Pleistocene and originating from an *in situ* depositions of hominin food debris, yielded equid, antelope and bovine remains, with no typical woodland species (e.g., cervids and suids). Additionally, animals that live in freshwater sources (e.g., hippo or turtle) are either absent or extremely rare at the Northern Negev.

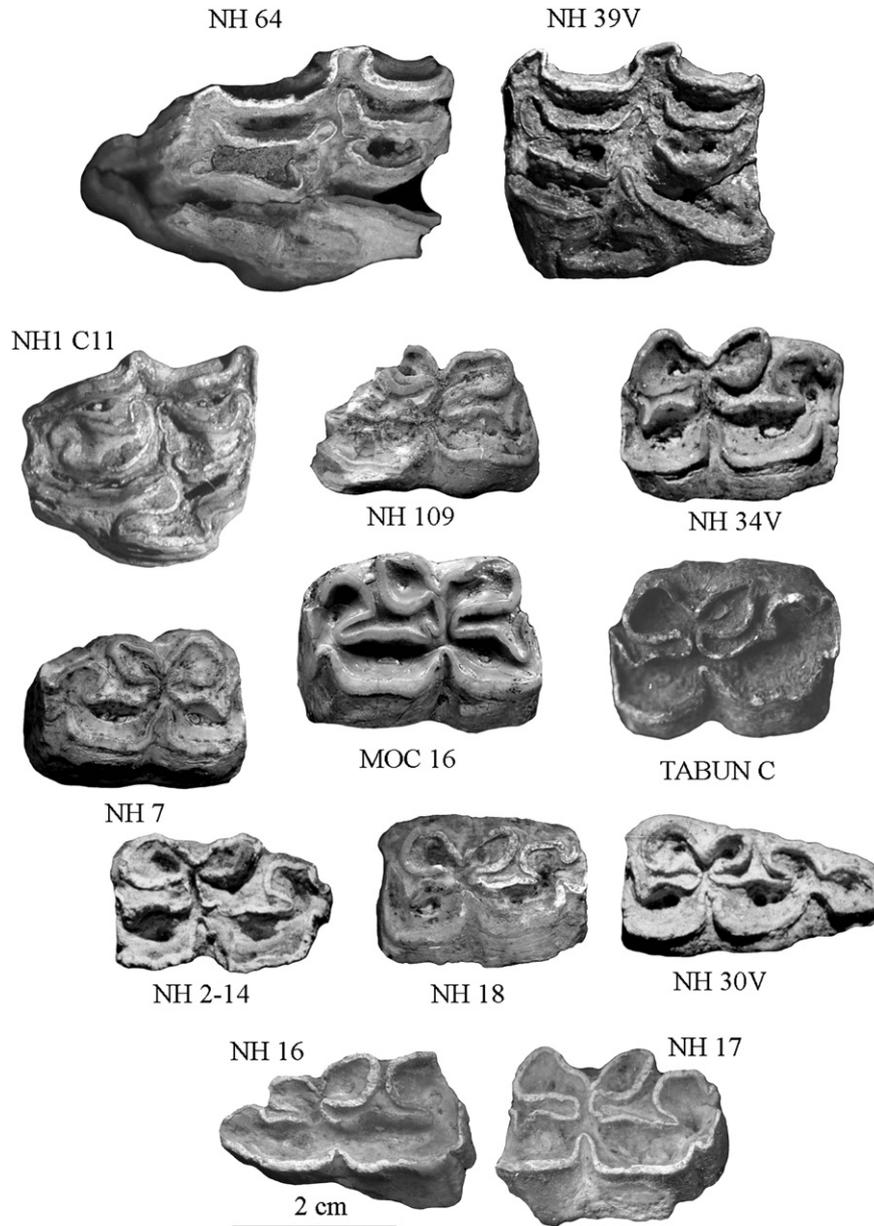
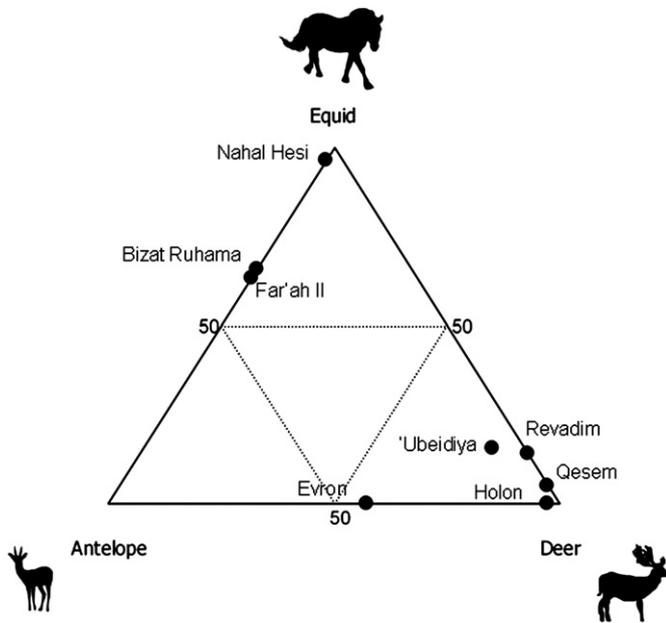


Fig. 9. Selected equid teeth from Nahal Hesi (NH), Tabun Cave and Ain Tit Mellil, (MOC).

It is remarkable that three faunal assemblages from the Lower Paleolithic and the Middle Paleolithic of the northern Negev share essentially the same faunal communities despite the wide chronological and cultural gaps that exist between them, clearly setting them apart from the sites further north. The Northern Negev today is a transitional zone between the Mediterranean climatic zone to the north and the arid Negev Desert in the south, and its climate is semiarid, receiving some 300–400 mm of rain annually. The archaeofaunal data suggest that the Pleistocene Northern Negev environment was in the range of a semiarid climatic zone as it is at present. Geological data from the immediate vicinity of the sites revealed the occurrence of more humid environmental episodes, but probably within the range of semiarid climate (Rosen, 1986; Dassa, 2002; Menashe, 2003). Little is known of Pleistocene faunas further south, in the present-day extremely arid desert. In the early Middle Paleolithic fauna of Rosh Ein Mor and in the Upper Paleolithic site Ein'Aqev, both located in the central Negev highlands, *Equus*, *Gazella*, and *Capra* dominate but *Bos*, which is less

adept to arid conditions, is rare or absent (Tchernov, 1976). Thus, the relative environmental stability stemming from our results may signal a northern limit to desertification and a southern limit to the Mediterranean woodlands of the southern Levant throughout the Pleistocene. Notwithstanding climatic fluctuations, no major northward or southward movements of climatic belts are indicated by our data. Recent paleoclimatic reconstructions using the timing of growth and isotopic composition of cave speleothems from the north-eastern Negev (presently semiarid to arid region) displayed several fluctuations in the amount of rainfall of that region, most of which were still in the range of semiarid environment (Vaks et al., 2006). The clear archaeofaunal dichotomy evident between the northern sites and the Northern Negev sites all along the Lower and Middle Paleolithic periods lends support to viewing the southern Levant Pleistocene climate as one dictated by the present-day geography. Specifically, mostly mild movements of the climatic belts occurred because of the region's extreme physiogeographic variability (Enzel et al., 2008). Thus, integrating the archaeofaunal,



**Fig. 10.** A triplot chart showing the relationship between three taxonomic groups, equids, deer and antelopes, at selected sites from the Southern Levant. See references in the text.

geomorphologic and isotopic proxies suggests to us that most fluctuations in the northern Negev were probably still in the range of semiarid climate and environment available to Lower Paleolithic hominins.

Significantly, it is important to note that archaeofaunal assemblages represent only points in time (in this case lacking precise radiometric dating), not a continuous sequence. Thus, it is possible that the sites merely represent the periods of climate amelioration which allowed hominin settlement in the northern Negev, whereas periods of aridification left no archaeological occurrences and associated faunal remains. However, the data presented in this study still imply that, given such a scenario, periods of climatic amelioration in the northern Negev did not reach the extent of true Mediterranean environment as reflected by archaeofaunas of the northern sites.

### Summary and conclusion

The Lower Paleolithic sites of Bizat Ruhama (Early Pleistocene) and Nahal Hesi (Middle Pleistocene), located on the northern fringe of the Negev Desert, yielded small but significant faunal assemblages probably deriving from anthropogenic meat-acquisition and butchery activities. The site of Nahal Hesi presents evidence for primary access of hominins to fleshed carcasses of large ungulates, while the earlier site of Bizat Ruhama may represent secondary access of hominins to carcasses. The assemblages are among the only Lower Paleolithic faunas in the southern Levant that are dominated by equids and lack cervids and suids. No elephants or amphibious animals were found, too. These findings indicate an open, relatively uniform environment with patchy water sources and trees, much like this region today. Bizat Ruhama and Nahal Hesi are among the rare Lower Paleolithic sites in the Southern Levant associated with such an ecological setting, thereby widening our knowledge of the spectrum of environments exploited by hominins in the region. We suggest that the fauna from the two sites, coupled with the Late Pleistocene faunal evidence of the same region, reflect a largely stable semiarid environment on the fringe of the Negev Desert throughout much of the Pleistocene.

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### Appendix. Supplementary Online Material

Supplementary data associated with this article can be found in the online version, at [doi:10.1016/j.jhevol.2010.01.008](https://doi.org/10.1016/j.jhevol.2010.01.008).

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