

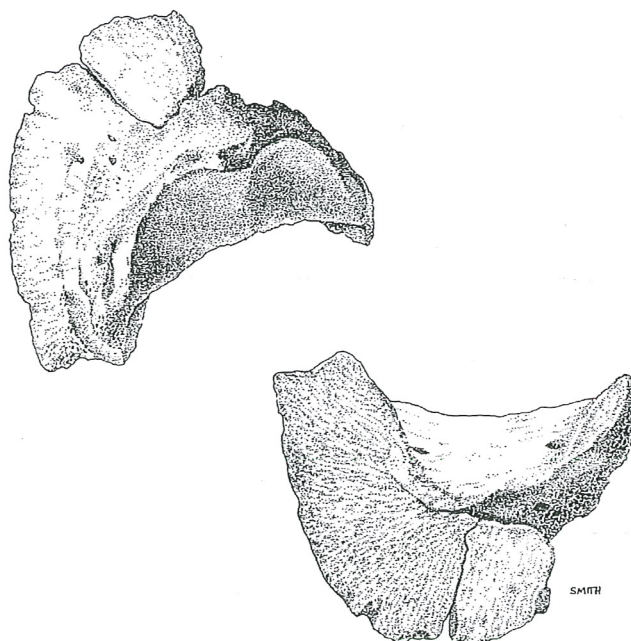


ARCHAEOZOOLOGY OF THE NEAR EAST III

Proceedings of the third international symposium on the
archaeozoology of southwestern Asia and adjacent areas

edited by

H. Buitenhuis, L. Bartosiewicz and A.M. Choyke



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Cover illustration: Dorsal and palmar aspects of a
Bronze Age horse phalanx from Arslantepe, Turkey,
identified by Sándor Bökönyi.
Courtesy by the artist, Patricia Smith (Reduction: 64%).

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Preface

This publication is the result of the third international symposium on archaeozoology of southwestern Asia and adjacent areas, held in Budapest, Hungary from 2 - 5 September 1996. The editors would like to thank all colleagues of the Working Group who helped with the translation of abstracts. Financial support for the publication was given by the Acker Stratingh Stichting, Groningen, The Netherlands.



Participants of the 3rd ASWA Conference, Budapest 1996

(Photo: Péter Komjáthy, Aquincum Museum)

Standing, left to right: B. De Cupere (Belgium), G. Bar Oz (Israel), H. Buitenhuis (The Netherlands), R. Rabinovich (Israel), L. Leblanc (New Zealand), N. Benecke (Germany), H. Hongo (Japan), N. Russell (USA), J. Speth (USA), A. Patel (India), E. Stephan (Germany), C. Cavallo (The Netherlands), W. Van Neer (Belgium), A.T. Clason (The Netherlands), T. Dayan (Israel), L. Van Es (The Netherlands), C. Becker (Germany), R. Meadow (USA), M. Mashkour (France), F. Poplin (France), E. Vila (France), Mrs. Poplin (France), L. Bartosiewicz (Hungary), E. Pellé (France), P. Ducos (France).

In front, left to right: E. Tchernov (Israel), L. Martin (Great Britain), A. Choyke (Hungary), I. Zohar (Israel).

Participants not shown in picture: D. Carruthers (Great Britain), D. MacHugh (Ireland), S. Whitcher (Great Britain).

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AN INVESTIGATION INTO THE ORIGINS OF DOMESTIC SHEEP IN THE SOUTHERN LEVANT

Liora Kolska Horwitz¹ and Pierre Ducos^{1,2}

Résumé

La présence d'*Ovis* au sud Levant est discutée: origine, distribution et identification. Sur la base d'une révision des restes osseux attribués à *Ovis* dans cette région durant l'Épipaléolithique et le Néolithique, nous concluons que dans la plupart des cas les déterminations de moutons, aussi bien domestiques que sauvages, ne sont pas formellement sûres avant le PPNB récent. Il est clair que le mouton domestique a été introduit dans le sud Levant et provient de zones situées plus au nord. Cependant, plusieurs faits concordants suggèrent fortement que durant le Natufien récent/Harifien le mouton domestique a étendu son aire de vie pour y inclure la zone Irano-Turanienne du Levant. Ce phénomène peut être lié aux changements paléoclimatiques du Dryas récent. La présence du mouton domestique, introduit par le Nord, est en revanche bien attestée à partir du PPNB récent.

Introduction

Today, as in the past, sheep (*Ovis*) and goats (*Capra*) are the most commonly exploited taxa by pastoralist and agriculturalist communities in the southern Levant (Bar-Yosef and Khazanov, 1992; Grigson, 1995). This probably stems from the fact that these animals are well adapted to the specific environmental conditions of the region, and are often herded together as they are complementary feeders. In addition to meat, they are exploited for a variety of products; milk and its products (cheese, yoghurt), skins, hair and wool (Redding, 1981). Reed (1960) was the first to show that both sheep and goats were domesticated in the Near East from wild stock that naturally occurred in this region. However, three decades later, information pertaining to the exact location and timing of this event still lacks precision (Bar-Yosef and Meadow, 1995; Crabtree, 1993; Harris, 1996; Uerpmann, 1987). Similarly, questions relating to whether their domestication was a monocentric or multicentric occurrence and whether the two taxa were domesticated simultaneously or if this was a staggered event (Bar-Yosef and Meadow, 1995; Bökönyi, 1993; Garrard *et al.*, 1996; Legge, 1996; Tchernov, 1995; Uerpmann, 1979) are yet to be clarified. With these issues in mind, we have investigated the evidence for the domestication of sheep in the southern Levant.

Until the Aceramic Neolithic period, remains of sheep and goats are rare in southern Levantine faunal assemblages (Davis, 1982; Legge and Rowley-Conwy, 1986; Tchernov, 1995). However, this pattern changes over time, so that by the late Pre-Pottery Neolithic period (circa 6500 bc) they predominate in the faunal record, with goats by far the most common species (Clutton-Brock, 1979; Garrard *et al.*, 1996; Horwitz, 1993; Legge 1996). Even in Pre-Neolithic periods, remains of sheep are extremely rare while goats are consistently present, although in relatively low frequencies (Davis, 1982; Tchernov, 1995). Only from the late Pre-Pottery Neolithic B onwards is the presence of *Ovis* in this region well documented and wide-spread (Ducos, 1993a,b ; Legge, 1996), while only in the Chalcolithic period are remains of *Ovis* as common as those of *Capra* (Grigson, 1995).

In this study, we have assumed that the pattern outlined above is a reliable indication of the changing abundance of *Ovis* in the faunal spectrum of this region, and is not due to socio-economic preferences of local populations for one species over another.

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Based on the available data we will try to assess the claims that the past distribution of wild sheep included the southern Levant (Davis *et al.*, 1982; Legge and Rowley-Conwy 1986; Uerpmann, 1987). We will further discuss whether the domestication of sheep in this region could have been an autochthonous event or whether, as proposed by some researchers (Bar-Yosef and Belfer-Cohen, 1989; Ducos 1993a,b; Legge, 1996; Tchernov, 1995), this species was introduced as a domesticate into the southern Levant from areas to the north. To this end, some reference will be made to information on the presence of *Ovis* in the northern Levant.

Background

Based on modern-day and sub-recent geographic distributions of wild Caprinae (Epstein, 1971; Harrison and Bates, 1991; Heptner *et al.*, 1988; Uerpmann, 1987), there are five species from three genera which need to be considered when discussing their biogeography in the southern Levant. They are:

1. The western Asiatic mouflon, *Ovis orientalis* which is found today in the mountain region of south-central Turkey and in isolated areas of the south-eastern Zagros (Harrison and Bates, 1991; Heptner *et al.*, 1988; Uerpmann, 1987). Wild sheep have been shot and sighted in Oman and Saudi Arabia since the 1960's (Harrison and Bates, 1991), but as noted by Uerpmann (1987:126) "*it is unlikely...that these animals are indigenous to the area*".
2. The barbary sheep, *Ammotragus lervia*, found in the mountains of North Africa from the Sudan and Egypt to the southern part of the Atlas mountains (Epstein, 1971; Uerpmann, 1987).
3. The Arabian thar, *Hemitragus jayakari* which inhabits the mountain region of Oman (Harrison and Bates, 1991; Uerpmann, 1987).
4. The nubian ibex, *Capra ibex nubiana*, which is an arid dwelling wild goat with a sub-recent distribution in the highlands of southern Israel, Jordan, the Sinai Peninsula, Upper Egypt, Saudi Arabia, Yemen, Oman and in the early part of this century may have been present in western Syria (SW of Palmyra) (Harrison and Bates, 1991; Uerpmann 1987).
5. The bezoar goat, *Capra aegagrus*, whose present day distribution ranges from the Sind and Pakistani Baluchistan in the east, through the Caucasus to remote parts of the Taurus mountains of Turkey (Epstein, 1971; Harrison and Bates, 1991; Heptner *et al.*, 1988).

Based on the presence of skeletons of animals shot in the last century and the early part of this century as well as archaeozoological finds, it is probable that these species probably had wider geographical distributions in the past (Epstein, 1971; Harrison and Bates, 1991; Uerpmann, 1987). The question which is relevant to our current investigation, is whether the distribution of wild sheep ever extended into the southern Levant, and if so could this genus have been domesticated locally.

In terms of habitat use, there are some marked differences between wild sheep and goats. The wild goats mentioned here are particularly well adapted to rocky mountain slopes and scale rocky areas and cliffs skillfully. They subsist primarily from grazing on shrubs and grasses and are more stenotopic than the west asiatic mouflon. They are not found in areas with dense bush or forests. The west asiatic mouflon is also adapted to rough terrain but not as steep or rocky as that inhabited by the wild goats. They are commonly found in rolling hill country or open grassland. They are not found in dense brush or woodlands or in deserts, but rather on the desert edge. Like goats, *Ammotragus* lives in rocky habitats. Although suitable habitats for all genera are to be found in the Levant, other biogeographic factors including the nature of the inter-specific competition for resources and/or the ability to withstand climatic change in the past, may have determined which of the Caprinae inhabited this region. Moreover, their present distributions and habitat preferences should be related to with caution when reconstructing past distributions, as in many cases they reflect refuges rather than preferential habitats (Davis *et al.*, 1982; Uerpmann, 1987).

Methodology

From an archaeozoological perspective, perhaps the most basic problem in the study of sheep and goat domestication is one of identification which relies upon the archaeozoologists ability to successfully separate bones of the two taxa. Although, a copious literature exists on methods of distinguishing between *Ovis* and *Capra* (e.g. Boessneck *et al.*, 1964; Buitenhuis, 1996; Cornevin and Lesbre, 1891; Grabler, 1985; Gromova, 1953; Payne, 1969, 1985; Pfund, 1961; Prummel and Frisch, 1986) often, these criteria cannot be applied to archaeozoological collections due to their fragmentary state. Furthermore, most of these methods are based upon skeletal criteria of domestic animals, most of which are derived from specific breeds. Consequently, the applicability of these morphometric criteria to wild caprines or primitive domesticates, is questionable. Finally, as the assessment of these morphological criteria are subjective, it is expected that researchers will vary in their criteria for determining the presence of particular features on skeletal remains.

As a result of these limitations, most of the caprine material recovered from an excavation is not identifiable beyond the generic level of "caprine", and is placed in a joint sheep/goat category. This pooling, does not mean that the sample definitely contains remains of both taxa, but merely that no definite identification could be made to the level of genus or species. Under such circumstances, definite attributions can only be given to remains that show clear morphometric features diagnostic of the genus *Ovis* or *Capra*. Material which exhibits morphometrical features that overlap between the two, cannot be used.

Probably many of the difficulties in separating the two taxa stem from our ignorance of the extent of morphological and metrical variation within and between different *Ovis* and *Capra* species. To try and overcome this problem, we need to have a precise and quantifiable definition, for both taxa, of the range of variation that exists within and between them. This is especially pertinent for those morphological or osteometrical characters which are commonly used in archaeozoology to distinguish between them.

Taking into account the problematics of separating sheep from goat, we have turned to metrical criteria taken on modern skeletons of known species and sex held in comparative zoological collections in several institutions, to aid in distinguishing between taxa. Material examined included: *Capra aegagrus* (bezoar goat) and *Capra ibex nubiana* (nubian ibex) held in the Department of Evolution, Systematics and Ecology, The Hebrew University, Jerusalem, the National Museum of Natural History, London and Field Museum of Chicago; *Hemitragus jemlaicus* and *H. hylocrius* (tahrs) held in the collections of the National Museum of Natural History, London (this as no post-cranial skeletons of Arabian tahr could be traced); *Ammotragus lervia* (barbary sheep) and *Ovis orientalis* (western Asiatic mouflon) held in the collections of the Musee d' Histoire Naturelle, Paris, the National Museum of Natural History, London and Field Museum of Chicago. On the same skeletons the morphological criteria outlined in the relevant archaeozoological literature (as cited above) were noted, to aid in distinguishing between taxa and in some cases species. This modern data set served as a standard against which we compared, both metrically and morphologically, bone remains recovered from archaeological sites in the southern Levant that had been identified by us as *Ovis*, or published in the literature as *Ovis*.

The archaeozoological material examined for the purposes of this paper are derived from several sites in the Levant (Fig. 1): Ghoraiife, Ramad I and Mureybet in Syria (some of the material is currently housed in France); Tel es-Sultan (Jericho) in the Palestinian Autonomous Region (housed in the Natural History Museum, London); Abu Salem, Rosh Horesha and Ramat Harif, southern Israel and Hatoula, central Israel (all housed in the archaeozoology collections of The Hebrew University of Jerusalem). In addition, reference has been made to published data and these are referred to in the text.

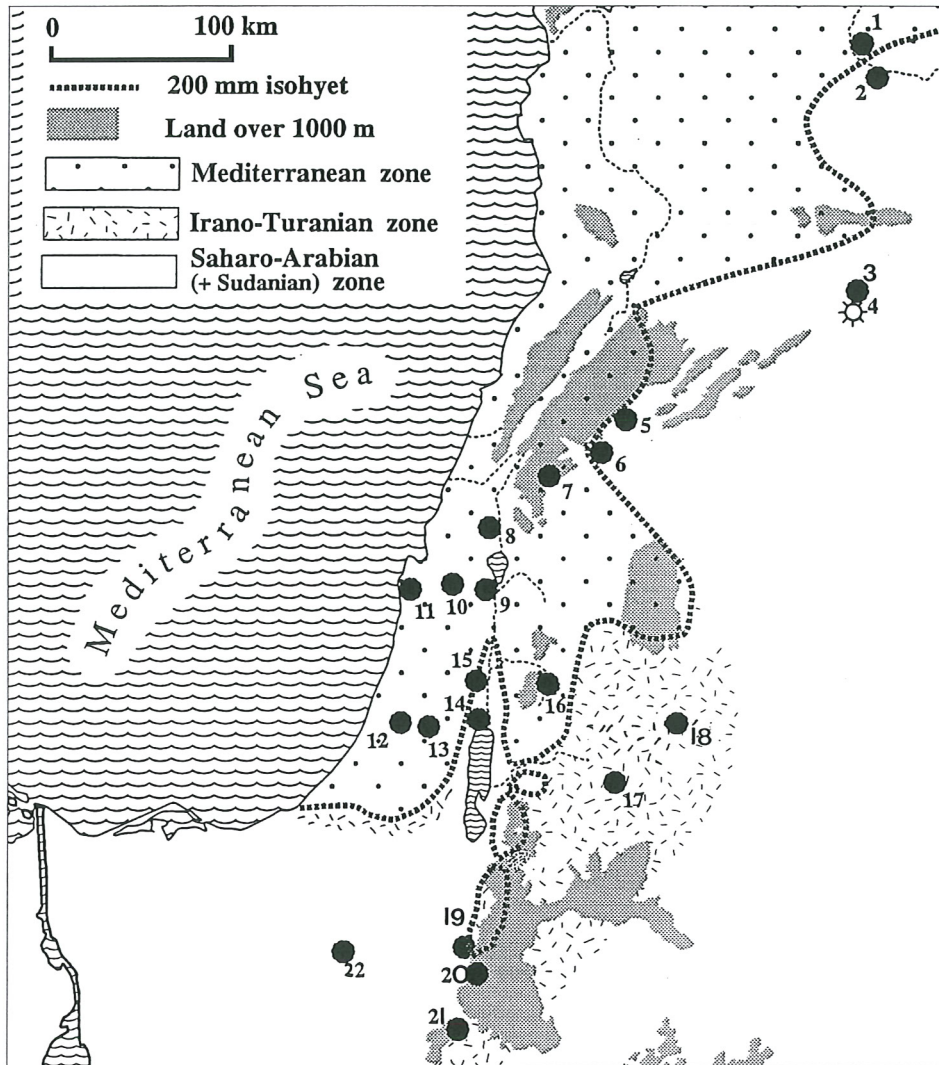


Figure 1. map of sites mentioned in the text. 1= Mureybet; 2= Tell Abu Hureyra; 3= Douara; 4= Palmyra; 5= Ghoraife; 6= Tell Aswad; 7= tell Ramad; 8= Ain Mallaha (Eynan); 9= Beisamoun; 10= Yiftahel; 11= Kfar Hahores; 12= Hatoula; 13= Abu Gosh; 14= Jericho; 15= Netiv Hagdud and Gilgal; 16= Ain Ghazal; 17= Wadi Jilat; 18= Azraq; 19= Beidha; 20= Basta; 21= Wadi Judayid; 22= Abu Salem, Rosh Horesha and Ramat Harif.

Results

(a) The Middle and Upper Paleolithic Periods

The earliest remains of wild sheep, *Ovis orientalis*, that have been identified from the Levant are those from the Middle Paleolithic (Mousterian) layers at the site of Douara situated in the Palmyra Basin, central Syria which places this site at the very interface between the southern and northern Levant (Payne, 1983). At present, the site is situated in a semi-arid regime with perennial grasses, a habitat considered amenable to sheep. The faunal species recovered from the Middle Paleolithic layers at the site indicate that a similar environment existed in the past.

Of the 12 *Ovis* bones identified at this site, only 4 (an astragalus, calcaneum and two metacarp) have been deemed by the investigator to be reliable identifications (Payne, 1983). As the material was not examined by us, we cannot offer any further insights into this assemblage, but would like to state that as shown in the photographs, at least some of the bones (such as the scapula) exhibit fea-

tures that are diagnostic of *Ovis*. Like Payne (1983), we see no biogeographic, environmental or paleoclimatic factors that would negate the natural occurrence of wild sheep near Douara cave during the Middle Paleolithic. However, it should be noted that none of the contemporaneous sites further south in Lebanon, Israel or Jordan, have yielded remains of *Ovis*. Similarly, no finds have been reported from the subsequent Upper Paleolithic sites in this same region (including Syria), despite the relatively large number of sites excavated.

(b) The Epi-Paleolithic Period

The absence of sheep remains continues through the Kebaran and Geometric Kebaran periods, which like the Upper Paleolithic, are well documented periods represented by numerous sites and studied faunal assemblages. However, to date none have yielded remains of *Ovis*. It is only in the Natufian period that remains of *Ovis* are once again reported, this time from six different sites, which are located in four different localities: Abu Hureyra, Syria (Legge, 1996; Legge and Rowley-Conwy, 1986); the late Natufian levels 4-5 at the site of Hatoula, central Israel (Davis, 1985); three adjacent Harifian (Late Natufian) sites in the Negev desert of southern Israel - Abu Salem, Ramat Harif and Rosh Horesha (Davis *et al.*, 1982); and the Natufian site of Wadi Judayid, southern Jordan (Henry *et al.*, 1985). Ducos (1993b) has refuted his earlier claims for the presence of sheep in the Natufian levels at Eynan and Nahal Oren.

Abu Hureyra

The Epi-Paleolithic levels at the site of Abu Hureyra, northern Levant, have yielded remains of *Ovis* but none of *Capra* (Legge, 1996). The exact number of sheep bones has as yet to be reported, but they appear to have comprised a minor element in the general faunal record at this time. Six radiocarbon dates were obtained directly on three sheep bones and yielded consistent dates clustering at circa 10,400 B.P. (uncalibrated), such that their chrono-stratigraphic context cannot be doubted (Legge and Rowley-Conwy, 1986). The researchers describe the morphometric traits of the remains used for radiocarbon dating and in all features they appear to conform well to accepted criteria for wild sheep. The site lies in close proximity to open, steppe environments which would have offered a suitable habitat for wild sheep.

Wadi Judayid

At the Natufian site of Wadi Judayid, situated in southern Jordan, 28 sheep bones were identified by Patricia Turnbull (in Henry *et al.*, 1985). This is an open site situated on a low terrace at the interface between the Mediterranean woodlands lying above, and grasslands below where presumably sheep could have been hunted.

We have not been able to re-study this collection, however it includes many bones that are commonly used for separation of sheep from goats: a horncore, 3rd phalanges, proximal femur, distal tibiae, astragala, calcanea, and a distal humerus. However, all the bones appear to be poorly preserved, and the horncore was reported to be crushed, broken and "very badly weathered". Its identification as *Ovis* was based on its size and the fact that it was "*bone-filled and not hollow as are goat-horn cores*" (Turnbull in Henry *et al.*, 1985) which based on our observations on archaeological material, is an unreliable characteristic due to both diagenetic processes and variation along the horncore. As illustrated in Henry *et al.* (1985: Figure 10), the proximal femur exhibits an abrupt transition between the caput femoris and trochanter resulting in a "u" shaped outline that is more typical of *Capra* than *Ovis*. However, this observation is based solely on the photographs given in the publication, and as such does not represent a rigorous analysis of the material as has been carried out by Turnbull. We have compared the measurements given in the publication to those taken by us on modern wild sheep and other archaeozoological material from this region. As shown in Figure 2a, the Wadi Judayid astragalus falls in close proximity to astragali from contem-

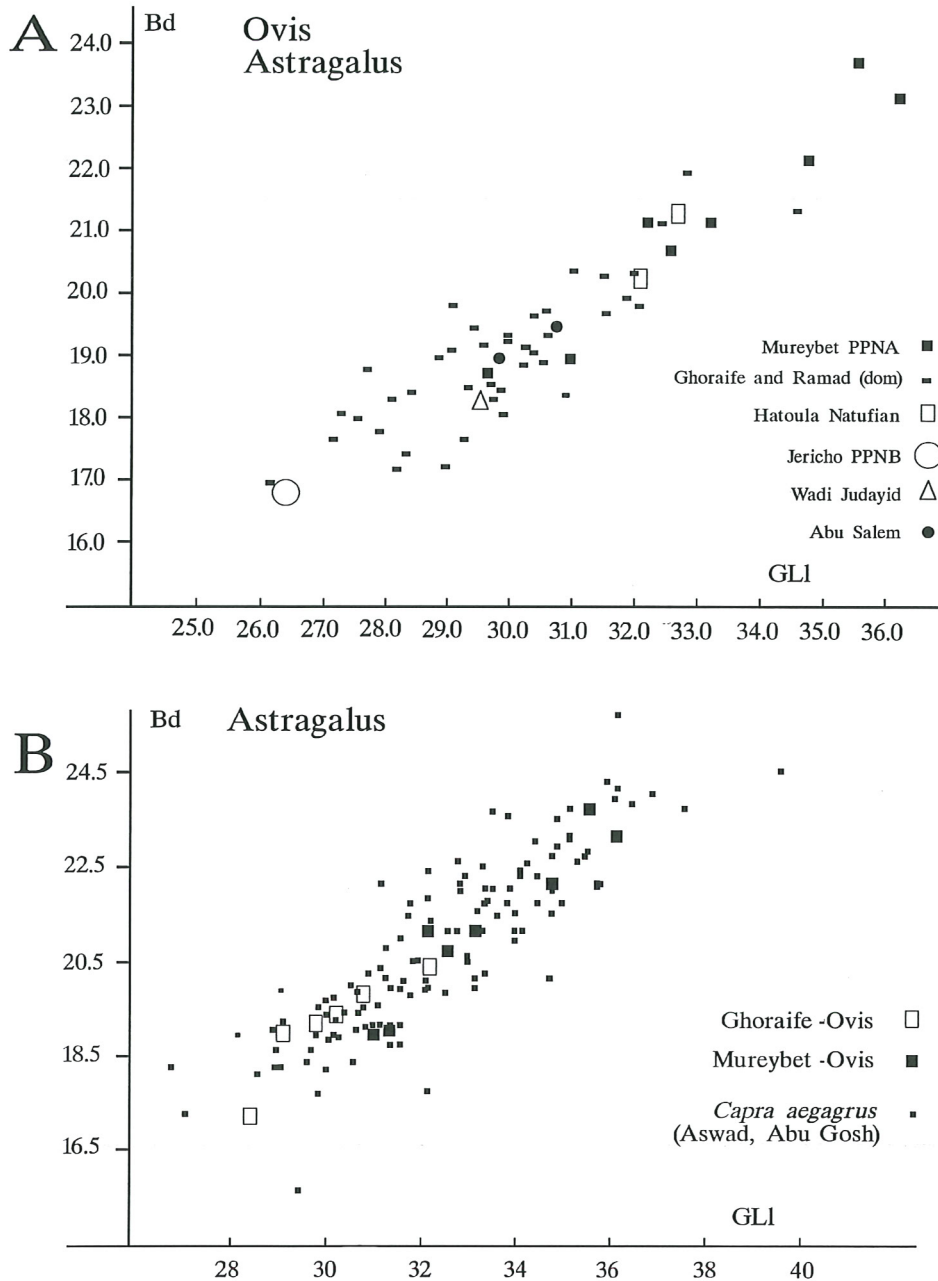


Figure 2. A = Scattergram showing astragalus measurements of *Ovis* from several archaeological sites in the Levant; B = Scattergram of astragalus measurements showing the overlap between *Ovis* and *Capra* for this bone.

poraneous sites in the Negev and Aceramic Neolithic material from Mureybet, remains which have been identified as wild sheep. However, this result does not aid us in determining whether the bones are those of sheep or goats, as astragalus measurements do not permit good distinction between these taxa due to the large overlap in their distributions (Fig. 2b).

Turnbull suggested that the remains may represent those of *Hemitragus*, due to the presence of this genus in Oman today. We have no reason to believe that this is the case, as firstly *Hemitragus* is much more goat-like in its morphology (see Fig. 3), and secondly it exhibits unique features in both skeletal morphology and size that distinguishes this species from other wild goats in the region (Harrison and Bates, 1991). To date, no remains of *Hemitragus* have been identified from the Le-

vant and it is unlikely that the distribution of this species ever extended into this region as it would have had to compete with two other species of wild goats, *C. ibex nubiana* and *C. aegagrus*, whose presence is well documented in this region. Consequently, Turnbull's suggestion seems highly unlikely.

We may conclude then, that in the absence of a hands-on re-examination of the remains, we have no basis to reject Turnbull's identifications of wild sheep. Furthermore, in terms of its location, wild sheep could have inhabited the grasslands below the site.

Hatoula

A total of 24 sheep/goat bones have been identified from the Late Natufian levels (5 and 4) at Hatoula, situated in the Mediterranean region of central Israel (Davis, 1985; Davis *et al.*, 1994). In the 1985 publication, Davis states that of the 8 caprine bones found up until then, all were of wild sheep. However, in the later publication (Davis *et al.*, 1994) a further 16 caprine bones have been added to this collection, but all have been placed in a joint sheep/goat category.

We have relocated only 10 of these 24 remains - 1 horncore, 2 astragali, 1 calcaneus, 2 humeri, a distal radius and 3 phalanges. The 2 astragali are large, and when plotted fall within the upper range for wild sheep and within the mid-range for wild goats (Fig. 2a,b). However, this criterion does not enable us to distinguish between the two taxa and merely indicates that the possibility that the bones are *Ovis* cannot be excluded. In terms of morphology we found that the horncore (of doubtful attribution as noted by Davis, 1985) and two other bones do not comply with the accepted criteria for *Ovis*. The calcaneum has a relatively straight corpus and a relatively short anterior process and slightly triangular shaped proximal epiphysis, features more commonly found in *Capra* than *Ovis*. The medio-anterior point of one of the astragali is more pronounced than in the recent wild *Ovis* we have studied, such that it is more *Capra*-like. The other astragalus complies quite well to the general features associated with *Ovis*. The horncore is extremely fragmented and we feel cannot contribute to this debate.

In addition, the two humeri that we relocated were not convincing as *Ovis*, partly due to their poor preservation on the posterior and medial aspects which obscured the original shape of the medial aspect, a feature considered a good separator of the taxa. In our opinion, we consider that the distal radius from Hatoula exhibits features which are common to both Genera and so we are cautious about identifying this bone as *Ovis*. Unfortunately, the sheep metapodia and 3rd phalanges noted by Davis (Davis, 1985; Davis *et al.*, 1994) were not relocated by us. However, we would like to note, that 7 of the bones identified by Davis as *Ovis* (Davis *et al.*, 1994) are proximal 1st phalanges. Following Boessneck *et al.* (1969) we have found this feature to be a poor criterion for separating sheep from goats.

Taken that we have only been able to relocate less than half the bones identified as *Ovis* from this site, we may only comment that on the basis of our examination, most of these bones bear a close resemblance to *Capra* or else exhibit features that are common to both Genera. Moreover, the absence of goat at the site would make Hatoula an exceptional Natufian site in the southern Levantine record as this species is present (albeit in low quantities) in all assemblages studied to date (Davis, 1982; Tchernov, 1995). The physical situation of the site, in the transitional zone between the coastal plain and the Judean mountains, the latter an ideal habitat for wild goat, makes the absence of this species even more difficult to understand. Furthermore, the site is situated today in the Mediterranean phyto-geographic zone, whereas the biogeography of wild sheep does not appear to have included the Mediterranean zone proper but rather its fringe (Uerpmann, 1987). Although the open topography of the Israeli coastal plain is suitable for sheep, we are uncertain that the paleoclimatic changes that characterized the Late Natufian (i.e. a trend of increasing aridification and decreased temperatures- Sanlaville, 1996; Tchernov, 1995) would have been of sufficient magnitude to create a suitable vegetational environment for this species close to Hatoula. Thus, the biogeographic position of the site provides a strong basis for doubting the presence of wild sheep at Hatoula, and we propose that the identification of the remains as *Ovis* should be treated as tentative.

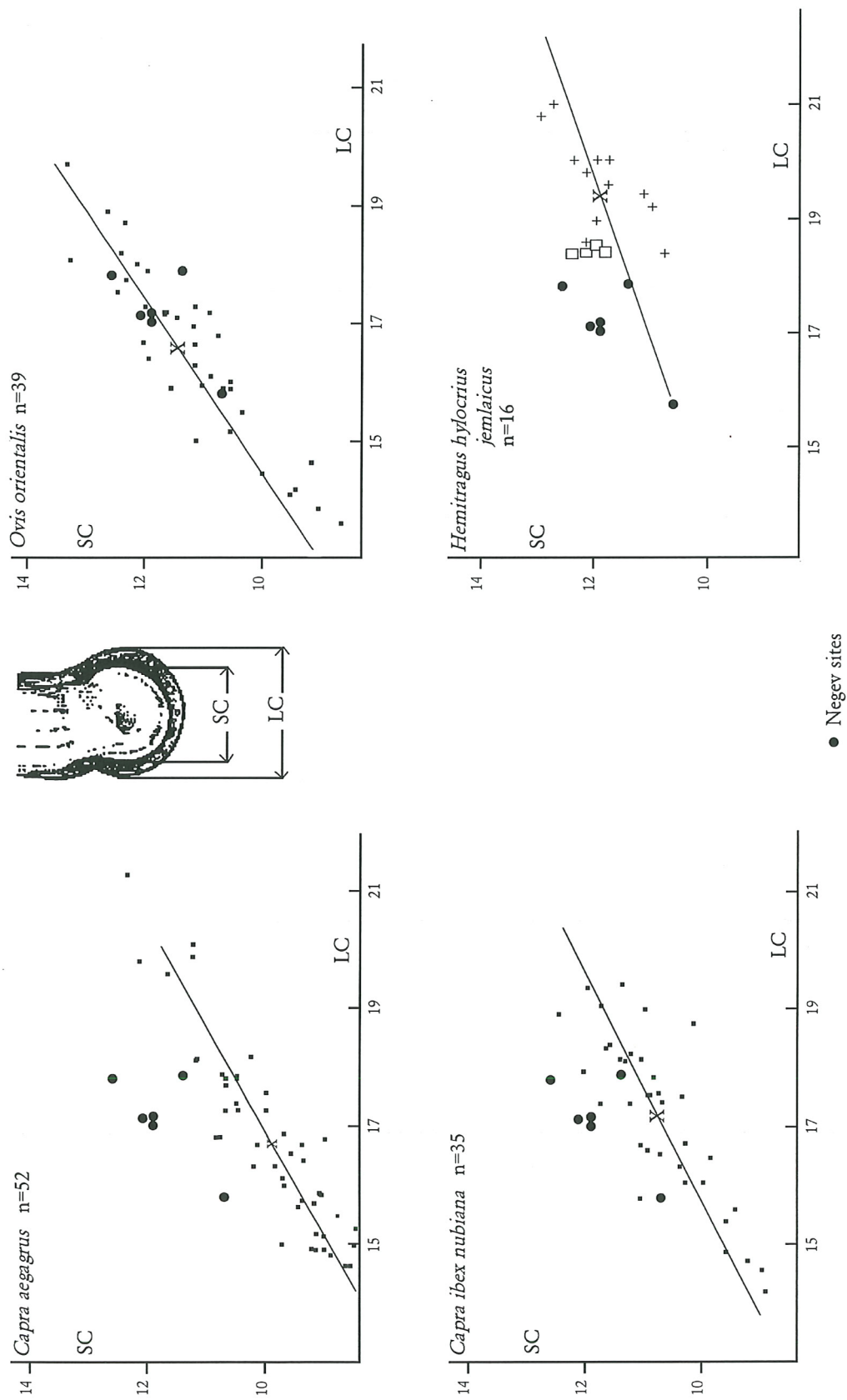


Figure 3. Scattergram of distal metacarpus measurements of *Ovis* from the Negev sites compared to series of modern Caprines.

Negev Sites

In 1982, Davis *et al.* reported the presence of sheep in three adjacent Harifian (Late Natufian) sites in the central highlands of the Negev desert, southern Israel. The steppic Irano-Turanian vegetation of this region offers a suitable habitat for wild sheep. The 20 bones recovered from these three sites include 11 metapodials, 3 astragali, a calcaneus and two 3rd phalanges.

As illustrated in Figure 2a, the two measurable astragali cluster together and fall close to that from the contemporaneous sites of Wadi Judayid, which indicates that their identification as *Ovis* cannot be excluded. In terms of their morphology, we agree with Davis *et al.* (1982), that both the astragali and calcaneum exhibit ovine characteristics. However, the most convincing data set is that obtained from the metrical analysis of the distal metacarpals from the sites. Davis *et al.* (1982) plotted the Negev sites against sheep and goat remains from archaeological sites in the Negev, with a limited comparison to modern wild and domestic goat and domestic sheep. However, wild sheep and *Hemitragus* were absent from this comparison, and the sample sizes of the modern and archaeological samples used were relatively small and so perhaps not representative of the wide size range encompassed by these species.

Figure 3 illustrates the distribution of distal metacarpals from the Negev sites compared to modern data taken on four possible caprine candidates that may have inhabited the Levant during this period - bezoar goat, Asiatic mouflon, ibex and thar. Though not illustrated here, as mentioned by Davis *et al.* (1982), the measurements for the North African barbary sheep, *Ammotragus*, fall within the range for *Capra*. From the plots given here, it is evident that the best fit with the Negev material is *O. orientalis* although, there is some overlap with the ibex, *C. ibex nubiana*. Obviously we do not claim that our modern samples cover the entire range of variation of these species. However, they offer a further test concerning the species attribution of the Negev samples and corroborate the original findings of Davis *et al.* (1982) that the Negev caprines probably represent remains of wild sheep.

(c) The Pre-Pottery Neolithic A (PPNA)

The faunal record for the earliest part of the Levantine Pre-Pottery Neolithic, namely the PPNA period (circa 10,300-9,300 BP uncalibrated), is characterized by low frequencies of caprines. As before, the majority of caprines present have been identified as goat with claims for sheep remains made at only three sites - Tel Mureybet in Syria, Jericho in the Palestinian Autonomous Region and Hatoula levels 3 and 2 in Israel.

Mureybet

A small number of sheep remains have been recovered from the lowest Aceramic Neolithic strata of Van Loon's excavation at Tell Mureybet (strata IB and II) in the northern Levant (Ducos, 1978b), dated to 10,600-10,500 BP (uncalibrated dates). This places the PPNA levels at Mureybet as earlier than the advent of the PPNA in the southern Levant (circa 10,300 BP) and contemporaneous with the Late Natufian in the southern region. Based both on their morphology and their large size, the sheep remains have been identified by Ducos (1988, 1993a,b) as representing *Ovis orientalis*.

Jericho

A key site in the southern Levantine sequence is Tel es-Sultan or the Jericho Tel. Clutton-Brock and Uerpmann (1974), reported the presence of 2 sheep bones in the PPNA levels at the site; a 1st phalanx and a shaft of a metacarpal (with no epiphyses), possibly from a juvenile animal. Based on morphology and metrical parameters the authors concluded that these remains represent sheep.

However, they stated that there was no osteological evidence to suggest that the bones represented domesticated animals, although this possibility could not be excluded. Subsequently, when Legge (1996) compared the measurements of the Jericho sheep (together with the sheep remains identified from the mid-PPNB layer at the same site) to those of wild sheep from Tel Mureybet and Abu Hureyra, he found that they were of smaller size. He suggested that they may represent domestic animals.

In our re-examination of the Jericho assemblage, we concluded that as the metacarpal shaft is so incomplete and fragmentary, combined with the fact that it probably derives from a juvenile animal, any reliable attribution of this bone to genus is not possible. Similarly, examination of the 1st phalanx from this site once again raises the issue of how diagnostic are the characteristics of this bone in separating sheep from goats. As noted by Clutton-Brock and Uerpmann (1974), even Boessneck *et al.* (1964) whose criteria they used for most of their identifications of the *Ovis* remains from Jericho, considered the 1st phalanx an unsuitable bone for separating these animals.

Although the environment of Jericho offers suitable habitats for sheep, the poor morphometric information derived from these remains, the fact that they are only two in number and that one of them is very poorly preserved have led us to conclude that the PPNA sheep remains from Jericho are an unreliable base upon which to rest claims for *Ovis* during this period. Furthermore, the fact that these remains are derived from a multi-period site with Bronze Age material overlying the Neolithic levels (Clutton-Brock, 1979), the possibility that some movement of material between strata may have occurred, should be considered (Villa and Courtin, 1983; Hesse and Rosen, 1988). The absence of any sheep bones from the neighbouring PPNA sites of Netiv Hagdud and Gilgal (Tchernov, 1995), as well as from the sites of El Khiam (Ducos, 1997) and Ain Darat (Horwitz, unpublished data), both situated to the south of Jericho, only serve to substantiate our reservations concerning the Jericho finds.

Hatoula

In the Khiamian levels at Hatoula, 6 sheep/goat bones were identified while the Sultanian levels yielded 5 sheep/goat bones (Davis *et al.*, 1994). As reported in this latter publication, the two taxa were not separated. However, in an earlier publication (Davis, 1985) 2 sheep bones were noted separately from the pooled sheep/goat material. They are derived from the Khiamian level 3 and comprise a distal radius and a complete 1st phalanx. We have re-examined the Hatoula assemblage, and of the 7 possible caprine bones found, all bones fitted our morphological criteria for *Capra*. Unfortunately none were measurable. We cannot exclude the possibility that some of the more convincing material studied by Davis has not been re-located by us.

However, we would like to note, that the bone elements identified by Davis (1985) as *Ovis* from Hatoula layer 3 (a 1st phalanx and distal radius), are considered by us as the least suitable elements for species separation (see discussion above). Consequently, in the absence of details from Davis on the criteria used in his attribution of the 11 caprine bones from Hatoula, we can only conclude that the possibility that sheep were present at the site in the PPNA is inconclusive. As discussed previously, based on the geographic position of the site the absence in the assemblage of a far more natural candidate, *Capra*, would be surprising.

(d) The Pre-Pottery Neolithic B (PPNB)

Recent publications on the archaeology of the PPNB in the Levant have advocated that greater cognizance be taken of the differences between the chronological phases within this period (e.g. Bar-Yosef and Belfer-Cohen, 1989; Cauvin and Cauvin, 1993; Rollefson, 1989). Consequently, any discussion of animal domestication in this period has to be within the framework of this chronological development (Garrard *et al.*, 1996; Horwitz 1993; Legge, 1996).

Early and Mid-PPNB

To date, no finds of *Ovis* have been reported from early-PPNB contexts in the southern Levant. This finding could be considered as relating to the general paucity of sites dating to this phase, if not for the fact that the same situation is found for sites dating to the mid-PPNB phase, with the exception of Jericho. At Jericho as further 12 sheep bones were identified from the mid-PPNB strata. Of these 7 were definitely attributed to *Ovis* by the researchers, while a further 5 were only tentatively attributed to this species (Clutton-Brock and Uerpmann, 1974).

Following re-examination of this material, we agree that some of the bones (the occipital, scapulae, astragalus and calcaneum) exhibit characteristics that are typical of *Ovis*, however others are, in our opinion, less convincing. One of these problematic bones, a distal metatarsal whose distal condylar measurements were used by Clutton-Brock and Uerpmann (1974) to attribute it to *Ovis*, is severely burnt and has an excessively slender shaft (SD 9.5). The bone resembles one derived from an animal suffering from osteoporosis, which being a pathological condition should exclude it from metric analysis. Alternately, the excessive thinness of this bone may be the result of shrinkage associated with burning (Shipman *et al.*, 1984). Due to the magnitude of shrinkage in such bones, it seems unwise to use metrical parameters taken on burnt material, especially when used to distinguish between taxa. We corroborate Clutton-Brock and Uerpmann's (1974) uncertainty in attributing the distal femur, distal tibia, and 1st phalanges to *Ovis*. However, we would add to this group the distal tibia which we found to exhibit features that were intermediary between the two species.

We therefore conclude that, as suggested by Clutton-Brock and Uerpmann (1974), some of the remains can be attributed to sheep. However, examination of the faunal record from other mid-PPNB sites in the southern Levant indicate that remains of *Ovis* are notably absent at all other sites including Abu Gosh (Ducos, unpublished data) and Munhatta 4-6 [Ducos, 1993b has refuted earlier attributions of domestic sheep for the mid-PPNB layers at Munhatta]; Yiftahel, Kfar Hahores and Nahal Betzet (Horwitz, unpublished data); Ain Ghazal (Rollefson, 1989); Beidha (Bökönyi, 1993); Jilat 7 (Garrard *et al.*, 1996). It should be noted that although Ducos (1978a) identified remains of *Ovis* including horncores from Beisamoun, this faunal collection is derived from surface finds of no known date or precise stratigraphic attribution. Consequently, this assemblage cannot in any way contribute to our understanding of the history of *Ovis* in this region. In his study of fauna from the PPNB site at Beisamoun, Davis (1982) did not identify remains of *Ovis*.

Based on the number of sites, their varied distributions and the fact that several different investigators have analyzed the collections, we can conclude that Jericho is the exception rather than the rule. Consequently, it is probable that the presence of the sheep bones in this strata may be due to some other factor, such as movement of material between strata, as has been suggested above.

Late-Final PPNB

As noted by Ducos (1993a,b), Legge (1996) and Garrard *et al.* (1996), it is only from the late-PPNB onwards (circa 6500 bc), that convincing evidence for the presence of *Ovis* is found in southern Levantine sites. In the northern Levant, such as at the site Abu Hureyra, domestic sheep are recognized earlier, circa 7500 bc (Legge, 1996). Similarly, by the time sheep appear in the Aceramic Neolithic sites of the Damascus Basin (Ghoraife, Ramad and Aswad) circa 6500 bc, they exhibit morphological traits and metric characteristics of domestic animals (Ducos, 1993a,b) which substantiates claims that this species was introduced into the southern Levant from the north only when domesticated.

Remains of sheep are found in several late PPNB sites, often in relatively substantial quantities. Deposits that have yielded sheep remains include Ghoraife and Ramad I (Ducos, 1993a,b), Basta (Becker, 1991), Ain Ghassal (Rollefson, 1989) and possibly Baga I (Gebel, 1988), Jilat 13, Jilat 25 and Azraq 31 (Garrard *et al.*, 1996).

Discussion

Although morphometric evidence is obviously the most important criterion that needs to be fulfilled when determining the presence of *Ovis* in an assemblage, several others qualifying factors need to be considered, especially when the difficulties in applying some of the morphometric criteria for separating these species are considered. In this regard, probably the most important feature to be considered is the natural environment and geography of the site/s containing these remains. Thus, remains ascribed to a species found in a locality that contradicts its known dietary needs or habitat preferences (obviously taking into account paleoclimatic change), may indicate an incorrect identification. Another factor to be considered is the relative frequency of this species in the assemblage as well as the number of localities in which it has been identified. Although, generally *Ovis* may have been a rare species in the Levantine landscape, it seems unlikely that if present it would not appear in more sites. A final consideration is stratigraphic integrity and the possibility of intra-strata displacement of material, especially in multi-layered sites such as tels.

As discussed above, a habitat suited to wild sheep could have existed in the past in close proximity to all of the sites noted here. However, if this was the case why have sheep remains been identified from so few sites, including others which lie in close proximity to amenable conditions? A good example of this phenomenon is the presence of sheep in the PPNA (Sultanian) layers at Jericho, but their absence in nearby, contemporaneous sites such as Gilgal and Netiv Hagdud (Fig. 1).

In this respect it is interesting to note that since 1986 when Legge and Rowley-Conwy published their synthesis on the evidence for *Ovis* in archaeological sites in the Near East, no new sites pre-dating the late PPNB have yielded sheep remains. This is certainly not due to the lack of new excavations, nor to the lack of archaeozoological studies of remains which have been carried out by a variety of researchers. Were sheep so rare in the Levantine landscape and hence in the sites, that only in sites with very large numbers of bones are they to be found? This does not seem to be the case, as the Negev sites have yielded relatively small, and not particularly well preserved bone assemblages, and yet they contain sheep remains. Similarly, Natufian assemblages of larger or similar size, such as those recovered from sites of Hayonim Cave B and its Terrace, Eynan, Nahal Oren, Salabiya I, have to date yielded no remains of *Ovis* (Tchernov, 1995). The explanation for this patterning is apparently not simple or clear-cut.

Based on the data described and discussed above it is clear that many of the remains from southern Levantine contexts, that have been attributed to *Ovis*, are problematic. In most cases this is due to a combination of factors. It may be due to the physical or phyto-geographic position of the site, the fact that neighbouring and/or contemporaneous sites lack similar remains, displacement of material in multi-period sites, the small size of the diagnostic sample, and uncertainty or disagreement over the diagnostic criteria used to identify *Ovis*. Consequently, we have concluded, that with the exception of the remains from the Natufian/Harifian site of Wadi Judayid and those from the three Negev sites, all *Ovis* attributions for the southern Levant pre-dating the late-PPNB, should be treated with extreme caution and noted as tentative rather than positive identifications.

If this is the case, how can we explain the presence of wild sheep in the southern Levant during the Natufian period? Paleobotanical evidence has indicated that circa 11,500 BP the Levantine forests, that had spread during the last glacial maximum due to increased rainfall, began to retreat. This phenomenon has been linked to the onset worldwide, of the cooler and drier "Younger Dryas" (Sanlaville, 1996). Pollen samples from the Late Natufian Negev site of Rosh Horesha and Harifian site of Abu Salem, both of which have yielded sheep remains, indicate that a marginal Mediterranean maquis existed at the time, one that was moister than today but drier than the preceding early Natufian (Horowitz quoted in Goring-Morris, 1987). Recent data from contemporaneous sites in the Negev highlands have raised the possibility that the Negev highlands was perhaps less affected by the changing climate, as evidenced by the fact that the *Juniperus* tree continued to grow here (Baruch and Goring-Morris, 1997). Taking these data into account, it is possible that during this

period of shifting climatic regimes, the Negev desert and southern Jordan continued to experience more mesic climatic conditions than today, which either attracted or maintained small populations of wild sheep.

During the Glacial maximum, the Levantine Mediterranean zone would have been covered with a relatively denser vegetation and heavier forest cover, possibly making it unsuitable for wild sheep. This factor may account for their absence in earlier periods. However, with the onset of drier and colder conditions in the Late Natufian, sheep may have entered the southern Levant. However, this dispersion of sheep into the southern Levant does not appear to have continued into the PPNA, probably as a result of the continuing aridification in the region. This factor taken together with the possibility of hunting pressure, may have contributed to the disappearance of this species in the Negev desert and southern Jordan. If this scenario is correct then the absence of more Natufian sheep remains from the semi-arid regions of the southern Levant is probably due to poor bone preservation in this area.

Consequently, the scenario presented here is one that favours the migration of wild sheep into the southern part of the Southern Levant during the Late Natufian/Harifian, followed by their disappearance by the PPNA. This genus is encountered once again in the faunal record of the southern Levant as a domesticate that is introduced from the northern Levant during the late PPNB, circa 6500 bc and not earlier. We find that these data do not support a model of autochthonous domestication for *Ovis*, in the southern Levant.

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