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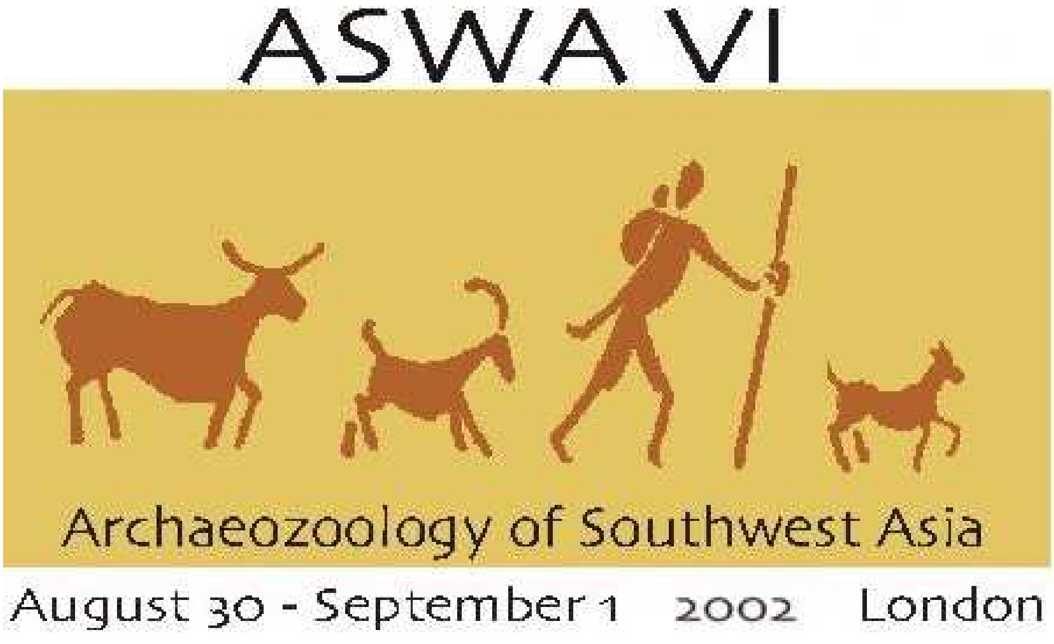

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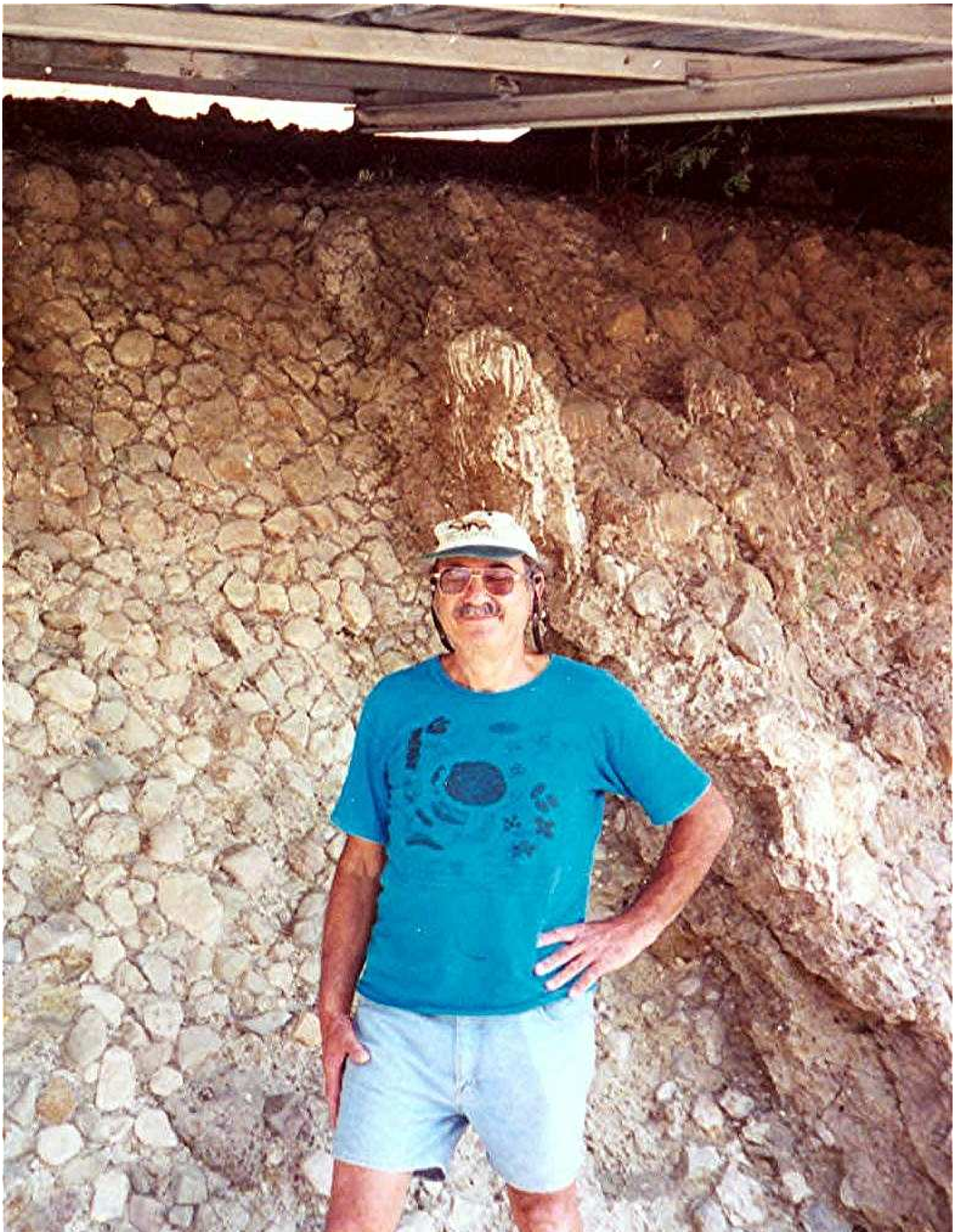

Prof.Dr. Eitan Tchernov

This volume is dedicated to the memory of Prof. Dr. Eitan Tchernov, in fond memory of his enthusiasm and support to many in the field of archaeozoology**.**

Preface

The ASWA VI meeting was held at the Institute of Archaeology, University College London, from 30th August-1st September 2002, timetabled to follow on the heels of the ICAZ meeting in Durham, UK. Over 55 participants attended the meeting, travelling from 13 countries, bringing the latest research results from our field. As usual, it was a pleasure to see so many doctoral students presenting their research – a sign for a very healthy future for zooarchaeology in south west Asia. It is still unfortunate, however, that colleagues from some Middle Eastern countries were unable to attend due to financial and political constraints.

Presentations were organized into the following six themes, which highlight the scope of the ASWA membership: Animals in Palaeolithic and Epipalaeolithic Levant; Neolithic Patterns of Animal Use; Animals in Neolithic Anatolia; Animals in the Chalcolithic and Bronze Ages; Iron Age, Nabatean and Roman Patterns of Animal Use; Animals in Ancient Egypt. There was also a poster session, and contributors were invited to submit papers to this volume.

As always with the ASWA forum, the meeting served to welcome new scholars to the group, but was also very much a reunion of old friends and colleagues who have been sharing new information and discussing issues of joint interest for many years now. In this vein, it is a great sadness that ASWA VI was the last international meeting attended by Prof. Eitan Tchernov, an original founder of the group and mentor and inspiration to so many. For many of us, it was the last time we saw Eitan, and experienced his usual incisive comment, unstoppable enthusiasm for the subject, and warm friendship. He will be greatly missed.

ASWA VI was supported by the Institute of Archaeology, UCL, who provided facilities and financial and administrative help. In particular, the organizing team was aided greatly by the administrative assistance of Jo Dullaghan at the Institute. ARC bv (Archaeological Research and Consultancy, Groningen, The Netherlands) once again shouldered the finances of the publication of the proceedings, and we are extremely grateful for their continuing support. Many thanks are also due to the postgraduate student helpers from the Institute of Archaeology who made the meeting run so smoothly: Banu Aydinoğlugil, Jenny Bredenberg, Chiori Kitagawa, Peter Popkin, and Chris Mosseri-Marlio (who also produced the logo reproduced on the frontispiece of this volume).

Many thanks to all the participants for making the meeting such a success!

Louise Martin
London 2005

Participants of the 6th ASWA Conference, held at the Institute of Archaeology, University College London.

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ZOOARCHAEOLOGICAL DIVERSITY AND PALAEOECOLOGICAL RECONSTRUCTION OF THE EPIPALAEOLITHIC FAUNAL SEQUENCE IN THE NORTHERN COASTAL PLAIN AND THE SLOPES OF MOUNT CARMEL, ISRAEL

Guy Bar-Oz[1] and Tamar Dayan[2]

Abstract

We carried out a detailed zooarchaeological study of four Epipaleolithic assemblages from the northern coastal plain and the slopes of Mount Carmel, Israel (Nahal Hadera V – early Kebaran, Hefzibah layers 7-18 – Geometric Kebaran, Neve David – late Geometric Kebaran, and el-Wad Terrace – Late Natufian) in order to gain an insight into the development of Epipalaeolithic subsistence strategies. The Epipaleolithic fauna is dominated throughout the sequence by mountain gazelle (*Gazella gazella*), followed by Persian fallow deer (*Dama mesopotamica*). Two changes are observed in species composition during the Natufian: fallow deer decreased dramatically and small low-rank fast game (in particular *Lepus capensis*, *Vulpes vulpes*, and *Alectoric chukar*) increased. Gazelle and other game species remain in constant frequencies throughout the sequence. Paleoecological reconstruction of the mammal spectrum reveals replacement of grassland-shrubland fauna in the Early Epipalaeolithic by fauna of a bushland and open woodland vegetation type during the Middle Epipalaeolithic. Conceivably, the decrease of fallow deer reflects environmental deterioration which reached its peak in the Late Epipalaeolithic.

Résumé

Nous avons conduit une étude archéozoologique détaillée sur 4 assemblages épipaléolithiques des plaines côtières du nord et des piedmonts de Mont Carmel, Israel (Nahal Hadera V –Kebaraen récent, Hefzibah niveaux 7-18 – Kebaraen géométrique, Neve David –Kebaraen géométrique récent, et el-Wad Terrace –Natufien récent) afin de mieux comprendre les stratégies de subsistances à l'épipaléolithique. La faune de cette période est dominée durant toute la séquence par la Gazelle de montagne (*Gazella gazella*), suivie par le daim de Mésopotamie (*Dama mesopotamica*). Deux changements sont observés durant le Natufien: Le daim décroît subitement et le petit gibier augmente (en particulier *Lepus capensis*, *Vulpes vulpes*, and *Alectoric chukar*). Les gazelles et les autres gibiers restent à des taux constants tout au long de la séquence. Les reconstitutions paléoécologiques du spectre mammalien révèlent le remplacement d'une faune de prairie / paysage arbustif au début de l'épipaléolithique par une faune correspondant à une végétation de type buisson et de forêt ouverte durant l'épipaléolithique moyen. On pourrait concevoir que la décroissance du daim reflète une détérioration environnementale qui atteint son summum à l'épipaléolithique récent.

Keywords: Epipalaeolithic, Levant, Kebaran, gazelle, fallow deer, small game.

Mots Clés: Epipaléolithique, Levant, Kebarien, gazelle, daim, chasse aux petits animaux.

Introduction

The Levant at the end of the last Glacial period during the Epipalaeolithic cultural sequence (*ca.* 21,500-11,500, all dates are calibrated ^{14}C dates before present) was a period of marked climatic and cultural change that played a major role in shaping past environments, landscapes, and available resources. The climatic changes were characterized by large-scale changes in humidity and temperature, together with a gradual rise in sea levels, which resulted in a narrowing of the Mediterranean coastal plain (Weinstein-Evron 1998 and references therein). The Epipalaeolithic cultural sequence which consists of the Kebaran (21,500-17,000 BP), the Geometric Kebaran (17,000-14,500 BP), and Natufian (14,500-11,500 BP) saw semi-sedentary and mobile foragers (in the Kebaran and Geometric Kebaran) develop into complex societies of hunters and gatherers using long-

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term occupation sites (in the Natufian). The Natufian culture is associated with the earliest known occurrence of cereal agriculture and incipient animal domestication, which eventually led to the appearance of the agricultural economies of the Neolithic (e.g. Bar-Yosef 2001, 2002; Bar-Yosef and Belfer-Cohen 1992; Kaufman 1992). Thus, the Epipalaeolithic cultures may hold the key to understanding the origin and process of sedentism and the later emergence of cultivation.

Some patterns in Natufian faunal exploitation have been suggested in recent years. Among them are:

1. a shift to a broad spectrum economy, featuring an increased number of small game species (Davis 1989, 1991; Henry *et al* 1981; Tchernov 1991, 1993a), and in particular consumption of proportionally large numbers of fast-moving species (Munro 1999, 2001; Stiner 2001; Stiner *et al* 1999, 2000; Stiner and Munro 2002);
2. an increase in the percentage of gazelle (*Gazella gazella*) exploited (e.g. Legge 1972; Davis 1982; Henry 1985; Tchernov 1991, 1993a, 1993b) coupled with an increase in the percentage of young gazelle (Davis 1983; Munro 2004), and a high proportion of male gazelles (Bar-Oz *et al* 2004; Cope, 1991; Tchernov 1991, 1993a, 1993b).

The roots of these subsistence strategy changes may lie in the preceding Kebaran and Geometric Kebaran cultures. Previous attempts to test the suggested patterns of Natufian faunal exploitation based on the published Epipalaeolithic literature failed to confirm such economic changes. Various methodological problems, variability in site types, in ecological settings, and in the depositional histories of the different sites prevented the use of much of the published data (Bar-Oz *et al* 1999 and reference therein).

We carried out a detailed taphonomic and zooarchaeological study of four Epipaleolithic assemblages from the northern coastal plain of Israel and the slopes of Mount Carmel in order to

Fig 1. Map showing the location of the four Epipalaeolithic sites analysed.

explore variability in animal exploitation strategies during the Epipalaeolithic. This area contains a large number of prehistoric sites, including numerous sites from the entire Epipalaeolithic sequence (Ronen 1983), providing the opportunity to study a continuous archaeological record of the Epipalaeolithic cultural transition. Three sites (Fig. 1), Nahal Hadera V (Early Kebaran; Bar-Oz and Dayan 2002a, 2002b, n.d), Hefzibah (layers 7-18 – Geometric Kebaran; Bar-Oz and Dayan 2003), and el-Wad Terrace (Late Natufian; Bar-Oz *et al* 2004), were recently excavated. Hefzibah 1-6 assemblage is eliminated from consideration here because of its markedly different state of preservation (Bar-Oz and Dayan 2003). The data collected from the three sites were added to the Neve-David assemblage (Late Geometric Kebaran) which was previously analyzed by the author (Bar-Oz *et al* 1998, 1999). The four Epipalaeolithic sites share many characteristics, such as site location within the Mediterranean vegetation belt at a relatively low elevation. In addition, all sites are large, composed of rich cultural deposits, and have a high density of artifacts with the presence of ground stone implements.

The four archaeofaunal assemblages were subjected to identical detailed taphonomic and zooarchaeological procedures. In this paper we provide the relative abundances of the different taxa and analyses of the zooarchaeological diversity of the Epipalaeolithic assemblages. We used these data to carry out a palaeoecological reconstruction of the northern coastal plain and Mount Carmel region.

The complete zooarchaeological and taphonomic coding and analysis procedures used to collect and present the data for this paper, the complete data sets for all studied assemblages and a detailed discussion of the Epipalaeolithic subsistence strategies are detailed in Bar-Oz (2004). The abundances of the different taxa were quantified using NISP (number of identified specimens) and MNI (minimum number of individuals from which the assemblage originated). These values were calculated using the methods described in Klein and Cruz-Uribe (1984). We employed the Jackknife technique to measure species diversity and to explore inter-assemblage variability (Kaufman 1998). NISP was used as a basic measure of taxonomic abundance (following Grayson 1984).

Representation of taxa

The MNI and NISP for all taxa in each of the five Epipalaeolithic assemblages are detailed in Table 1. The total NISP for all assemblages is 33,152 complete and fragmentary bones from a minimum number of 684 individuals representing 23 different species. The major prey species exploited throughout the Epipalaeolithic sequence are mountain gazelle (*Gazella gazella*) and Persian fallow deer (*Dama mesopotamica*).

Other large mammals, such as the extinct hydruntine equid (*Equus hydruntinus;* (Vera Eisenmann pers. communication, 2000) and hartebeest (*Alcelaphus buselaphus*) from the coastal plain, and the extinct aurochs (*Bos primigenius*), roe deer (*Capreolus capreolus*), and red deer (*Cervus elaphus*) from wooded areas, are represented in small proportions. Aurochs is slightly better represented at Hefzibah 7-18. Carnivores are represented by fox (*Vulpes vulpes*), wolf (*Canis lupus*), jungle cat (*Felis chaus*), lion (*Panthera leo*), spotted hyena (*Hyaena hyaena*), beech marten (*Martes foina*), mongoose (*Herpestes ichneumon*), and badger (*Meles meles*). Foxes are the dominant carnivores and their remains comprise almost 90% of the carnivore specimens in all assemblages. Small game, found in all assemblages, is represented by fox, hare (*Lepus capensis*), tortoise (*Testudo graeca*), and partridge (*Alectoris chukar*). Note the relatively high proportion of small game at el-Wad Terrace. Other reptiles include the legless lizard (*Ophiosaurus apodus*) and agamid lizard (*Agama stellio*), but their taphonomic status is unclear, and they could represent intrusive fauna.

At Nahal Hadera V, Hefzibah, and Neve-David, gazelle and fallow deer comprise the main hunted species (> 90%). Two major temporal changes are observed in species composition during the Late Natufian of el-Wad Terrace. First, the frequency of fallow deer decreased dramatically from about 30% of the NISP in the pre-Natufian assemblages to less than 2% in the Natufian site. Second, small game, such as hare and tortoise, and small carnivore species increase in abundance (Fig. 2). Gazelle remain in relatively constant frequencies throughout the sequence. Other game species, such as aurochs, roe deer, and wild boar remain at relatively low and constant frequencies throughout the sequence.

Table 1. Species abundance (NISP/MNI) of the taxa represented in the five Epipalaeolithic assemblages.

Species	Common name	Nahal Hadera V	Hefzibah 7-18	Neve-David	el-Wad Terrace
Gazella gazella	Mountain gazelle	12528/202	6169/83	1540/45	28/2095
Alcelaphus buselaphus	Hartebeest	154/10	7/1	6/1	-
Bos primigenius	Aurochs	43/2	212/6	13/1	6/1
Dama mesopotamica	Fallow deer	5414/94	1685/26	780/21	56/2
Capreolus capreolus	Roe deer	17/2	-	26/2	5/1
Cervus elaphus	Red deer	-	-	8/1	-
Sus scrofa	Wild boar	10/1	11/1	9/2	10/1
Equus hydruntinus	European wild ass	100/4	1/1	-	
Lepus capensis	Hare	474/20	239/7	39/7	185/6
Vulpes vulpes	Fox	190/6	105/6	41/3	197/7
Canis lupus	Wolf	5/1	-	10/1	6/1
Felis chaus	Jungle cat	15/1	7/2	-	11/1
Panthera leo	Lion	2/1	-	-	-
Hyaena hyaena	Striped hyena	1/1	-	-	-
Herpestes ischenum	Mongoose	-	-	3/1	-
Meles meles	Badger	-	-	-	1/1
Martes foina	Beech marten	-	1/1	1/1	1/1
Erinaceus europaeus	Hedgehog	106/17	8/1	1/1	9/1
Sciurus anomalous	Squirrel	-	-	3/1	-
Hystrix indica	Porcupine	-	-	1/1	-
Testudo graeca	Spur-thighed tortoise	320/14	60/5	33/4	229/8
Ophisaurus apodus	Legless lizard	133/8	11/1	2/1	37/6
Agama stellio	Agamid lizard	1/1	-	-	9/3
Alectoris chukar	Partridge	-	3/1	-	42/5
		19513/385	**8519/142**	**2495/95**	**2899/73**

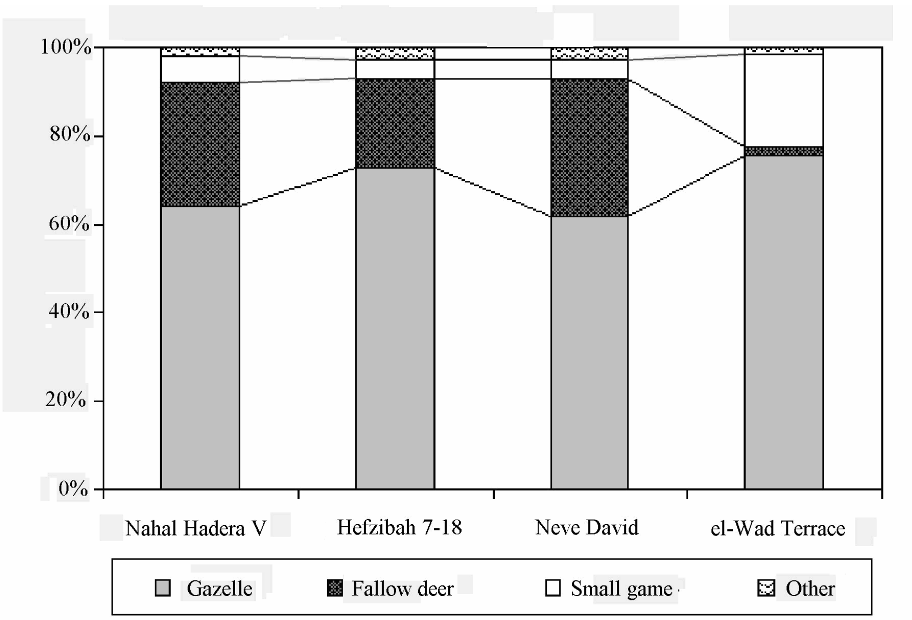

Fig. 2. Proportional occurence of gazelle, fallow deer and small game species in the four Epipalaeolithic assemblages, based on NISP.

Zooarchaeological diversity

Zooarchaeological diversity was calculated for each of the Epipalaeolithic assemblages based on measures of species richness and evenness using the Jackknife technique. The greater the evenness value, the more evenly the specimens are distributed across species. Comparison between the assemblages according to their mean richness and evenness values (Fig. 3) reveals that el-Wad Terrace has the highest evenness value, the result of a high proportion of small game, while Neve-David exhibit the highest richness value. However, no significant differences were found (Jackknife tables and ANOVA results of evenness and richness for intra-site comparisons are given in Bar-Oz 2004), perhaps because of the dominance of gazelle and fallow deer, which constitute the main hunted species in all five assemblages. Thus, inter-site comparisons show no evidence for changes in species evenness and richness between the Natufian and the pre-Natufian assemblages.

Stiner and Munro (2002) have recently shown that increasing ratios of low- *versus* high-ranked prey across the Palaeolithic were obtained only when small animals were classified according to predator escape mechanisms (i.e. fast *versus* slow), rather than the number of species or genera, or prey taxa categorized by body-size (see also Stiner 2001). In light of these results we used another method to examine variability in diet breadth throughout the Epipalaeolithic sequence and to estimate the contribution of small game to the Natufian economy. Prey species from the four Epipalaeolithic assemblages were grouped according to five prey types:

1. High-ranked slow-moving, small game – tortoises
2. Low-ranked fast-moving, small game – hare, partridge and small carnivores
3. Medium size game – gazelles and roe deer
4. Medium-large size game – fallow deer, hartebeest, equids, red deer, and wild boar
5. Large size game – aurochs.

The remaining species with questionable economic significance were excluded from the analysis. A two-dimensional Chi-square distribution of the five prey types was performed based on correspondence analysis using NISPs. Results of this comparison show significant differences in the abundance of the different prey groups between assemblages (χ^2=648.42, P<0.001). Figure 4 displays the strength and direction of the calculated standard deviations from the expected mean values of the five assemblages for each prey type. This was computed as the square-root of the contribution to Chi-square values from the mean values of the combined assemblages. The main differences are an increase in the proportions of both slow and fast small game in the Natufian assemblage of el-Wad

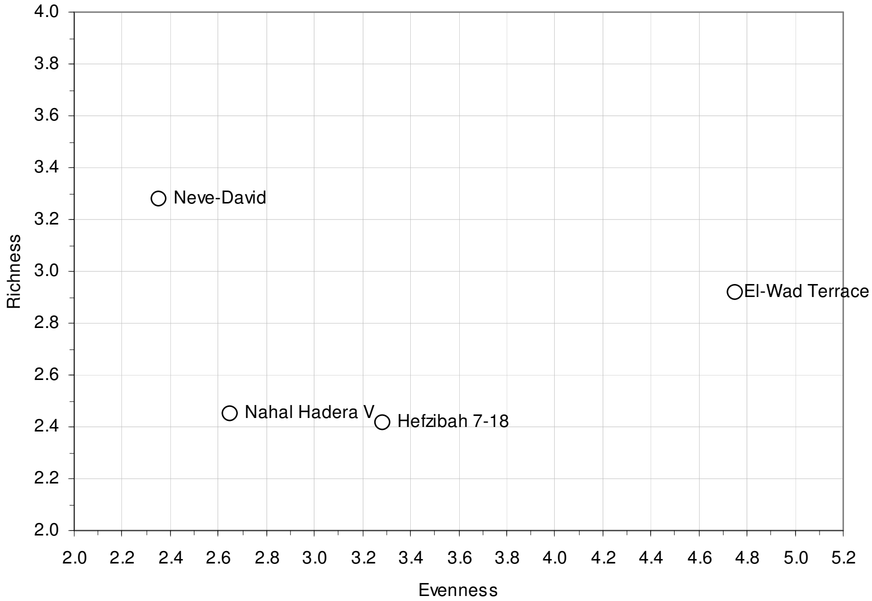

Fig. 3. Scatterplot of the mean richness and eveness values from the studied Epipaleolithic assemblages.

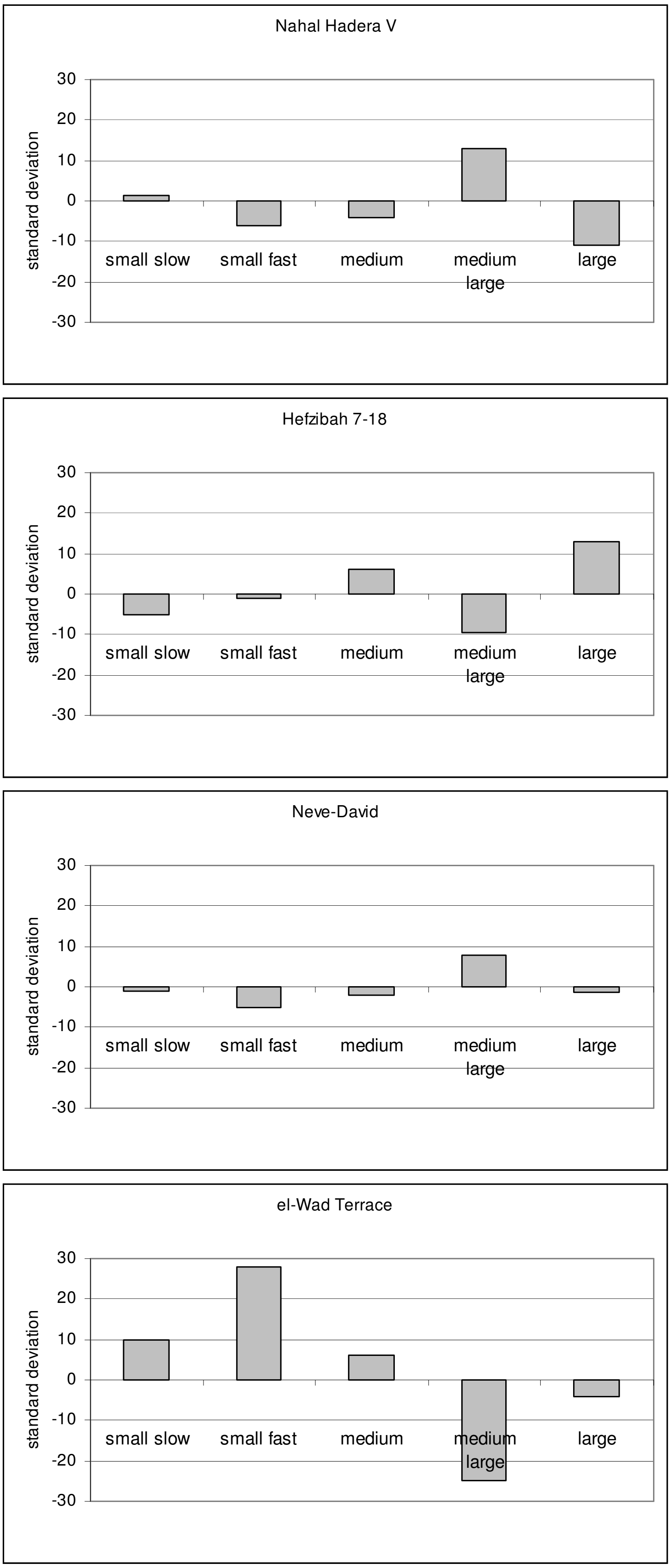

Fig. 4. Standard deviation of five prey size groups for the four Epipalaeolithic assemblages in relation to the calculated mean value for each body-size from the entire assemblage. Based on NISP.

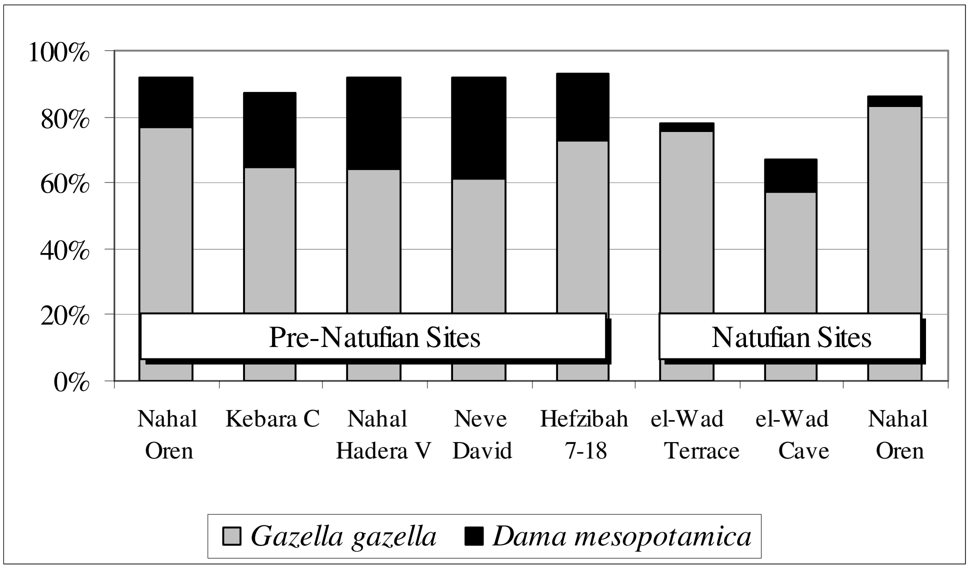

Fig. 5. Relative frequencies of gazelle (gray) and fallow deer (black) in Epipalaeolithic assemblages from Mount Carmel and northern coastal Israel.

Terrace, as evidenced by a positive deviation (of over 27 standardized deviations for fast-small game and over 9 standard deviations for slow small game) from the mean values of the five Epipalaeolithic assemblages in comparison to a negative deviation in all other Pre-Natufian assemblages (except for Nahal Hadera V which holds a small positive deviation of slow small game). The increased proportion of low ranked species, in particular fast-moving small game, suggests an increase in diet breadth during the Natufian.

On the other hand, comparison of the medium size group (exclusively gazelle in all assemblages) shows that the contribution of gazelle to the Natufian economy of el-Wad Terrace does not differ from other assemblages and is equal to the Geometric-Kebaran assemblage of Hefzibah 7-18 (positive six standard deviations in both assemblages). These results demonstrate that increased exploitation of gazelle is not unique to the Natufian and it is characteristic of the whole Epipalaeolithic sequence. Results of this comparison also reveal a strong decrease in fallow deer exploitation during the Natufian (over 25 standard deviations).

Comparison of the ratios of fallow deer in pre-Natufian *versus* Natufian assemblages from the northern coastal plain and the slopes of the Mount Carmel (Fig. 5; references are listed in Table 2) show a significant difference, with fallow deer less common in the Natufian (combined Early and Late phases; $U_{[5,3]}$=0, P=0.03). Conversely, gazelle frequency shows no significant difference throughout the Epipalaeolithic sequence (note that the ratios of gazelle to fallow deer are not entirely independent of each other; $U_{[5,3]}$=6, P=0.65). This is in accord with previous analyses that showed an even exploitation of gazelle throughout the studied period.

Table 2. The proportions of gazelle and fallow deer remains in Epipalaeolithic assemblages in the northern coastal plain and the slopes of Mount Carmel, Israel.

	Gazelle	Fallow deer	Reference
Nahal Oren (Kebaran)	0.77	0.15	Legge in Noy *et al* 1973
Kebara Cave	0.64	0.23	Saxon 1974
Nahal Hadera V (Kebaran)	0.65	0.28	Bar-Oz 2004
Hefzibah 7-18 (Geometric Kebaran)	0.73	0.2	Bar-Oz 2004
Neve-David (Geometric Kebaran)	0.61	0.31	Bar-Oz 2004
el-Wad Cave (Early Natufian)	0.57	0.10	Rabinovich 1998
Nahal Oren (Late Natufian)	0.83	0.03	Legge in Noy *et al* 1973
El-Wad Terrace (Late Natufian)	0.76	0.02	Bar-Oz 2004

Palaeoecological reconstruction

The faunal remains recovered from the Epipalaeolithic sites of the northern coastal plain and Mount Carmel region are representative of the local species hunted in the vicinity of these sites during the Late Glacial, a period of cooler, more humid conditions than today (Weinstein-Evron 1998 and references therein). Ecological analysis of the faunal remains indicates the presence of species that occupied an array of habitats.

Some of the species found at these sites, such as the mountain gazelle, aurochs, hartebeest, and *Equus hydruntinus* preferred open landscapes. The prehistoric distribution of the now extinct hydruntine equid included central Europe and southern Turkey, and went as far east as Azerbaijan (Eisenmann and Patou 1980). Northern Israel may have been included in the southern most point of its distribution (Davis 1980; Uerpmann 1981: Figure 1.2). This species was also identified in the Middle Palaeolithic layers of Tabun C (Garrod and Bate 1937) and Kebara Cave (Eisenmann 1992). The hartebeest, most probably *Alcelaphus buselaphus*, is adapted to savannah woodland, and is the only species of the genus found north of the Sahara belt (Dorst and Dandelot 1970). Hartebeest have also been found in other Epipalaeolithic sites from southern and central Israel (e.g. Davis 1994), and in sites from earlier periods (e.g. Garrod and Bate 1937; Gilead and Grigson 1984). Other species, such as the red deer, and the Syrian squirrel (*Sciurus anomalus*) found at Neve-David also preferred wooded landscapes (Harrison and Bates 1991). Other palaearctic woodland mammals found in these sites include the Mesopotamian fallow deer and roe deer.

The large mammal assemblages suggest grassland-shrubland habitat during the Kebaran. Conversely, during the Geometric Kebaran, they suggest an increase of bushland and open-woodland vegetation types. This shift is witnessed by the replacement of the now locally extinct European wild ass and hartebeest at Nahal Hadera V, with an increasing percentage of red deer and roe deer at Neve-David, coupled with a rise in the frequency of the now locally extinct aurochs at Hefzibah 7-18 (Fig. 6). Similarly, microfauna assemblages demonstrate that during the Kebaran the relative frequencies of open woodland species, particularly *Microtus guentheri*, increased and the relative frequencies of arboreal species, particularly *Apodemus* sp., decreased (Tchernov 1981, 1988; see also Tchernov 1982, 1997 for correlations of micro and macro-mammals in the southern Levant).

It is conceivable that the decrease in the relative abundance of fallow deer between the Early – Middle Epipalaeolithic (Kebaran, Geometric Kebaran) and the Late Epipalaeolithic (Late Natufian) may have resulted from the decline of densely wooded areas within the Mediterranean environment, which itself was driven by increasing aridity during the Late Natufian (Garrod and Bate 1937; Davis

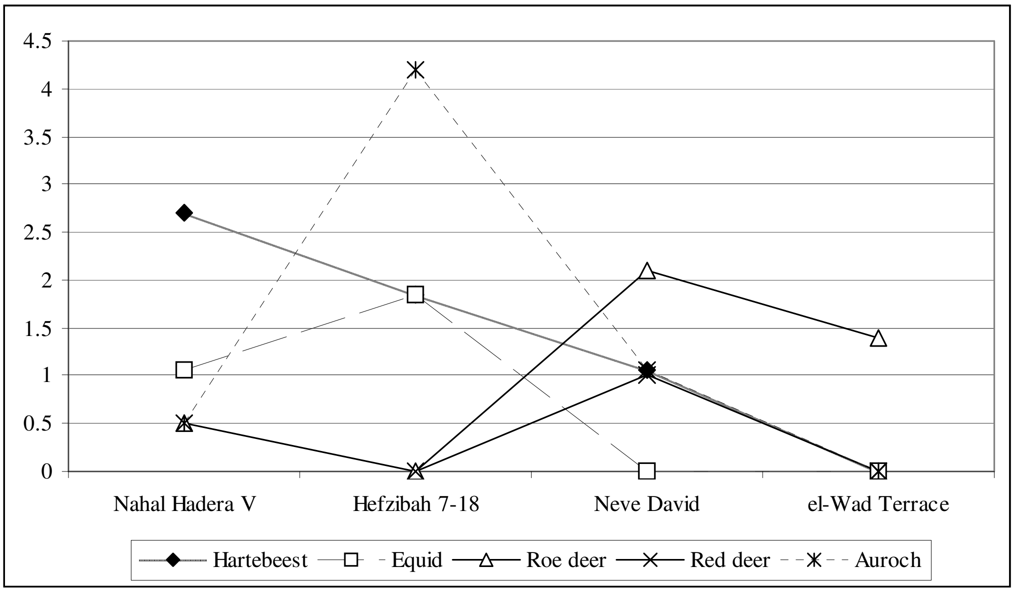

Fig. 6. Changes in species composition in the studied Epipalaeolithic assemblages of the coastal plain, based on MNI.

1982). This phase is most probably associated with the Younger Dryas climatic event and is supported by body-size reduction of a wide array of mammal species, in accordance with Bergmann's (1847) rule (e.g. Davis 1981; for review and discussion see Bar-Oz 2004).

Conclusions

The diversity of exploited faunal remains from the coastal plain and Mount Carmel sites reflects Epipalaeolithic foraging behaviors and hunting preferences. The results of this study document faunal trends during the Epipalaeolithic cultural sequence. Throughout the sequence, the Epipalaeolithic fauna is dominated by gazelle followed by fallow deer. During the Late Natufian, fallow deer exploitation decreased dramatically and the percentage of small game (including small carnivore, mainly fox) increased. Comparison between the five major prey-types also demonstrates that Late Natufian foragers procured significantly more small game, and in particular small fast game, than those of earlier periods. This comparison is in accord with the studies of Stiner and colleagues (1999, 2000; Munro 1999; 2001; Stiner and Munro 2002) and provides further support for increasing dietary breadth during the Natufian as evidenced by the increasing frequency of low-ranked resources.

The rising percentage of small game exploitation likely reflects increased hunting pressure and supports the premise of the broad spectrum revolution (Flannery 1969). This pattern is closely linked to long-term food stress, rising human population densities, and increasing environmental exploitation during the Natufian in the southern Levant (Stiner and Munro 2002). Reduced mobility of Natufian populations, in comparison to the Kebaran and Geometric Kebaran (e.g. Bar-Yosef 2002), together with a change in the local environment of the coastal plain (Weinstein-Evron 1998), probably contributed significantly to this pattern.

The results of this study reveal a moderate turnover of macro-fauna from grassland-shrubland vegetation type in the Kebaran, at the beginning of the Epipalaeolithic, to a bushland and open woodland vegetation type during the Geometric Kebaran. The substitution of the extinct *Equus hydruntinus* and hartebeest with increasing percentages of red deer, roe deer, and the locally extinct aurochs during the Geometric Kebaran marks this trend. These ecological trends are consistent with those of classic zooarchaeological and palaeoenvironmental studies from the region and point to climatic amelioration between the Kebaran (cold and dry) and the Geometric Kebaran (more humid). A period of climatic deterioration and desiccation in the Late Natufian is witnessed by a decrease of fallow deer frequencies (see discussion in Bar-Oz 2004).

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