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V

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Preface

When I participated in the IVth International Conference of ASWA, held in the summer of 1998 in Paris, I was gratified to learn that the Scientific committee had unanimously agreed to hold the next meeting in Jordan. Thus, on 2 April 2000, the Vth International Conference of the Archaeozoology of Southwest Asia and Adjacent Areas was held for the first time within the region at Yarmouk University in Irbid, Jordan after being held on the past four occasions in Europe.

The themes of this conference were divided into five areas including:

- Paleo-environment and biogeography
- Domestication and animal management
- Ancient subsistence economies
- Man/animal interactions in the past
- Ongoing research projects in the field and related areas

I wish to thank all those who helped make this conference such a success. In particular, I would like to express my appreciation to the Director of the Institute of Archaeology and anthropology at Yarmouk University Special thanks are due to his excellency, the President of Yarmouk University, Professor Khasawneh, who gave his full support and encouragement to the convening of this conference at Yarmouk University and to all those who contributed the working papers which made the conference possible.

I also wish to thank members of the organizing committee who worked very hard for many months in preparing the venue for this conference.

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Note from the editors:
The editors wish to thank Dr. László Bartosiewicz for his excellent assistance in preparing and checking the contributions to this volume.

Participants at the 5th ASWA Conference, held at theYarmouk University in Irbid, Jordan, 2000

Contents

MAN VERSUS CARNIVORES IN THE MIDDLE - UPPER PALEOLITHIC OF THE SOUTHERN LEVANT

Rivka Rabinovich[1]

Abstract

In many sites, especially in cave sites, the imprint of carnivores can be observed, either in the presence of their actual bones in the fossil record, or in the way they have damaged the bones, or in both. This "intercalation" of human/carnivore is quite common; there is evidence from the Middle Paleolithic until the beginning of the Epi-Paleolithic when this pattern tends to peeter out. Several essential issues regarding our ancestors were directly related to this "intercalation": meat eating, hunting vs. scavenging, spatial organization as reflected by hearth distribution, sharing, mortuary practices, early bone tools, paleopathologies and even artistic manifestations. While examining the environment in the time span of ca. 200,000 - 20,000 BP, some of these issues will be addressed.

Résumé

Dans beaucoup de sites, spécialement dans les grottes, la présence des carnivores peuvent être observées soit par l'intermédiaire de leurs restes osseux, soit par les dégâts qu'ils ont causés aux os, ou encore les deux. Par ailleurs, l'"alternance" de la présence des hommes et des carnivores est relativement courante dans les grottes; les témoignages proviennent du Paléolithique moyen jusqu'au début de l'Epi-paléolithique, où elles tendent à s'émousser. Plusieurs questions fondamentales à propos de nos ancêtres, sont directement liées à cette "alternance", à savoir : prise de viande, chasse contre charognage, organisation spatiale reflétée par la répartition des foyers, partages, pratiques mortuaires, premiers outils en os, paléopathologie et même les manifestations artistiques. Tout en tenant compte du milieu environnemental entre 200,000 - 20,000 BP, certaines de ces questions seront vérifiées.

Key Words: Middle – Upper Paleolithic, Carnivores, Levant

Mots Clés Paléolithique moyen - Paléolithique supérieur, Carnivores, Levant

Introduction

In our endless journey towards understanding of human past, we come across many gaps, many vague points that get blurred or become clearer with changes in research methods, or scientific judgement, and are a constant issue of debate. In spite of the romantic view of one man/woman excavating and telling the complete story, we have today to embrace more and more research fields in order to fill in the gaps.

Hominids consumed high-quality animal foods before the development of stone tools and the origin of the genus Homo, according to stable carbon analysis of 3 million years old *Australopithecus africanus* (Sponheimer-Matt and Lee-Throp 1999). The role of carnivores is observed in earlier sites in Africa and latter on in Europe. Though beyond the scope of this paper, it should be pointed out that hominids and carnivores are related in connection to dispersal events (Arribas and Palmqvist 1999; Lewis 1997; Martinez-Navarro and Palmqvist 1999; Turner 1990, 1995).

In the Pleistocene sequence of the southern Levant there is only scarce known evidence of bone accumulation that is not in relation to human made tools. This is true for the earlier parts of the Pleistocene, and definitely true for the latter parts. Subsequently, the faunal record is based entirely on human selected species. But, in many sites, especially in cave sites, the imprint of carnivores is noticed, either in their presence in the fossil record, or in their damaging of the bones, or in both. This "intercalation" of human/carnivore is quite common; there is evidence from the Middle Paleolithic until the beginning of the Epi-Paleolithic when this pattern tends to disappear.

Several essential issues regarding our ancestors - *sensu lato* - were in direct relation to this "intercalation" - meat eating, hunting vs. scavenging, spatial organization as reflected by hearth distribution, sharing, mortuary practices, early bone tools, paleopathologies and even art manifestations.

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While examining the environment in the time span of ca. 200,000 - 20,000 BP, I will try to address some of these issues.

Palaeocological background

An ongoing debate concerns the magnitude of the climatic changes in the Eastern Mediterranean region, their reflection in the area (ca. cold dry, vs. cold wet). Studies of continental evidences (from caves- speleothems and from rich organic layers sediments) might result in a finer magnitude of to the study of the paleoenvironment. Speleothems from Nahal Soreq Cave have determined several climatic changes between 60,000-17,000 and between 17,000 to present (Bar-Matthews *et al*. 1977, 1999). The first period had four cold peaks at 46, 35, 25 and 19 ky, and two warm peaks at 54 and 36 ky. The 19,000 event is considered to be the coldest and driest (12°C, 250 mm/y), similar conditions prevailed during the other cold peaks (at 46, 35 and 25 ky). The two warm peaks at 54 and 36ky reflect the warmest and wettest conditions. Part of the fluctuations seen in the speleothems of the Nahal Soreq Cave correlate well with global events (Bar-Matthews *et al*. 1999). Thus even during the warmer stages - 107,000-100,000 and 85,000-79,000 - the weather was semi-arid, similar to present, but actually with more precipitation (Ibid).

Paleoanthropological record

Hominid species represented by anatomical modern human (AMH) and Neanderthals, are more and more found not to be so different in their readable archaeological behavioural patterns. Two hominid species exist, and then one continues. Although major changes occur in the latter’s behaviour, it is not easy to follow them (Hovers 1998). Based on the Levant data it seems that the major changes occurred much later (towards the Natufian), although a prolonged variation is noticeable in the frames of the general scheme.

Carnivores

Carnivores occupy variable ecological settings, they have various locomotion skills, different methods of foraging, and they feed on various food types - vegetal, prey or both. Furthermore predators’ prey age selection depends on method of acquiring prey and according to ungulate size classes (Gittleman 1989).

Several species are candidates for leaving their imprint in the paleontological record: lion, bear and hyaena. Each one has a selective pattern of prey-size and age, denning behaviour, feeding behaviour and distinctive age and sex cohort. None of these species is very common in the Pleistocene faunal record of the southern Levant.

Large felids are rare, though represented by a few bones in many sites (Kurten 1965; Dayan 1989; Garrard 1980). Lion (*Panthera leo*) was found only in the Mousterian layers of Qafzeh Cave (Dayan 1989) while leopard (*Panthera pardus*) is more common (ibid; Dayan 1994; Kurten 1965). None of the assemblages have any characteristic that might hint to large felids’ accumulation[2].

Bears (*Ursus arctos*) are known from several sites: Abri Zumoffen, Zuttyieh (under the Mousterian deposition in a sterile layer), Tabun, Kebara and Ksar Akil, (Kurten 1965). Based on the available data none of these sites seem to carry the attributes of denning - hibernation of bears, where they might die due to starvation, or be attacked by other predators (Stiner *et al*. 1996). Thus the role of bears in the southern Levantine area as an accumulator of bones is not common. In the sites where they were found there is no evidence of age distribution, or other cluster that can point towards their contribution, although we have to remember that in many of the sites the excavation methods were not modern, and a selection of body parts is observed.

Among the few sites "deprived" of human artifacts is the ‘Bear Cave’ in northern Israel (Tchernov and Tsoukala 1997), a karstic cave in the Upper Galilee, with faunal remains of mainly large carni-

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[2] High relative frequency of large felids, high relative frequency of juveniles and typical pattern of bone breakage.

vores, 90% of them (9 individuals, mainly adults) *Ursus deningeri*. In this assemblage some of the bones indicate activity of large carnivores and rodents (porcupine?) resulting in many incomplete bones, scratches and possible tooth marks. The rest of the species are mainly carnivores: *Canis lupus* cf. *mosbachensis*, *Crocuta crocuta* cf. *praesplelaea*, *Panthera leo* cf. *spelaea* as well as *Dama* sp. (ibid). Tchernov and Tsoukala (1997) indicate a possible coexistence of the two bear species (*Ursus arctos* and *Ursus deningeri*).

This leads us to the basic problem that only a few sites have been studied in detail, in such a manner that will allow reconstruction of the history of deposition. Taphonomy deals with these aspects, meaning the reconstruction of every possible agent collecting and destroying bones. Both recent and fossil data are used to build a comprehensive framework. This complex setting is also typical of European sites, although the magnitude and chronology are different.

The large carnivore species - Hyaena

Needless to say, carnivores comprise a small percentage of the biomass. In the Levantine record, there are few studies that deal in detail with carnivores (Kurten 1965; Dayan 1989, 1994; Tchernov *et al*. in preparation). The definitions of carnivore species and their biogeographical and paleoecological interpretation, species distribution, and species richness were the main issues in these studies. Chronological correlations between dated archaeological layers have changed much since Kurten's time. Apparently two species of hyaena were present in the fossil record, spotted hyaena (*Crocuta crocuta*) and striped hyaena (*Hyaena hyaena*) (Dayan 1989). *Crocuta crocuta*, the spotted hyaena, is the most common large carnivore in the fossil record. Its range is now confined to the Ethiopian region. It was known from Ubeidiya (ca. 1.4 million years), but disappeared from the southern Levant in the Upper Pleistocene. Kurten mentioned the presence of several sub-species - where the spotted hyaena went through dwarfing: Crocuta *crocuta dorotheae* (Zuttyieh), which had large premolars and small carnassials, and *Crocuta crocuta debilis* (Kebara Natufian), of a dwarf size. These size and morphological variations have, however, not yet been examined in light of new evidence (Tchernov *et al*. in preparation).

Both hyaenid species tend to bring chunks of their prey to dens, break and damage the bones, and their cubs tend to use the den for the first year of their life. Thus, their presence in an archaeological context creates problems of interpretation.

A short chronological description of some of the most important sites

Most larger Middle-Upper Palaeolithic (MP: ca. 230,000-40,000; UP: ca. 40,000-20,000 BP) faunal collections came from cave sites in the Mediterranean zone. Most of these faunal assemblages derive from inadequate sieving, and the reports lack quantification (Garrard 1980; Rabinovich in press). Carnivores, including hyaena have been recovered from almost every Paleolithic site. Given the lack of quantified reports, however, it is hard to reconstruct the role of carnivores in the accumulation of the faunal assemblages (Fig. 1, Table 1). For example in the Adlun caves (Lebanon coastal line), in Mugharet el-Bezez B (Mousterian). *Crocuta crocuta* comprises 13.4% of the sample, while other large carnivores include *Panthera leo, Panthera pardus*, and *Ursus arctos*. Because of the absence of damaged bones, possible hunting of the *Crocuta* was suggested (Garrard 1983)[3]. The coastal site of Ksar-Akil, represents a long sequence from the Middle-Epi-Paleolithic, where numerous animal remains were revealed, including small, medium and large size carnivores. Large carnivores included: *Ursus arctos* (only teeth were reported), a large *Felis pardus* and *Crocuta crocuta*. Most of the *Crocuta* remains are jaw fragments and isolated teeth (18 NISP, from levels 31-19). The majority of the spotted hyaena originates from the earlier levels (27A and 27B) (Hooijer 1961), but no further indication is available concerning their contribution to the faunal accumulation.

The fauna from the Wadi el Mughara Caves (Israel, Mount Carmel; Bate 1937; Garrard 1980) seems to have been selectively collected, a major impediment to taphonomic studies. Kurten (1965) studied the carnivores, followed by Garrard (1980) and Dayan (1989, 1994).

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[3] Although sieving was not carried out at the site

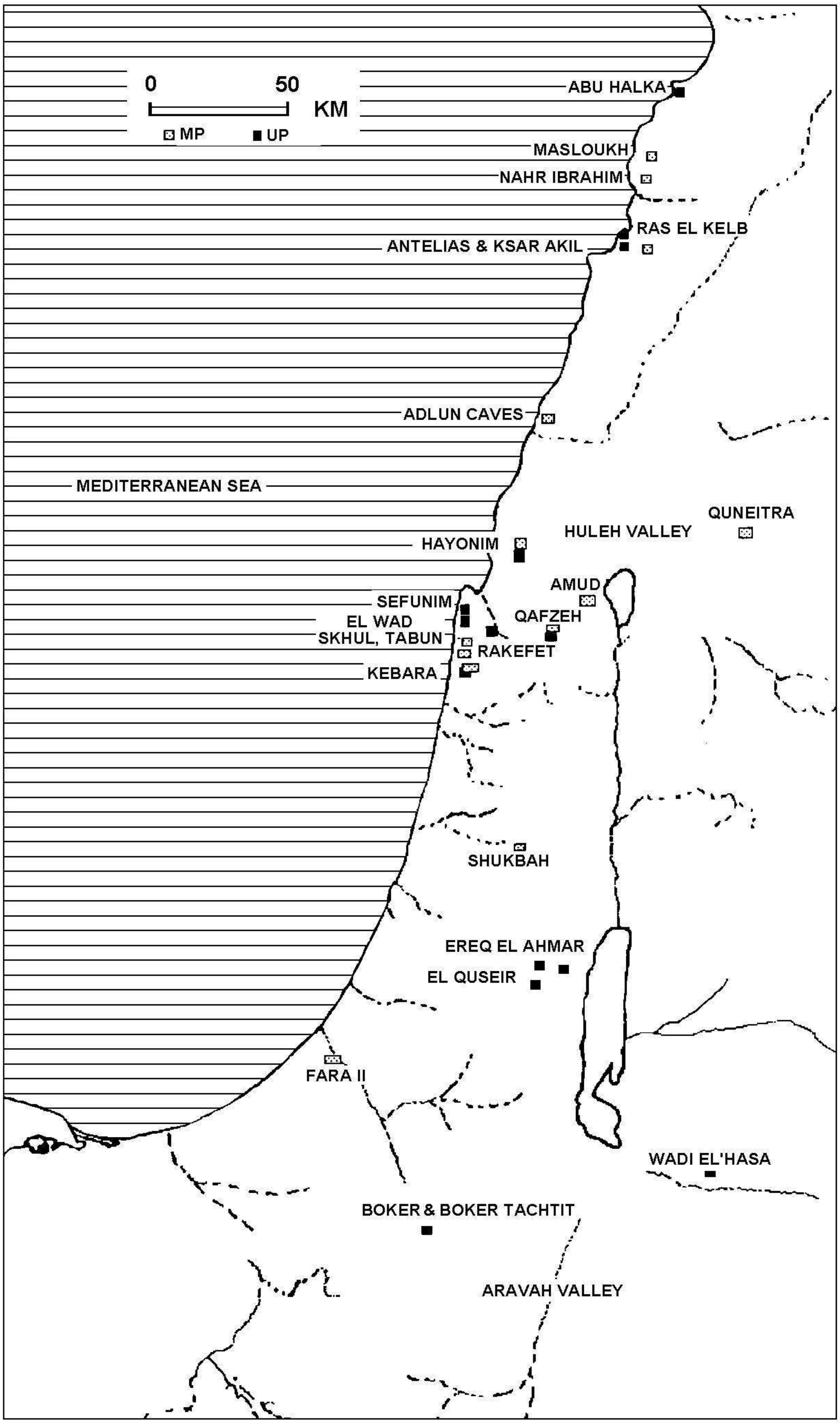

Fig. 1. Map of the sites mentioned in the text

In the long sequence of Tabun, cave hyaena is represented in small numbers. One of the earliest evidences of *Hyaena hyaena* originates from its lower layers (Ea, Eb: ca. 300,000 BP). *Crocuta crocuta* occurred (Bate 1937; Kurten 1965) in the upper layers D, B and C (150,000-50,000 BP).

Level E of El Wad cave (UP, Wadi el Mughara) is the richest in *Crocuta* remains including a juvenile (17 NISP; Kurten 1965:10). Here, two leopard teeth were also uncovered. The collection, which suffered from the expected problems (missing unidentifiable elements), does not display clear signs of carnivore destruction (personal observations).

Table 1. Sites with carnivore remains and carnivore damage.

MOUSTERIAN RECORD OF HYAENIDAE AND EVIDENCE OF CARNIVORE ACTIVITY

	Hyaenid Remains*	**Young Hyaenids**	**Other large carnivores#**	**Damaged bones**	**Coprolites**	
Zuttiyeh MP	1		***v***	**x**		Bate 1927
Hayonim E		1	***v***	?		Dayan 1989
Tabun Ea	2		***v***			Kurten 1965
Tabun Eb	1		***v***			Kurten 1965
Tabun D	1		***v***			Kurten 1965
Tabun C	2		***v***			Kurten 1965
Tabun B	4		***v***			Kurten 1965
M. el-Bezez	19		***v***	?		Garrard 1980
Ksar Akil 31-26A	18		***v***	?		Hooijer 1961, Kurten 1965
Quneitra			***v***	x		Rabinovich 1990, Davis *et al.* 1988
Qafzeh	15	8	***v***	x		Dayan 1989, Rabinovich and Tchernov 1995
Kebara	15		***v***	x	x	Dayan 1989
el Wad G	5		***v***			Kurten 1965
Skhul	1		***v***	?		Kurten 1965
Shukbah D	4	1	***v***	x		Bate 1942, Kurten 1965
Erq el -Ahmar H	1		***v***	?	x	Vaufrey 1951
Geula B1	8		***v***	x		Petter and Heintz 1970
Geula A	2		***v***	x		Petter and Heintz 1970

#- -large felids, bear
v=less than 10 specimens
* = hyaenid remains of both species

UPPER PALEOLITHIC RECORD OF HYAENIDAE AND EVIDENCES OF CARNIVORE ACTIVITY

	Hyaenid Remains*	**Young Hyaenids**	**Other large carnivores#**	**Damaged bones**	**Coprolites**	
el Wad F	2		***v***			Garrard 1980, Kurten 1965
el Wad E	17	1	***v***			Garrard 1980, Kurten 1965
el Wad D	3		***v***			Garrard 1980, Kurten 1965
el Wad C	3		***v***			Garrard 1980, Kurten 1965
Kebara	27	7	***v***	x	x	Dayan 1989
Kebara D	5		***v***	x		Saxon 1974
Kebara E	2		***v***	x		Saxon 1974
Hayonim D	1		***v***			Rabinovich 1998
Qafzeh	32	2	***v***	xx	x	Dayan 1989, Rabinovich 1998
Erq el -Ahmar D	1		***v***	?		Vaufrey 1951
Erq el -Ahmar C	1		***v***	?		Vaufrey 1951

#- -large felids, bear
v=less than 10 specimens
* = hyaenid remains of both species

Kebara cave is situated on the western slope of the Carmel Ridge and was occupied through a long sequence. The MP and UP levels (60,000-20,000) yielded thousands of animal bones. Detailed studies of the fauna enabled us to understand the nature of accumulation in an incomparable better way. In spite of the presence of hyaena adults and cubs (mainly *Crocuta crocuta*), modified bones (gnawing and pit marks), and coprolites, it seems that most ungulates were hunted. Neandertals were the hunters and the major transporters of body parts, creating vast accumulation of cut marked elements, burnt elements, hearths and ash lenses (Speth in Bar-Yosef *et al*. 1992; Speth and Tchernov 1998, 2001). The UP sequence is more ephemeral, having fewer hearths and ash lenses, less dense lithic and fauna accumulation, a higher ratio of ungulates/carnivores and a higher degree of carnivore damage to bones[4].

Hayonim cave in western Galilee was occupied through a long period (MP: ca. 200,000 – Natufian: ca. 12,000 BP), with rare traces of carnivores and carnivore activity[5] through its entire sequence.

Qafzeh cave in lower Galilee has both MP (ca. 90,000 BP) and UP (ca. 30,000 BP) occupation levels with no continuity between them. In the Mousterian layers, a few large carnivores were found including some *Crocuta* bones from both cubs and mature animals. Carnivore damage does appear on

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[4] Spotted hyaena - 22 NISP, 7 NISP of a young specimens, in addition to striped hyaena - mature and cub (Dayan 1989)

[5] Spotted hyaena cub of one month old - the only find (Dayan 1989).

the animal remains as well as evidence of human activity (cut marks and burnt bones) (Dayan 1989; Rabinovich and Tchernov 1995). The density of animal bones is quite low, preventing a clear reconstruction of the nature of the accumulation, though the human imprint seems clear[6]. It has been suggested that during the UP, Qafzeh served periodically as a hyaena den based on the presence of spotted hyaena cubs (Dayan 1989). Carnivore bone modification, although not very frequent (4%), clearly indicated carnivore accessibility to animal bones. Thus, the site provides an interesting case of alternating human and carnivore activities (Rabinovich 1998).

In the Mousterian cave of Amud, in the Jordan Valley, hardly any evidence of carnivores or any carnivore activity was found (Rabinovich in prep).

There are other sites suggesting possible interference of carnivores and humans as in Geula cave in Mount Carmel (Rabinovich and Horwitz 1994) and at the Erq el-Ahmar rock shelter in the Judean Desert (Vaufrey in Neuville 1951),

Site types are an important factor in the distribution of carnivores. Very few faunal reports from open-air sites exist: Tirat-Carmel (Ronen 1974), Far'ah II (Gilead and Grigson 1984) and Quneitra (Davis *et al*. 1988; Rabinovich 1990). Quneitra and Far'ah II are dominated by large species such as aurochs and equids, not a typical frequency distribution for other Mousterian sites[7]. Perhaps the open-air sites are a result of short and specialized activitis in comparison to longer occupational sequences, representing much more complex sets of activities in caves. For example, at the site of Quneitra, various damage marks, both human and carnivore, body part distributions and their spatial distribution suggested human butchery on the spot, while carnivore activity occurred after hominid consumption. Both felids and hyaena probably fed on the remains (Rabinovich 1990).

Throughout Europe, mixed bone assemblages with evidence of human and hyaena activity exist. In France, hyaenas are present in Lower and Middle Palaeolithic, in lower Upper Palaeolithic Châtelperronian levels (Grotte de Fées at Châtelperron , Pair-non-Pair, La-Roche-au-Loup) and in Aurignacian levels (Brassempouy, Haurets, Pair-non-Pair) (Fosse 1999). The cave hyaena (*Crocuta crocuta spelaea*) is an abundant species and usually the most common carnivore. It ranges in frequency between 15-30% of NISP (*ibid*). Distribution of ungulate skeletal parts differs between anthropic and hyaena dens, with elements being more complete in the latter. In hyaena dens, hyaena remains are more numerous, their cranial parts are more numerous, and there is a high frequency of marks left by hyaenas plus their coprolites. Moreover, it does appear that there is a relationship between the size of the dominant herbivore, the number of hyaena bones and the landscape in the Upper Pleistocene of Europe (*ibid*: see references there).

The anatomical and behavioural hyaenid characteristics and their relevance to our problem

Anatomical characteristics and differences between spotted and striped hyaena

Many carnivores crack bones with their teeth, the propensity of hyenids to feed on large diameter bones is legendary. Therefore their masticatory apparatus has been studied extensively, revealing that many craniofacial features of adult hyenids represent adaptations for a durophagus (hard-food feeding) diet. The ultrastracture of the premolars and contour of their skull indicate a capacity for production and dissipation of high masticatory forces associated with bone cracking with the premolars (Biknevicius and Leigh 1997). Unique frontal sinuses exist in fossil and living Hyaenidae - where the elongated frontal sinuses completely overlie the brain cavity. They provide better resistance to muscular load (Joeckel 1998).

Another distinctive feature is the cross-sectional configuration of cortical bone in the mandibular corpus. In the jaws of adult hyenids there is a significant increase in external diameter, as well as increased thickness of cortical bone, immediately caudal to premolars. This is apparently a prenatal

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[6] Layers XV, XVf and XIII suggest occupations of longer duration as seen in the higher lithic densities, highest burnt artefacts and diversity of lithics (Hovers 1998).

[7] Further research in Jordan may expose more open air sites (Henry 1998)

phenomenon. *Crocuta* cubs have gracile deciduous teeth and they feed minimally on hard foods during most of their denning period (*ibid*).

The conformation of the body of the hyaena is a compromise between adaptations to lifting power, stability and cursorial locomotion. The myology of the neck and forelimb of striped hyaena shows the general adaptations to lift heavy load by mouth (flat articulation surface of the shoulder joint, broad elbow joint, large ulnar carpal bone, and large tuberosity on the intermedioradial carpal bone, relatively short humerus). The extensors of the neck and head are very well developed; the scapula is firmly attached to the thorax. Moreover there are adaptations for tearing and seizing large prey and swift walking while carrying heavy load (long neck and forelimbs, flat scapula, elongated articular surface of the shoulder joint and the ridges of the elbow joint restrict the movement to the sagital plane and prevent unwanted transverse movements during cursorial locomotion) (Spoor and Badoux 1986).

Morphological adaptations to lifting and carrying large and heavy loads observed in *H. hyaena* occur also in *C. crocuta*. As noticed by many, *C. crocuta* has a more predatory and less scavenging way of life, seen in the difference in length of the lumbar region and the development of the psoas minor, "*suggesting a more important role of the back during fast locomotion in crocuta*". So the larger size and more robust morphology of *C. crocuta* enable it to hunt and master larger prey (Spoor and Badoux 1989). The musculature of the back and hindlimb of *Hyaena hyaena* is very robust. This morphology is considered as an adaptation to stabilizing the body while the hyaena carries large and heavy load. The relative shortness of the lumbar region and the large breadth of the ilium are less explicit in *C. crocuta* than *in H. hyaena* "*which may be related to the more hunting and less scavenging way of life*" (Spoor and Badoux 1988).

Social structure

Spotted hyaena lives in female dominated clans, of forty or more members. They are capable of identifying individual conspecifics on the basis of their long-distance vocalization (Holekamp *et al*. 1999). Each clan has a territorial hunting ground, marked by scent marking boundaries. Normally they den communally, up to four females with cubs, each having up to two cubs per litter. Cubs are born with their eyes open and their teeth functional. Up to 25% of the cubs die from fights among them[8]. Gestation is 98-110 days, nursing 8-18 months (sometimes 6-12), depending on the dominance of the mother. If she is more dominant, the cubs will get to eat from the kills from a much younger age, so will be weaned earlier. Dens are visited from sundown and continue off and on through the night.

Striped hyaena usually forages alone. One to six cubs are born per litter, gestation 88-92 days. Immature family members will help feed younger siblings by bringing food back to the den. Nursing continues until 12 months.

Feeding behaviour

Whenever the feeding of an animal is studied, it is necessary to know the availability of its food, for predators, the distribution and abundance of the prey and their population dynamics such as breeding success and sex ratios, is essential. For scavengers it is important to know about the mortality factors of potential food species. Striped hyaena and spotted hyaena usually coexist by avoiding each other's habitat areas and prey size (Kruuk 1972, 1976).

Spotted hyaena is a co-operative hunter as is *Panthera leo* and *Canis lupus*, or they can hunt alone. They tend to hunt wildebeest, gazelles, zebra, rhino calves and other ungulates. Hunting is at night, but can occur during daytime as well. They can leave the kill, often carrying, a large chunk of meat or bone away with them. Sometimes they store food underwater. One hyaena can eat 14.5 kg per meal. Seasonal characteristics might occur in their diet, depend on the species availability, migratory animals and scavenging opportunities (Cooper *et al*. 1999). Across a range of habitats, there is a reverse relationship between the densities of wild dogs (*Lycaon pictus*) and *Crocuta crocuta*. It has been sug-

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[8] Especially two sisters from the same litter - siblicide. This was questioned by various studies.

gested that this is because hyaenas act as "kleptoparasites" and steal food from dogs (Gorman *et al*. 1998).

Striped hyaena is smaller, is predominantly a scavenger of large and medium sized mammals, also eats fruits, insects, and kills small animals like hare, rodents, reptiles and birds. It visits established food sites, such as garbage dumps. Hyaenas tend to hunt whichever prey species are most abundant during each month of the year (Holekamp *et al*. 1997).

Based on examination of striped hyaena dens in northern Kenya it was suggested that striped hyaena prey on small livestock and demonstrate opportunistic behaviour, which enable them to live in a marginal environment. Also suggesting that more bones are collected causing less damage than spotted hyaena. Scooping being an uncommon form of damage, leaving less indeterminate fragments. These differences might be related to the less powerful jaws of the striped hyaena, being less reliant on bone for their nutrition (Leaky *et al*. 1999).

Body part representation

There is a certain pattern of body parts representation in hyaenid dens, small animals being represented by cranial parts (Lam 1992), and larger species by postcranial and cranial elements (Kerbis-Peterhans 1990). In a recent study of a striped hyaena den from Israel, Horwitz (1998) showed that bones of smaller species (dog size) are more severely damaged than those of equids. Further suggesting that "*larger species, which appear to be more evenly represented in skeletal elements and to undergo less destruction, may serve as a more reliable source of information on hyaenid bone taphonomy*." (Horwitz, 1998: 41).

A marked difference between the den material of striped hyaena and homesteads of Turkana people was detected (Leaky *et al*. 1999). The Turkana keep large numbers of livestock: sheep, goats, cattle, camels, donkeys and domestic dogs. Examination of their dump showed the differences with the striped hyaena den: their dump had more vertebrae and metapodials, more human damage was noticed on the bones and more complete mandibles of caprini were present, while long bones were less damaged.

Regurgitation and "The last supper"

Studies of recent coprolites revealed the diet of what the animal has eaten in the last 24 hours (Horwitz and Goldberg 1989). Road kills and natural deaths of striped hyaenas (3 specimens) from Israel have preserved their last supper content[9]. The stomach contents were very different from each other in spite of the fact that two of the hyaenas were from the same area in the north of Israel (Huleh Valley, Fig. 1). There are obviously various degrees of damage, caused by digestion in the stomachs (see also Smuth 1979). The northern specimens had both undigested fragments and digested bones in their stomach, limb parts (representing more than one animal), carpals, tarsals, phalanges, mainly of caprini (sheep/goat) and also unidentifiable pieces of long bones.

The southern striped hyaena (Aravah Valley, Fig. 1) had ingested the remains of at least two young hares (*Lepus capensis*) and various unidentifiable fragments. These preliminary observations of stomach contents suggest both scavenging of domestic species and hunting of smaller wild species (Kerbis-Paterhans and Horwitz 1992). It is interesting to note the little damage had been caused to the hare bones, which was probably just hunted in comparison to the digested phalanges and carpals of larger animals that must have spent longer periods in the stomach.

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[9] After two years of burial in a mesh as our regular procedure of collection treatment. This situation might mimic, to a certain degree, an archaeological situation of fast cover after deposition.

Species distribution

Even very detailed analyses cannot separate between the prey species introduced by hyaena in comparison to the species introduced by man, since the variability of the hyaenid feeding behaviour is quite opportunistic suggesting a possible similarity with the human one. Nowadays spotted hyaena feeding tends to vary with habitat and season. It seems that in every area there is a tendency to prey on certain species (Smuts 1979; Cooper *et al*. 1999).

The relative frequency of the animal species and their age profiles can serve as a reliable factor, since in hyaena dens the carnivore to ungulate ratio is quite high, hyaenid remains have an attritional age profile, while remains of other carnivores are of mature animals.

Infestations

It is often suggested that the "*prevalence of infectious diseases increased considerably in the wake of animal domestication and have posed a serious health threat in this region ever since*" (Smith and Horwitz 1998, 233). A similar model is noticed from other areas of the world, where increasing population morbidity is in association with the increased sedentism and population density associated with agriculture and urban life (Uberlaker 1998).

But what was the situation before sedentism? In the more humid-cold environment the organic matter would have survived longer, allowing a prolonged period of infestation from the cave debris. Feces can also contain parasites, some contagious to humans. Zoonotic diseases may be the explanation to the minimized interaction between carnivores and humans. Probably the major cause would have been Tick-Transmitted diseases.

Ticks are blood feeding external parasites of mammals, birds and reptiles throughout the world. There are hard tick (Ixodidae), and soft ticks (Argasidae). Ticks can cause paralyses, toxicoses, allergic reactions and are vectors of a broad range of viral, rickettsial, bacterial and protozoan pathogens. Approximately 12 argasid species (Argas and Ornithodos) are frequently found attached to humans who enter tick-infested caves and burrows (Estrada- Pena and Frans 1999).

Today spotted hyaena is known to be a reservoir of *Trichinella nelsoni* in the Serengeti ecosystem (Tanzania) (Pozio *et al*. 1997), and to suffer from canine distemper virus (CDV) infection (Haas *et al*. 1996), as well as parasites like *Ancylostoma braziliense, A. caninum* and *A. duodenale*. In the same area lions, bat-eared foxes, hyaenas and domestic dogs were recently afflicted by a canine distemper virus (CVD), while lions and spotted hyaenas in Namibia Nature reserve have developed immunity to anthrax, thus reducing the number of wildebeest (*Connochaetes taurinus*) (Berry 1997).

Surveillance of rabies in different animal species in Jordan indicated that 12.77% of the cases occurred in wild animals such as the wolf, fox , badger and hyaena (Al-Qudah *et al*. 1997).

Seasonality was found in ticks on sheep, goat and cattle from West Azerbeidjan, Iran, suggesting the existence of seasonal distribution: hard ticks were apparently found throughout the year, but were more abundant in spring and least in autumn, whereas soft tick were observed only during autumn and late winter. The maximum tick count per animal was 21-50, in microhabitats determined at 10-20°C and 50-70% relative humidity (Rahbari 1995).

Plague can be transmitted through fleas, which can also infest humans temporarily. Rodents and their arthropod ectoparasites are important vectors of pathogenic agents; the increase in rodent populations is followed by an increase in many zoonotic diseases. In a study of rodents in Egypt, it was found that the maximal flea index was in spring and the minimal in winter in *Rattus rattus, R. norvegicus* and *Mus musculus*, in descending order. The rodent population fluctuates as well, maximal in autumn and minimal in winter (Bakr *et al*. 1996). Seasonal abundance and the flea ectoparasites of *Gerbillus pyramidus* were studied in Al Arish, North Sinai. The flea ectoparasites were more common in autumn and less in summer, the jerboa more common in summer and less common in winter (Morsy *et al*. 1993).

How long would a cave remain infested after the hyaena left the den?

Hard ticks have 3 distinct life stages, larva, nymph and adult, the completion time of the entire life cycle may vary from less than a year in tropical regions to over three years in cold climates, where certain stages may enter diapause until hosts are again available. There are a one-host tick lifecycle, two-host tick lifecycle and even three. The soft tick life cycles includes larva, a multiple nymphal stages and adult and the cycle is generally much longer than of hard ticks, lasting several years. Ticks can also resist starvation and can survive for many years without a blood meal. Most of them are nest parasites, residing in sheltered environment such as burrows, caves or nests. Certain biochemicals such as carbon dioxide as well as heat and movement serve as stimuli for host seeking behavior.

The danger of infestation[10] was probably quite high under more humid conditions as prevailed during the MP and UP in the Southern Levant. If the "coexistence" was dangerous what should we expect:

- A time lag between occupation of hyaena and human occupation to prevent infestation.
- A time lag did not exist and in consequence the level of infestation was high.

Unfortunately the available human skeletons are not enough nor they carry any pathogenic signs suggesting infestation by zoonotic diseases.

What would influence the presence of hyaenas in a cave?

1. Natural setting of the cave/den.
2. Demographic density - densities of spotted hyaena vary; the territory size is determined by the dispersion pattern of food, mainly by the average distance between food sites. It varies between 10-1776 animals per km^2 in various surroundings (Mills 1990: 164, Table 4.8).
3. Longevity of occupation - intensity of occupation. A few *Crocuta* females tend to den together with cubs (ca. 4 females, 4 cubs). In the southern Kalahari (Mills 1990) the period of den occupation was short - ca. 1.5 months, while in the Kruger National Park the den was used for 6 months, even several years.
4. Fleas infestations are a major reason for leaving the den. Most of the dens are used only for one period by hyaenas. There are other observations that have shown utilization of longer periods.
5. Availability of food/prey.
6. Seasonal occupation - either food/mating dependant. Although spotted hyaenas are capable of breeding throughout the year, they exhibit a moderate degree of seasonality that most likely reflects responses to seasonal variation in energy availability (Holekamp *et al.* 1999), based on a study of equatorial free living population in Kenya, over 10 years. Conceptions occurred most frequently when food abundance was greatest. Seasonal changes were not very clear in spotted hyaena in spite of some prey and mating fluctuations.

Competition with man

Competition between hyaenas and human was mentioned several times based on their ecological similarity, mentioned earlier; because of their opportunistic feeding behaviour and tendency to prey whenever possible on medium size animals. Today the flight distance of striped hyaena is ca. 50 meters and spotted hyaena usually run from people nowadays.

If indeed scavenging was part of the human diet, did they scavenge the remains of abandoned kills, or did they confront and chase large carnivores off their kills. Interactions between large carnivores and human in rural Uganda support the view that early hominids could have chased large carnivores from their kill (Treves and Naughton-Treves 1999). Among the carnivores hyaenas attacks were the fewest, though fatal in comparison to lions and leopards (Ibid, Table 1).

Thrichera Dolina level 6 (TD6) in Sierra de Atapuerca is believed to be the most ancient deposit in Europe where Homo (*H. antecessor*) and spotted hyaenas coexisted and probably competed ecologi-

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[10] Tick infections did exist already as the first fossil soft ticks (*Ornithodoros antiquus*) in amber is from 30-40 million years ago.

cally (Garcia and Arsuaga 1999)[11]. Garrard (1984) have suggested that the *Crocuta* might have become extinct from the Levant during the Upper Pleistocene because of the interspecific competition with man.

Spatial distribution

The usage of a den for birth and maternity requires its end, or most hidden spot. Indeed in several cases the cave wall is where the hyaena remains and activity is identified - Kebara, Middle Pleistocene sites in Italy (Stiner 1994). But other studies mention the entrance of the cave, or the central area of the cave. As Horwitz (1998) remarks it might be related to the presence of humans in the cave cleaning the main hole, and therefore leaving the clear carnivore signature only on the rear end near the cave wall.

At Qafzeh the excavated area is very small, so it is hard to see a clear spatial distribution, while in Kebara detailed taphonomical study combined with spatial distribution showed that the rear end had a clear mark of human activity in spite of the hyaena remains (Speth and Tchernov 2001).

Hominids

Do hominid remains carry signs of carnivore modifications? Human bones were found in hyaena dens and they are even known to have plundered graves (Horwitz and Smith 1997; Sutcliffe 1970).

In several Middle Paleolithic sites hominid were buried, Skhul, Qafzeh, Kebara, Amud, and even considered to have graves offering (Belfer-Cohen and Hovers 1992; Hovers *et al.* 1995; Hover *et al.* 2000). Carnivore damage on the human bones is not known for any of these sites, although it requires a more detailed examination.

At this stage fine taphomical examination of Qafzeh hominids is quite difficult since many bones have been covered with glue embedded in sediments, but macro damage (gnawing and scooping) was not observed (i.e., Qafzeh 8 and 9). The Neanderthals from the recent excavations at Amud cave were examined (X10-40) and no carnivore damage pattern was found (Amud 7 (baby) and Amud 9).

The preservation of the fragile remains of neonates and infants - Qafzeh 13, Kebara I, Amud 7 is difficult to explain unless they were intentionally buried (Hovers *et al.* 1995). Moreover where hyaena activity is implied, survival of babies suggests long interim or good cover[12].

In a large cave in northwestern Syria, Dederiyeh Cave, several bones were defined most likely as Neanderthals, an infant humerus was found in situ from the Mousterian stratum (Akazawa *et al.* 1993).

Until now there are negative evidences to relate hyaena activity with human remains in the southern Levant.

Folklore and myth, Palaeolithic art

The notion that hyaena changes sex from male to female and back again - dates back to ancient Greece (although Aristotle refuted it). Probably because the genitals of the two sexes are nearly identical, this trend continues nowadays where extensive studies try to understand the biology and genetic of the phenomenon and its influence on the behaviour. Even ideas that hyaena mate with lioness to produce a strange hybrid called the leucrotta prevailed in the Medieval Europe. All over the African continent it is believe that some witches can turn themselves into hyaenas. The reason for despising hyaenas in many cultures is probably related to that they eat human corpses.

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[11] *Crocuta crocuta* is believed to have first occurred in Europe in the late early Pleistocene and subsequently invaded the rest of Europe during the Middle and Late Pleistocene (Garcia and Arsuaga 1999).

[12] For a different view see Gargett (1999).

In the Paleolithic art of Europe, where bears and lions are common hyaenas are poorly represented.
In our area there are descriptions by P.E. Schmitz - regarding - "Hyaenas from the Holy Land", he describes the presence of the "D'Ba" all over the country. In the area of Jerusalem alone, he collected between 1908-1912 more than 20 animals. He also describes that they do not attack people and are actually frightened of them. It should be noticed that this is after the introduction of the rifle to the area. It is also described that in order to chase them out of a cave one man holds a torch and a knife while his friend has a rifle to shoot the fleeing animal. He also mentions that in spite of their scavenging diet they tend also to attack herds of caprini (Mendelssohn and Yom-Tov 1987).

Discussion

Since the views of "man the hunter", "man the scavenger" are not as apparent as previously thought, the reconstruction of the paleoecological human food acquisition strategies face several obstacles. Much of the debate about hunting/scavenging is based on studies of recent carnivores and their foraging behaviour. For example, the major question regarding the species distribution is still relevant: under intercalating situations what prey species was introduced by whom? In other words can we differentiate between species that are introduced by man and species introduced by hyaena (or other carnivores), since both species tend to have opportunistic feeding behaviors.

Moreover comparison with other areas where human/carnivore-hyaena intercalations do occur is not necessarily relevant. Not only the European spectra is different (and varied in itself) also the southern-Levantine one (situated along the eastern Mediterranean) is different from the European and the African systems. In the southern Levant the climatic fluctuations are not as severe as the European ones. Thus the activity of the species in the higher trophic level is likely to be affected by the range of species, their body size, their density, their flight distance, herd size, mating season, territoriality, territory size, herd composition and feeding needs. A picture of the expected properties of the medium size species and their behaviour related to hunting will be described.

Paleolithic cave sites of the southern Levant contain mainly the remains of mid size ungulates (e.g., Dama, Gazella). Large species (> 1000 kg.) the size of rhinoceros and hippopotamus are quite rare and very poorly represented in these caves, mainly by teeth parts. Aurochs (*Bos primigenius*) is more common, though not the main prey species. Differences between recent human waste and striped hyaena den were observed (in species and body part representation, see Leaky *et al.* 1999), although this comparison might not be as reliable when hunter-gatherers in a non-marginal environment are compared with.

The carnivore-damaged bones are less than 10% of the faunal residues, the mixed assemblages hardly encompass complete bones, large carnivores are less than 10% (1-4%) of the animal species (except Qafzeh UP), and the relative frequency of the juveniles among the carnivores is less than 10% (based on various reports see Table 1). As previously revised hyaena seems to be the major carnivore collector species in these sites. In all cases spotted hyaena remains outnumber the striped hyaena ones thus implying its major role as bone accumulator and bone destroyer. Furthermore, it is very problematic to examin the role of carnivores in assemblages that were not excavated in modern methods (screening, drawing, location of each item and collecting unidentifiable splinters[13]).

It seems that mainly the relative frequency of species and their age profile can serve as a reliable factor. In hyaena dens the carnivore to ungulate ratio is quite high, and carnivore remains not from the collecting species derive from mature animals, while the hyaenid remains have an attritional age profile.

Today local striped hyaena collects bones and destroys them (Kerbis-Peterhans and Horwitz 1992). Is there any change in the intensity of carnivore interference that is related to the disappearance of the *Crocuta* from the area, or is a change in the human usage of sites the reason for the restriction of this phenomenon[14].

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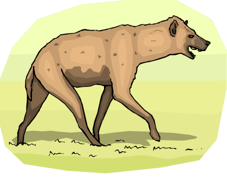
[13] Selective collection of the more complete elements is a major obstacle in taphonomic reconstruction.

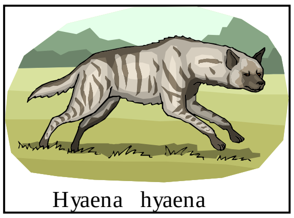
[14] Kurten (1965) explained the different existence of the two species by climatic changes, but this seems hardly the case. Recent data have shown that both species are present through the MP and UP (see Introduction)

In order to study the Evolution-history of infectious diseases, it is crucial to the understand behavioural, ecological and cultural background (Ewald 1998). Is it plausible to assume that humans have learned quite early how to prevent infestation from zoonotic sources, including cave debris. One method can be by keeping time intervals. In the case of Kebara cave a change in human seasonality was observed during the Mousterian, as well as in the carnivore activity (Speth and Tchernov 2001). Based on the behavioral patterns of hyaena den usage an inevitable "meeting" occurred with the human inhabitants. Therefore a more ephemeral usage of the cave, not on yearly bases is advocated (Table 2)[15]. Since the human impact is very clear at this site, it is more likely that the hyaena were intermittent users of the cave (Ibid). Numerous hearths present at Kebara cave might have served also as a barrier against hyaenas that tend to flee from fire. Only close examinations of all aspects using high-resolution analysis can lead a step forward to the comprehension of this intriguing phenomenon.
Can carnivores (hyaenas) presence be an indicator to the sort of possible human occupation? Only as a support to other evidence, because carnivore activity appears both in very dense/intense human occupation (e.g. Kebara) and in less intense more ephemeral occupations (Qafzeh). Site type has a major influence on our interpretation. Open-air sites are more likely to reveal other carnivore species activity (e.g., felids).

Seasonal usage of Kebara Cave*

	mid Mousterian	late Mousterian	Upper Palaeolithic
Season of human occupation*	**late spring/summer**	**winter/early spring**	**late spring/summer**
Carnivore activity and presence	more carnviores	less carnivores	more carnivores
?? Possible carnivore usage of cave	fall-winter	summer-fall	fall-winter
Mating season of hyaena	winter, spring, year long		
Birth season of hyaena	sping-summer		
Possible den usage	spring-summer-early fall		


Crocuta crocuta


Hyaena hyaena

Season			**Human**		**Hyaena**
		mid Moust	late Moust	UP	
winter	December		▒		
winter	January		▒		
winter	February		▒		
spring	March		▒		▨
spring	April		▒		▨
spring	May	■		■	▨
summer	June	■		■	▨
summer	July	■		■	▨
summer	August	■		■	▨
summer/fall	September				▨
fall	October				▨
fall	November				

* = Human occupation (based on Speth and Tchernov 2001) and possible hyaena usage of the cave.

Table 2 - A model of seasonal usage of a cave by humans and hyaena, Kebara cave - as a case study.

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[15] If we assume a similar season pattern as today.

Mortuary practices during the MP were doubted on the basis of the taphonomical and carnivore activity in caves (Garget 1999). On the other hand, others confirm burial practices (Belfer-Cohen and Hovers 1992; Hovers *et al*. 2000) suggesting certain similarities and differences between AMH to Neanderthals ones (Hovers *et al*. 1995). Rare cases of human/carnivore intercalations were observed after sedentism, and the onset of domestication, although ephemeral settlement patterns continue to occur. Is it possible that with the establishing of more prolonged occupations of a sedentary nature we do not look for the "ephemeral" ones anymore? Is it that the carnivore activity is not noticed simply because our research is oriented towards other issues? In the Southern Levant the intensity of excavation is quite high. Normally Prehistoric research is more concentrated in caves, and quite often a cave will contain recent shepherd residues and remains from the Byzantine period on top. Several later sites were studied and clear den activity was noticed in their animals remnants such as: Nahal Heimar, a PPNB special cult burial place in the Judean Desert (Davis, 1988) that was used by hyaena at some stage, Nahal Qanah, in Samaryia a Chalcolithic special cult burial cave and a probable carnivore den after the human activity ended (Horwitz 1996) and Ketef Jericho near Jericho, a Roman cave site (Horwitz 1996).

It seems that in the southern Levant the contemporaneous presence of carnivore and human activity is probably more related to human usage of the sites (mainly caves). For the Middle Paleolithic is seems that: "...both lithic variability and subsistence-related behavior cannot be linked directly with climate changes." (Hovers 2001: 136). Hominid behaviour is most likely to be the major factor in the sites mode of occupation and accumulation in most cases.

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