The Paleolithic Background of Early Food Producing Societies in the Fertile Crescent - Faunal Analysis

Hannes Napierala

The Paleolithic Background of Early Food Producing Societies in the Fertile Crescent
- Faunal Analysis

Dissertation
der Mathematisch-Naturwissenschaftlichen Fakultät
der Eberhard Karls Universität Tübingen
zur Erlangung des Grades eines
Doktors der Naturwissenschaften
(Dr. rer. nat.)

vorgelegt von
Hannes Andreas Napierala M.A.
aus Filderstadt

Tübingen 2011

Tag der mündlichen Qualifikation: 24.02.2012

Dekan: Prof. Dr. Wolfgang Rosenstiel

1. Berichterstatter: Prof. Dr. Dr. Hans-Peter Uerpmann
2. Berichterstatter: Prof. Nicholas J. Conard, Ph.D
3. Berichterstatter: Prof. Dr. Dr. Joris Peters

Table of contents

1. Introduction

1.1. *Aims and objectives*

The work presented here investigates the assemblages from Wadi Mushkuna, Ain Dabbour, Kaus Kozah and Baaz, which can be integrated into a long chronostratigraphy, and which lie within a small geographical area. The excavations and research are part of the Tübingen-Damaskus Ausgrabungs- und Survey-Projekt (TDASP) led by a joint team of archaeologists from the universities of Tübingen, Germany and Damascus, Syria.

The scientific framework for the analysis of the faunal remains was provided by a project funded through the Deutsche Forschungsgemeinschaft, entitled Ungulate Domestication and Early Animal Husbandry in the Upper Euphrates Basin. The project, representing collaborative work between the University of Tübingen and the University of Munich, was initiated by Prof. Joris Peters and Prof. Hans-Peter Uerpmann.

Despite the more classic description and interpretation offered below of the zooarchaeological material from the sites, the final analysis aims at providing a more substantial understanding of the Paleolithic background of early food producing societies in the Near East. The small assemblages analyzed for this study will not be able to revolutionize Near Eastern zooarchaeology. Further work will be necessary to test the hypotheses set up in this study. Special attention will be placed on the Natufian assemblages, as I consider these finds essential in providing an understanding of the key processes involved in animal domestication. Future research should focus on locating stratified assemblages from the Epipaleolithic in the north of the Fertile Crescent, where pre-pottery Neolithic (PPN) sites such as Göbekli Tepe and Nevalı Çori seem to document the initial phase of food production.

After a brief introduction describing the history and geography of the research area, the first part of my thesis outlines the framework in which the sites will be discussed. As the main objective here is to consider the economic development within the Paleolithic and the move toward the initial domestication of animals, a brief overview is provided of recent discussions in the field concerning Paleolithic subsistence patterning.

The second, and largest part of this thesis describes the analysis of the faunal assemblages of the TDASP sites (fig. 1).

In the final part, I will synthesize the data and discuss them in respect to the existing theories on Paleolithic subsistence outlined earlier. The Natufian will receive the most attention here, as Natufian „innovations" require more careful consideration. I will also address the issue of the initial domestication of food animals and how the results from the TDASP excavations can be integrated into the wider discussion of small game exploitation and the Natufian-PPN relationship.

The comparative osteometric data were in part taken from unpublished data that Hans-Peter Uerpmann produced for his own thesis in the 1970s and which he generously provided to me for the analysis below. Also, Joris Peters and Nadja Pöllath provided data from recent excavations in the Upper Euphrates region for which I am also grateful.

1.2. Research History in the TDASP research area

The archeological wealth of Egypt, which borders the Levant in the southwest, has attracted archaeologists since the very beginning of archeological research. Napoleon Bonaparte was the first European to gather scientists of various disciplines in Egypt to explore and describe the land. Their "Déscription de l'Égypt" of 1812 was the foundation on which Egyptology developed. Many scholars followed: Jean-Francois Champollion and his 1822 translation of the Rosetta Stone; Flinders Petrie, the first professor of Egyptology in England; Howard Carter and the discovery of Tutankhamun in 1922, which further stimulated the rising public interest in archaeology.

Alfred Rust, a German electrician, was also captivated by this popular interest in archaeology in the 1920s. To improve his knowledge about prehistory, and due to a lack of money, he began a bicycle trip from Hamburg, Germany, to the Egyptian Pyramids in 1930. On his way through Syria he became ill, forcing him to interrupt his journey. While he slowly recovered in the hospital in Yabroud, he explored the surrounding area and discovered the famous rockshelters of Yabroud, which he excavated in the following years.

These sites are still renown for their deep stratigraphic sequence, covering mostly Middle and Upper Paleolithic time periods. Rust's excavations were also the starting point of Paleolithic research in our working area, his assemblages providing valuable

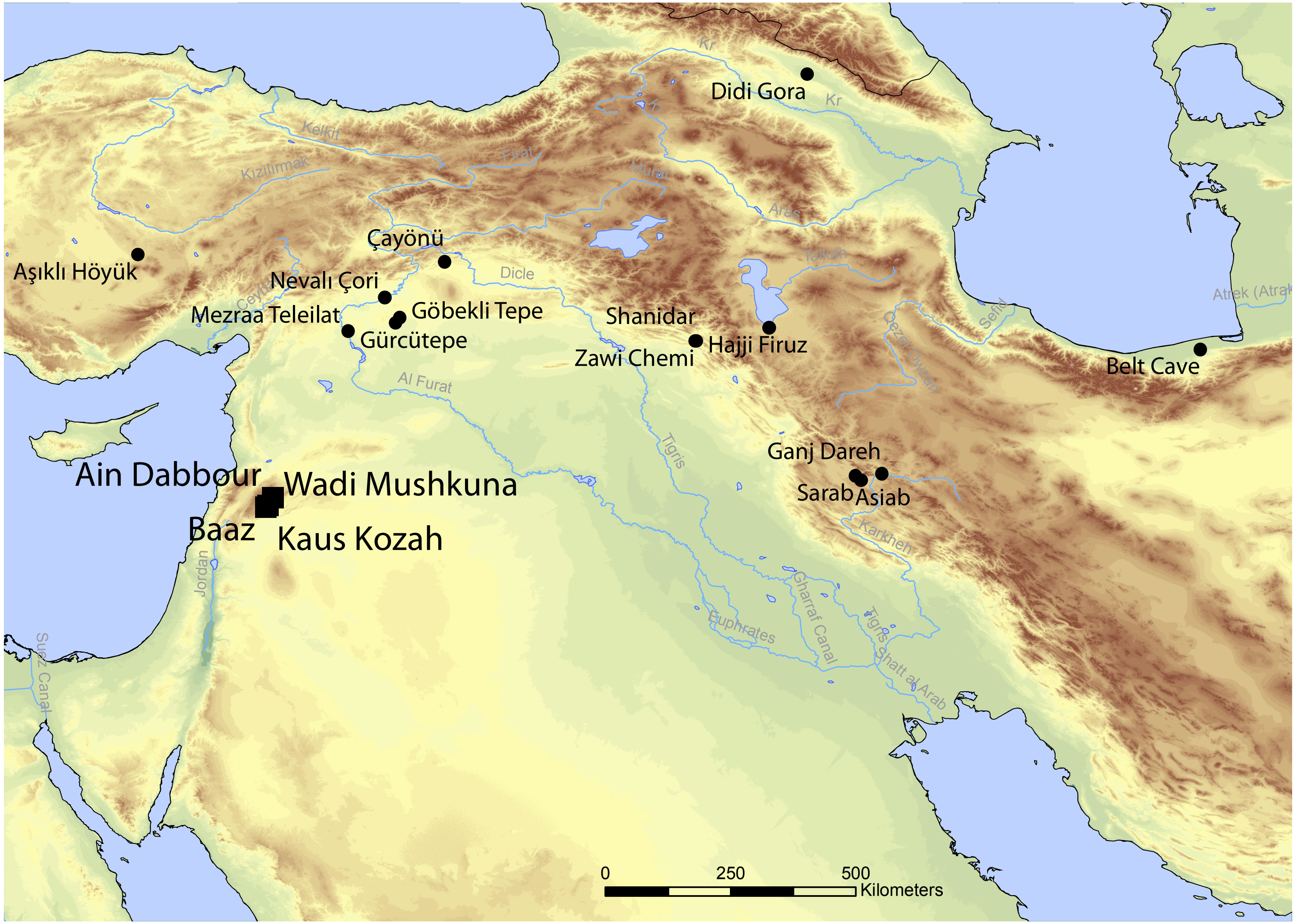

fig. 1. Map of the Fertile Crescent and adjacent areas. The TDASP-sites are labeled with squares, the comparative sites for osteometry are labelled with circles.

comparative collections for both our lithic and faunal findings. Most research since the time of Alfred Rust has similarly concentrated on the area around Yabroud (e.g. SOLECKI & SOLECKI 1986).

1.3. Paleolithic occupation of the region

Syria is part of the "Levantine Corridor", one of the major dispersal routes between Africa and Eurasia (e.g. BAR-YOSEF 1987). In contrasting, our immediate research area has not received much attention from archaeologists apart from the Yabroud excavations, which provide the nearest comparative faunal assemblage.

Most archaeological maps lack sites in this area, but whether this implies a realistic indicator in occupation history is rather unlikely. Systematic surveys for more than ten years by the TDASP-teams have recovered lithic artefacts from all Paleolithic periods (CONARD et al. 1999, 2000, 2003, 2004, 2007b, 2008a).

The earliest human occupation of our immediate research area dates back to the Lower Paleolithic, from which we frequently recovered artefacts on our surveys. They are distinct from the younger, Middle Paleolithic finds not only technologically but also in their general appearance, with more patination and rounded edges.

Yabroud Shelter IV is most probably the site thus far with the oldest stratified deposits in our research area. Stratified late Lower Paleolithic, i.e. Acheulean and Yabrudian, finds originate from the lower part of the sequence from Yabroud Rockshelter I (BORDES 1955, FARRAND 1970, RUST 1950). There are some indications that Wadi Mushkuna Rockshelter will have a deep enough stratigraphy to extend into deposits from the Lower Paleolithic (CONARD personal communication).

The Middle Paleolithic (MP), then, is very well represented (CONARD et al., 2010), and through their Levallois appearance also easy to identify on survey. Stratified Mousterian and Micoquian assemblages were excavated by Rust in the 1930s (RUST 1950) and again in the 1960s by SOLECKI & SOLECKI (1986) at Yabroud.

The bones from the Yabroud sites were studied by D. PERKINS JR. (1968) and U. LEHMANN (1970). The MP Yabroud faunal assemblages are of interest when considering our assemblages from Wadi Mushkuna and the possible MP find fraction from Kaus Kozah, although the assemblages are all small in number.

The Upper Paleolithic (UP) is less well represented in the TDASP research area than the MP. In fact it seems as if the occupation intensity of the area decreases from the Early Upper Paleolithic onwards. The site of Baaz, with its horizon V, is among the few sites from the Late UP in the region. Besides Baaz AH VII, early UP assemblages also exist at Yabroud III, with its famous multiple shifts from UP to Levalloisian technology and back.

On survey, Epipaleolithic tools were recovered with even more scarcity than tools from the UP. One factor here is that the EP is typically represented by small bladelets, which have less retrieval probability than, for example, large Levallois points. However, these microlithic artefacts are many thousand years younger, which would more likely raise their chances of being preserved. Nonetheless, a number of bladelet cores provide evidence for the Epipaleolithic occupation of the area.

In the cave sites, the EP is very well represented, and in three of the four sites we found stratified Epipaleolithic assemblages. Also at Yabroud III, Layers 7 to 2 can be dated technologically to the Epipaleolithic (HILLGRUBER 2010), with the Natufian of Layer 2 being especially interesting as compared to Baaz, and the Falitian/Geometric Kebaran of Layer 3 as compared to Ain Dabbour.

2. Theories in prehistoric economy

For most of human history, human beings acquired their food through various means of hunting and gathering. Only within the last 10,000 years did human beings begin to produce food by cultivating plants and breeding animals, and turned away from a foraging subsistence (for overviews see e.g. PETERS et al. 1999, UERPMANN 1979, 2007, BAR-YOSEF 1990 and references therein). The period preceding this turnover in human economy, in the Levant, has been termed the Natufian, which is well documented in the stratigraphy of Baaz Rockshelter.

The Natufian has already been shown to be very different to the preceding periods with regard to many aspects of their culture (BELFER-COHEN 1991), a fact also expressed in the faunal remains. Nevertheless, the Natufians were also hunters-and-gatherers, as were their predecessors, and no form of food production has of yet emerged. It has been hypothesized that the factors steering the cultural changes towards the Natufian indicate the starting point for processes ultimately leading to food production (e.g. BELFER-COHEN 1991).

The Natufian, though, occurs mainly in the western branch of the Fertile Crescent, whereas the earliest Neolithic, when defined as a food producing economy (UERPMANN 1979), seems to occur further north, in the Upper Euphrates Basin. Whether the Neolithic economy could still be rooted in the Natufian will have to be discussed later in this work.

The Natufian will be treated here similarly to the Neolithic, using an economic definition. LUBBOCK (1865) introduced the term “Neolithic” to describe the period of ground stone tools. Researchers have since then discovered ground stone tools in earlier contexts. Their occurrence does not seem connected to any substantial changes in human lifeways. The term “Neolithic” has nevertheless remained in use to describe the youngest period within the Stone Age. It is clear, though, that this shift in human prehistory, which Lubbock was describing, was in need of a different definition. Although some authors still understand the term "Neolithic" as a "time period and not an economy" (BAR-YOSEF 2002), there is good reason to follow the approach of CHILDE (1936) who regards the economic changes as triggering cultural and social turnovers, making it the main criterion for the definition of the Neolithic period (for a detailed discussion of the difficulties in defining the term, see UERPMANN 1979).

The Natufian is noteworthy not only due to the occurrence of lithic lunates, but also due to the semi-sedentary lifestyle and the harvest and storage of wild cereals. Permanent structures become very frequent, occurring in many regions for the first time in the Natufian. These "houses" are typically D-shaped, and are often associated with large mortars for processing plant foods, especially wild cereals. This is well documented in sites like Ain Mallaha (GORING-MORRIS & BELFER-COHEN 2008).

UERPMANN (1979) considered the storage of wild harvests as the essential feature, differentiating the Natufian from earlier cultures. He used the term "Protoneolithic" to emphasize the strong similarity it shared with the early Neolithic way of life.

2.1. *Prey choice of hunters and gatherers*

Hunters and gatherers are here defined according to WINTERHALDER (2001) as "those peoples who gain their livelihood fully or predominantly by some combination of gathering, collecting, hunting, fishing, trapping, or scavenging the resources available." Other authors have used more narrowly determined definitions, but it is useful here to summarize all foraging economies within the scope of hunter and gatherers as a means of applying a term that stands in contrast to the food-producing-economies of the Neolithic and thereafter.

As the stratigraphies of the sites analyzed in the work below document human subsistence from the Middle Paleolithic onwards, they offer a good opportunity for us to investigate the development of subsistence patterns towards the Natufian. The trends observed can then be extrapolated into the early Neolithic, allowing us to determine whether food production (and especially the domestication of animals) is the logical consequence of the preceding trends in subsistence.

Many attempts have been made, both in terms of chronology and geography, to explain the variability in faunal assemblages. Models have been proposed to predict what leads foragers to choose or abandon a specific prey or inhabit or leave a specific area. Concerning the Paleolithic, many of the proposed models from the last few decades were influenced by neo-Darwinian theory.

The foraging theories adopted from behavioral ecology basically assume that humans, like other organisms, seek to optimize their effectiveness in energy (nutrition) acquisition. Foragers unconsciously weigh different options, choosing the option that seems most promising (LUPO 2007). According to this approach, a forager will abandon a resource if the encounter rate, and therefore the time and energy spent per acquired calorie, is expected to be higher in a different location or for a different resource (LACHER et al. 2002, WINTERHALDER 2001, LUPO 2007).

Change in subsistence patterns within one setting occurs, according to the optimal foraging theory, mainly through changes in the environment or through feedback-mechanisms between the environment and its exploitation by humans. Depending on the technological options of a group of foragers, the effort needed to acquire a resource can vary, therefore leading to variations in targeted species (BAR-YOSEF 2004). The influence of technology on prey spectrum is undoubted, and will be a point of discussion in the forthcoming chapters.

In Europe, the differences between the Late Middle and the Early Upper Paleolithic are evident in the material culture, and comparative studies between faunal assemblages have also discovered differences, although rather gradual (e.g. GRAYSON & DELPECH 2003, SOFFER 1989). An increase in the number of exploited taxa, especially small game, has been reported. The use of birds and fish also seems to be characteristic of the Upper Paleolithic.

A stronger specialization on single prey species has also been noted in the Upper Paleolithic, and was interpreted as indicating the possibility of selective hunting and greater planning depth by Modern Humans.

In the Levant, the situation is very different. The Middle to Upper Paleolithic transition is indeed a transition and not a break, as is the case in Europe. KAUFMANN (2002) notes very similar values of richness and evenness in the faunal assemblages of the Levant. Consequently, there does not seem to be a major difference in hunting strategies or subsistence patterns for Neanderthals and Early Modern Humans in the Levant in general. They both were effective hunters and not scavengers (SPETH & TCHERNOV 2001, KAUFMANN 2002).

The lack of clear changes in the faunal assemblages indirectly implies similar technological levels and hunting strategies by both archaeological groups. There are also similarities e.g. in the lithic technologies, and technological concepts of the Middle Paleolithic (which cannot be assigned exclusively to Neanderthals or Modern Humans in the Levant and Northern Africa) move almost uninterrupted into the Ahmarian (Upper Paleolithic) blade technology (BAR-YOSEF et al. 1996, BAR-YOSEF & KUHN 1999, COPELAND 2003, MARKS 2003, ŠKRDLA 2003, GORING-MORRIS & DAVIDZON 2006).

Technological innovations, which would strongly affect hunting strategies, such as the spear-thrower or bow and arrow, have only been securely documented for the Late Upper Paleolithic (STODIEK 1991, ROSENDAHL et al. 2006). Based on the faunal assemblages, it seems very plausible that they were not invented at a much earlier time period. Subsistence strategies do not seem to change considerably within the Upper Paleolithic of the Levant, but do so suddenly in the late Epipaleolithic, i.e. the Natufian.

BAR-YOSEF (1998) calls the Natufian a "socioeconomic threshold," thereby implying the importance of the Natufian as a first step towards the Neolithic Revolution. Much has been speculated about the emergence of the Natufian culture, but no consensus has yet been achieved. The sites analyzed for this thesis should add another piece to the puzzle, allowing for a broader picture to emerge.

Prey ranking

Predicting human behavior according to the models used in behavioral ecology (WINTERHALDER 2001) is reliant on identifying the ranks of prey species in the zooarchaeological assemblages (LUPO 2007).

Researchers rely on ethnographic and experimental studies in trying to establish generalized orders to assist them in ranking species in an assemblage. Higher ranked animals are defined as being more attractive to hunters than lower ranked species. In theory, hunters will only target lower ranked species if the higher ranked species are in any way difficult (energy-intensive) to access for hunting purposes.

An extensive overview of ranking systems has been determined by LUPO (2007). The many possible influences she lists for the individual rank of a prey are so manifold, and their crosslinking so complex, that it seems impossible to determine the prey ranking order for a society many thousands of years in the past.

A modern analogy can easily illustrate the problems connected with this approach:

Were ranking systems stable over even short periods of time, even from individual to individual, everyone who visits a specific supermarket would have the same things in his or her shopping cart every time. Asking the customers what influences their decisions, we would get very similar answers to those we can imagine for Paleolithic hunters-and-gatherers: personal (or other persons') preference for specific items, the available money (=hunting gear), the means of transportation of the goods, the storability, cost-performance-ratio, and so on.

Every individual will choose different items every time he/she goes shopping. And although in most cases the customers will go to the supermarket with a defined set of things in mind they want to buy, they will end up with a cart full of other things — some of them as alternatives to things which were not available, others chosen simply because they were offered or still others because of how they were advertised.

Predicting behavior according to rational ranking systems seems almost impossible under these circumstances, and the only generalization to which all scientists will agree to is the one that customers can only buy what is being offered and what they can afford.

Concerning the emergence of and the developments within the Natufian, Natalie Munro and Mary Stiner have applied a ranking system which is ordered mainly by the predator-defense mechanisms or cost-of capture of a specific prey (STINER & MUNRO 2002, STINER et al 2000, MUNRO 1999, 2003, 2004). As the main prey species rely on flight as the principal defensive mechanism, their ranking is based primarily on how fast they run. We have published a critique of this ranking system (NAPIERALA et al., in press a) as we consider its underlying assumptions as too simplistic.

The sites of El-Wad and Tabun (GARROD & BATE 1937) illustrate well how humans in the Middle Paleolithic were already able to hunt game such as gazelles, which are among the fastest runners, capable of outrunning every predator but the cheetah (ESTES 1991). The assemblage from Late Middle Paleolithic Kebara is similarly dominated by gazelle (SPETH & CLARK 2006), and in many other sites of the Levantine Middle Paleolithic, gazelle quantities follow closely that of fallow deer (YESHURUN et al. 2007).

Although gazelles are larger than hares, and their caloric return rate therefore higher in Munro's and Stiner's models, their flight distance is beyond that of hares by at least several hundred meters (THOULESS et al. 1991, ESTES 1991). Hares, in contrast, rely on their camouflage. It is indeed hard to spot them in rocky terrain or between spotty vegetation. Hares will not take flight until they feel discovered, a behavior that can be taken advantage of, if they are approached very carefully so as to slay them with throwing sticks, spears, stones, etc.

If hares were nevertheless not hunted regularly in the Middle Paleolithic and Early Upper Paleolithic, the reason for this cannot be based on the capability, or incapability, of humans or the quickness of the animals.

Resource stress and risk-sensitive adaption

By applying evolutionary foraging models to the faunal assemblages, researchers have tried to reveal some of the steering mechanisms behind socioeconomic changes, and to evaluate the influence of climate. That climate strongly affects the prey spectrum was already shown by GARROD & BATE (1937) and the famous correlation of the Gazella-Dama fluctuation of the Wadi El-Mughara sites with climatic episodes.

It has now been generally accepted that the late glacial interstadials, and hence the environment, play an important role in the emergence of the Natufian. BAR-YOSEF (1998) suggests that an "abrupt environmental change [...] necessitated a new approach to the way resources were exploited".

MUNRO (2003, 2004) and STINER et al. (2000) have similarly been addressing the topic of resource stress in their work on the Wadi Meged sites. They have explained the trend towards more small game through human population growth and consequent resource stress, thereby following the basic ideas of FLANNERY (1969) and COHEN (1977). They suggest that food shortages first led to the expansion of dietary resources towards small game and finally to the adoption of agriculture and animal husbandry.

Although I agree that understanding the causes for these peculiar Epipaleolithic subsistence patterns will push us a great deal forward in explaining the Neolithic Revolution, the explanation through resource stress is debatable.

Others have already criticized this approach with regard to animal domestication (UERPMANN 1972, BRAIDWOOD 1960), stressing the fact that shortages had existed in human prehistory before, and that the advantages of having domestic livestock would have been exploited if the possibility to do so had existed. This argument can be applied similarly to Natufian small game increase, adding further to the notion that resource stress would not have disappeared at the end of the Natufian.

Especially in early PPN times, with rising populations and the appearance of fortified villages, when cereals were already cultivated but animals had not yet been domesticated, an intensified need for animal proteins must have existed. None of the PPNA sites though have offered similarly high small game proportions as the Natufian sites.

Risk of failure

Resource stress very definitely occurred at the transition from the Pleistocene to the Holocene on a worldwide scale, simply because established subsistence strategies had to change in a changing environment. Change is stress, as predictability decreases and the risk of failure rises. WINTERHALDER et al. (1999) defined risk as the "unpredictable outcome in the variation of behavior." The definition is based on the assumption that the environment is stable, and the study by WINTERHALDER et al. (1999) investigates behavioral changes in respect to this.

I consider it important to realize that any environmental changes will similarly increase risk if behavior remains unchanged. This correlation is very important and has to be emphasized, as it also implies that increased mobility (resulting in a changing environment relative to human perception) also increases stress and is therefore an adaptive disadvantage.

Consequently, people would have always stayed within known territory and kept to established subsistence strategies as the predictability of resources is essential for hunters and gatherers without long-term storage practices. In fact, storage and sharing seem to be the most commonly observed strategies in reducing risk when resources are not stable WINTERHALDER et al. (1999).

As high mobility and storage are not compatible, a high predictability of resources is essential for mobile hunters and gatherers. UERPMANN (1979) considered the storage of plant foods as the essential innovation in allowing for permanent settlements with a receptive economy.

Depending on the degree of environmental change at the Pleistocene-Holocene transition, resource stress varied depending on the region. In Europe, with the disappearance of Pleistocene herd animals and an open, steppe-like environment, the stress was enormous. High mobility was necessary in finding the relatively territorial prey animals inhabiting a forested environment. In the preceding Magdalenian, the animals (reindeer, horse, mammoth) migrated, and humans could await their arrival, as soon as they had learned how to predict their movements.

In the Mesolithic, animals (red deer, aurochs) were more territorial and stayed within a relatively small area. Hunters had to migrate between these areas and were forced to leave after the area was exploited. To survive in a Mesolithic environment, the entire settlement strategy had to change, finally resulting in a much lower population density. The dramatic increase in small game, though, precedes this decline by at least three thousand years and coincides with the occurrence of large base camps and the flourishing of Magdalenian art in sites such as Kesslerloch (NAPIERALA 2008, HEIERLI 1907, MERK 1875, NÜESCH 1904) and Brillenhöhle (BOESSNECK & VON DEN DRIESCH 1973).

Climatic alterations also affected the Near East, but with very different consequences, in fact almost in complete contrast to Europe (UERPMANN 2007). While in Europe the late Pleistocene hunters lived in large basecamps, and had to increase their mobility with the onset of the Holocene, the spread of wild cereals in the Near East made reduced mobility possible. This notion is counter to the approaches cited above, as it indicates that the Natufian adaption was a positive reaction to new possibilities, and not a desperate reaction to resource stress.

The Natufian had an economy similar to that of harvest peoples in North America who relied on acorns. The wild cereals, which could be harvested in the Levant during one season, were probably so plentiful and the harvest so predictable that supplies could be stored for the rest of the year. It is not surprising, then, that mobility decreased, large settlements arose and art and symbolic objects appeared — the same correlation as in the Magdalenian of Europe, though with the one major difference that the occurrence of plants is even more predictable than the movements of herd animals such as reindeer. The climatic processes, which led to the end of the Magdalenian in Europe, only created the conditions that led to the Natufian in the Levant.

In the following chapters, the faunal assemblages of the four sites of Baaz, Kauz Kozah, Wadi Mushkuna and Ain Dabbour will be described in detail. The results of these analyses will later be synthesized, and they will be discussed with regard to the economic framework laid out above.

3. Methods

3.1. Excavation methods

The excavation procedures in the TDASP project have been adopted from the excavations conducted by the University of Tübingen's Institute of Pre- and Protohistory in the Paleolithic Swabian Jura, excavations that are also under the direction of Prof. N. J. Conard. The spectacular finds from Hohle Fels and Geißenklösterle Cave have led archaeologists to continuously improve and test excavation methods to reach the highest possible resolution within the available amount of time. Many TDASP team members have already participated in N. J. Conard's Swabian excavations and were familiar with the procedures.

Excavations were generally dug in layers and quarter square meters. All identifiable faunal remains recovered were directly recorded in three dimensions with a laser theodolite. Among the non-diagnostic pieces, all bone fragments larger than 5 cm were similarly recorded. The smaller finds, as well as the sediments within a quarter square, were collected in a 10-liter bucket, and a collective measurement of the excavation height ("z-value") was taken in the center of this quarter square. In general, the sediments of a 10-liter bucket would equal about three centimeters of excavation height. The maximum error in the recorded collective position is theoretically half the diagonal of a quarter square meter, i.e., 35 cm in the horizontal plane, and 1.5 cm in the vertical ("z-axis").

In all sites, the sediments from the buckets were then carefully sieved to recover even the smallest finds, e.g. small ornaments which were expected especially in the Epipaleolithic units. The lowest mesh size was 2.5 mm.

This procedure proved successful, not only for the ornaments, but even more so for the fauna: some of the smaller species would have been missed without sieving. This is especially important in the case of the fish bones, which are a valuable environmental indicator, producing some surprising results (NAPIERALA et al., in press b). The sieving, though, also increased the amount of small bone fragments, which tend to be overlooked by the primary excavators. These fragments were, for the most part, impossible to identify, despite the occasional fishbone, small rodent or hare bone. Also, a number of pieces of tortoise shells were usually among the finds recovered in sieving.

As expected, the sieving increased the number of finds from small species in relation to large species, therefore altering the quantitative results. Looking simply at NISPs makes it problematic in comparing sites with different excavation methods or different taphonomy. The latter is due to the fact that different taphonomic processes result in different fragmentation grades and therefore, different recovery rates. Interestingly though, if quantified by weight, the quantitative ratios are not strongly biased. This is due to the fact that the rare, identifiable large species among the finds from sieving weigh many times more than the numerous small finds from hares and tortoises. These two factors—fragment weight and recovery frequency— seem to balance each other out.

3.2. Measures of abundance

This factor alone already confirms the preference of bone weight for most statistical analysis. However, finds were also counted (NISP), and most quantitative information will be presented in both ways.

Dexter Perkins saw the issue of "economic importance" as the "most important objective" of zooarchaeology (PERKINS, 1973). Although zooarchaeology has strengthened due to numerous additional means of analysis, subsistence can still be considered among the main issues of zooarchaeological research.

Different researchers have preferred a variety of quantification methods, creating a problem when comparing different assemblages. Each method has its own problems, most of them being due to some amount of variability in contributing factors:

The NISP is partly problematic due to different numbers of skeletal elements between species and by age of the individual (PERKINS 1973). Also, some authors have considered it critical to evaluate whether more than one bone came from a single individual. While Perkins worked under the assumption that each bone was from a different individual, others have preferred the use of MNI as a possible way for overcoming this bias.

KUBASIEWICZ (1956) and UERPMAN (1972) promoted the use of bone weight, as it relates to a certain degree the weight of the find to former biomass and hence, economic importance: Larger animals that provide more food have larger bones. Interestingly, the ratio of bone weight to live weight is relatively stable in wild mammals. Usually around 7-8% of the body mass of an animal belongs to the bones (KUBASIEWICZ, 1956).

This often cited ratio was evaluated with the available records of reference skeletons, with known live weights, in the University of Tübingen's osteology collection. It was not always clear whether the actual live weight had been recorded, or the weight of the gutted animal. Some of the variance might be attributed to this circumstance, as well as to some other minor technical problems. For the skeletal weight, the horns, for example, were usually drawn from their bone cores and not included in the skeletal weight. This was not possible in the case of an Ammotragus, raising its weight by approximately 2,5kg. Unfortunately, most animals were not fully adult, a circumstance which is consistent with archaeological assemblages on the whole.

Despite all these drawbacks, the skeletal weight ranged mostly between 6 and 9 percent of the live weight, with some extremes of 3 or 11 percent (tab. 1). It is clear that this

tab. 1. Relation of animal live-weight and boneweight in specimens from the reference collection in Tübingen.

inv.no.	**species**	**sex**	**age**	**live-weight [kg]**	**skeletal weight [kg]**	**weight ratio [%]**	**comment**
MU41	*Martes foina*	m	subadult	1,7	0,08	5,0	
AT14	*Antilope cervicapra*	f	adult	15,0	1,50	10,0	
AT15	*Antilope cervicapra*	f	juvenile	10,0	0,81	8,1	
AT16	*Antilope cervicapra*	m	juvenile	14,5	1,11	7,7	
AT17	*Antilope cervicapra*	f	juvenile	14,0	1,28	9,2	
AT18	*Antilope cervicapra*	m	juvenile	10,0	0,78	7,8	
AT20	*Antilope cervicapra*	m	adult	24,0	2,05	8,5	
CP100	Ovis	f	adult	24,5	1,08	4,4	
CP101	Ovis	m	adult	30,0	1,14	3,8	
CP47	*Ammotragus lervia*	f	juvenile	31,0	1,97	6,3	
CP34	*Ammotragus lervia*	m	adult	12,0	0,94	7,9	
CP35	*Ammotragus lervia*	m	adult	124,0	13,82	11,1	incl. horns
CP36	*Ammotragus lervia*	m	adult	111,0	6,75	6,1	
CP48	*Ammotragus lervia*	f	juvenile	32,0	1,88	5,9	
CP58	*Ammotragus lervia*	f	infantile	19,0	1,03	5,4	
SU93	*Sus scrofa*	NA	juvenile	16,0	1,28	8,0	
FE20	*Panthera leo*	f	infantile	1,2	0,04	3,5	
FE21	*Panthera leo*	f	infantile	1,0	0,03	2,8	
FE27	Catus	m	adult	4,0	0,24	6,1	
FE29	*Lynx lynx*	f	adult	7,7	0,85	11,0	
MU20	*Mustela putorius*	m	adult	0,9	0,06	6,8	
SU78	SUS x *Sus scrofa* (1:3)	NA	juvenile	4,0	0,30	7,4	

variability is considerably less than the variability in bone breakage, i.e., in how many identifiable pieces (NISP) a complete bone can be broken into at any given site. The pattern observed in the data shows the younger the animals, the lower the ratio. The weight ratio is also lower in domestic animals and higher in carnivores. The wild, adult ungulates, which we usually encounter in Paleolithic assemblages, group very tightly in between, with a variance of only 4-5%.

The ratio between wild mammal bone weights in an archaeological assemblage consequently resembles the rough ratios of food that these animals formerly provided (KUBASIEWICZ 1956, UERPMANN 1972). It has to be stressed, though, that this does not imply, as seen in some MNI-based calculations, former absolute values.

In fact, any attempt to estimate the former number of animals slaughtered at a site probably underestimates their number. A well-known example, which strongly illustrates this point, is the analysis of Fort Ligonier by GUILDAY (1970), who showed that the number of animals as MNI would have sustained the fort's garrison for a single day only (CRABTREE & CAMPANA 1989). Bone loss must be assumed to be many magnitudes higher for assemblages of Paleolithic age.

Additionally, all methods connected to minimum numbers (MAU, MNI, MNE...) usually face the problem of values increasing in a non-linear fashion. This is simply due to the limits of comparing finds directly with each other, i.e., the larger the assemblage, the greater the possibility of overlap among finds. Researchers will always have only so much space available for spreading out finds in order to observe and compare them. Time is also limited in most cases, and comparing each find with hundreds of others is time consuming. Therefore, minimum numbers are somewhat subjective, depending heavily upon the available space, time and the individual assessment of the researcher.

The use of diagnostic zones, as e.g. special foramina, and computer-based statistics provide one possibility for handling and simplifying comparative analysis. Still, other methodological problems exist:

Site taphonomy, especially the amount of loss is the most difficult to assess. This also concerns the bone weight and NISP, although we assume that taphonomic effects are similar on all bones within one taphonomic unit. In a whole stratum then, differences will level each other out and produce relative weights, which are still close to the original ratios. Looking at the distribution of skeletal elements within an assemblage also allows us to estimate whether a shift in relative bone weights has occurred. Chemical weathering and dissolution by soil-forming processes will alter bones of low density more adversely than the hard and dense tissue of teeth or the pars petrosum of temporal bones. Consequently, in a heavily corroded assemblage, remains with hard tissue will be overrepresented with regard to a complete skeleton.

Alternatively, the physical weathering which occurs through insulation and the resulting thermal stress, especially in hot, arid climates, will more strongly affect hard tissue and will lead to an overrepresentation of vertebras and short bones (CONARD, et al., 2008).

The assessment of skeletal part representation can also be carried out on bone weights, as will be shown below.

Returning to minimum calculations, taphonomy becomes more problematic. First of all, the taphonomy of a settlement area is usually a palimpsest of many occupations, with a single stratum at times covering thousands of years. In such an open archaeological context it is impossible to estimate what part of the former bone assemblage is preserved.

In fact, not a single bone might be present for many animals, because remains were not covered quickly enough through sediments, because they were removed from the settlement area, or because they are located in the unexcavated part of the site. Although these factors might be clear to the zooarchaeologist, other researchers who are using the data are often mistaking minimums as the actual values, calculating MNIs by live weights to estimate food values. This is very different in closed contexts, which were, e.g., intentionally covered by soil, as would have been the case for graves. Here it is important and methodologically unproblematic to evaluate the number of individuals which were formerly present.

A second problem includes the archaeological division of sites, a problem that could be linked to taphonomy: excavators define layers, units and features. Minimum numbers are calculated within the divisions, and while in one stratum the MNI might be highest in the lower third molar, in the next stratum it might be the distal tibia. If researchers decide, for example, after micromorphological analyses or radiocarbon dating, that two divisions should be treated as one, then the new MNI will not be the sum of both former numbers! Or conversely, if a layer has to be subdivided, then the MNI will suddenly rise.

This demonstrates that any minimum calculation is not proportional and linear, making comparisons impossible. Moreover, since almost every single bone might be from a different occupation, now assembled within one layer, we should in fact calculate the MNIs for each occupation individually, counting almost each bone as an individual. We observe this in cases involving rare species: in many assemblages there are a couple of species represented by only one tooth or one phalange. The smaller the assemblage, the higher is the ratio of individuals per finds, leading to a disproportional dependence of NISP and MNI.

In summary, bone weight is for most quantitative evaluations the least problematic evaluation strategy. It is also objective and easy to apply.

In case of environmental reconstruction, where it is more interesting to know the quantitative ratios of individuals rather than how much food they provided, the NISP is the most appropriate approximation to former numbers. We need to keep in mind that the animal spectrum in an archaeological site is not a representative sample of the environment. Human selection and taphonomic processes are potentially involved.

3.3. *Measures of size and age*

Toothwear and epiphyseal fusion

Several factors deserve special attention when we consider the issue of animal domestication, although for most units, due to their age, animal domestication is irrelevant.

Animal size and the age and sex-demography were carefully documented. Toothwear-stages of teeth were recorded according to PAYNE (1973) for sheep and goat, and MUNRO et al. (2009) for gazelle. Using Munro was a compromise decision, since this work was concerned with Levantine mountain gazelle (Gazella gazella), whereas the goitered gazelle (Gazella subgutturosa) is present in the TDASP sites. Also, crown heights were measured among other tooth measurements as suggested by HELMER (2000). Unfortunately, preservation conditions were not ideal for teeth. Most teeth were heavily fragmented and only 2-3 teeth from each level were ageable. These teeth were from adult individuals with very few exceptions. The same applies to epiphyses, which were mostly fused.

LSI

Metric comparisons within and between assemblages are often restricted by preservation conditions. An elegant way to enlarge the statistical sample is by applying logarithmic size indices (LSI), allowing for comparison among different skeletal elements. The method goes back to the work of DUCOS (1968), and was further developed by UERPMANN (1979, 1982) and MEADOW (1981). The logarithmic measurements of a comparative specimen are subtracted from those of an archaeological specimen. If the difference is positive, the animal represented by the archaeological specimen was then larger than the reference specimen.

The mean is then calculated for all measurements on one specimen to produce one representative log-index. It is important to leave out length-measurements in this calculation, since stouter animals have wider but often relatively shorter extremities. The indices of length and width/breadth would subsequently level each other out, producing then a meaningless mean value for the specimen.

The reference individual is an adult wild sheep from western Iran, stored in the Field Museum of Natural History in Chicago under the registration code 57951. It was measured and published by UERPMANN (1979). The measurements of this specimen are given in tab. 2, along with values not included in the LSI-calculation for reasons mentioned tab. 2. Measurements (mm) of the reference individual for sheep LSI-calculation, an adult female wild sheep from western Iran, housed in the Field Museum of Natural History in Chicago, registered as specimen 57951 (see also Uerpmann, 1979).

	SLC	GLP	LG	BG			
Scapula	19,5	33	26	22			
	Bd	BT	KD	Bp	Tp	GLC	GL
Humerus	33	29,5	15,5	44	46,5	143	160
	Bp	KD	Bd	GL	BFp	BFd	
Radius	33,5	16	31	171,5	30,5	25,5	
	BPC	TPA	GL				
Ulna	19	27,5	207,5				
	Bp	Tp	KD	Bd	Td	GL	
Metacarpus	25	17,5	14,3	26,5	16,6	147	
	Bp	KD	Bd	GL			
Phalanx 1, anterior	13,2	10	12,5	38,5			
	Bp	DC	KD	Bd	BTP	GLC	GL
Femur	48	21,1	17,5	39,5	19,5	187	196,5
	Bp	KD	Bd	Td	GL		
Tibia	42,5	16	26,5	20,5	231,5		
	Ll	Lm	Tl	BC			
Talus	31,3	29,3	17,4	19,6			
	GL	GB	GT				
Calcaneus	64	20,5	24,5				
	Bp	Tp	KD	Bd	Td	GL	
Metatarsus	22,5	22,5	12	26	17	164,5	
	Bp	KD	Bd	GL			
Phalanx 1, posterior	13,1	9,2	11,5	40			

above. If it was not possible to determine whether the remains were anterior or posterior, as in the case of metapodials or phalanges from among the archaeological specimens, the mean value of the respective anterior and posterior measurements of the reference specimen was used in the calculation. Unfortunately, no comparative data for second phalanges were available, although they are often well preserved in the archaeological material.

The "Variability Size Index" (VSI), developed by UERPMANN (1982), offers some mathematical advantages but is not applicable due to the lack of a reference population. This method will therefore not be discussed in further detail.

Results are best plotted as a combination of a boxplot with Kernel density estimations, as schematically explained in fig.1. The horizontal boxplot with quantiles provides some insight into the variability of values. The mean and median are in a large and representative sample identical, meaning that their distance from each other indicates the reliability of the results. The density is calculated with a bandwidth, which is computed by the Silverman-rule-of-thumb, which has proven to produce the best smoothing of the curve, without eliminating bimodality. The bimodality that is often observed is an indication of sexual dimorphism or more generally, two subpopulations of different size (weight).

Bimodality can also indicate wild versus domestic animals, which is especially interesting when investigating domestication events. If wild and domestic animals reveal only little size difference, and wild females have similar LSI-values as domestic males, then the bimodality disappears or, in an ideal case, produces a curve with three peaks. Through the height of the peaks, a rough estimate of the numerical relationship of the different groups/subpopulations is possible. For example, a decrease in the number of males in a sexually dimorph species would produce lower medians and means, although the absolute size of the animals of each group stays the same.

3.4. Statistics and software used

For all statistics, plots and diagrams, the software "R" was used. Simple calculations were made within the main database in MS Access. The initial cataloging of finds was made in KNOCOD, a software program especially created for the analysis of zooarcheological

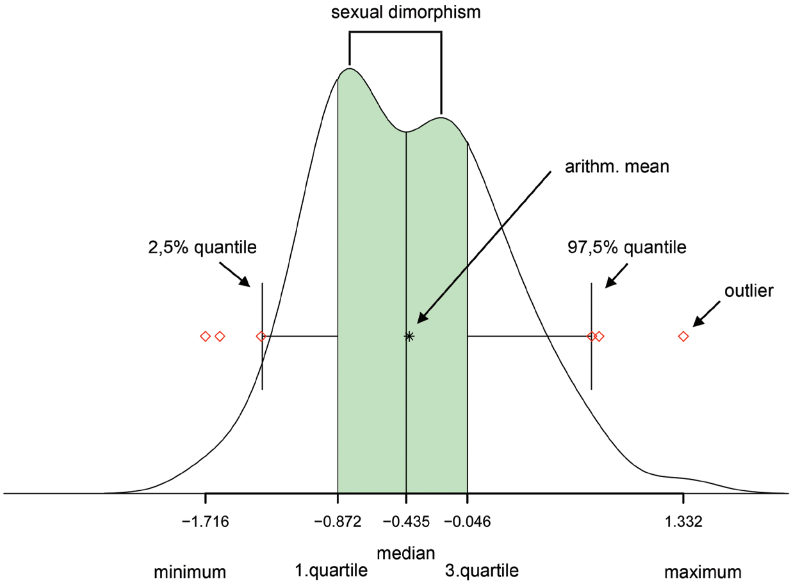

fig. 2. Explanation of the combined density estimations and boxplots to display the LSIs.

assemblages. In fact, it was the first software of this kind, developed by H. P. UERPMANN in the 1970s. With only minor modifications, the program is still very stable and highly appreciated by the institute's staff.

ESRI ArcMap was used to display information in a geographic context.

3.5. Some notes on identification

Specimens identified to at least subfamily (e.g. Caprinae) are considered as "identified" specimens in mammals. The identification of fish and birds is more difficult, and an identification level of "family" is already considered as "identified" (e.g. Cyprinidae, Phasianidae). The same applies for reptiles and amphibians. Consequently, only these will be included in the NISP (number of identified specimens). The NISP is treated differently in the literature. While some also include pieces that have only been categorized by rough size classes, it seemed necessary here to restrict most statistics to only those of well identified specimens. The small to medium-sized ruminants, which are of special interest to the issues addressed below, are unfortunately so diverse that a find from this generalized category is of little value for the final analysis.

The following details are meant to explain some further difficulties in taxonomy and identification, which might be familiar to the zooarchaeologist, but which require explanation for readers from other archaeological disciplines.

Dog (CANIS)

Dogs can be expected in assemblages from the Epipaleolithic and younger periods. Among the assemblages, Kaus Kozah has a relatively high number of dog bones worth noting. Dogs must also have spent some time living in the cave as can be concluded from a number of chewed and digested bones.

Some difficulties in the morphological determination arise from the fact that another medium-sized canid, the golden jackal (*Canis aureus*), is (or at least was) common in the area. In size, a large jackal can equal a primitive dog, and not all skeletal elements allow for a morphological distinction. On many fragments, though, it could be noted that the canids in the assemblage are larger than jackals but smaller than a wolf. Morphologically, the incisors, for example, are somewhat different: In *Canis aureus*, the lower incisors have a convex buccal surface; they are rather flat in dogs. This is observed in a find from AH I (square 50/37, #51). The jackal is generally more gracile and resembles a very large fox in many postcranial elements.

Hare

The hare is a widespread species, occurring from northern Europe to southern Africa with relatively little morphological difference. Attempts to differentiate species morphologically were undertaken, under the general assumption that populations so far from each other should differ in some respect.

Defining the two extremities as *Lepus europaeus* (European Brown Hare) and *Lepus capensis* (Cape Hare) produced yet another problem: Where was the limit of these species to be drawn, and regarding the research area of this study, to which species belonged the hares of the Levant, at the "bottleneck" of the geographical extremities? Recent genetic studies have revealed that Leporids are far more diverse genetically than one would expect according to their uniform appearance.

The fact that I chose to call the hares in this work *Lepus europaeus* is due to the fact that, looking at the species represented in the sites, the fauna is dominated by Eurasian species, with only few examples found to be of formerly African origin. With regard to site interpretation, this taxonomic question is meaningless. Other authors call the Levantine hares Lepus capensis, but the animals are essentially the same.

Small ruminants

A large number of finds were classified as small ruminants due to the lack of diagnostic criteria. In other regions, the small ruminant category contains only one or two plausible species and, depending on size and probability, the researcher can often make a good guess as to how to classify finds from this category.

Our research area is problematic in this respect. The gazelles are large and overlap in size with domestic caprines (Ovis and Capra) and roe deer (*Capreolus capreolus*). Large domestic sheep and goat overlap with their wild forms (*Ovis orientalis, Capra aegagrus*), small fallow deer (*Dama mesopotamica*) and medium-sized antelopes, such as the hartebeest (*Alcelaphus buselaphus*), which could have once populated the region. There is also the possibility that other species of antelope might have occurred in the area during prehistoric times.

Tooth fragments were often not identifiable beyond the small ruminant category. In fact, only relatively well-preserved teeth could positively be identified as sheep or goat, because they lie in the size class with the greatest overlap with other species, and small fragments are morphologically difficult to distinguish from those of other medium-sized bovids. Since teeth from small gazelles and especially cervids are relatively identifiable, it is very probable that most of the teeth in this category are indeed from sheep and goats (in both their wild and domestic form). Still, the finds of this category are considered "unidentified" due to the remaining uncertainty and are therefore of little use, unfortunately, for the interpretation of the site.

Sheep and goat

On most skeletal elements, the differentiation between sheep and goat is possible with some statistical probability (BOESSNECK et al. 1964). The larger the fragment, the more likely it becomes that diagnostic criteria can be combined into a highly probable identification. The bone fragmentation at most sites in arid regions in general, and our research area in particular, is strong, and diagnostic features are often damaged. Therefore, identification was only possible for a small portion of caprine remains.

Equally, few bones were measurable, leading to the fact that in many cases we have no metrical data to help us in the identification of wild vs. domestic forms. Despite the lack of measurements, some bones were so large in comparison to the skeletons in our reference collection that they were classified as a wild caprine.

Most finds though, even if measurable, could not be classified. The available measurements for each site were analyzed taking this into consideration. The undisturbed Paleolithic units (e.g., Wadi Mushkuna IV, or Baaz III), representing time periods when domestication had not yet occurred, can be used as the wild reference group for PPN, PN or possibly disturbed units in which both forms might be present.

Microfauna

Microfaunal remains usually have a different taphonomic origin than the large mammals. The identified small rodents (Muridae), songbirds (Passeri), reptiles (Agamidae and Serpentes) and amphibians (Anora) are usually too small to justify the effort in hunting them. This does not mean that they were never eaten. Most of these small animals, though, usually found their way naturally into the cave. An exception is probably the mole rat (*Spalax* cf. *ehrenbergi*), which will be discussed later.

3.6. *species*

The identified species are listed here in systematic order with both latin and common names. In the following quantitative tables, species are ordered alphabetically by their common names to facilitate orientation for archaeologists without detailed zoologic knowledge.

Mammals

- order Insectivora
    - family Erinaceidae
        - ***Erinaceus europaeus*** (european hedgehog)
        - ***Hemiechinus auritus*** (long-eared hedgehog)

- order Chiroptera
    - family Rhinolophidae
        - ***Rhinolophus*** sp. (bat)

- order Lagomorpha
    - family Leporidae
        - ***Lepus europaeus*** (brown hare)

- order Rodentia
    - family Spalacidae
        - ***Spalax cf. ehrenbergi*** (blind mole rat)
    - family Dipodidae
        - ***Allactaga*** sp. (jerboa)
    - family Cricetidae
        - ***Microtus*** sp. (vole)
        - ***Cricetulus migratorius*** (grey dwarf hamster)
    - Familiy Muridae
        - ***Meriones*** sp. (jird)

- order Carnivora
    - family Ursidae
        - ***Ursus arctos*** (brown bear)
    - family Canidae
        - ***Canis lupus;* CANIS** (wolf; dog)
        - ***Vulpes vulpes*** (red fox)
        - ***Vulpes ruepelli*** (Ruepell's fox)
    - family Mustelidae
        - ***Martes sp.*** (marten)
        - ***Meles meles*** (european badger)
        - ***Vormela peregusna*** (marbled polecat)
    - family Felidae
        - ***Panthera pardus*** (leopard)
    - family Hyanidae
        - ***Hyaena sp.*** (hyena)

- order Perissodactyla
    - family Equidae
        - ***Equus ferus***; **Caballus** (wild horse; domestic horse)
        - ***Equus africanus***; **Asinus** (african wild ass; donkey)
        - ***Equus hemionus*** (onager)

- order Artiodactyla
    - family Cervidae
        - ***Capreolus capreolus*** (roe deer)
        - ***Cervus elaphus*** (red deer)
        - ***Dama mesopotamica*** (fallow deer)
    - family Bovidae
        - ***Bos primigenius;*** **Bos** (aurochs; cattle)
        - ***Capra aegagrus;*** **Capra** (wild goat; domestic goat)
        - ***Ovis orientalis;*** **Ovis** (wild sheep; domestic sheep)
        - ***Gazella subgutturosa*** (goitered gazelle)
    - family Suidae
        - ***Sus scrofa***; **Sus** (wild boar; pig)

Birds

- order Galliformes
    - family Phasianidae
        - ***Coturnix coturnix*** (common quail)
        - ***Alectoris chukar*** (chukar partridge)
        - **Gallus** (domestic chicken)

- order Falconiformes
    - family Accipitridae
        - ***Circus*** sp. (harrier)
        - ***Aquila*** sp. (eagle)
- order Strigiformes
    - family Strigidae
        - ***Bubo bubo*** (eagle owl)

- order Gruiformes
    - family Gruidae
        - ***Anthropoides virgo*** (demoiselle crane)

- order Columbiformes
    - family Pterocleidae
        - ***Pterocles*** sp. (sand grouse)

- order Passeriformes
    - family Corvidae
        - ***Corvus cf. cornix*** (hooded crow)

Fish

- order Cypriniformes
    - family Cyprinidae
        - ***Capoeta*** sp.

- order salmoniformes
    - family Salmonidae
        - ***Salmo trutta fario*** (brown trout)

Reptiles

- order Testudines
    - family Testudinidae
        - ***Testudo graeca*** (spur-thighed tortoise)

4. Geographical setting

4.1. Site locations

The sites from the TDASP excavations, discussed in this thesis, are located roughly 35 km north of Damascus, Syria, in the eastern ridges of the Anti-Lebanon Mountains. The sites in this area bridge the gap which had developed— probably for political reasons— between the sites in the Southern Levant and those in Northern Syria and East Anatolia.

The sites which will be analyzed metrically with regard to animal domestication extend the scope of this work to other parts of the Fertile Crescent, which stretches along the foothills of the western Zagros and southern Taurus mountains, from Iran and Iraq to Syria, Turkey, Lebanon, Israel and Jordan.

4.2. Landscape and geology

The TDASP research area covers a highly diverse landscape, from elevations of more than 2000 m a.s.l. in the Anti-Lebanon, to the eastern steppes and deserts at ca. 800 m a.s.l. (fig. 3)

The limestone cliff, in which Baaz and Kaus Kozah are situated, rims the Al-Majar Basin, which can be considered the heart of the research area. This basin is a tectonic syncline, which was formed through the course of uplift of the Lebanon and Anti-Lebanon Mountains. The limestone ridges to the east of the Anti-Lebanon comprise mainly Tertiary rocks, and the cliffline itself is dated to the Oligocene (DODONOV 2006).

The outlet of the Al-Majar Basin is near the town of Yabroud, where the largest natu-

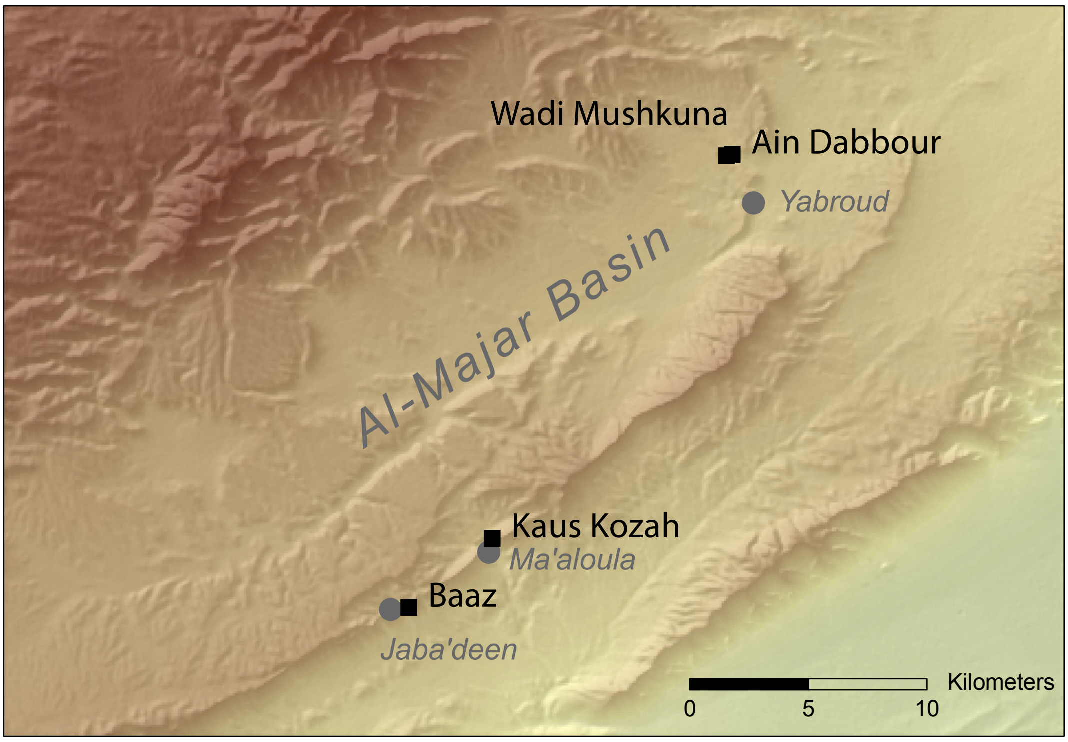

fig. 3. The location of the four TDASP-excavations (squares).

ral springs are located. Today, the landscape has suffered severely from overgrazing by sheep and goats, and the barren soil can hold only little water. Any precipitation immediately flows off the surface, furthering the erosion of the remaining soil. Consequently, the landscape looks more arid than the climate would dictate. An account of what the landscape looked like prior to the intensive anthropogenic impact can be found in old reports such as the one by William WRIGHT (1895), who wrote the following passage about Yabroud in his "Account of Palmyra and Zenobia with Travels and Adventures in Bashan and the Desert":

> *In a quarter of an hour I had got up out of the amphitheatre or basin, at the bottom of which Maloula stands, and just as I gained the level plateau I came on a party of very savage-looking men [...]. A ride of three hours over swelling hills, with a range of slate-coloured mountains on the right, and a wide red plain stretching away to distant mountains on the left brought us to a gorge in the mountain choked with vegetation. Beyond the gorge, high over the green, rose a curious conical hill, white as snow, called Ras el-Kowz. At the base of this hill stands Yabroud [...]. I entered the town past a beautiful fountain which pours its wealth of waters through the village and gardens, creating a little paradise among the parched hills. (WRIGHT 1895)*

This paradise surely attracted people (and animals!) ever since, and it is very probable that even during the driest phases of the Pleistocene, the large Al-Majar Basin still "collected" enough water to keep the springs at Yabroud flowing.

Springs also exist at Ma'aloula and Jaba'deen, pouring from the base of the cliff into wadis which disappear somewhere in the eastern desert. Ma'aloula and Jaba'deen have been built at places from which the highlands can be accessed through narrow gorges or passages in the cliffline.

These passages also act as gullies by which the sediments of the highlands are eroding, creating the "amphitheatre" which WRIGHT (see quotation above) mentions. The gullies also give an impression of the immense quantities of Pliocene and Pleistocene sediment, which fills the Al-Majar Basin.

At some point in time, the gully of the "amphitheatre" at Ma'aloula must have been blocked, preventing surface water from draining through the gorge into the wadi below. Lake sediments containing lithic artifacts indicate that a temporary lake had developed here (DODONOV 2006). A date on a gastropod shell from these sediments reveals an age of 35.730 + 800 / -730 BP, which is almost contemporaneous to the oldest dates from Baaz. Surprisingly, the much closer site of Kaus Kozah did not contain evidence of an Early UP occupation.

Abundant lithic raw material occurs with high diversity in the entire TDASP research area, mostly including varieties of chert. These raw materials are most frequently found in natural outcrops of the lowlands to the east of the cliffline. The outcrops are often located along the hilly ridges that formed through the selective erosion of the asyncline, to which the main cliffline also belongs.

These geomorphologic features, which produce clear zonation of the landscape, were used to define units within the research area (fig. 4). These units were helpful in the analysis of survey data and in understanding settlement patterns.
As a summary of the main geomorphologic features, I quote the TDASP report from 2004 (CONARD et al. 2004):

1. The highland plateau formed on Pliocene conglomerates with thick calcrete at the top tilting slightly downward toward the northwest
2. The highland hills formed on Pliocene conglomerates
3. The resistant Oligocene limestone that forms the Ma'aloula – Jaba'deen cliff-line
4. The slope at the base of the cliff covered by Late Pleistocene and Holocene colluvium
5. The lowland hills formed on Eocene marl and limestone and Middle Quaternary conglomerates
6. The lowland plain formed on the Middle Quaternary proluvial conglomerates tilted slightly downward toward the southeast.

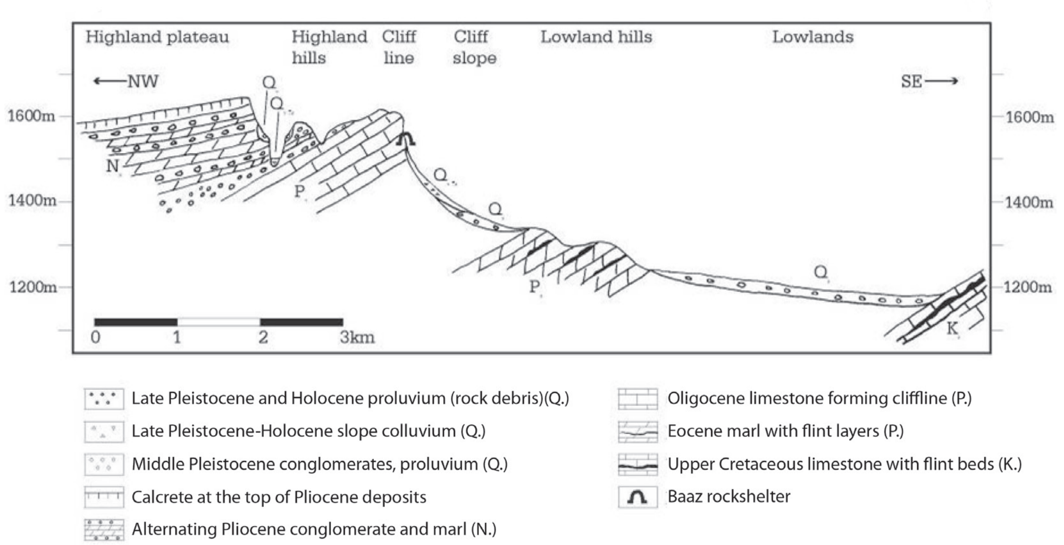

fig. 4. Geomorphologic cross section through Baaz Rockshelter (DODONOV 2006).

4.3. *Climate*

Our knowledge of past climates is essential in understanding human settlement dynamics. Temperature, precipitation, and their distribution within the yearly cycle affect vegetation and consequently the animals that are available for human predation. The daily availability of water is also crucial for humans and for many animal species.

Especially in an area like the one under study, on the margin of today's deserts and at the very limit of environments suitable for hunters and gatherers, a slight shift in climatic conditions could have dramatically altered the living conditions for animals and human beings.

Climate records for our research area exist in various forms. We have our recent direct and individual experiences, which are not objective and cover only a very short period of time. But we must acknowledge that, although past populations had no means to measure atmospheric pressure and the like, they would surely have had an opinion on whether the climate was pleasant or not, just as we do today. Especially with regard to our estimation of site seasonality, our personal impressions can prove to be valuable.

Recent climatic data exists from the Meteorological Department of Syria. Annual data for temperature and precipitation are available for the years 1959-1974 through the NOAA Climate Database Modernization Program. According to these data, current annual precipitation averages 240 mm measured at nearby Ma'aloula between 1959 and 1974. Due to the geographical situation near a mountain chain, precipitation varies considerably

fig. 5. Kaus Kozah. Drops of water reactivate small stalagtites during wet periods, as in fall 2009. Photo: Andrew Kandel

in both spatial and temporal scales. The TDASP research area lies in a sharp precipitation gradient, decreasing significantly from west to east. Slight changes in the general climatic situation therefore strongly affect the hydro-geography around the sites. In wet years, Ma'aloula regularly experiences more than 300 mm of precipitation (with an extreme of 366 mm in 1969), but suffers from drought when precipitation drops below 150 mm (as in 1959 and 1973 with 114 and 141 mm, respectively).

Paleoclimatic archives exist in the form of speleothems and the ratios of stable isotopes preserved in them. Kaus Kozah itself has stalactites on the ceiling, but no stalagmites have yet been observed and therefore no isotope study has yet been undertaken. In modern times, yearly growth does not seem to occur. Only during very wet periods do we observe some dripping (fig. 5).

Well-studied speleothems are from the Southern Levant, especially Soreq Cave (BAR-MATTHEWS et al. 1997, BAR-MATTHEWS et al. 1999) and Ma'ale Ephraim Cave (VAKS et al. 2003). There has been some criticism on whether the isotope ratios in the speleothems are in fact representative of ratios in precipitation, and if plants and soils above the caves do alter the isotopy. A problem lies also in the dating of the speleothems, which still has a standard deviation of several hundred years (BLOCKLEY & PINHASI 2011).

Somewhat farther away are the Sea of Galilee, the Dead Sea and former Lake Lisan, which also responded to climatic changes with fluctuations in their lake levels. Their limnological histories have therefore also been interpreted according to climatic trends in prehistory (HAZAN et al. 2005). A major problem though is the dating of ancient shorelines and limnological features, making it difficult to detect short climatic episodes.

Drillings from lake or sea bottoms also exist, providing paleoclimatic data through pollen ratios or sedimentation histories. As with most of these records, the dating is often problematic, usually undertaken by trying to identify (seemingly) established paleoclimatic trends within the drilling core. The cores from Lake Hula, the Ghab and Dor have been well studied (KADOSH et al. 2004).

According to these studies, it is commonly believed that cold phases (stadials) lead to an aridification of the Levant, as evaporation and precipitation decrease. This relationship will be addressed in the discussion of the results of this analysis.

5. Baaz Rockshelter

5.1. *Excavation and stratigraphy of Baaz*

Baaz was discovered in 1999, in the initial phase of our project's research in Syria. It was then excavated in three campaigns until 2004 (fig. 6).

At Baaz, seven archeological horizons were defined, with several subdivisions (fig. 7). To provide a representative sample, the subdivisions were not individually analyzed with regard to the faunal remains. A narrower analysis would, though, be possible by using the main excavation database if micromorphologic studies, for example, or later excavations suggest the necessity of this approach.

The deposits are somewhat split into two principle parts. The lower part, AHs VII-IV, consists of geogenic sediments, which are all Upper Paleolithic in age. The upper part of the stratigraphy is Epipaleolithic and younger, and comprises large amounts of an-

fig. 6. Baaz Rockshelter. View along the cliffline and down onto the wadi and the road leading to Jaba'deen further to the right. The site had to be protected by a cage against looters. Photo: Andrew Kandel.

thropogenic deposits. Most striking is the Natufian house floor uncovered here, made of clay that was carried in from the wadi below or the highland plateau above the site (STAHLSCHMIDT 2010).

The sequence begins with AH VII, for which two radiocarbon dates (tab. 3) on charcoal exist (CONARD 2002, DECKERS et al. 2009). Both dates place this layer in an Early Upper Paleolithic time range. The technological and typological analysis is under way, and the affiliation to either an Ahmarian or Levantine Aurignacian has not yet been observed (BRETZKE pers. comm.)

The layer above, AH VI, has the lowest number of finds and, as with AH VII, contained

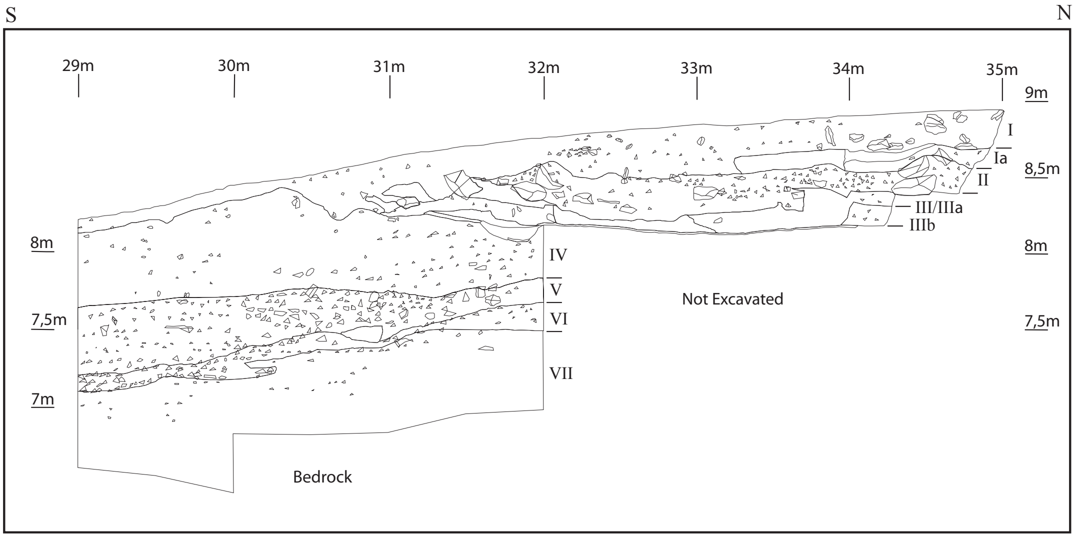

fig. 7. Baaz Rockshelter. North-South profile at the eastern 20m-line. Drawing: Mareike Stahlschmidt

tab. 3. Baaz Rockshelter. Radiocarbon-dates (Conard 2002, Deckers et al., 2009)

lab.nr.	square	f.nr.	AH	14C BP	calBP
KIA-11580	20/33	163	AH Ia	5.241 ±35	6.178-5.918
KIA-11579	20/33	425	AH II	5.707 ±34	6.629-6.407
KIA-11578	20/33	672	AH II	10.667 ±97	12.813-12.230
KIA-11577	20/33	714	AH III	10.942 ±65	13.066-12.641
KIA-11576	20/33	745	AH IIIa	10.470 ±121	12.624-11.997
KIA-30307	19/31	1067	AH V.1	21.310+740/-680	27.762-23.900
KIA-30308	19/31	1068	AH V.1	23.040+270/-260	28.477-2.6944
KIA-30310	19/31	1413	AH VII	32.060+600/-560	38.401-35.211
KIA-30309	19/31	1403	AH VII	34.200+1460/-1240	42.369-36.422

only two identifiable faunal remains.

AH V, which is rich in finds, has been dated through two radiocarbon dates, both in the range of the Last Glacial Maximum (LGM) or to the Late Upper Paleolithic/Early Epipaleolithic.

AH IV has a large average depth of approx. 70 cm, with mostly low find densities. There is of yet no direct date from this layer. The lithic analysis indicates an Epipaleolithic occupation (HILLGRUBER 2010), and it might well be that the artefacts belong to the Natufian occupation.

AH III is mostly undisturbed, as well as the layers below, which are sealed by the house floor at the bottom of AH III, or IIIb. Two dates from AH III and one from AH II are Late Natufian.

AH II also has a Pottery Neolithic (PN) date, which proves some mixing has occurred. As will be shown, I nevertheless consider the majority of finds from AH II to be of Natufian age.

AH I still has a major Natufian component, but younger residues are also present, as shown by two PN dates and flint artefacts of various ages, such as Khiam points from the Early Prepottery Neolithic (HILLGRUBER 2010). It is not possible to distinguish different phases within AH I, making this layer problematic for interpretation.

The AHs II and I are of deep brown color, which apparently derives from rather recent caprine dung (STAHLSCHMIDT 2010). Consequently, AHs II and I must be somewhat turbated, the extent of which must be evaluated at a later date. The distribution of typologically characteristic lithics has led HILLGRUBER (2010) to assume that AH I and parts of AH II show some degree of admixture. Micromorphologic investigations, although limited to small sampling areas, seem to confirm this (STAHLSCHMIDT 2010).

5.2. Faunal remains from Baaz Rockshelter

From Baaz, a total of 16,638 finds were analyzed, with a total weight of 5.152 grams. This assemblage is only the second largest among the four, but probably the most interesting. An overview has already been written in NAPIERALA et al. (in press), with special regard being paid to small game. One find, discovered in the bags among the faunal remains, was a burnt human ulna, which will be omitted from the calculations, reducing the relevant, faunal portion of the assemblage to n=16.637 and ∑=5.136g.

As with the other assemblages, the portion of unidentified remains is high. A total of 2,391 finds with a weight of 2.044 g were identifiable, which is an identification rate of 14% by NISP and 40% by weight. The identification rate decreases from top to bottom of the sequence (tab. 4).

A number of finds are probably not associated with the human occupation, or only secondarily. Among these are the 23 finds which were classified as "background fauna", including small rodents, reptiles and amphibians as well as small passerine birds, birds of prey and corvids. These finds will not be treated as human prey and will mostly be excluded from the discussion concerning human subsistence. Mammalian carnivores belong also to a group that must be discussed with regard to the circumstances of their deposition. The "background fauna" as well as the carnivores were very low in number, indicating a low amount of natural bone accumulation.

Baaz is a very interesting site for several reasons:

Its stratigraphy covers a long time period, and the layers below AH I are relatively well preserved, making it possible to observe diachronic trends. The Late Natufian assemblages of AH III and II are especially noteworthy, as the Late Natufian is the transition from an Epipaleolithic hunter and gatherer economy to the food production of the Neolithic.

The finds of small game increase towards the younger layers, with a dramatic increase towards the Late Natufian in AH III. This shift has been observed in many sites. Even the Late Glacial sites of Europe show a strong increase in hares and birds in the Magdalenian. The issue of small game trends will be discussed in detail below.

The presence of fishes, as indicators of open waters and a humid environment, contrasts with the find of a Rueppel's fox, which is a desert animal. These two taxa mark the extremities of environmental indicators, with all the other species observed falling somewhere in between them. Assuming that these different species did not find their way into the assemblage through long distance transport, the faunal spectrum illustrates the diversity of environments and ecological niches created by the diverse topography of

tab. 4. Baaz. Overview of identifiability by layer.

	number			**weight**		
AH	**identified**	**unidentified**	**%ident.**	**identified**	**unidentified**	**%ident.**
-	113	621	15,4	60,1	106,9	36,0
SURF	11	160	6,4	5,9	32,1	15,5
I	590	3429	14,7	707,9	713,2	49,8
II	1079	5072	17,5	721,5	986,7	42,2
III	448	2299	16,3	275,1	369,3	42,7
IV	43	607	6,6	38,7	120,8	24,3
V	103	1881	5,2	226,1	719,8	23,9
VI	2	56	3,4	6,9	24,2	22,2
VII	2	121	1,6	1,8	19,1	8,6

the region.

A detailed description of the findings in each layer will be given below. The discussion of these finds will be integrated with those of the other sites in a separate chapter.

AH VII

The Early Upper Paleolithic layer VII provided only two identifiable remains, a gazelle tibia and a metacarpus of a wild caprine (either wild sheep or wild goat, the former being zoogeographically more probable). Both are shaft fragments, which did not provide any measurements.

Among the finds are also two rodent remains: a femur and a lower incisor. The latter is most likely from a blind mole (*Spalax*).

All other finds are small, unidentifiable long bone fragments with poor surface preservation. The chemical weathering is also well advanced, with collagen not being preserved (BOCHERENS & DRUCKER, pers.comm.). All that can be said about these unidentifiable finds is that they originated almost exclusively from medium-sized (sheep/goat/gazelle-sized) animals and that only one of the fragments can be classified as hare/fox-sized.

AH VI

In AH VI, there is a humerus shaft of a wild caprine and a cranial fragment of a hare (*Lepus europaeus*). A fragment of the shaft of a tibia was identifiable as a small ruminant, which could be a gazelle, a caprine or a small cervid.

AH V

With its 103 identifiable remains, the Late Upper Paleolithic layer V yielded an assemblage which can be analyzed quantitatively (tab. 5).

Dominant above all other species are the typical prey species of the Levantine Upper Paleolithic: wild caprines and gazelles. A large portion of the unidentified finds from small ruminants (n=39) and unidentified medium-sized or medium-to-large mammals (n=267 and n=144 respectively)very likely originated as well from caprines and gazelles. Species-specific remains revealed the presence of wild sheep, *Ovis orientalis* (n=6) and the goitered gazelle, *Gazella subgutturosa* (n=2). One proximal carpal (*os carpi ulnare dexter*) from a caprine was classified as goat according to the criteria published by BOESSNECK et al. (1964). Although not measurable, the size of the find, when compared to specimens from the reference collection, makes it most likely a domestic goat (CAPRA). This indicates a small amount of intrusion, which is most probably due to the excavation tab. 5. Baaz Rockshelter, AH V. Identified specimens by number and weight.

taxa AH V	**n**	**%n**	**Σ**	**%Σ**
identified specimens				
brown hare, *Lepus europaeus*	4	3,9	1	0,4
vole, *Microtus* sp.	1	1,0	0,1	0,0
equid, *Equus* sp.	5	4,9	37,5	16,6
domestic goat, CAPRA	1	1,0	0,8	0,4
wild sheep, *Ovis orientalis*	6	5,8	26,7	11,8
wild caprine, *O.orient*. or *C.aegagrus*	44	42,7	102,7	45,4
goitered gazelle, *Gazella subgutturosa*	2	1,9	3,9	1,7
gazelle, *Gazella* sp.	37	35,9	52,7	23,3
tortoise, *Testudo graeca*	3	2,9	0,7	0,3
total identified	**103**	**100,0**	**226,1**	**100,0**
unidentified specimens				
small rodent, Rodentia	5	1,1	0,5	0,1
small ruminant	39	8,6	85,2	17,7
medium-sized bird	2	0,4	0,2	0,0
large undet.	4	0,9	5,4	1,1
medium-sized to large undet.	128	28,2	80,2	16,6
medium-sized undet.	267	58,8	308,3	63,9
small to medium-sized undet.	9	2,0	2,8	0,6
total w. size class	**454**	**100,0**	**482,6**	**100,0**
undet. (w/o size class)	1427		237,2	
total AHV	**1984**		**945,9**	

process rather than the stratigraphy itself, which seemed to be very pristine below the house floor of IIIb.

A small equid is present among the finds, and although only five finds were identified as coming from this genus, the larger size of the bones totals 37,5 g, which is two thirds of that of the gazelles (ignoring the unidentified finds). Accordingly, equids, and in this case most probably the Syrian onager, *Equus hemionus*, have to be added to the typical prey species of the Baaz Upper Paleolithic, completing the trinity of caprines, gazelles and equids which are the dominant species in so many Levantine sites.

Further species include the tortoise (*Testudo graeca*), with two fragments of the carapace and a proximal radius, as well as four remains of the hare (*Lepus europaeus*). Two bones are from a medium-sized bird, i.e., in the size class of a rock partridge (*Alectoris chukar*). The presence of tortoises, hares and birds, although in small numbers, is noteworthy as an indicator that the prey spectrum is diversifying when compared to earlier periods. It also shows that these bones are not generally lacking due to taphonomic processes, as they are, in principle, preservable. The trend towards more small game will have to be discussed in more detail in a later chapter.

Among the microfauna, a molar was identified as being from a vole (*Microtus* sp.). Several postcranial finds of small rodents were not further identified.

The find distribution shows no anthropogenic pattern, which could suggest activity zones or features. A steady increase from the southeast (entrance) to northwest (back of the cave) can be observed. This observation is consistent with the inclined surface of this stratum, which leads to an increased soil movement towards the valley, and subsequently to a higher loss of finds towards the cave entrance.

No cut marks have been observed, which is at least partly due to the poor surface preservation of the finds in AH V, but cut marks are generally scarce in the sites under study. In contrast, impact fractures are relatively frequent. Sixteen bones from gazelles, caprines and equids in layer V show clear signs of bone processing for marrow. Eighteen bones were classified as having been in contact with heat.

Among the gazelle bones, only three had epiphyses preserved, allowing for us to describe the fusion state. All three—a proximal radius, a proximal tibia and a first phalange—had their epiphyses fully fused.

None of the finds from wild sheep were ageable, and among the wild caprines, only a single proximal radius was recorded as fused.

The general appearance of bones from this layer indicated adult individuals. The preservation conditions might be partly responsible for the complete lack of bones from young individuals as well as the general scarcity of preserved epiphyses.

AH IV

This layer includes a total of 650 faunal remains, with a weight of 159 grams (tab. 6). Despite these seemingly moderate numbers, the find density is low when considering the deepness of the layer.

The finds are scattered vertically, indicating either low occupation intensity or a high sedimentation rate. The latter is unlikely with respect to layer V and its relatively high find density, which does not show any marked difference in the nature of the sediments. In fact, the faunal spectrum also indicates low human impact. Most frequent among the identified taxa are small rodents, with only one find being identifiable as *Microtus* sp.

An ulna of a large vulture (*Gyps* sp.) might similarly have found its way naturally into the cave, as well as the unidentified bones of small birds and of a small reptile.

That humans visited the rockshelter at least sporadically is confirmed by a number of clear lithic artefacts, among them a drill. It is not surprising then, that the trinity of gazelles (n=14), wild caprines (n=8) and equids (n=1) are again present. Interestingly though, the hare (*Lepus europaeus*) is fairly numerous as well, and together with the gazelles ranks first with 14 finds among the identifiable find portions. By weight, though,

tab. 6. Baaz Rockshelter, AH IV. Specimens by number and weight.

taxa AH IV	**n**	**%n**	**Σ**	**%Σ**
identified specimens				
brown hare, *Lepus europaeus*	14	32,6	2,7	7,0
vole, *Microtus* sp.	1	2,3	0,1	0,3
equid, *Equus* sp.	1	2,3	0,3	0,8
wild caprine, *O.orient*. or *C.aegagrus*	8	18,6	13,3	34,4
wild or domestic caprine, *Ovis/Capra*	1	2,3	0,1	0,3
gazelle, *Gazella* sp.	14	32,6	13,1	33,9
vulture, *Gyps* sp.	1	2,3	8,7	22,5
tortoise, *Testudo graeca*	3	7,0	0,4	1,0
total indentified	**43**	**100,0**	**38,7**	**100,0**
unidentified specimens				
small rodent, Rodentia	18	15,4	1,8	2,7
small ruminant	3	2,6	4,5	6,9
medium-sized bird	1	0,9	0,1	0,2
small bird	5	4,3	0,5	0,8
reptile, Reptilia	1	0,9	0,1	0,2
large undet.	5	4,3	5,2	7,9
medium-sized to large undet.	32	27,4	16,1	24,5
medium-sized undet.	46	39,3	36,4	55,5
small to medium-sized undet.	2	1,7	0,5	0,8
small undet.	2	1,7	0,2	0,3
very small undet.	2	1,7	0,2	0,3
total w. size class	**117**	**100,0**	**65,6**	**100,0**
undet. (w/o size class)	490		55,2	
total AH IV	**650**		**159,5**	

the order is reversed, with wild caprines and gazelles (13,3 g and 13,1 g, respectively) being far heavier than the small hare remains. Although the statistical relevance should not be overestimated due to the low numbers, it is noteworthy that AH IV would fit well into an Epipaleolithic subsistence pattern.

Only one bone has a clear impact fracture, but signs of fire become more frequent the higher we move up the stratigraphy. A problem exists with brown colors, since their provenance is unclear. STAHLSCHMIDT (2010) assumes that some of the staining in the upper layers (AH I & II) derives from caprine dung. Whether this also applies to the lower layers is questionable, since the house floor of layer III would have prevented anything from trickling through the upper layers. Bones, though, are certainly burned that are black, grey or white in color. These total 49 pieces, while the dark brownish bones total 75 pieces in AH IV.

AH III

The taphonomic circumstances and sedimentation in AH III change drastically (see chapter STRATIGRAPHY). The turbation processes (STAHLSCHMIDT 2010) observed in the upper layers also touches the upper portion of III.

Not only does the taphonomy change, but the faunal spectrum (tab. 7) as well shows a marked shift. The most frequent species both in NISP and weight is the hare (*Lepus europaeus,* n=215, ∑=77,3g). Only if we assume that the category "wild caprine" is composed mostly of wild sheep (*Ovis orientalis*) does this species take the lead in bone weight. One single find among the caprines shows characteristics of *Capra*, i.e., a fused antebrachium, which is rather unusual in *Ovis*. Since this feature is not perfectly reliable for the identification to species, this find was classified as wild caprine only. According to these numbers, wild sheep seem to have been much more common to the area than wild goat.

It is clear that small animals like the hare play a substantial part in Late Natufian subsistence. If we accept that bone weight and life weight are proportional with similar ratios in all wild mammals (see chapter "Measures of abundance"), then so many hares were hunted that their combined weight almost equaled that of all wild caprines that were brought to the site. Despite hares, other small animals were hunted. Among the birds, the chukar partridge (*Alectoris chukar*, n=3) and the quail (*Coturnix coturnix*, n=1) could be identified. But the prey spectrum in this layer extends also towards reptiles, specifically the tortoise (*Testudo graeca*), which is also quite common in this archaeological horizon (n=78, ∑=18,0).

Among the large game species, –and in addition to the caprines already mentioned– the assemblage is made up of gazelles and equids and a single fragment of a first phalange tab. 7. Baaz Rockshelter, AH III. Identified specimens by number and weight.

taxa AH III	**n**	**%n**	**Σ**	**%Σ**
identified specimens				
brown hare, *Lepus europaeus*	213	47,5	76,3	27,7
mole rat, *Spalax ehrenbergi*	1	0,2	0,1	0,0
jird, *Meriones* sp.	1	0,2	0,1	0,0
red fox, *Vulpes vulpes*	4	0,9	0,8	0,3
ruepell's fox, *Vulpes ruepelli*	1	0,2	1,4	0,5
equid, *Equus* sp.	8	1,8	42,6	15,5
aurochs, *Bos primigenius*	1	0,2	15	5,5
goitered gazelle, *Gazella subgutturosa*	6	1,3	5,5	2,0
gazelle, *Gazella* sp.	50	11,2	17,4	6,3
wild sheep, *Ovis orientalis*	11	2,5	40,2	14,6
wild caprine, *O.orient.* or *C.aegagrus*	50	11,2	51,8	18,8
wild or domestic caprine, *Ovis/Capra*	10	2,2	4,1	1,5
tortoise, *Testudo graeca*	78	17,4	18	6,5
quail, *Coturnix coturnix*	1	0,2	0,1	0,0
chukar partridge, *Alectoris chukar*	3	0,7	0,8	0,3
cyprinid, Cyprinidae	5	1,1	0,5	0,2
salmonid, Salmonidae	5	1,1	0,4	0,1
total identified	**448**	**100,0**	**275,1**	**100,0**
unidentified specimens				
small rodent	4	2,1	0,4	0,3
medium-sized carnivor	2	1,0	0,2	0,1
small carnivor	1	0,5	0,1	0,1
small ruminant	20	10,4	10,1	7,4
small bird	1	0,5	0,1	0,1
large undet.	4	2,1	9,7	7,1
medium-sized to large undet.	18	9,4	21,8	15,9
medium-sized undet.	93	48,4	85,3	62,2
small to medium-sized undet.	8	4,2	2,4	1,8
small undet.	34	17,7	6,4	4,7
very small undet.	7	3,6	0,6	0,4
total w. size class	**192**	**100,0**	**137,1**	**100,0**
undet. (w/o size class)	2107		232,2	
total AH III	**2747**		**412,2**	

from the aurochs, *Bos primigenius*. The equids provided no diagnostic fragment for determining species. The size and general appearance, though, suggest that it is the onager, or Equus hemionus, which has been identified in AH I on a tooth.

Six of the 56 gazelle finds were identified as goitered gazelle (*Gazella subgutturosa*) while the rest remained unspecified. Epiphyses were mostly fused (tab. 9), except a single proximal radius, which was still fusing at the time of the animal's death. This animal must have been between 3 and 7 months old (accepting the analogy from mountain gazelle in MUNRO et al. 2009). The pattern does not change in the other Natufian layers (AH II and AH I).

The caprine remains are also mostly from adult individuals, although the early fusing epiphyses do not allow for a precise age estimation. The fusion status for all Natufian layers is summarized in tab. 8. The sheep in AH III and AH II do not differ in any substantial way from the pattern, which is evident in the gazelle remains. The scarcity of adult sheep in AH I must be noted, but as there are only few specimens, it is difficult to interpret these finds. The predominance of adult individuals is usually seen as a typical age profile produced by hunters, whereas a majority in young animals could represent culling in a pastoralist context (DUCOS 1968, PAYNE 1973). As mandibular teeth, which allow a more precise ageing (see discussion in VIGNE & HELMER 2007), are poorly preserved at Baaz, a survivorship curve cannot be calculated.

Interesting to note is the presence of two different fox species. The typical red fox (*Vulpes vulpes*) is the more frequent fox species, but one mandible is so small that it can only be from a Ruepell's fox (*Vulpes ruepelli*). The latter occurs today in very arid, steppic-to-desert like environments, but only in the harshest environments is the Ruepell's fox able to outcompete the larger red fox, which is the more common species in the assemblage.

A surprising discovery turned out to be several fish bones from AH III upwards (see also chapter "Fish remains"; for a detailed discussion see NAPIERALA et al. 2009). AH III itself contained five cyprinid and five salmonid bones.

The fact that AH III has several intact features, such as the fireplace and the mortar, makes it plausible that faunal remains might similarly show distribution patterns resembling special task areas within the site. Our first step was to plot only single finds, because they are recorded by their individual position in three dimensions, as opposed to the finds uncovered in sieving, which are always from quarter square meters, with a somewhat generalized find position.

Our next step was to plot the finds from sieving, with their positions weighted by number or by the total weight of the finds from this quarter square meter.

Although no clear spatial patterning was determined for any of the species in AH III, the general distribution of single finds produced an obvious pattern: The density of finds increases towards the west and abruptly ends at a imaginary line in a NNW to SSW direction (fig. 8), which would also connect the larger stones in this stratum. This observation tab. 8. Baaz, Natufian horizons III-I. Fusion status of the epiphyses from wild sheep (*Ovis orientalis*), wild caprines (in round brackets), wild or domestic caprines (in square brackets) and domestic sheep (in curly brackets). f=fused, j=fusing, o=open.

***Ovis orientalis* (ind. wild caprines in brackets)**	**AH III**			**AH II**			**AH I**		
	f	**j**	**o**	**f**	**j**	**o**	**f**	**j**	**o**
radius proximal				1					
phalanx 2 prox	(3)[1]		1	3 (1) {1}			{1}		
phalanx 1 prox	1			(1)		[1]			[1]
humerus distal	3			(1)					
pelvis	1								
scapula glenoid fossa									
tibia distal				(1)		[1]			
femur proximal									
calcaneus, prox				2 (1)					
metatarsus distal									1
metacarpus distal	1								
ind. metapodial distal	1 (1)			(1)		1		1	
femur distal									
ulna distal									
humerus proximal									
radius distal									
tibia proximal									
ulna distal									

tab. 9. Baaz, Natufian horizons III-I. Fusion status of the epiphyses from gazelles. f=fused, j=fusing, o=open.

***Gazella* sp.**	**AH III**			**AH II**			**AH I**		
	f	**j**	**o**	**f**	**j**	**o**	**f**	**j**	**o**
radius proximal		1		2			1		
phalanx 2 prox	2			14			5		
phalanx 1 prox	2			5		3	4	1	
humerus distal				1					
pelvis									
scapula glenoid fossa									
tibia distal					1				
femur proximal									1
calcaneus, prox				1		1			
metatarsus distal				1					
metacarpus distal									
ind. metapodial distal	2			2		4	2		
femur distal									
ulna distal									
humerus proximal									
radius distal					1				
tibia proximal				1					
ulna distal									

can best be explained by the "wall effect", i.e., by the presence of a barrier (a tent wall?) during find accumulation, causing the finds to concentrate at the barrier.

The stones could be the foundations of this former wall construction. Interestingly, this effect is more visible in the bone finds than in the lithic artefacts, where HILLGRUBER (2010) did not find a clear distribution pattern. According to his plots, the lithic find density is also highest around the stones, but without the sharp border.

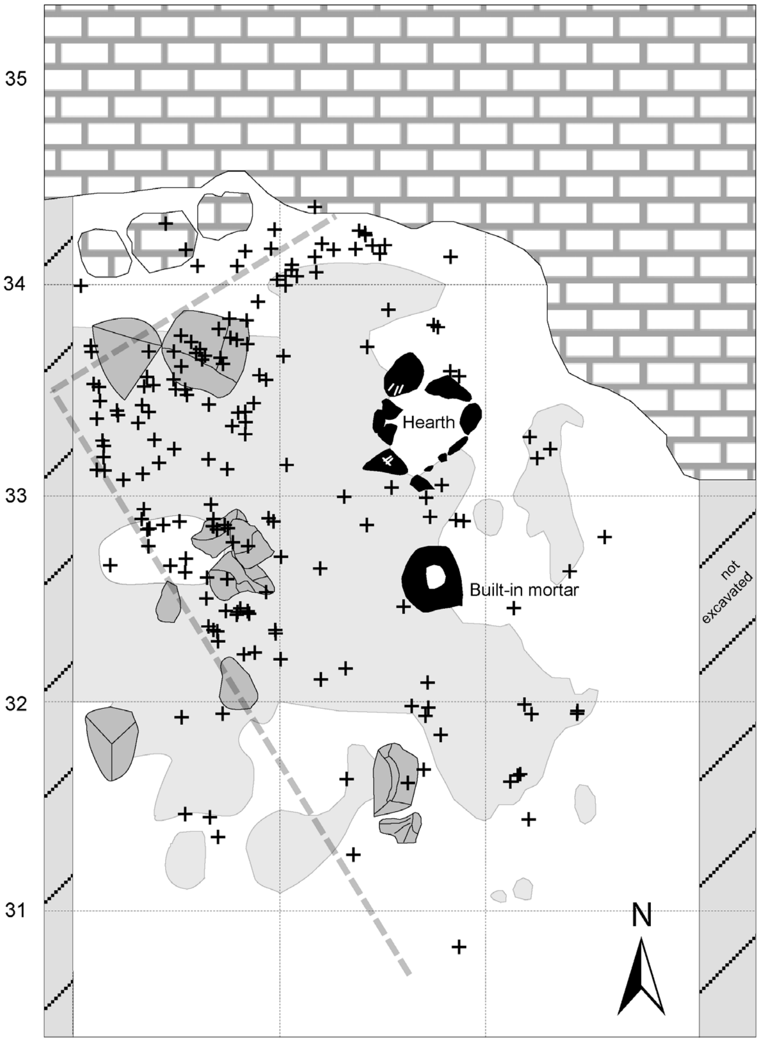

fig. 8. Baaz Rockshelter, AH III. Distribution of individually recorded finds (crosses) in relation to the features in AH III. The grey shaded area indicates the housefloor, the stippled line indicates the imaginary borderline of the find distribution.

Adding the finds from the sieving to the plot (fig. 9), the pattern becomes even more evident. The central area of the site, around the mortar and the hearth, are almost empty of finds, while many finds are surrounding the stones. The distribution of faunal remains therefore supports what had been assumed during the excavation: that the limestones are constructive elements associated with the Natufian house, of which the hearth, the mortar and the floor are further elements (CONARD 2002).

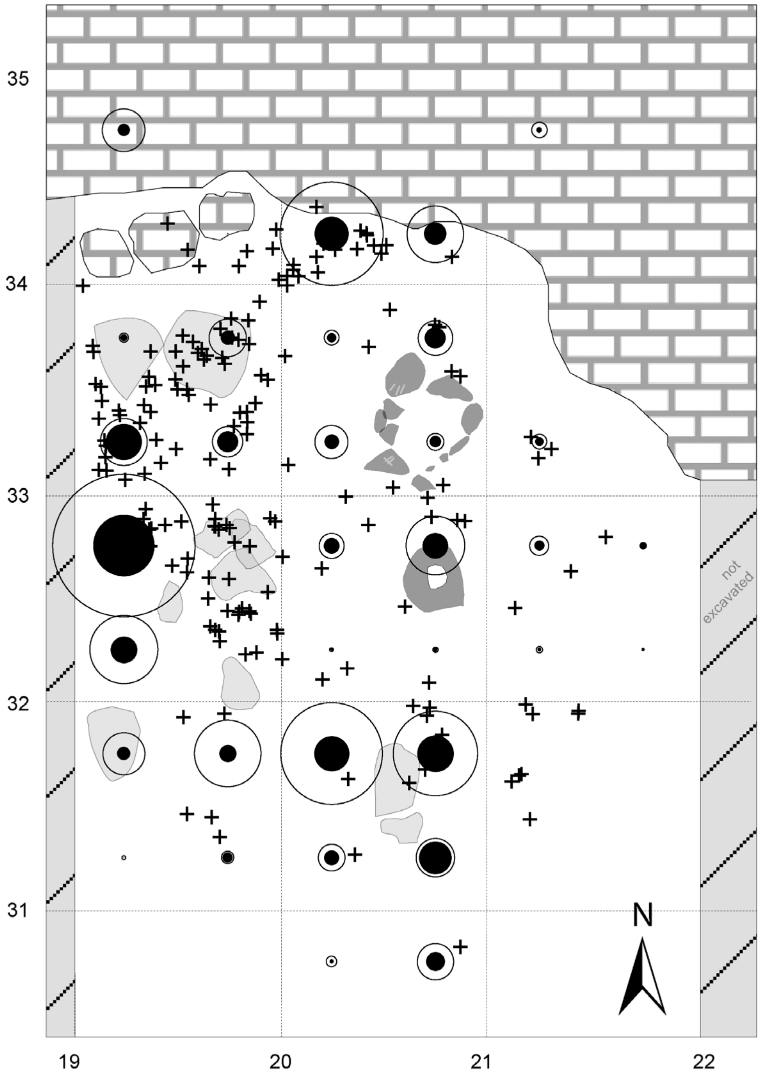

fig. 9. Baaz Rockshelter, AH III. Distribution of individually recorded finds (crosses) in regard to the finds from the seaving (circles). The diameter of the circles is proportional to the sum of seaving-finds by number (hollow circle) and weight (black circle).

Stones as the basal constructive elements of Natufian shelters seem to be a common feature. This has also been observed at e.g. Wadi Hammeh 27 and Mallaha (Eynan) (GORING-MORRIS & BELFER-COHEN 2008).

AH II

The species composition and their relative quantities in AH II (tab. 10) resemble to a great extent those from AH III.

The hare (*Lepus europaeus*), is again the most frequent animal (n=554, ∑=248,3g), making up an even higher proportion of the assemblage than in AH III. With 180 finds, tortoise (*Testudo graeca*) ranks second by NISP. The small game is therefore again a very relevant portion of the assemblage of this layer, supplemented by a number of bird bones (*Alectoris chukar*, *Corvus* cf. *cornix*, *Circus* sp. and several small unidentified Passerinae) and fish bones (see chapter "Fish remains").

Gazelles are also frequent, with a total of 154 remains (∑=105,1g). Nineteen remains have been identified as *Gazella subgutturosa*, and one ulna has some characteristics of *Gazella gazella*. The articular surface of ulna and radius is among the most diagnostic criteria to distinguish the two species postcranially (UERPMANN, unpublished manuscript). The lateral part of the articular surface shows a dorsally protruding "dent" in *G. subgutturosa,* which is absent in *G. gazella*. Although this dent itself is missing in the archaeological specimen due to fragmentation, the medially adjacent articular surface shows no tendency to continue into a dent on its lateral side.

Since the TDASP research area lies in a transitional area between the mountainous habitats of the mountain gazelle (*Gazella gazella*) to the west and the steppes, or classical distribution areas, of the goitered gazelle (*Gazella subgutturosa*) to the east, it is likely that individual animals of both species might occasionally make an advance into the habitats of the other species. Human hunters could also be expected to be mobile, and hunting parties from Baaz might have also roamed further west, where they could have encountered the mountain gazelle.

However, the high fragmentation of the piece, and the fact that it remained the only possible evidence for the mountain gazelle, seemed too unreliable for listing separately in the tables.

Among the caprines, 80 remains have been classified, according to their size, as being from wild animals. Nineteen of these remains are wild sheep (*Ovis orientalis*). Wild goat could not be definitively identified among the finds.

A total of 34 finds were either too fragmented or in a size range that made it unable to confirm whether they were from wild or domestic caprines. Two of these were from wild or domestic goats, three from wild or domestic sheep. A fragment of a third phalange was the only measurable find among these of uncertain domestic status. It is from a sheep, and the breadth of the articular surface is, with 8,8 mm, rather small. Since this skeletal element has a high degree of variability, it is not possible to confirm its domestic status.

An almost complete second phalange was classified as being from a domestic sheep. This specimen is very small, and only its morphology, not its size, distinguishes it from the gazelles of the same layer. The find indicates that some intrusion occurred from the above layer. As will be shown, it is very probable that the assemblage nevertheless consists almost entirely of finds of Late Natufian Age.

Noteworthy are finds of three cervid species: a first phalange of a roe deer (*Capreolus capreolus*), a proximal fragment of a radius from fallow deer (*Dama mesopotamica*) and two pelvis fragments from red deer (*Cervus elaphus*).

One of the red deer finds was refitted to two fragments from AH I to produce a large fragment of a pelvis from a female red deer (*Cervus elaphus*). Its identification is based on the very deep, typically cervid-like depression where the tendon of the rectus femoris is attached to the pelvis (“rectusgrube”). Also, its gracile shape and its size are well in accordance with female red deer specimens from our reference collection.

Its identification as a female is also confirmed by the reduced thickness of the dorsal side of the acetabulum. The other fragment from AH II is from the same individual, but it cannot be fitted directly to the other pieces, as some fragments seem to be missing. The two fragments are both from square 21/34, and lay approximately 10 cm apart from each other. The finds from layer I, which can be fitted onto the larger fragment, were found a little more than one meter apart, in squares 20/34 and 21/33. Despite some modern damage to the edges of the finds, the real fracturation took place when the bone was still breaking as a fresh bone. The breaks are therefore not recent. The fact that refittings between layers I and II exist once again confirm our impression that AH I and the upper part of AH II are not closed stratigraphic units, and that some finds from AH I are contemporaneous with those of AH II.

The identification of the phalange as roe deer is based on the shape of the palmar side of the distal articular surface, which shows the typical wavy border of a cervid. Its size and its gracile appearance correspond well to a roe deer. The radius fragment is also a typical cervid in the shape and position of the lateral tuberositas. The size corresponds well to a small (female?) fallow deer. Cervids are commonly interpreted as indicating higher vegetation, e.g., high shrubs or even trees, which they seek to hide their calves. Cervids therefore indirectly point to higher humidity.

Cervids, especially the fallow deer (*Dama mesopotamica*), are far more frequent in the Natufian sites of the Western Galilee, where they usually rank first or second by NISP (e.g., HOOIJER 1961, DAVIS 1982). In the Carmel, fallow deer seem to decrease in the Natufian, an occurrence that has been interpreted as a climatic shift (GARROD & BATE 1937).

tab. 10. Baaz Rockshelter, AH II. Identified specimens by number and weight.

taxa AH II	**n**	**%n**	**Σ**	**%Σ**
identified specimens				
hedgehog, Erinaceidae	1	0,1	0,1	0,0
brown hare, *Lepus europaeus*	554	51,3	248,3	34,4
mole rat, *Spalax ehrenbergi*	7	0,6	1,2	0,2
vole, *Microtus* sp.	2	0,2	0,2	0,0
jird, *Meriones* sp.	1	0,1	0,1	0,0
dog, Canis	3	0,3	2,2	0,3
red fox, *Vulpes vulpes*	13	1,2	13,2	1,8
equid, *Equus* sp.	21	1,9	84,9	11,8
roe deer, *Capreolus capreolus*	1	0,1	0,6	0,1
red deer, *Cervus elaphus*	2	0,2	29,8	4,1
fallow deer, *Dama mesopotamica*	1	0,1	0,9	0,1
wild or domestic cattle, *Bos*/BOS	2	0,2	3	0,4
wild sheep, *Ovis orientalis*	19	1,8	39,3	5,4
domestic sheep, OVIS	1	0,1	1	0,1
wild caprine, *O.orient.* or *C.aegagrus*	61	5,7	84,9	11,8
wild or domestic caprine, *Ovis/Capra*	34	3,2	27,4	3,8
goitered gazelle, *Gazella subgutturosa*	19	1,8	32,7	4,5
gazelle, *Gazella* sp.	135	12,5	72,4	10,0
chukar partridge, *Alectoris chukar*	3	0,3	0,3	0,0
harrier, *Circus* sp.	1	0,1	0,1	0,0
hooded crow, *Corvus* cf. cornix	1	0,1	0,2	0,0
cyprinid, Cyprinidae	3	0,3	0,4	0,1
salmonid, Salmonidae	14	1,3	1,3	0,2
tortoise, *Testudo graeca*	180	16,7	77	10,7
total identified	**1079**	**100,0**	**721,5**	**100,0**

taxa AH II	**n**	**%n**	**Σ**	**%Σ**
unidentified specimens				
small rodent	21	3,9	2,4	0,6
medium-sized carnivor	2	0,4	0,4	0,1
small ruminant	84	15,7	48,6	13,0
small bird	1	0,2	0,1	0,0
medium-sized bird	3	0,6	0,7	0,2
small bird	3	0,6	1,2	0,3
medium-sized fish	2	0,4	0,2	0,1
small reptile	3	0,6	0,3	0,1
medium-sized amphib	5	0,9	0,5	0,1
large undet.	8	1,5	16,5	4,4
medium-sized to large undet.	37	6,9	50,2	13,4
medium-sized undet.	234	43,7	211,4	56,4
small to medium-sized undet.	22	4,1	12	3,2
small undet.	102	19,1	29,3	7,8
very small undet.	8	1,5	0,8	0,2
total w. size class	**535**	**100,0**	**374,6**	**100,0**
undet. (w/o size class)	4537		612,1	
total AH II	**6151**		**1708,2**	

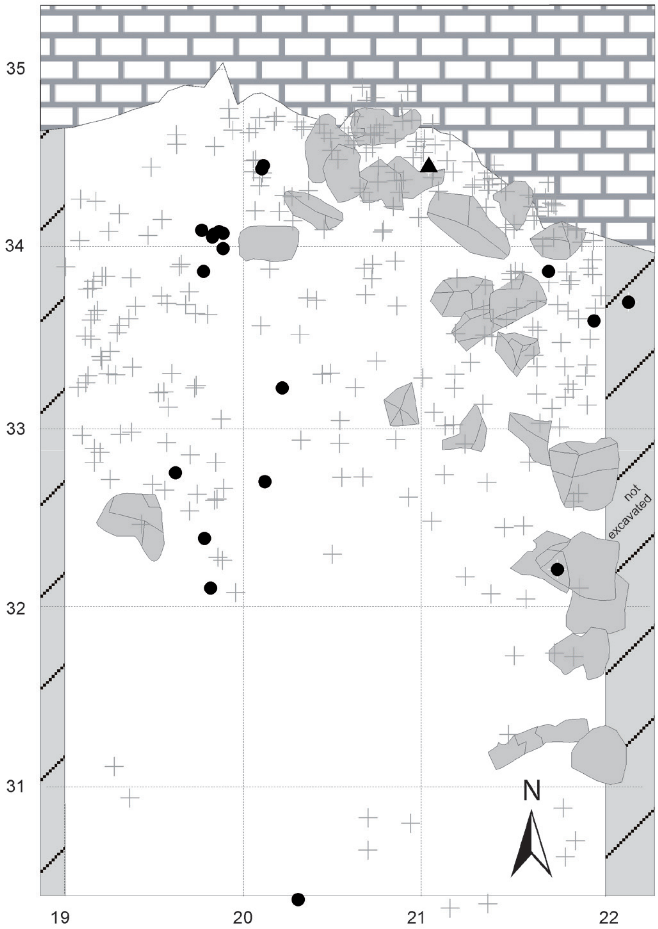

fig. 10. Baaz Rockshelter, AH I. All individually recorded finds (crosses) and the scatter of cattle remains (black circles) which might all belong to the same individual.

AH I

The uppermost layer again resembles AH II and III with regard to faunal composition and their relative proportions (tab. 11).

It differs only in one major aspect, being the high amount of cattle, which is evident mainly in bone weight. All of the finds most likely belong to one single skull of domestic cattle, despite the fragment of a first phalange and a rib, which are the only postcranial elements.

The skull was recognized during excavation by a maxillar tooth row in its original position (fig. 11). The cranial bone was almost completely gone, making a complete recovery impossible. Some of the smaller tooth fragments, which were not located in direct asso-

fig. 11. Baaz Rockshelter, AH I. An *in situ* tooth row is all that's left from a probably once complete cattle skull. Photo: Andrew Kandel.

ciation with the tooth row, were so small that it was impossible to make a size estimation or determine whether they are indeed from domestic cattle. Their appearance in terms of preservation, surface texture and individual age makes it very probable that they belong to the same individual as the tooth row.

The distribution of the finds confirms (fig. 10) that AH I is somewhat turbated. Although many of the finds still lay close to the intact tooth row, some were found more than two meters away.

The fact is interesting that so few other skeletal elements are present from Bos. It seems as if only the skull (including the mandible) was taken up to the rockshelter, although this skeletal part does not have much nutritional value. Bearing in mind that mainly teeth survived, a taphonomic explanation should also be considered.

Bone preservation in layer I is quite poor. Gypsum crystals have destroyed many of the bones to such a degree that it is impossible to recognize even the size class of animals.

Despite the cattle, hares (n=276 ∑=119,4g) and tortoises (n=93, ∑=52,3g) are the most frequent species by NISP. Gazella is also well represented (n=72, ∑=72,8g), ranking second by bone weight among the wild fauna.

The wild caprines, including the identified wild sheep (*Ovis orientalis*), total 25 finds with a bone weight of 52,6 g. For a relatively large number of caprines (n=45, ∑=33,4g), it was not possible to determine whether they belonged to the wild or domestic form with any degree of certainty.

Among the equid remains of this layer (n=11, ∑=71,3g), one mandibular tooth was preserved well enough to observe the enamel patterns and determine the species. The asymmetry of the lobes of the metaconid and metastylid, together with a nearly tab. 11. Baaz Rockshelter, AH I. Identified specimens by number and weight.

taxa AH I	n	%n	Σ	%Σ
identified specimens				
hedgehog, Erinaceidae	1	0,2	0,3	0,0
brown hare, Lepus europaeus	276	46,8	119,4	16,9
mole rat, Spalax ehrenbergi	2	0,3	0,3	0,0
vole, Microtus sp.	2	0,3	0,2	0,0
jird, Meriones sp.	1	0,2	0,1	0,0
red fox, Vulpes vulpes	3	0,5	1,1	0,2
onager, Equus hemionus	1	0,2	23,0	3,2
equid, Equus sp.	10	1,7	48,0	6,8
red deer, Cervus elaphus	2	0,3	35,2	5,0
wild or domestic cattle, Bos/BOS	18	3,1	32,8	4,6
cattle, BOS	21	3,6	219,8	31,0
domestic caprine, CAPRA/OVIS	2	0,3	1,4	0,2
domestic goat, CAPRA	3	0,5	1,5	0,2
wild sheep, Ovis orientalis	9	1,5	36,6	5,2
domestic sheep, OVIS	2	0,3	2,0	0,3
wild caprine, O.orient. or C.aegagrus	16	2,7	26,0	3,7
wild or domestic caprine, Ovis/Capra	45	7,6	33,4	4,7
goitered gazelle, Gazella subgutturosa	6	1,0	16,3	2,3
gazelle, Gazella sp.	68	11,5	56,5	8,0
quail, Coturnix coturnix	1	0,2	0,1	0,0
chukar partridge, Alectoris chukar	3	0,5	0,8	0,1
demoiselle crane, Anthropoides virgo	1	0,2	0,4	0,1
sand partridge, Pterocleidae	1	0,2	0,1	0,0
cyprinid, Cyprinidae	2	0,3	0,2	0,0
salmonid, Salmonidae	1	0,2	0,1	0,0
tortoise, Testudo sp.	93	15,8	52,3	7,4
total identified	**590**	**100,0**	**707,9**	**100,0**

taxa AH I	**n**	**%n**	**Σ**	**%Σ**
unidentified specimens				
small rodent	30	8,3	3,2	1,3
small carnivor	1	0,3	0,1	0,0
small ruminant	42	11,6	34,7	13,7
medium-sized bird	6	1,7	0,7	0,3
small bird	3	0,8	0,3	0,1
fish	1	0,3	0,1	0,0
small reptile	1	0,3	0,1	0,0
amphib	4	1,1	0,3	0,1
large undet.	19	5,2	22,1	8,7
medium-sized to large undet.	53	14,6	41,0	16,1
medium-sized undet.	132	36,4	130,4	51,3
small to medium-sized undet.	9	2,5	4,4	1,7
small undet.	54	14,9	16,3	6,4
very small undet.	8	2,2	0,5	0,2
total w. size class	**363**	**100,0**	**254,2**	**100,0**
undet. (w/o size class)	3066		459,0	
total AH I	**4019**		**1421,1**	

V-shaped valley in between them, provide useful indicators for the onager (*Equus hemionus*), a diagnostic feature first described by RÜTIMEYER (1875) and frequently applied to faunal assemblages in Europe and Southwest Asia ever since (e.g., STEHLIN & GRAZIOSI 1935, TURNBULL & REED 1974).

There are also a few birds from among the finds of this layer, such as quail (Coturnix coturnix) as well as a sandgrouse (*Pterocles* sp.). The latter is a family of birds related to pigeons, of which three species occur in Syria today. These are the pin-tailed sandgrouse (*Pterocles alchata*), the spotted sandgrouse (*Pterocles senegallus*) and the black-bellied sandgrouse (*Pterocles orientalis*). Their habitat varies according to the exact species, but generally sandgrouse indicate rather arid, steppic environments. They are commonly considered poor food, but are eaten nevertheless.

The chukar partridge (*Alectoris chukar*, n=3) is again the most frequent bird, but birds are generally less frequent than in layers II and III.

A cervical vertebra of a small crane (Gruidae) could not be further identified. The reference specimen for demoiselle crane (Anthropoides virgo) in the Tübingen collection does not correspond perfectly to this find, a fact which might be related to intraspecies variability. As a migratory bird, its identification would provide a seasonal indicator. Today the birds winter in South Asia and Africa, and move north to breed in Turkey, Greece and several Central Asian countries. Syria and neighboring countries are part of the migration route: In spring, thousands of cranes, including the Demoiselle Cranes, stop here, for example, in the Hula Valley. Spring is also the period when the occupation of Baaz most likely occurred.

Four bones of fish, two cyprinids, one salmonid and an unidentified osteiychtes again confirm the relation of AH I to the Natufian occupation, with the better preserved assemblages of AH II and III.

Surface

The site was initially discovered, and its potential recognized, by lithics and bones found on the surface. Before any soil was removed, all surface finds were documented and recovered. Although it is clear that these finds cannot be interpreted with any certainty, it should be noted that very few finds indicated an intense modern occupation.

The rockshelter seemed to have been used as a barn for sheep and goats, but very little "settlement activities", i.e., ceramics, fireplaces, or simple modern garbage, were noticed. Also among the bone finds recovered, recent material is scarce, if at all present. The 171 finds are very fragmented, but the 11 identifiable pieces are again mostly from the typical Natufian prey species: hare (n=4), gazelle (n=2), wild caprine, tortoise, chukar partridge (each one find) and wild or domestic sheep or goat (n=2).

Among the unidentified finds are two rodents, one mid-size ruminant and many small fragments from mid-sized animals, most likely from gazelles or caprines.

Seasonality

The season of occupation is difficult to estimate for the seven layers of Baaz, and the faunal assemblage has little to offer in this regard. Judging from today's climate, an occupation during spring is most favorable. Vegetation has profited from some winter precipitation and the rising temperatures are much easier to endure at the high elevations of the area. The even higher ranges of the Anti-Lebanon could have been sought during the warmest times of the year. In winter, minus zero degrees (Celsius) and occasional snowfall around Ma'aloula and Jaba'deen do not seem to offer favorable conditions for a stay in the area.

Nevertheless, to reduce the people's choice of settlement area to the mere comfort of climate would be neglecting some other important factors. Natural resources are among the most relevant:

The migration of animals, the ripening of plant foods and the availability of water are some examples. But raw materials such as flints, pigments or ores could also draw people into an area during unfavorable seasons. Despite being drawn into a territory, the possibility of being "pushed" into this region to avoid conflicts or resource shortages must also be considered, especially for younger time periods.

The lower layers dated to the Upper Paleolithic simply did not provide us with enough finds for any meaningful interpretation. All caprines, gazelles and equids in these layers have fused epiphyses. Young individuals, whose presence would aid us in determining season of occupation, are not found in the assemblage. This could be biased somewhat by taphonomy. Most finds in the UP layers are shaft fragments, and articular ends seem to have weathered away. Whatever the reason, season of occupation is difficult to decipher.

Layer III shows some investment in permanent installations, such as the house floor, the mortar and the constructed hearth. These features indicate longer periods of stay to justify the building effort. Consequently, a multi-seasonal occupation must be considered. In fact, the bones do support this idea:

The fishes, especially the salmonids in the Natufian horizons, can be expected in springtime, when large, adult individuals, as the ones observed in the assemblage, migrate upriver to mate and lay their eggs.

The lack of very young (infantile and juvenile) individuals among the ruminants would be unusual, had these species been hunted at the same time as the fishes. Only a second phalange of a wild sheep and a single distal metapodial of a wild caprine are unfused.

This is, though, not a taphonomic bias: among the hares, there are two proximally unfused femurs, while a tibia and a metacarpus are distally fusing. Hares give birth several times a year, from spring into early winter. The unfused femurs are from animals which died sometime in the second half of the year.

The botanical remains and the lithics recovered at the site also make an occupation in the fall less probable than in the spring. There is very little evidence of harvesting wild grains (DECKERS et al., 2009) which would be available in fall. Neither the cereals themselves have been found,nor indirect evidence through sickle-gloss on lithic artefacts (HILLGRUBER 2010). Nevertheless it is hard to imagine that the mortars were used for anything else than processing plant foods.

The crane vertebra in layer I is also an indication of spring, when these birds are migrating north.

5.3. *Bone modifications*

heat exposure

In no other site was it more difficult to decide if a bone was burnt or not. Especially the finds from AH I-III proved very difficult in this respect, and the classical evaluation by color was almost impossible. Due to the lack of soil moisture necessary for the mobilisation of manganese and iron, those remains black in appearance are with high certainty examples of burnt bones. The calcined, grey and white bones are also distinguishable

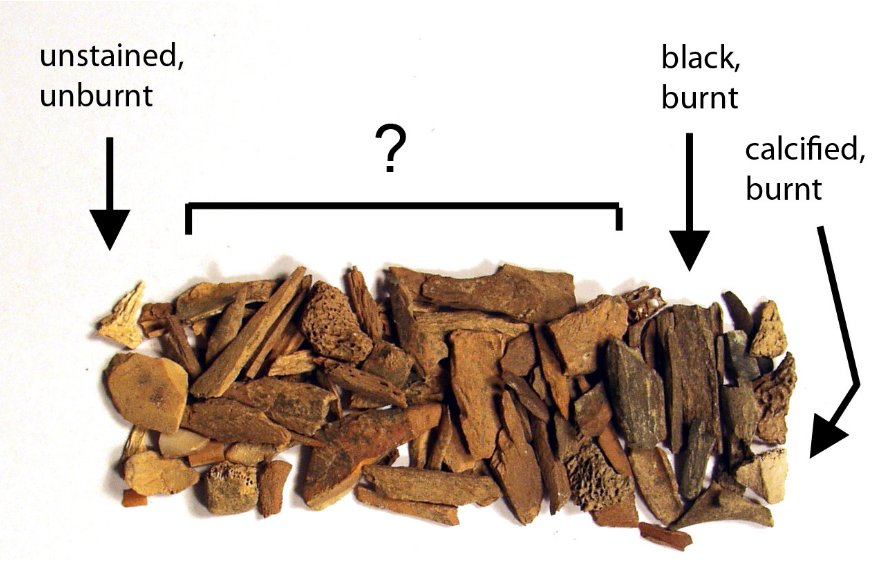

fig. 12. Baaz Rockshelter. Finds from a single bucket of sieved sediments, ordered by color and potential heat exposure.

from the unburnt bones. There is, though, a wide variety of stained bones, in all shades of brown and beige, making it impossible to determine whether they are burnt or not without further analysis through either FT-IR or fluorescence microscopy. In a single find bag with finds from sieving, all variants in color might be found (fig. 12). Finds were therefore classified by color only.

A similar problem has recently been addressed by CLARK & LIGOUIS (2010) for the South African site of Sibudu. They found that even the lightly tanned bones had been exposed to mild heat of <400°C. Such mild heat is most probably related to the unintentional burning of bones buried in the sediment beneath and around a hearth (BENNETT 1999, STINER et al. 1995, DE GRAAFF 1961).

A tortoise "cooking pot"?

Upon inspection of the material, several fragments of tortoise carapaces revealed a peculiar kind of heat exposure: The outside was blackened, sometimes showing a black, shiny coating, while the inside seemed to be completely unburnt (fig. 13).

Four of the 13 pieces with this characteristic are from AH IA, two from AH I, four from AH II, and three from AH III. I have also noted such fragments among the assemblage of Kaus Kozah and from the Upper Paleolithic assemblage of Ghar-e Boof in Iran. Due to the small sample of faunal material analyzed, however, this was not further investigated.

Among the 345 pieces of tortoise shells at Baaz, 13 pieces of the carapace revealed this selective blackening on the outer side of the shell. None of the remains showed an exclusive staining on the inner side. Staining of the complete bone in brown, black,

fig. 13. Baaz Rockshelter. Outer (left) and inner (right) side of a tortoise shell „cooking pot“ fragment. Note the black coating on the outer side. Find from sq.21/33, #768.

grey and white occurred in altogether 102 finds. While the latter have been exposed to homogenous heat, the selective heating of the 13 pieces requires further explanation, since the uniform direction of heat exposure is unlikely to be incidental. Based on ethnography reports we might assume the carapace was used as a "cooking pot." Giatti (1943), for example, reported the following from his expeditions to Africa in a popular magazine:

> *The river is filled with turtles, which supply meat and a cooking pot at the same time.*

This probably refers to the possibility of cooking a turtle in its own shell, by simply laying it upturned in the fire. Archaeological finds around the world and in all sorts of historic and prehistoric contexts have been interpreted in this way, not only for terrestrial, but also for marine turtles (DESSE & DESSE-BERSET 2000, CARLSON 1999, RIGHTER 2002).

Bertrand Ligouis (Institute for Scientific Archaeology, University of Tübingen) analyzed one larger fragment from AH IA microscopically to determine whether the black coloration is indeed a sign of heating and to investigate the nature of the shiny black coating.

Several small pieces of this find were therefore embedded in epoxy resin in various angles and then ground and polished to be inspected microscopically for their optical properties. The reflectance was also measured to determine the temperature of the heat exposure (CLARK & LIGOUIS 2010).

The results are well in agreement with the "cooking pot"-hypothesis. It is though unlikely that, as mentioned above, the turtle itself was cooked in its shell. The ceratin of the shell would have probably left thicker and more visible, porous burning residues. The thin coating by residues on the outside of the shell and within the blood vessels (fig. 14) of the carapace also do not resemble burnt fat, which would also be expected to be more porous, but rather resemble burnt proteins. These proteins are probably from blood or

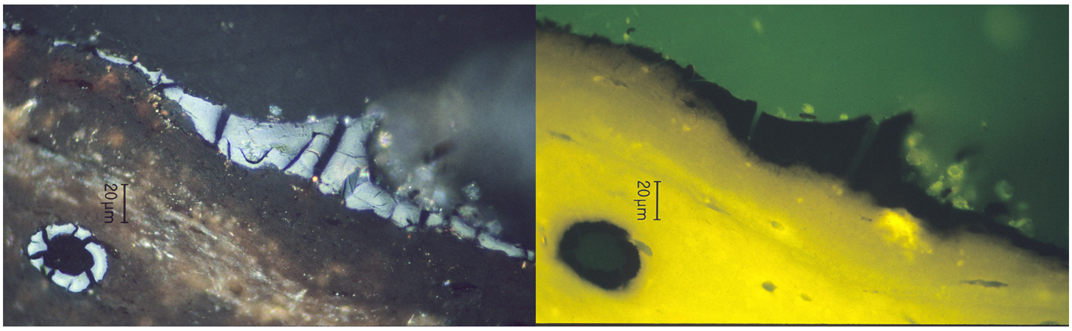

fig. 14. Baaz Rockshelter. Tortoise carapace, microscopic views of a tangential crossection under reflected white light (left) and in fluorescence mode (right). The left picture shows chared proteins on the outside of the shell, and in a blood vessel. The picture on the right shows in bright yellow color, that the bone was only little, if at all, affected by heating. This very low heating depth supports the „cooking-pot-hypothesis".

collagen from the carapace itself, dissolved in the liquid which was heated in the shell, diffused through the bone and partially burned on the outer surface of the shell. This liquid would have cooled the bone despite its exposure to heat, thus impeding a residue-free combustion. Therefore, only a very thin, outermost layer is indeed carbonized at temperatures of around 300°C and coated by residues, while the inner part is virtually unchanged, revealing fresh bone with some amount of collagen still preserved. This collagen also indicates that the shell was not used very often, since all of the collagen would have eventually been "boiled out" by the heated liquid. This would not have been the case, though, if the liquid itself had contained collagen.

If any unburnt tortoise shell had been used as a vessel to carry liquids and dry matter, we are unfortunately unable to determine this.

Other artefacts

There are several other finds that can be classified as artefacts. Noteworthy are several bone points or awls, and an implement of unknown purpose from AH IIIA (fig. 15).

The latter is not complete, but has a notch on the straight end for fixing some sort of twine or cord. The other end of the artefact is curved, broken here in antiquity, the complete artefact being formerly U-shaped. The length of the preserved part is 59 mm.

The breakage pattern shows that the bone was still fresh when the damage occurred. The artefact has also experienced some heat exposure, but an intentional burning or a disposing of the broken piece in fire can be ruled out, as this would have destroyed the find completely and the color would have become whitish or grey. I suggest that it was

fig. 15. Baaz Rockshelter, AH IIIA. Bone artefact of unknown purpose.

some kind of hook, as the breakage pattern resembles indeed an overloaded and failed hook. We could speculate whether it could have been used to hang things over a fire, which would explain the uniform heat exposure and its disposal in a settlement context.

Although this implement resembles the fishing hooks from the European Neolithic, and while it is tempting to refer then to the fish bones in the assemblage, it is very unlikely that it is in fact a fishing hook, as its size would be suited for very large fishes only, and the notch is too shallow for a string strong enough to secure such large fishes.

The presumed fishing hooks from the Natufian of Kebara are smaller, the maximum being 33.4 mm long (CAMPANA 1989). They are also somewhat stouter and appear to be less carefully manufactured.

6. Kaus Kozah

6.1. The excavation and stratigraphy of Kaus Kozah

The site of Kaus Kozah (fig. 16) is located only a short uphill walk from the village of Ma'aloula, in the well protected backside of the limestone cliff, facing the highlands. It is an impressive cave with a large interior.

The top of the cliff line is easily accessible from the site, providing a wide view of the lowlands. Despite these many attractive features, the surface of the cave lacked hardly any signs of modern activities when the site was discovered in 2000.

Excavation began in 2004 and lasted until 2006. Among the most remarkable discoveries here are two child burials from the Epipaleolithic or Early PPNA.

Excavators were able to define four archeological horizons (fig. 17), AH I being the richest in faunal remains. Professor Nicholas CONARD, head of the excavation team, reported that this layer seemed to be almost "plastered" with bones.

Among the lithics, a Levallois component was noted along with the Epipaleolithic/PPNA industry. The Levallois artefacts seem to be limited mostly to the lowest layer, AH IV (HILLGRUBER 2010).

The child burials, which were dated in 2006, proved to be intrusive in the possibly Middle Paleolithic AH IV, and yielded a date which might be either Late Natufian or early PPNA. It was clear that this intrusion would make it difficult to separate the Middle Paleolithic from younger material. We also suspected, due to the proximity to the village, recent disturbances to the deposits at Kaus Kozah.

Despite our effort to identify a potential post-PPN occupation through radiocarbon dating of seemingly younger material, it took us many attempts before we were able to date a dog bone to the early Iron Age, and a grape seed (*Vitus*) to the modern period (>1954 AD). All the other 10 dates are surprisingly PPN.

The radiocarbon dates confirm a meaningful occupation of the site from the Late Natufian or early PPNA—as is also probable from the appearance of the lithic industry (HILLGRUBER 2010)—to the earliest PPNB. Two dates, one on a fallow deer metatarsus, and one on a celtis seed, date the occupation into a late PPNC. A true PPNB occupation, or anything between the PPNC and the Iron Age, has not yet been dated.

6.2. Faunal remains from Kaus Kozah Cave

The faunal assemblage from Kaus Kozah is the largest, but also the most difficult of the sites examined here with respect to dating and stratigraphy. I will therefore present a more detailed analysis of the taphonomy of the assemblage than I did for Baaz, and before describing the finds, the stratigraphy requires some attention.

Taphonomic considerations

The preservation and bone surfaces offered one possibility for detecting turbations in the stratigraphy. Especially in squares 51/40 and 51/41, the bone preservation in AH IV very much resembled layers I and II, while the adjacent square meters 50/40 and 52/40 seemed undisturbed.

But even in the obviously disturbed squares, the bone preservation shifts towards typical AH IV preservation with increasing depth. In square 51/40, this shift in preservation happens roughly with the shift to what the excavators called AH IVB. Unfortunately, IVB contains very little identifiable material.

The distorted stratigraphy in these squares is most probably related to the child burials, which were identified in squares 51/40 and 51/41, and which are thought to be intrusive to the Middle Paleolithic AH IV. Their late Epipaleolithic/early PPNA age corresponds well with most of the other dates. This will have to be evaluated in future investigations, if organic remains from the Middle Paleolithic are in fact preserved, or if the association of bones and Levallois artefacts is caused by a hiatus in the stratigraphy.

Two incisors from a cervid in square 52/41, probably from red deer (*Cervus elaphus*) and, according to size and abrasion, from the same individual, were each assigned to AH II and IV. Both finds were discovered in the sieving, and their vertical position shows

fig. 16. Kaus Kozah.

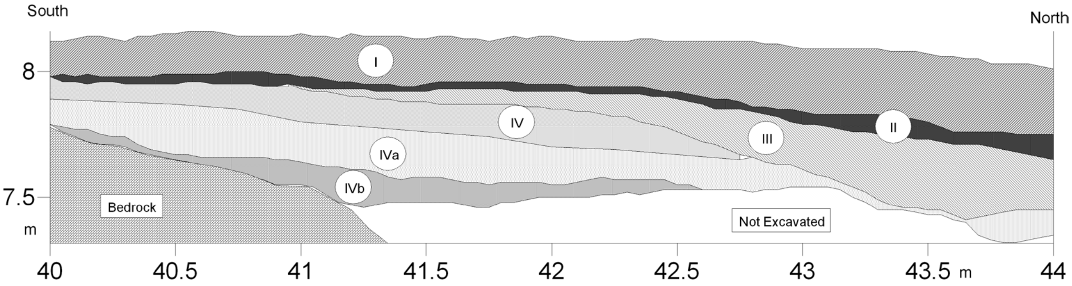

fig. 17. Kaus Kozah. Schematic profile from North-South.

a distance of only 6 cm from each other. Taking into account that bucket finds have somewhat generalized coordinates, with a vertical uncertainty of several centimeters, it is possible that a disturbance in this particular square is not as likely as it seems by the mere comparison of finds and their respective AHs.

In statistic calculations, the archaeological horizon recorded by the excavators is our reference. We can only try to evaluate the reliability of the given stratigraphical context for single, obvious cases. We must therefore evaluate Kaus Kozah with some degree of caution, avoiding any interpretations based simply on single observations.

In other cases, we have clear indications that turbations must have been absent. One such case is a diaphysis of a metacarpus of a small ruminant (most probably gazelle) from AH IV in square 50/40. The animal was so young that the two rays of the metacarpus are yet unfused. Had there been any disturbance to this area, they would have been easily separated. They were found still lying together, having not been moved since their deposition.

In the northern part of the excavation, outside the drip line of the cave, we observed more disturbances in the form of biogalleries than we did in the southern part (CONARD et al., 2006). This might also account for the date of a piece of charcoal from AH IV of square 50/43, from ca. 10.8 ka BP, making it very similar in age to the child burials.

A first phalange of a domestic sheep comes from AH IV, although the sediments from which it was recovered through sieving was initially recorded as belonging to AH III. Through the change in provenance, the sheep phalange now is the only certain domestic animal within this presumably Middle Paleolithic layer. Data from this square (51/41), as well as data from square 51/40, will have to be treated with care in the metrical and quantitative analyses. In the following, I will present the data by AHs. I will also discuss whether statistical changes occur if these disturbed squares are included or excluded in the analysis. Although necessary, it is very unfortunate having to exclude the "disturbed" squares, as they are the richest in finds.

This is also the case with the measurable finds, reducing, for example, the presumably unproblematic finds of the wild sheep in AH IV to only one.

General remarks on the faunal assemblage

All recovered finds were analyzed in their entirety, totaling 40,501 finds. Among these are 385 finds which were classified as "background fauna", i.e., rodents, amphibians, several small reptiles, snakes, bats and small passerine birds, as well as birds of prey and vultures. They will be discussed in a separate paragraph at the end of this chapter, and are excluded from the basic statistics.

As the majority of these animals probably found their way naturally into the cave, they tab. 12. Kaus Kozah. Radiocarbon-dates and calibration.

lab.nr.	square	f.nr.	AH	14C BP	calBP
KIA-44012	49/34	61	I	1.359 ± 22	1.310-1.265
KIA-44009	50/38	141	I	7.357 ± 39	8.311-8.037
KIA-44011	50/40	227	IV	7.794 ± 39	8.640-8.455
KIA-41198	50/41	145	III	9.433 ± 60	11.068-10.505
KIA-41202	51/41	106.2	IV	9.775 ± 42	11.252-11.145
KIA-44008	50/43	168	I	10.116 ± 45	11.981-11.407
KIA-28696	51/41	107.4		10.125 ± 66	12.013-11.403
KIA-30306	51/41	123.11	IV	10.486 ± 48	12.590-12.147
KIA-41201	51/41	104.3	III	10.618 ± 39	12.671-12.433
KIA-41199	50/43	197	IV	10.864 ± 45	12.895-12.611
KIA-41200	51/41	71	II	11.283 ± 44	13.294-13.095
KIA-44010	50/40	224	IV	>1954 A.D.	

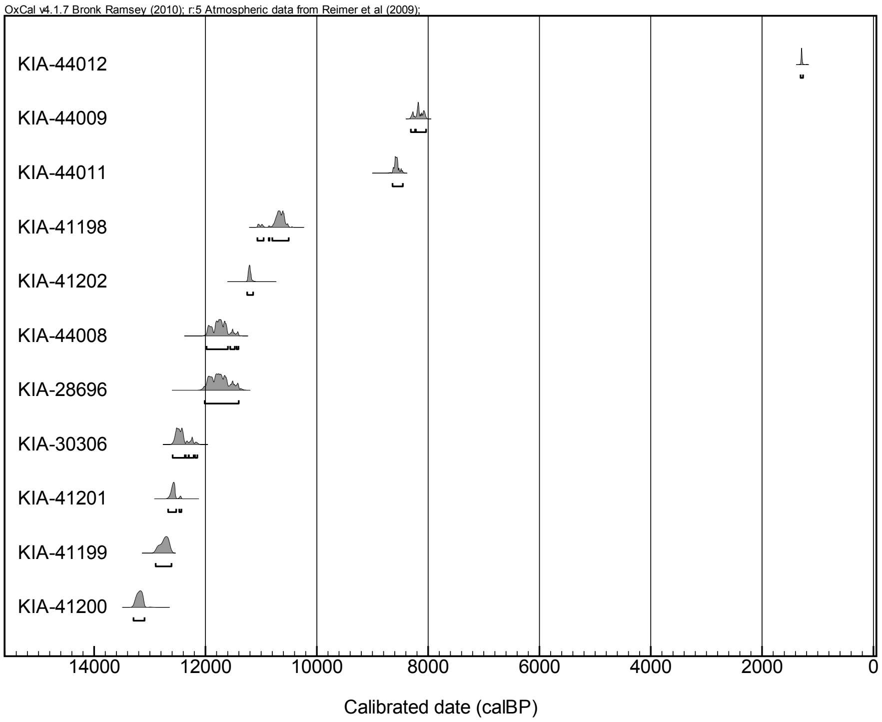

fig. 18. Kaus Kozah. Probability curves for calibration.

tab. 13. Kaus Kozah, AH IV. Faunal remains excluding background fauna. Finds from the problematic squares 51/40 and 51/41 are excluded in the columns to the right.

	all squares				excl. 51/40 and 51/41			
taxa AH IV	**n**	**n%**	**Σ**	**Σ%**	**n**	**n%**	**Σ**	**Σ%**
identified specimens								
brown hare, *Lepus europaeus*	25	17,48	5,2	0,92	11	15,94	2,4	0,54
wild horse, *Equus ferus*	1	0,70	279	49,15	1	1,45	279	63,31
equid, *Equus* sp.	2	1,40	4,1	0,72	1	1,45	0,6	0,14
brown bear, *Ursus arctos*	2	1,40	2,4	0,42	1	1,45	0,4	0,09
wolf, *Canis lupus*	2	1,40	0,2	0,04	2	2,90	0,2	0,05
dog, Canis	1	0,70	0,1	0,02	-	-	-	-
red fox, *Vulpes vulpes*	4	2,80	0,4	0,07	-	-	-	-
marten, *Martes* sp.	1	0,70	0,1	0,02	1	1,45	0,1	0,02
hyena, Hyaeninae	1	0,70	1,4	0,25	-	-	-	-
fallow deer, *Dama mesopotamica*	1	0,70	0,5	0,09	1	1,45	0,5	0,11
cervid, Cervidae	4	2,80	13,7	2,41	3	4,35	13,4	3,04
aurochs, *Bos primigenius*	1	0,70	0,1	0,02	1	1,45	0,1	0,02
wild or domestic cattle, *Bos*/BOS	3	2,10	19,1	3,37	-	-	-	-
wild goat, *Capra aegagrus*	2	1,40	33	5,81	2	2,90	33	7,49
wild sheep, *Ovis orientalis*	11	7,69	63,1	11,12	2	2,90	27	6,13
domestic sheep, Ovis	1	0,70	0,7	0,12	-	-	-	-
wild caprine, *O.orient.* or *C.aegagrus*	21	14,69	57,9	10,20	15	21,74	37	8,40
wild or domestic caprine, *Ovis/Capra*	17	11,89	29,5	5,20	9	13,04	23,1	5,24
gazelle, *Gazella sp.*	39	27,27	53,8	9,48	17	24,64	22,1	5,01
tortoise, *Testudo graeca*	3	2,10	2	0,35	2	2,90	1,8	0,41
chukar partridge, *Alectoris chukar*	1	0,70	1,3	0,23	-	-	-	-
total identified	**143**	**100,00**	**567,6**	**100,00**	**69**	**100,00**	**440,7**	**100,00**
unidentified specimens								
large carnivor	4	1,5	1,3	0,5	2	1,2	0,5	0,3
medium-sized carnivor	1	0,4	0,2	0,1	1	0,6	0,2	0,1
large ruminant	4	1,5	4,7	1,8	2	1,2	1,9	1,2
small ruminant	82	30,7	47,4	17,9	57	33,9	28,2	18,4
large bird	1	0,4	0,2	0,1	-	0,0	-	0,0
medium-sized bird	1	0,4	0,1	0,0	-	0,0	-	0,0
small bird	3	1,1	0,3	0,1	1	0,6	0,1	0,1
large undet.	16	6,0	66,9	25,3	10	6,0	31,5	20,6
medium-sized to large undet.	29	10,9	64,2	24,3	9	5,4	40,2	26,3
medium-sized undet.	113	42,3	77	29,1	79	47,0	49,2	32,2
small to medium-sized undet.	6	2,2	1,2	0,5	2	1,2	0,4	0,3
small undet.	2	0,7	0,4	0,2	1	0,6	0,3	0,2
very small undet.	5	1,9	0,5	0,2	4	2,4	0,4	0,3
total w. size class	**267**	**100,0**	**264,4**	**100,0**	**168**	**100,0**	**152,9**	**100,0**
undet. (w/o size class)	12370		2495,7		5130		1083,7	
AH IV total	**12780**		**3327,7**		**5367**		**1677,3**	

are not related to human subsistence. Consequently, their bone weight does not provide us with any valuable information. Their numbers, though, might provide us with some insight into environmental factors, especially in the case of rodents.

A considerable number of finds have no clear stratigraphic provenance, i.e. are from ambiguous sections of the stratigraphy or were recovered from small sections of collapsed profiles. The relevant quantity of faunal remains, excluding background fauna and fauna from uncertain provenance, amount to 35,727 finds with a weight of roughly 15.760 g. Among these could very well be animals that were not human prey, especially among the carnivores. This will be discussed in the respective paragraphs.

AH IV

The spacially restricted intrusion into AH IV mentioned above should be contemporaneous to the burials, since many of the children's bones were still lying close together and any later disturbance would have easilydistorted the fragile and unfused bones. This is especially the case for square 51/40, where the cranium of the child and several long bones were found within a very small area.

The fact that a domestic sheep was identified in AH IV of square 51/41 can be understood if we consider the above-mentioned change in the designated AH, and the difficulties in the stratigraphy which this implies. The averaged z-value (depth of recovery) of the sediments from which the sheep was found, in the sieving, is 7.84 m, making it the uppermost "bucket" from AH IV, with a difference of only 4 cm to the lowermost "bucket" from AH III in the same quarter-square meter.

Although this circumstance helps to explain the sheep within a potentially well-preserved Epipaleolithic pit, it also shows that the disturbances through post-burial occupations of Kaus Kozah extend closer to the level of the burial in square 51/41 than in 51/40.

As mentioned above, the preservation of faunal remains in AH IV is markedly different from those of the layers above. The bones are typically more mineralized, have a different color and some manganese oxide dendrites often on their surfaces. Among the 12,780 finds, the majority coming from the disturbed squares, leaves 3,478 finds with a weight of 630 g from presumably undisturbed areas.

Interestingly, the exclusion of the disturbed squares shifts the find proportions between layers somewhat. AH IV has then the most finds, although these finds are difficult to identify. Only 69 finds, from among those in AH IV, with a weight of 440 g were identifiable.

An overview of the faunal remains from AH IV is given in tab. 13. The comparison of the faunal spectrum with and without the disturbed squares is interesting, and confirms the necessity of this step: The basic pattern stays the same, the relative proportions are very

fig. 19. Kaus Kozah. Seven incisors (or rather six incisors and one canine) of a single wild sheep.

stable despite the low find number, but certain domestic animals (including the dog) disappear with the exclusion of these squares. Also, the chukar partridge disappears, which is well represented in the upper layers, as well as the fox. As partridge and fox are considered typical components of Epipaleolithic assemblages, and the dog does not appear in the Levant until the Natufian, they could well (chronologically) be associated with the burials.

An incisor of a hyena from AH IV also comes from the disturbed squares and consequently disappears from the species list. The tooth is though most probably indeed from this layer, as the preservation shows the typical AH IV-characteristics. Hyenas might nevertheless have occupied the cave throughout the sequence, as coproliths from layer I indicate. Also some portion of the etched and digested bones, which occur in all layers, might be attributed to hyenas.

The most frequently found species (by NISP) in the undisturbed portion of AH IV are the gazelles (n=17, ∑=22,1g) and the wild caprines, of which two finds were each identified as wild goat and wild sheep. Fifteen finds from wild caprines were not further identifiable as either species. Several small finds, especially tooth fragments, were too fragmented to determine if they were from the domestic or wild forms. In the potentially disturbed square, six incisors from a single wild sheep were found, to which another incisor from AH II of the same square could be matched (fig. 19, fig. 20). The finds were still lying close to each other, and even the tooth from AH II was found only a little more than 4 cm away from the nearest incisor in AH IV. These teeth must have still been in the mandible when they were deposited.

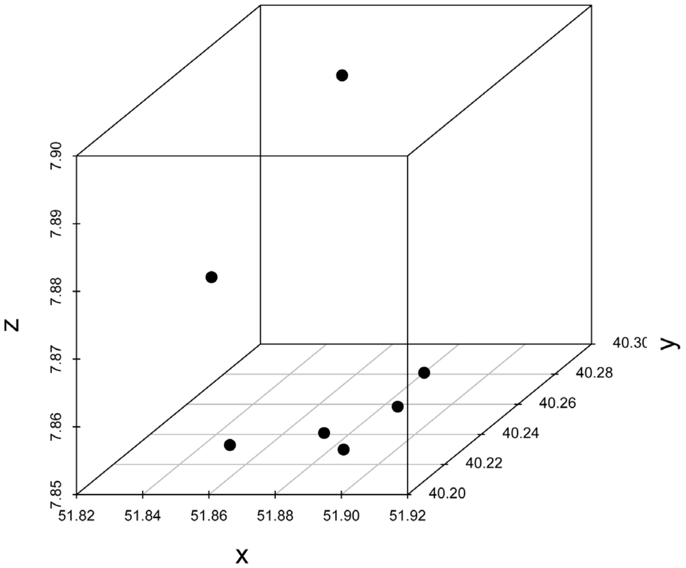

fig. 20. Kaus Kozah. Plot of the wild sheep incisors in three dimensions. The lower five finds are still in their anatomical position, forming roughly an arch. The two incisors further up in the stratigraphy have travelled somewhat towards the surface - indicating postdepositional turbation after the mandibular bone had already disintegrated.

Looking at bone weight, the single metacarpus of a horse is heavier than all the other identifiable finds together. The metacarpus is very large, and wider than in any onager or wild ass. Equids are present in all layers, but most are indeed from the smaller onagers and asses. This find is definitively from a horse, and it is interesting to note that PERKINS (1968) also found large horses at Yabroud Rockshelter IV, together with remains of a species of Pleistocene rhinoceros. This could indicate a similar age for Yabroud IV and Kaus Kozah AH IV, but not necessarily. Horses only occasionally migrated from central Asia into Europe and the Levant. UERPMANN (1987) correlates the expanding distribution of horses with climatic coolings.

If the horse metacarpus at Kaus Kozah is indeed contemporaneous with the Levallois lithic industry from the same layer, late OIS 6 or late OIS 5 might be the time of occupation, with OIS 4 technologically less probable, although the few artifacts are not very diagnostic (BRETZKE & CONARD person. comm.). Horses have also been identified in the assemblage of Yabrud Rockshelter I (PERKINS 1968), but it is currently impossible to determine whether the assemblages are therefore in fact contemporaneous. Horses, gazelles and cervids occurred in the Levant not only in one specific period. At Yabroud I, remains of rhinoceros were found, and this animal is not present in Kaus Kozah. The only available absolute dates for Yabroud I are from level 4, from which two burnt flints were dated by ESR. Their ages range from 139ka to 115ka (PORAT & SCHWARCZ 1991).

Generally speaking, the assemblage of Kaus Kozah AH IV is again dominated by gazelles, caprines and equids, as is the case with almost every other assemblage in our research area despite the Late Natufian at Baaz. Interesting here turns out to be the wild goats, which seem to be more frequent in the Middle Paleolithic than in younger periods. Although the find number is low, and statistics therefore somewhat problematic, the evidence for wild goat becomes a common feature of Kaus Kozah and Wadi Mushkuna, and a major difference as compared with Baaz, where we have not uncovered any confirmed evidence of wild goat.

Typical small game species, such as hares and tortoises, are present in AH IV, but their respective bone weights are all below 1% of the total. Their contribution to human subsistence is therefore minor.

AH IV also reveals some evidence for natural bone accumulation, especially regarding carnivore remains, which could have contributed some of the finds to the assemblage.

The bear tooth and phalange are relatively small, as is characteristic for the subspecies of brown bear, which occurred in Syria up until recently (*Ursus arctos syriacus*). Since these bears typically hibernated in caves or tree stumps at high elevations, it is very probable that the finds do not result from the human occupation of Kaus Kozah. The deep, and relatively dry interior of the cave would have been an ideal bear den. Similarly, the hyena incisor, despite its find position in one of the disturbed squares, is most likely from layer IV. It could be from a weakened, older individual that sought shelter in the cave and then died there.

AH III

This layer was originally named and classified in the northern squares, and was found not to extend into the southern part of the excavated area. The assemblage has the fewest finds. I consider it a mixture of sediments poor in finds, with intrusion from layers above and below, caused by bioturbation. This would correspond well with the observation that bioturbation increases in the northern squares, where AH III is exclusively present. The finds from this layer are highly fragmented and therefore mostly non-diagnostic, often hardly identifiable to animal size. The finds identifiable were not statistically unusual (tab. 14). They included equids, gazelles and caprines, many finds in the "small ruminant" category, and small numbers of finds from hare (n=3), tortoise (n=1), badger (n=1), dog (n=1) and fox (n=1). I identified one find as a domestic caprine due to its small size.

Since the find number is low, the dating and stratigraphic unity unclear, and as I was not able to observe any notable find pattern, I will not interpret AH III any further here.

A piece of charcoal from AH III was dated to 9.4 ka BP, a date chronologically marking the

fig. 21. Kaus Kozah, AH III. This lower premolar of a goat was dated to 10.6 ka calBC, which is somewhat contradictive to is small dimensions (implicating domestic status).

tab. 14. Kaus Kozah, AH III. Faunal remains excluding background fauna.

taxa AH III	n	n%	Σ	Σ%
identified specimens				
brown hare, *Lepus europaeus*	3	6,1	0,7	0,5
dog, Canis	1	2,0	0,4	0,3
red fox, *Vulpes vulpes*	1	2,0	0,1	0,1
badger, *Meles meles*	1	2,0	0,1	0,1
equid, *Equus* sp.	7	14,3	81,5	55,2
wild or domestic cattle, *Bos*/Bos	2	4,1	5,5	3,7
wild caprine, *O.orient.* or *C.aegagrus*	6	12,2	16,4	11,1
wild or domestic caprine, *Ovis/Capra*	16	32,7	17	11,5
domestic caprine, Capra/Ovis	1	2,0	1,5	1,0
gazelle, *Gazella* sp.	10	20,4	23,8	16,1
tortoise, *Testudo graeca*	1	2,0	0,7	0,5
total identified	**49**	**100,0**	**147,7**	**100,0**
unidentified specimens				
medium-sized carnivor	1	0,9	0,4	0,5
small ruminant	75	65,8	28,7	33,7
medium-sized bird	4	3,5	0,9	1,1
small bird	1	0,9	0,1	0,1
large undet.	5	4,4	27,8	32,6
medium-sized to large undet.	12	10,5	15,4	18,1
medium-sized undet.	16	14,0	11,9	14,0
total w. size class	**114**	**100,0**	**85,2**	**100,0**
undet. (w/o size class)	1632		329,5	
total AH III	**1795**		**562,4**	

change from the PPNA to the PPNB, a time when domestic animals (except the dog) are not yet expected.

A lower premolar from a goat, which provided a date on the apatite, is also from AH III (fig. 21). The Leibnitz laboratory in Kiel undertook several tests to clarify whether the date is reliable and concluded that the calculated age of ca. 10.6 ka BP can be trusted. With a length of only 8.7 mm and a crown height of 9.5 mm, this tooth seemed small, indicating domestic goat. The date though makes it very unlikely that goats were already domesticated at this time. There is then either a problem with the dating or there were small wild goats present. I hesitate from assuming that this is indeed a sign for a much earlier domestication than hitherto established. This is due to the fact that local domestication is unlikely considering the low occupation density of the area and the lack of large permanent settlements where this might have taken place. From other areas within the natural range of wild goats, no such small goats have yet been reported. This same problem applies to a proximal metacarpus of another presumably domestic goat from AH I, dated to 10.1 ka BP. As the latter find is fragmented, and the proximal metacarpus is not the most diagnostic of bones, it might also represent a case of osteologic misinterpretation.

AH II

The second layer in Kaus Kozah underlies AH I as a thin stratum with a depth of only 5 cm (fig. 17). It runs parallel to AH I in all the squares and is distinguished from the latter by less limestone debris. The burial pit in which the children were laid had been dug from the surface of that time into the Middle Paleolithic deposits. For the sake of interpreting AH II and AH I, it would be interesting to know if this former surface is still present, and how it relates chronologically to AH II and AH I.

AH II contains finds from domestic cattle (Bos), which were domesticated only in the Late PPNB, and would therefore postdate the burial. The cattle also indicate that the former Epipaleolithic surface no longer exists as a distinct layer. Finds from the Epipaleolithic have been mixed with finds from this younger occupation in a second disturbance event after the Epipaleolithic burial.

The only yet available date for AH II was acquired on a gazelle metacarpus, in square 51/41. The date of ca. 11.2 ka calBC is again in the Epipaleolithic/early pre-ceramic range of the child burials. Since this date is roughly 2500 years older than the date from AH III, profit represents proof that AH II is also subject to disturbances (although the dates are from different squares). It might in fact be a reworked and mixed assemblage of the former Epipaleolithic occupation, a PPN occupation and a younger, post-PPNB occupation due to the finds of domestic animals.

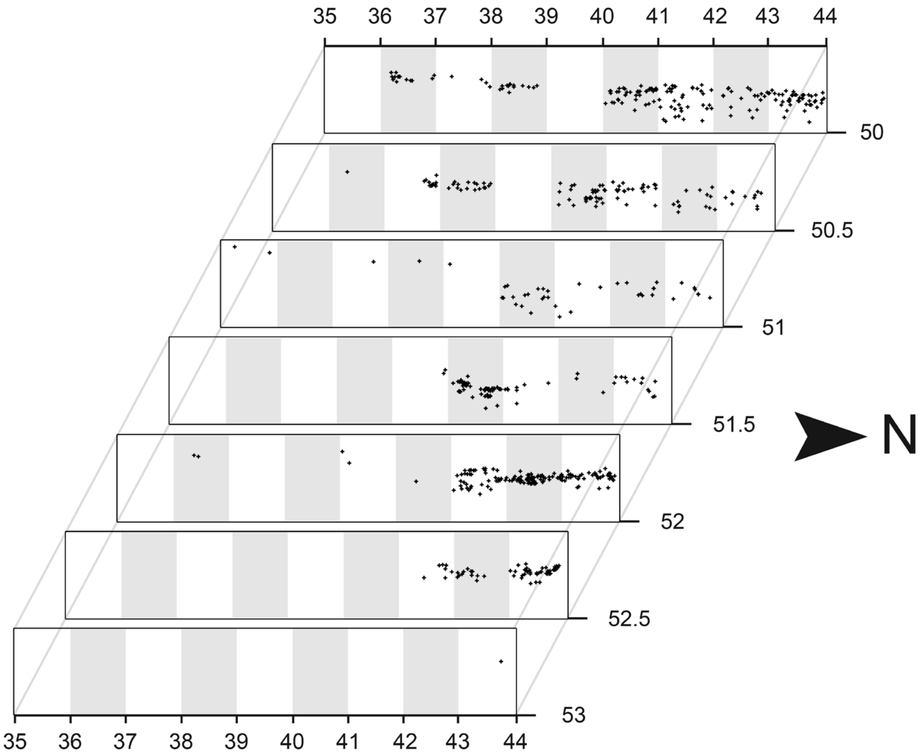

fig. 22. Kaus Kozah. Plot of individually recorded finds, projected onto artificial profiles.

Almost 90% of all finds from AH II were found outside the squares 51/40 and 51/41 (which were identified as disturbed down to AH IV). This low find density was surprising, as the thickness of AH II is for the most part uniform in the entire excavated area.

To evaluate whether the low find density is somehow related to the burial, i.e. might indicate a former pit, finds were plotted in profile and by layers. All individually recorded finds from the main excavation area were piece-plotted in artificial profiles (fig. 22). The plot shows the finds from each 0.5-meter section (North-South-orientation), projected together in one profile. The horizontal and vertical scale in the plot is identical, making it easier to compare the distances of finds. The shading of every second square was done to help with the visual orientation in the graph. Not all squares in the sections have been excavated, i.e., the 35-, 37- and 39-meter-squares, but surface collections were made.

Although the plot does show some areas of higher and lower find density, the distribution does not show an evident pattern. Explaining find distribution might be as simple as follows:

The squares, in which the burials were found, are the most "comfortable" for habitation based on the architecture of the cave. They are located just behind the drip line of the cave, offering shelter from wind, sun and rain, but are not within the dark and cool interitab. 15. Kaus Kozah, AH II. Faunal remains, excluding background fauna. Finds from the problematic squares 51/40 and 51/41 are excluded in the columns to the right.

	all squares				excl. 51/40 and 51/41			
taxa AH II	**n**	**n%**	**Σ**	**Σ%**	**n**	**n%**	**Σ**	**Σ%**
identified specimens								
brown hare, Lepus europaeus	31	11,6	10,6	1,5	23	11,1	8,2	1,3
wolf or dog, Canis/CANIS	1	0,4	0,7	0,1	1	0,5	0,7	0,1
dog, CANIS	8	3,0	10,6	1,5	6	2,9	8,8	1,4
red fox, Vulpes vulpes	9	3,4	13,4	1,8	5	2,4	12,8	2,0
marbled polecat, Vormela peregusna	1	0,4	0,1	0,0	-	-	-	0,0
marten, Martes sp.	1	0,4	1,3	0,2		0,0		0,0
badger, Meles meles	1	0,4	1,5	0,2	1	0,5	1,5	0,2
wild horse, Equus ferus	2	0,7	10,4	1,4	2	1,0	10,4	1,6
wild or domestic donkey, Equus africanus/ASINUS	2	0,7	34	4,7	2	1,0	34	5,4
onager, Equus hemionus	1	0,4	52	7,2	1	0,5	52	8,2
equid, Equus sp.	24	9,0	74,9	10,3	21	10,1	63,9	10,1
fallow deer, Dama mesopotamica	1	0,4	2	0,3	1	0,5	2	0,3
cervid, Cervidae	1	0,4	0,1	0,0	1	0,5	0,1	0,0
wild or domestic cattle, Bos/BOS	3	1,1	34,3	4,7	3	1,4	34,3	5,4
cattle, BOS	8	3,0	53,5	7,4	4	1,9	34	5,4
wild sheep, Ovis orientalis	6	2,2	37,4	5,1	5	2,4	36,8	5,8
domestic goat, CAPRA	3	1,1	18,1	2,5	2	1,0	14,7	2,3
domestic sheep, OVIS	1	0,4	8,2	1,1	1	0,5	8,2	1,3
wild caprine, O.orient. or C.aegagrus	9	3,4	32,5	4,5	7	3,4	26,9	4,3
wild or domestic caprine, Ovis/Capra	57	21,3	128,6	17,7	46	22,1	111,1	17,6
domestic caprine, CAPRA/OVIS	4	1,5	7,7	1,1	4	1,9	7,7	1,2
goitered gazelle, Gazella subgutturosa	1	0,4	2,5	0,3	1	0,5	2,5	0,4
gazelle, Gazella sp.	75	28,0	185,9	25,6	58	27,9	158,1	25,0
chukar partridge, Alectoris chukar	5	1,9	1	0,1	4	1,9	0,7	0,1
tortoise, Testudo graeca	13	4,9	5,1	0,7	9	4,3	2,9	0,5
total identified	**268**	**100,0**	**726,4**	**100,0**	**208**	**100,0**	**632,3**	**100,0**

	all squares				excl. 51/40 and 51/41			
taxa AH II	**n**	**n%**	**Σ**	**Σ%**	**n**	**n%**	**Σ**	**Σ%**
unidentified specimens								
medium-sized carnivor	2	0,4	0,5	0,1	2	0,5	0,5	0,1
small carnivor	1	0,2	0,1	0,0	1	0,3	0,1	0,0
large ruminant	2	0,4	0,9	0,2	2	0,5	0,9	0,2
small ruminant	183	39,3	103,5	21,1	161	42,3	95,7	23,5
medium-sized bird	4	0,9	0,5	0,1	4	1,0	0,5	0,1
small bird	3	0,6	0,3	0,1	3	0,8	0,3	0,1
large undet.	29	6,2	89,5	18,3	28	7,3	85,1	20,9
medium-sized to large undet.	91	19,5	146,1	29,8	37	9,7	86,8	21,3
medium-sized undet.	135	29,0	146,2	29,8	127	33,3	135,2	33,2
small to medium-sized undet.	2	0,4	1,2	0,2	2	0,5	1,2	0,3
small undet.	2	0,4	0,4	0,1	2	0,5	0,4	0,1
very small undet.	12	2,6	1	0,2	12	3,1	1	0,2
undet.	4637	90,9	1119,5	69,5	3385	89,9	851,2	67,6
total w. size class	**466**	**100,0**	**490,2**	**100,0**	**381**	**100,0**	**407,7**	**100,0**
undet. (w/o size class)	4637		1119,5		3385		851,2	
total AH II	**5371**		**2336,1**		**3974**		**1891,2**	

or of the cave. This position also allows a good view of the landscape, while hiding those inside from being seen below. If this spot were also chosen by prehistoric people as a favorable dwelling place, they might have “swept“ the floor of bones, removing them to the surrounding squares. This would also have caused a further mixing of finds from different ages.

It is unclear, though, how many of the finds from the different occupation phases contributed to the faunal assemblage of these upper layers. I have the impression that geologic horizon 2 (GH 2) is not a separate archeological unit. The lower amount of limestone debris in comparison with AH I might be a consequence of deflation of fine sediments in AH I, producing what seemed for the excavators to be separate archaeological units. AH I and AH II could be combined for the sake of analysis, as they both consist of a similar mix of finds from the same occupation phases, and have therefore the same chronological depth. I will still keep them separate, as it will be easier to combine them in future work than it would be to separate them once the data have been combined.

The table (tab. 15) shows that no fundamental change occurs in the assemblage when the "burial squares" are excluded. It is therefore not necessary to exclude squares 51/40 and 51/41 from the analysis of AH II and AH I, as the layers are probably thoroughly mixed already, and not spacially restricted, as in AH IV. Definitive domestic animals from younger occupations, although present, make up only a minor portion of the assemblages, as the dates have shown. We tried with much effort to find bones which would give us a date for the post-PPN-occupation, but we failed for the most part.

Gazelles and wild caprines, which are typical Epipaleolithic and early PPN prey species, are abundant. The very low number of absolute dates from post-PPN times also indicates that, when the turbation of the deposits occurred, very little 'new' material was involved. Among the lithics, single pieces of pressure flaked artefacts are the remnants of these occupations (HILLGRUBER 2010).

Summarizing the absolute quantities, the faunal spectrum is dominated by gazelle, closely followed by caprines and equids. Among the latter two, some difficulties exist in determining which animals belong to the domestic, and which to the wild forms, because most finds were not measurable. In fact, even measurable finds proved problematic, as no large sample and little comparative data exist for this region.

Among the equids, most of the remains are also not identifiable to species level, but they are chiefly from small equids. Nevertheless, AH II has all three principal species, the caballine wild horses, the half-asses and the asses. The forth equid species, the European wild ass (*E. hydruntinus*), which can be found in species lists of older faunal studies, has recently been identified as being genetically within the variability of the onager (ORLANDO et al., 2009), i.e., both are variants or subspecies of the same species. Differences in tooth morphology, which have been used in differentiation (UERPMANN 1987), are therefore only reflecting intraspecies variability.

Since half-asses, i.e., onagers (*Equus hemionus*), were never domesticated, these are certainly wild animals. Despite the teeth, a ramus fragment of the mandible also confirms this species.

The wild horse (*Equus ferus*) is represented by a very large piece of a proximal metatarsus and a very large proximal splint bone. They lay in neighboring square meters (50/43 and 51/43) with a vertical difference of less than 2 cm. UERPMANN (1987) concluded that horses disappeared from the Levant at the end of the Pleistocene. He lists the latest finds, which are from the Epipaleolithic of Ksar Akil, from Shouqba Cave in Wadi en-Natuf, and the site of Mdamagh in Jordan. The Epipaleolithic and early PPNA occupation of Kaus

Kozah would fit well within this time frame. The preservation of the two finds from AH II is very different from the horse metacarpus in AH IV, and they might very well be of different age, as is implied by the associated lithics of AH II and AH IV.

The asses are more difficult to determine with respect to their domestic status. The size would usually be an indication, but wild asses are generally small in this area as can be seen in the finds from Wadi Mushkuna, where the wild ass (*Equus africanus*) is present together with the onager (*Equus hemionus*) in the Middle Paleolithic. With its adaption to arid environments, the wild ass could have survived in Syria long into the Holocene, and as UERPMANN (1987) suggested, "a zone of overlap with the hemiones would have existed where changing orographic conditions provided biotopes preferred by the respective species": a description which corresponds perfectly to the topography of the TDASP research area.

It is therefore not possible to confirm whether the asses are indeed wild, or in fact domestic donkeys. In the latter case, they would have to be Early Bronze Age or younger, i.e., in or after the 4th millennium BC, since donkey domestication is assumed around that time (ROSSEL et al. 2008). It could therefore belong to the same occupation as the dated dog, i.e., early Iron Age.

The hares and the tortoises turn up a little more frequently than in the layers below, but they are hardly one tenth as frequent as one would expect for a Late Natufian occupation, as in Baaz. This is noteworthy, since the radiocarbon dates overlap, and the burials at Kaus Kozah were originally classified as Natufian burials based on their radiometric age. In his work on the lithic industry, HILLGRUBER (2010) has tentatively favored dating the occupation to an early PPNA, or Khiamian age, which would also be consistent with the radiocarbon dates. From the zooarcheological point of view, this assessment can be supported, since the proximity of the sites excludes major ecological differences for explaining the different small game portions.

The cervid incisor and one of the sheep incisors have already been mentioned in the description of AH IV. The preservation looks much more like AH IV than the typical finds of AH II.

Cervids seem to have been present in the area during the Middle Paleolithic (Yabroud Rockshelter I and Kaus Kozah AH IV) and Epipaleolithic (Baaz). With increasing precipitation in the early Holocene, living conditions for cervids would have even improved. Interestingly, there is no evidence for cervids in the Wadi Mushkuna assemblage and the Upper Paleolithic of Baaz, which might indicate increased aridity during these times.

AH I

In AH I, as in AH II, the exclusion of squares 51/40 and 51/41 does not alter the relative frequencies of the observed taxa (tab. 16). Only one single species would "disappear" from the tables, i.e., the leopard (Panthera pardus). I therefore suggest that the exclusion of these squares from the analysis is not necessary. In fact, the amount of finds from the two squares is small, indicating again a smaller find density than in the surrounding squares. This can be explained similarly to the same observation in AH II.

The most frequent taxa are again gazelles, caprines and equids. Domestic animals are present as cattle and domestic caprines. The equids are again difficult to interpret. As has already been discussed, the asses might well be domestic (= donkeys). One of the teeth is a lower M2 from the left side. It refits anatomically to an M3 from the surface of the cave floor. The teeth show a pathologic abrasion pattern, which resembles the abrasion caused by a bridle. The preservation of the teeth also looks somewhat fresh, less stained, and consequently younger than the majority of the material.

Two coproliths from square 52/41 (#20 and #85)(fig. 23) confirm the temporal presence of hyenas at Kaus Kozah. While skeletal remains could have been imported, the coproliths are a definite indicator that hyenas dwelled here. As a number of finds reveal strong etching by digestive acids, it is clear that some portion of the assemblage was either "reworked" by hyenas when the bones were fresh, or was brought in parts to the cave, indicating a bias in the quantitative analysis of the assemblage. A single hyena incisor in AH IV and two coproliths in AH I are far from the amount one would expect in a highly frequented hyena den. I consider the general quantitative patterns in the faunal assem-

fig. 23. Kaus Kozah, AH I. Two coproliths from hyenas (square 52/41, #20 and #85).

blage to be representative of human subsistence patterns.

Apart from the observed quantitative relationships, the evidence of a leopard (Panthera pardus) proves interesting here. The find is a complete first phalange (fig. 24) with some staining by heat. As the heat exposure was low, probably around 300-400°C, it is likely that heating was unintended and occurred accidentally through the proximity of a hearth. Leopards are now extinct in almost the entire Levant, except for a small population in the Jordan Rift Valley (HENSCHEL et al. 2008). It formerly was the most widespread species of large cats, and has been a symbol of strength and power throughout history. GROSMAN et al. (2008) published the recovery of an extraordinary burial from the Natufian of Hilazon Tachtit. An elderly woman was buried there with an array of goods, among them a peculiar set of animal parts: an eagle, two martens, an aurochs, a wild boar, several tortoises and a leopard. The available date for Hilazon (10.750±50 BP; GROSMAN 2003) falls immediately between the two dates from the burials of Kaus Kozah.

Although the association of faunal remains with the burials is not certain at Kaus Kozah, since a burial pit could not be distinguished during the excavation, the concurrence of a rare leopard bone and a burial is noteworthy. The phalange is moreover from the same square, 51/41, as the burials.

Among the birds, the chukar partridge is by far the most frequently recovered species in this layer.The only other species is represented by one single find identified as quail.

fig. 24. Kaus Kozah, AH I. First phalange of a leopard (square 51/41, #23.5).

tab. 16. Kaus Kozah, AH I. Faunal remains excluding background fauna. Finds from the problematic squares 51/40 and 51/41 are excluded in the columns to the right. However, the exclusion might not be necessary, as no marked shift is observed.

	all squares				**excl. 51/40 and 51/41**			
taxa AH I	**n**	**n%**	**Σ**	**Σ%**	**n**	**n%**	**Σ**	**Σ%**
identified specimens								
brown hare, Lepus europaeus	85	11,0	35,0	1,5	75	11,4	27,4	1,3
brown bear, Ursus arctos	1	0,1	6,3	0,3	1	0,2	6,3	0,3
wolf or dog, Canis/CANIS	4	0,5	2,2	0,1	3	0,5	1,7	0,1
dog, CANIS	19	2,5	40,2	1,7	18	2,7	36,6	1,7
red fox, Vulpes vulpes	16	2,1	14,5	0,6	14	2,1	13,4	0,6
canid, canidae	1	0,1	0,4	0,0	1	0,2	0,4	0,0
marten, Martes sp.	1	0,1	0,1	0,0	1	0,2	0,1	0,0
marbled polecat, Vormela peregusna	1	0,1	0,1	0,0	1	0,2	0,1	0,0
leopard, Panthera pardus	1	0,1	2,1	0,1	-	-	-	-
wild or domestic horse, Equus sp.	2	0,3	57,0	2,4	2	0,3	57,0	2,6
wild or domestic donkey, Equus africanus/ASINUS	4	0,5	95,0	4,0	4	0,6	95,0	4,4
onager, Equus hemionus	1	0,1	35,0	1,5	1	0,2	35,0	1,6
equid, Equus sp.	78	10,1	511,5	21,4	70	10,7	443,3	20,6
fallow deer, Dama mesopotamica	3	0,4	7,8	0,3	2	0,3	4,7	0,2
red deer, Cervus elaphus	3	0,4	15,9	0,7	3	0,5	15,9	0,7
cervid, Cervidae	1	0,1	1,5	0,1	1	0,2	1,5	0,1
wild or domestic cattle, Bos/BOS	12	1,6	51,1	2,1	12	1,8	51,1	2,4
cattle, BOS	14	1,8	138,0	5,8	10	1,5	114,2	5,3
wild goat, Capra aegagrus	5	0,6	27,5	1,1	5	0,8	27,5	1,3
domestic goat, CAPRA	9	1,2	31,3	1,3	7	1,1	25,0	1,2
wild sheep, Ovis orientalis	16	2,1	81,7	3,4	15	2,3	79,5	3,7
domestic sheep, OVIS	2	0,3	3,5	0,1	2	0,3	3,5	0,2
wild caprine, O.orient. or C.aegagrus	38	4,9	84,8	3,5	34	5,2	72,6	3,4
wild or domestic caprine, Ovis/Capra	159	20,6	335,9	14,0	125	19,1	303,1	14,1
domestic caprine, CAPRA/OVIS	24	3,1	56,4	2,4	19	2,9	40,9	1,9
goitered gazelle, Gazella subgutturosa	3	0,4	17,7	0,7	1	0,2	15,0	0,7
gazelle, Gazella sp.	204	26,5	705,4	29,5	173	26,4	652,6	30,3
wild or domestic pig, Sus/SUS	11	1,4	4,1	0,2	11	1,7	4,1	0,2
chicken, GALLUS	1	0,1	1,7	0,1	1	0,2	1,7	0,1
chukar partridge, Alectoris chukar	14	1,8	3,6	0,2	11	1,7	2,0	0,1
partridge, Perdicinae	1	0,1	0,1	0,0	1	0,2	0,1	0,0
pheasant or partridge, Phasianidae	1	0,1	0,1	0,0	1	0,2	0,1	0,0
quail, Coturnix coturnix	1	0,1	0,1	0,0	1	0,2	0,1	0,0
tortoise, Testudo graeca	35	4,5	25,5	1,1	30	4,6	22,3	1,0
total identified	771	100,0	2393,1	100,0	656	100,0	2153,8	100,0

	all squares				excl. 51/40 and 51/41			
taxa AH I	**n**	**n%**	**Σ**	**Σ%**	**n**	**n%**	**Σ**	**Σ%**
unidentified specimens								
large carnivor	3	0,2	1,9	0,1	2	0,1	0,8	0,1
medium-sized carnivor	2	0,1	0,3	0,0	2	0,1	0,3	0,0
small carnivor	1	0,1	0,3	0,0	1	0,1	0,3	0,0
large ruminant	10	0,6	32,1	2,0	10	0,7	32,1	2,4
small ruminant	922	55,0	435,5	26,8	870	64,5	408,4	30,2
medium-sized bird	10	0,6	2,3	0,1	10	0,7	2,3	0,2
small bird	3	0,2	0,3	0,0	3	0,2	0,3	0,0
large bird	1	0,1	0,7	0,0	1	0,1	0,7	0,1
medium-sized fish	1	0,1	0,2	0,0	1	0,1	0,2	0,0
large undet.	152	9,1	514,3	31,7	101	7,5	409,9	30,4
medium-sized to large undet.	186	11,1	276,8	17,0	118	8,8	229,2	17,0
medium-sized undet.	337	20,1	349,2	21,5	183	13,6	256,2	19,0
small to medium-sized undet.	6	0,4	5,2	0,3	6	0,4	5,2	0,4
small undet.	7	0,4	1,5	0,1	6	0,4	1,2	0,1
very small undet.	36	2,1	3,2	0,2	34	2,5	3,0	0,2
total w. size class	**1677**	**100,0**	**1623,8**	**100,0**	**1348**	**100,0**	**1350,1**	**100,0**
undet. (w/o size class)	11954		4155,6		10643		3648,3	
total AH I	**14402**		**8172,5**		**12647**		**7152,2**	

Surface

Although the surface shows clear signs of recent activities, such as the humerus of a badger with a very "recent" smell, there are also finds which are clearly old. Some finds show the same encrustations and stainings as finds from AH IV.

The most interesting of these finds is a piece of antler (fig. 25) from a large Mesopotamian fallow deer (*Dama mesopotamica*), identified as such due to the position and shape of the brow antler, which is more dominant, standing at a wider angle to the main antler, in both *Cervus elaphus* and *Dama dama*.

The find is moreover a piece of a cast antler, a raw material often used in all prehistoric cultures to which this material was available. A cast antler from any cervid does not reflect subsistence patterns in terms of nutrition. Also, it does not necessarily indicate that fallow deer or red deer lived in the vicinity of the site. As with any other artefact or raw material (e.g. obsidian), it could have been imported from farther away. Antler is therefore always excluded from quantitative analysis.

Background species

A third phalange from a large bird of prey, Accipitridae, was classified as vulture, Aegypiinae, as the overall thickness of the phalange certainly rules out the genus *Aquila*, and the topography of the articular surface is much shallower than in *Bubo*. The latter two taxa are also present in the assemblage (tab. 17).

Three posterior phalanges are from at least two eagle species, according to their very different size. Although the sexual dimorphism is great in eagles, the phalanges' sizes are definitely too different. All three eagle finds are from AH I, but from different squares (50/25, 50/38 and 52/42). The eagle owl is confirmed through a fragment of a sternum and a first posterior phalange.

There are also some long bone fragments from very large birds, such as a tibiotarsus, which could possibly be from an eagle as well, but these pieces were usually too fragmented to be identifiable beyond doubt.

Among the rodents, again the problem exists in evaluating which species might be human prey, and which were brought to the site by birds or carnivores.

One such species is the jerboa (*Allactaga* sp.), which was identified by its characteristic posterior metapodials. The morphology of the distal end is clearly Allactaga and not Jaculus, following the criteria published by PAYNE (1983). Several Beduin tribes in Jordan consider jerboas edible (QUMSIYEH 1996), but jerboas are also a common prey of owls, such as the eagle owl from AH I. As jerboas are nocturnal, hunting them is difficult without artificial light, something we need only imagine in prehistoric contexts.

The setting of traps is possible, but unlikely, since trapping for other species would require the same effort, though providing more return, such as trapping for diurnal hares or partridges. Since jerboas would also require very specialized baits, an accidental capture of these animals can be ruled out. Jerboas are compatible with a steppe-like environment.

The mole rats (*Spalax* cf. *ehrenbergi*) and the jirds (*Meriones* sp.), which are among the most common rodents in Neareastern sites (WEISBROD et al. 2005), are the most frequent rodents at the site. It has to be stressed, though, that micro-mammals were not the focus of this study, and postcranial elements were only identified in very obvious cases, such as the jerboa metapodials or the mole rat humeri. The orders of frequency are therefore derived mainly from teeth, mandibles and cranial fragments.

More rare species include the jerboas (*Allactaga* sp.) already mentioned, the grey dwarf hamster, which has been identified on a mandible from AH II, and voles (*Microtus* sp.), with seven remains from AH I and II. The common mouse (*Mus* sp.) is also present with a mandible and a cranial fragment from layers I and II, respectively.

fig. 25. Kaus Kozah, surface. A proximal piece of a cast antler from *Dama mesopotamica*.

Several amphibians, frogs or toads (order Anura) were identified, as well as several reptiles, i.e., lizards (Agamidae) and snakes (Serpentes). Tortoises (*Testudo* sp.) have not been considered as "background fauna", which is zoologically inconsistent, but archeologically very plausible.

The snakes are from the Colubrinae and Natricinae subfamilies of snakes, while among the Colubrinae we have at least two species. The snakes must have been relatively large, with some as long as 1,5 m. No small snakes below ca.70-80 cm have been observed. Although snakes do seek shelter in caves either to avoid the hot summer sun, or to hibernate in winter, it is worth mentioning that snakes also play a role in the symbolic world of the PPNA, as reliefs on the pillars of Göbekli Tepe illustrate. The snakes are summarized under one category in the table, as they were not systematically identified.

tab. 17. Kaus Kozah. Finds from the „background species“. Finds from this category were not weighted, as they are not reflecting subsistence patterns.

UNIT	AH	taxa	n
-	-	jerboa, *Allactaga cf. euphratica*	1
		jird, *Meriones* sp.	1
		mole rat, *Spalax ehrenbergi*	1
		small rodent, Rodentia	1
		snake, Serpentes	3
49/34	I	small rodent, Rodentia	3
	II	bird of prey, Accipitridae	1
	II	small rodent, Rodentia	1
49/35	I	*jird, Meriones* sp.	3
	SURF	small rodent, Rodentia	1
50/28	I	eagle, *Aquila* sp.	1
	I	jird, *Meriones* sp.	1
	I	mole rat, *Spalax ehrenbergi*	1
	I	small rodent, Rodentia	1
50/36	I	small rodent, Rodentia	1
50/38	I	eagle, *Aquila* sp.	1
	I	mole rat, *Spalax ehrenbergi*	2
	I	small rodent, Rodentia	2
50/40	-	snake, Serpentes	1
	II	small rodent, Rodentia	2
	II	snake, Serpentes	1
	IV	small rodent, Rodentia	2
	SURF	mole rat, *Spalax ehrenbergi*	1
50/41	I	mole rat, *Spalax ehrenbergi*	1
	II	small rodent, Rodentia	3
	SURF	snake, Serpentes	1
50/42	I	snake, Serpentes	1
	II	mole rat, *Spalax ehrenbergi*	1
	II	small rodent, Rodentia	2
	III	small rodent, Rodentia	2
	IV	jird, *Meriones* sp.	1
	IV	mole rat, *Spalax ehrenbergi*	1
	IV	snake, Serpentes	1
50/43	I	amphib, Amphibia	1
	II	grey dwarf hamster, *Cricetulus migratorius*	1
	II	small rodent, Rodentia	2
	II	snake, Serpentes	1
	III	jird, *Meriones* sp.	1
51/40	-	agamid, Agamidae	1
	I	eagle owl, *Bubo bubo*	1
	I	mole rat, *Spalax ehrenbergi*	2
	I	snake, Serpentes	1
	II	mole rat, *Spalax ehrenbergi*	1
	II	small rodent, Rodentia	1
	II	snake, Serpentes	1
	IV	agamid, Agamidae	1
	SURF	vulture, Aegypiinae	1
51/41	I	frog, Anura	1
	I	jird, *Meriones* sp.	2
	I	small rodent, Rodentia	10
	I	snake, Serpentes	4
	II	frog, Anura	2
	II	jird, *Meriones* sp.	2
	II	mole rat, *Spalax ehrenbergi*	1
	II	small rodent, Rodentia	5
	II	snake, Serpentes	1
	II	vole, *Microtus* sp.	1
	III	small rodent, Rodentia	3
	IV	jird, *Meriones* sp.	2
	IV	small rodent, Rodentia	6
	IV	snake, Serpentes	1
	SURF	small rodent, Rodentia	2
	SURF	vole, *Microtus* sp.	1

UNIT	AH	taxa	n
51/42	-	small rodent, Rodentia	2
	I	jerboa, *Allactaga cf. euphratica*	1
	I	jird, *Meriones* sp.	2
	I	mole rat, *Spalax ehrenbergi*	1
	I	snake, Serpentes	1
	II	jird, *Meriones* sp.	3
	II	lump-nosed bat, *Plecotus* sp.	1
	II	small rodent, Rodentia	4
	II	snake, Serpentes	3
	III	mole rat, *Spalax ehrenbergi*	1
	III	small rodent, Rodentia	3
	SURF	mole rat, *Spalax ehrenbergi*	1
	SURF	small rodent, Rodentia	3
51/43	I	jird, *Meriones* sp.	4
	I	mole rat, *Spalax ehrenbergi*	2
	I	mouse, *Mus* sp.	1
	I	small rodent, Rodentia	13
	I	snake, Serpentes	2
	II	agamid, Agamidae	1
	II	frog, Anura	2
	II	jird, *Meriones* sp.	8
	II	mole rat, *Spalax ehrenbergi*	1
	II	mouse, *Mus* sp.	1
	II	small rodent, Rodentia	28
	II	snake, Serpentes	1
	II	vole, *Microtus* sp.	1
52/40	I	mole rat, Spalax ehrenbergi	2
	I	reptile, Reptilia	1
	I	small rodent, Rodentia	20
	I	snake, Serpentes	6
	I	vole, Microtus sp.	1
	II	jird, Meriones sp.	1
	II	mole rat, Spalax ehrenbergi	1
	II	reptile, Reptilia	1
	II	small rodent, Rodentia	19
	II	vole, Microtus sp.	1
	IV	jird, Meriones sp.	3
	IV	small rodent, Rodentia	11
52/41	I	small rodent, Rodentia	1
	I	snake, Serpentes	1
	II	eagle owl, *Bubo bubo*	1
52/42	-	small rodent, Rodentia	1
	I	agamid, Agamidae	1
	I	amphib, Amphibia	1
	I	eagle, *Aquila* sp.	1
	I	jerboa, *Allactaga cf. euphratica*	1
	I	jird, *Meriones* sp.	16
	I	mole rat, *Spalax ehrenbergi*	8
	I	small rodent, Rodentia	92
	I	small songbird, Passeri	2
	I	snake, Serpentes	4
	I	vole, *Microtus* sp.	7
	II	jird, *Meriones* sp.	2
	II	mole rat, *Spalax ehrenbergi*	1
	II	small rodent, Rodentia	10
	II	snake, Serpentes	1
	II	vole, *Microtus* sp.	1
	III	jird, *Meriones* sp.	1
	III	small rodent, Rodentia	1
52/43	I	agamid, Agamidae	1

7. Ain Dabbour

Ain Dabbour is a huge cave with a small spring pouring from the wall, making it seem an ideal site for habitation.

The assemblage from Ain Dabbour fills to a certain degree the chronological gap between Baaz AH V and AH III. The site was dated typo-technologically by flint artefacts as a Geometric Kebaran (HILLGRUBER 2010). A recently processed 14C date on bone confirms this interpretation, although the collagen content of the sample was low, as was the δ13C; the Leibnitz Laboratory therefore does not consider this date reliable. The date of 15020 + 350/-340 BP, though, corresponds well with the technological observations by HILLGRUBER (2010).

The deposits seem to be largely undisturbed, although the stratigraphic profile is more difficult to interpret and the strata are hard to distinguish. Two main layers were defined, with two substrata each.

This assemblage is poorly preserved. It was clear from the very beginning of my analysis that hardly any of the remains would be identifiable. This represents a stark contrast to the finds from Wadi Mushkuna, a site that is only a few hundred meters away and where the preservation is very different. This difference can probably be attributed to different sedimentation rates, since it is crucial for bone preservation that basic sediments cover the bones as quickly as possible. While the location of Wadi Mushkuna meant it was periodically covered with fluviatile sediments from the wadi, the location of Ain Dabbour is higher up the side slopes of the wadi (fig. 26) and therefore better “protected” from sediment deposition.

As HILLGRUBER (2010) considered the entire lithic assemblage very homogenous, I will not distinguish layers to decrease the sample further.

All of the individually recorded finds were analyzed, as well as a sample of finds from the sieving (tab. 18). Only 27 out of the 834 finds analyzed were identifiable, and some effort was taken to arrange the remaining finds by animal size classes. This was possible for 275 finds.

The classes that were defined use primarily bone thickness as a reference, and this thickness can vary within the skeleton. Therefore overlaps among the bone thicknesses occur between animals of very different life sizes. A slender shaft fragment from the femur of an onager would probably similarly classify as "medium-large" just as a thick tibia fragment of a wild caprine. Some overlap exists also between gazelles and caprines, which are both medium-sized animals.

The size classes show a very similar distribution as the identifiable finds, with the expected increase in the medium-sized category. This size class is most likely composed entirely of small ruminants, such as gazelles and caprines. In the identified portion, gazelles are only present with 0.5% of the bone weight of all identifiable specimens. This ratio is somewhat depleted by preservation, shifting the identification towards teeth, which are more corrosion-resistant. As equids have large and easily recognizable teeth, their relative frequency rises with increasing chemical weathering of an assemblage. The 6% for medium-sized animals in the size-classified portion, plus 1% from small ruminants, is

fig. 26. View from the interior of Ain Dabbour Cave. Photo: Alexander Gonschior.

probably closer to the true relevance of gazelles and caprines for human subsistence at Ain Dabbour.

Among the equids, a mandibular tooth fragment on which the molar isthmus is narrow and parallel for ca.1 mm was tentatively identified as *Equus hemionus*, as it is usually wider in the wild horse, and not parallel in the wild ass. A dorsal tibia shaft fragment of an equid that was very thick and strongly sculptured was identified as wild horse (*Equus ferus*) by H.-P. Uerpmann. This same bone was also sent for dating to the Leibnitz Laboratory in Kiel, but the collagen content proved to be too low.

Interestingly, tortoises and hares, which remain easily recognizable even under bad preservation conditions, are almost entirely absent. This means that the small game increase observed at Baaz is not a phenomenon of the Epipaleolithic in general, but of the Natufian exclusively.

A piece of mother-of-pearl was also among the finds, but no modification is visible. A coprolith from a hyena was also recovered in AH II of square 18/14 (#45).

tab. 18. Ain Dabbour. Identified specimens and those which were classified by size only.

Ain Dabbour	**n**	**%n**	**Σ**	**%Σ**
identified specimens				
brown hare, *Lepus europaeus*	1	3,7	0,1	0,2
wild horse, *Equus ferus*	1	3,7	18	42,2
onager, *Equus hemionus*	1	3,7	2,1	4,9
equid, *Equus* sp.	23	85,2	22,3	52,2
gazelle, *Gazella* sp.	1	3,7	0,2	0,5
total identified	**27**	**100,0**	**42,7**	**100,0**
unidentified specimens				
small ruminant	7	2,6	1,4	1,2
large undet.	24	9,0	28,1	23,5
medium-sized to large undet.	221	82,5	83,6	70,0
medium-sized undet.	20	7,5	7,1	5,9
small to medium-sized undet.	2	0,7	0,4	0,3
small undet.	1	0,4	0,2	0,2
total w. size class	**268**	**100,0**	**119,4**	**100,0**
undet. (w/o size class)	532		42,9	
total analysed	**827**		**205**	

8. Wadi Mushkuna

Wadi Mushkuna shows the best stratification among our four sites, and the least disturbances. The site was discovered on the last day of the 2006 field season after looters had dug a pit below a rockshelter, probably in the search for gold. Among the material excavated by the looters, Levallois artefacts were identified (CONARD et al. 2007, 2008). Despite the looters' pit, the deposits preserve well-stratified layers of alternating reddish and grey color. While the reddish, sandy layers are rather sterile in terms of anthropogenic signals, the grey layers are full of ashes, with significant proof for combustion activities: charcoal, burned flints and cobbles (possible remains of hearths), burned bones and sediment, which has turned red by the exposure to heat.

The sterile layers are often cemented and very hard, making it easy to follow their levels through the site.

The site thus far has 18 defined layers, with several substratas within the 2,5 m depth of the deposits. The excavations are still being continued.

The Levallois component is prominent from AH IV downwards, and a Middle Paleolithic age is implied. Although some efforts have already been made to acquire absolute dates from the site, this has not yet been successful, since no collagen is preserved. Even if it were, the age of the Levallois-dominated layers is probably beyond the limits of radiocarbon dating. A dosimeter for TL-dating has been installed by Daniel Richter but the data still need to be analyzed.

My personal impression is that the accumulation of sediments from AH IV downwards could have been a very quick process. Despite the depth of the sediments, the entire sequence might cover no more than a century in time. The sterile reddish layers would

fig. 27. Sieving in front of Wadi Mushkuna Rockshelter. The site was protected by a cage against looters. Photo: Alexander Gonschior.

then be periodic occurrences, such as floods after snowmelt or heavy rainfall, and the few finds in these layers would be reworked material from the layer below. At the bottom of the sequence, a hiatus to a potential pre-Levallois layer is possible.

CONARD et al. (2010) see a change in the lithic technology with an increase of platform cores and bladelets towards the upper layers, which might indicate a longer time depth than I am currently assuming. The typo-technology of the assemblages indicates the late Middle Paleolithic.

For the purpose of this study, layer IV was chosen for complete analysis, with only random samples being considered from the other layers. A detailed analysis of the site, and a synthesis of the results from the fauna, the lithics (Nicholas CONARD and Knut BRETZKE), the botanical remains (Simone RIEHL), the micromorphology (Mareike STAHLSCHMIDT) and the dating (Daniel RICHTER) will follow after the excavations have been completed. Layer IV was chosen since it is one of the richest layers, chronologically predating Baaz AH VII and probably postdating the Middle Paleolithic of Kaus Kozah and Yabrud. It seems to be very well preserved, with little chance of intrusions.

The upper layers I-III are not as univocal, and were omitted for this initial analysis. An Upper Paleolithic age is possible due to the platform component in the lithic assemblages, though some Levallois artefacts have also been identified (CONARD et al. 2008). Layers I and II are also not very rich in finds. Their sedimentological appearance is also different from the rest of the stratigraphy, indicating therefore the possibility of a different formation process at work.

The excavations at Wadi Mushkuna are still in progress, and therefore only a sample of the finds was analyzed to serve as a reference for a well-stratified Middle Paleolithic assemblage.

The finds so far excavated from AH IV, together with its subdivision IVA, were analyzed entirely. This sample comprised 5949 finds, with a weight of 2208 grams. Although the preservation is surprisingly good for a Neareastern Middle Paleolithic assemblage, most bones are heavily broken into small fragments and are accordingly unidentifiable. The breakage patterns of these unidentified bones often resemble fresh bone fracture.

A total of 143 finds were identifiable, all of them from mammals (tab. 19). Although this low number represents only 2.4% identification by number of finds, the identification rate by weight is 23%, which is acceptable, although much of the weight comes from equid teeth.

A single bone from an unidentified small bird was the only non-mammal evidence in the analyzed archaeological units.

Equids dominate all other taxa, and it has to be stressed that this is not only due to preservation conditions. Equids are easy to identify on small tooth fragments that preserve well under most conditions. Nevertheless, the primacy of equids is also denoted by the high portion of unidentified bone fragments in the "medium-large" and "large mammal" categories. As no other large animals have yet been identified in the assemblage, there is only some overlap with very large male caprines in these unidentified finds.

Only few bones were identified as small ruminants, and together with the remains of "medium-sized" animals, these confirm the presence of a lesser amount of caprines and gazelles.

Among the equids, both the onager (*Equus hemionus*) and the wild ass (*Equus africanus*) have been confirmed, and both species are almost equally well represented.

Two onager teeth from AH IV are shown in fig. 29. The maxillar tooth has a small plica caballina, while the protocone is longer than in *E. africanus*. The enamel lobes of the buccal side of paracone and metacone are intermediately between typical concave shapes in horses and convex shapes in asses and donkeys.

The mandibular tooth has a shallow, U-shaped linguaflexid, which is usually typical for caballine horses, but its overall shape is somewhat unusual, with a very circular metastylid and an irregular metaconid, raising doubt about the reliability of this feature in this specific case. As the metastylid is not angled or pointed, we could also argue against a true caballine horse. The ectoflexid extends considerably towards the isthmus, which is commonly associated with asses and half-asses. Identifying it as onager seems therefore most likely, as onagers are in many osteologic features morphologically intermediate between horses and asses.

The illustration below (fig. 28) shows two maxillar teeth from wild ass (*Equus africanus*). These two teeth are from the same individual, as they fit perfectly together. The lack of a plica caballina and the very short protocone are clear indications for this species. The two teeth are from different square meters, though only at a distance of ca. 13 cm from each other. It confirms again that the sediments were hardly affected by turbation.

Besides the equids, caprines constitute a major part of the assemblage. Both the wild goat and the wild sheep have been identified among the assemblage. Gazelles, hares and tortoises were also hunted by the Middle Paleolithic inhabitants of Wadi Mushkuna, but to a lesser extent.

tab. 19. Wadi Mushkuna, AHs IV and IVA. Faunal remains by number and weight.

taxa AH IV+IVA	**n**	**%n**	**Σ**	**%Σ**
brown hare, *Lepus europaeus*	3	2,1	0,3	0,1
wild ass, *Equus africanus*	5	3,5	117	22,4
onager, *Equus hemionus*	3	2,1	75,6	14,4
equid, *Equus* sp.	89	62,2	259,5	49,6
wild goat, *Capra aegagrus*	1	0,7	4	0,8
wild sheep, *Ovis orientalis*	4	2,8	3,6	0,7
wild caprine, *O.orient.* or *C.aegagrus*	31	21,7	56,6	10,8
gazelle, *Gazella* sp.	6	4,2	6,5	1,2
tortoise, *Testudo* graeca	1	0,7	0,3	0,1
total identified	**143**	**100,0**	**523,4**	**100,0**
small rodent	2	0,4	0,1	0,0
small ruminant	19	3,7	14,2	2,3
small bird	1	0,2	0,1	0,0
large undet.	38	7,3	141,3	22,6
medium-sized to large undet.	415	80,0	409,2	65,5
medium-sized undet.	62	11,9	73,6	11,8
small to medium-sized undet.	2	0,4	0,4	0,1
small undet.	2	0,4	0,2	0,0
total w. size class	**541**	**100,0**	**639,1**	**100,0**
undet. (w/o size class)	5265		1046,2	
total analysed	**5949**		**2208,7**	

fig. 29. Wadi Mushkuna, AH IV. A mandibular premolar and a maxillar molar from an onager (*Equus hemionus*).

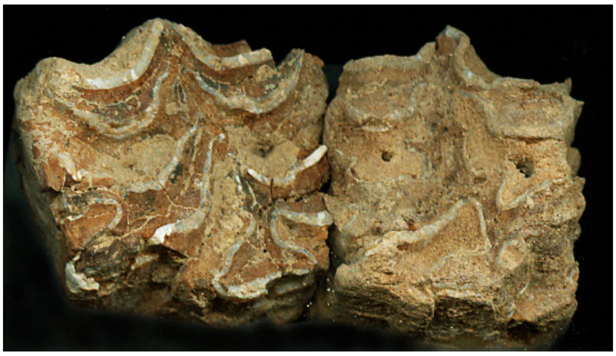

fig. 28. Wadi Mushkuna, AH IV. Two maxillar teeth from an african wild ass (*Equus africanus*).

9. Fish remains

Among the sites studied, only Baaz provided a notable number of fish remains. This is quite surprising, since the main occupation at Baaz falls within a time that was thought to be a "climatic crisis", or a "dry spell", i.e., the Younger Dryas. In contrast, Kaus Kozah only provided one single fish vertebra, most likely from a marine species (fig. 30). This conflicts with the common notion that the PPNA witnessed more humid conditions.

The identifiable fish bones at Baaz consist of 22 remains of Salmonidae and 10 of Cyprinidae (tab. 20). The identification of fish bones was supported by Wim Van Neer (Katholieke

fig. 30. Kaus Kozah, AH I. The only fish bone from this site is a single vertebra, very probably from a marine species. The picture shows three views of this same find. The dating is uncertain.

fig. 31. Baaz Rockshelter. Several vertebra of brown trout (*Salmo trutta*).

Universiteit Leuven) and Davit Vasilyan (University of Tübingen). A detailed analysis of the fish finds from Baaz and their palaeoenvironmental interpretation has been published by NAPIERALA et al. (in press b). The following paragraphs provide a summary of this publication.

The salmonid bones are, with the exception of a dentary fragment, all vertebrae. The various size classes indicate that they are from different individuals and that fish was not an exceptional part of the diet for the people at Baaz. The respective estimated standard length (SL - distance between the tip of the snout and the base of the tail) ranges from 15-20 cm SL to 40-45 cm SL, with most remains in the size class 25-30 cm SL. Although identification of vertebrae to species level is usually not possible on a morphological basis, the size combined with the narrow width of the growth bands on the vertebral centra indicates that they are from *Salmo trutta*, the brown trout (fig. 31). In the eastern Mediterranean, this is the only extant salmonid species and is represented by *Salmo trutta* macrostigma in Anatolia (GELDIAY & BALIK 1996).

A pharyngeal tooth was identified as coming from an individual of the cyprinid genus *Capoeta* of about 30 cm SL (fig. 32). The identification of an os suspensorium as *Capoeta* is not as certain because of its fragmentary preservation, but the find does show some similarity to this genus.

One incomplete pharyngeal plate (fig. 33) belongs to a cyprinid genus other than *Capoeta*. This means that the fish from Baaz comprise at least three taxa, which are *Salmo trutta*, *Capoeta* sp. and the undetermined cyprinid mentioned above.

Most fish remains come from the lower part of AH II and most probably belong to the Late Natufian occupation. The fish finds are distributed almost horizontally and seem to form a single layer, parallel to the house floor below (fig. 33). We found fish remains in seven different square meters, ruling out the possibility of a more recent, spacially limited pit which could have been overlooked during excavation. All of the fish remains were found during the dry-screening of the sediment, which was carried out with a mesh size of 2.5 mm. The fish bones are well preserved. No etching is visible, which would tab. 20. Baaz Rockshelter. List of fish remains, identified by Wim VanNeer.

species	element	square	f.nr	geol.hor. (GH)	arch.hor. (AH)	length estimation in cm SL
Cyprinidae	basipterygium	20/31	253	GH 2	AH II	20 - 30
Cyprinidae	Weberian apparatus	19/33	623	GH 2	AH II	20 - 30
Cyprinidae	pharyngeal plate	21/34	278	GH 1a	AH Ia	10 - 20
Cyprinidae	pharyngeal plate	19/31	305	GH 3	AH III	>15
Cyprinidae	pterygophore	21/34	55	GH 1	AH I	> 20
Cyprinidae	pterygophore	21/34	258	GH 2	AH II	> 20
Cyprinidae	precaudal vertebra	21/32	837	GH 3c	AH IIIc	15 - 25
Cyprinidae	precaudal vertebra	19/31	305	GH 3	AH III	15-20
Capoeta sp.	pharyngeal tooth	20/34	557	GH 3a	AH IIIa	> 40
Capoeta sp. ?	os suspensorium	21/34	321	GH 3a	AH IIIa	15 - 20
Salmonidae	os dentale	21/32	837	GH 3c	AH IIIc	30 - 35
Salmonidae	precaudal vertebra	21/33	731	GH 2	AH II	25 - 30
Salmonidae	precaudal vertebra	21/34	317	GH 0-2	AH0-II	40 - 45
Salmonidae	precaudal vertebra	21/34	568	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	19/31	368	GH 3	AH III	15 - 20
Salmonidae	caudal vertebra	19/32	715	GH 2	AH II	15 - 20
Salmonidae	caudal vertebra	19/33	623	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	19/33	623	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	20/34	530	GH 3a	AH IIIa	15 - 20
Salmonidae	caudal vertebra	20/34	530	GH 3a	AH IIIa	15 - 20
Salmonidae	caudal vertebra	21/32	540	GH 2	AH II	15 - 20
Salmonidae	caudal vertebra	21/32	540	GH 2	AH II	30 - 35
Salmonidae	caudal vertebra	21/32	910	GH 0-3a	AH 0-IIIa	25 - 30
Salmonidae	caudal vertebra	21/33	601	GH2	AH II	25 - 30
Salmonidae	caudal vertebra	21/33	617	GH2	AH II	30 - 35
Salmonidae	caudal vertebra	21/33	689	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	21/33	877	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	21/33	878	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	21/33	881	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	21/34	178	GH 1	AH I	25 - 30
Salmonidae	caudal vertebra	21/34	282	GH 2	AH II	25 - 30
Salmonidae	caudal vertebra	21/34	614	GH 2	AH II	30 - 35
Pisces indet.		19/33	752	GH 2	AH II	
Pisces indet.		21/34	282	GH 2	AH II	
Pisces indet.		21/34	362	GH 1a	AH Ia	

indicate digestion by carnivores, birds or humans. Neither have the vertebrae been used as beads, which could have explained a distant provenance.

Clarifying whether these fishes lived in the vicinity of the site is crucial for their interpretation as palaeoenvironmental markers. Evidence for salmonids is lacking at other sites in Syria, Lebanon or the countries of the Southern Levant. It is improbable that brown trout was transported over long distances to only this one site, and not to other sites farther west, such as Nacharini from which no such evidence has yet been reported.

fig. 32. Baaz Rockshelter. Pharyngeal tooth from *Capoeta*.

Salmonids do not occur naturally in Syria today, be it in the Orontes (KRUPP 1987, VAN NEER et al. 2008) or in the Syrian Euphrates (IFAP 1999). In his work on brown trout zoogeography, MACCRIMMON et al. (1970) speculated that the brown trout occurs naturally in the upper reaches of the Orontes in Lebanon. Maccrimmon's note though, was not based on direct observation but on personal communication. KRUPP's detailed examinations did not confirm this hypothesis (KRUPP 1987).

The closest documented, recent natural occurrence of brown trout lies in the Ceyhan and Seyhan rivers of southern Turkey (ca. 400 km distance) and, somewhat further away, in the headwaters of the Euphrates and Tigris river systems in the same country (GELDIAY & BALIK 1996).

Late Pleistocene distribution patterns of the brown trout lead us to conclude that indeed, as MACCRIMMON et al. (1970) hypothesized, the "upper reaches of the Orontes" once held a salmonid population, though in the Late Pleistocene rather than in historical times (for a detailed discussion see NAPIERALA et al., in press b). Through GIS-analysis, we were able to show that these "upper reaches" of the Orontes, began just above the site, in the al-Majar Depression, making it possible that these fishes were indeed caught not far away from Baaz. The analysis confirmed that the Al-Majar Depression drains through Yabroud and into the Orontes about 20 km north of Homs, near Al-Rastan (NAPIERALA et al. in press).

Baaz lies at the southernmost edge of this theoretical Orontes drainage system. Given adequate precipitation, a continuous connection of streams to the Mediterranean would be possible and consequently the colonization of those streams by brown trout, migrating along the seashores during times of low marine salinity (high rates of glacial meltwater) and establishing freshwater populations in the adjacent watercourses. The same streams could also sustain *Capoeta* and at least one other cyprinid genus. Compared to the salmonids, a scenario for the colonization of the area by cyprinids would involve bridging less significant distances, since several genera of cyprinidae live in the present day Orontes (KRUPP 1987).

The taphonomic agent responsible for the deposition of the fish remains still needs to be established, but it is clear that these finds reflect an environment that no longer exists. In regard to the reconstruction of this environment, the salmonid bones are therefore especially noteworthy.

fig. 33. Baaz Rockshelter. Pharyngium of a cyprinid.

The water temperatures required for the brown trout to flourish are 10-15°C. Occasional higher temperatures of 20° can be survived only for short periods, but no growth is possible (ELLIOTT 1994). Such cool, well-oxygenated upland waters must have existed year-round in the vicinity of Baaz, which contradicts conventional wisdom about the environments of the YD.

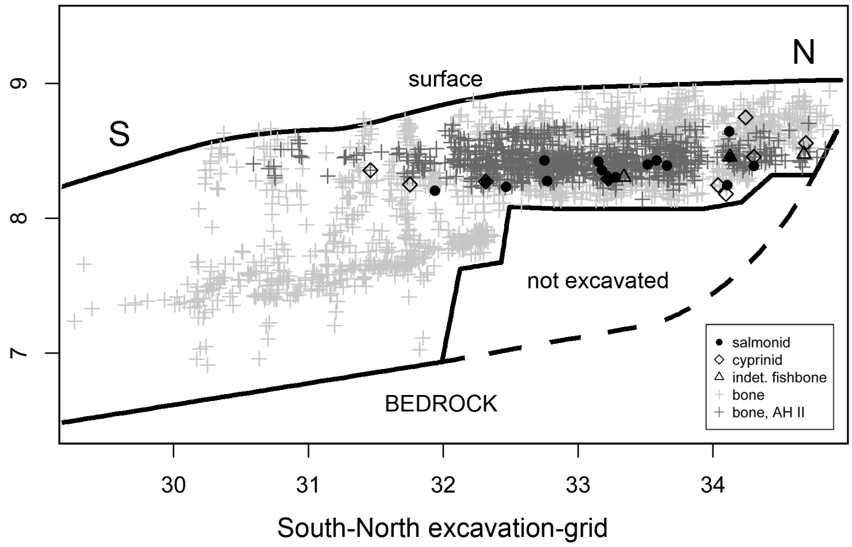

fig. 34. Baaz Rockshelter. Plot of fishbones in relation to all other bone finds. NAPIERALA *et al*. 2009

Further evidence for salmonids needs to be found at other sites in the region to determine whether fish are a phenomenon of the very latest Pleistocene (the Natufian) or whether they occurred in older time periods.

Isotopic and genetic analyses could further reveal more details about the palaeoenvironment and the relationship to other Mediterranean trout (sub-)species, such as those from Sicily, Morocco or Turkey.

10. Site comparisons

10.1. Subsistence changes in the TDASP sites

Differences in the composition of faunal assemblages can be based on a variety of reasons, which were briefly discussed in a previous chapter ("Theories in prehistoric economy"). The surrounding environment, and therefore the available taxa, is one major factor to consider. The environment might change over time, with alterations in topography, elevation and latitude. Indirectly, the access to the environment might change through changes in technology (e.g., hunting gear) and the size of the "catchment area" of prehistoric people, as well as site function and seasonality.

With regard to the existing theories and models, the assemblages from Baaz, Kaus Kozah, Ain Dabbour and Wadi Mushkuna will be discussed in this chapter. Some of the influences mentioned above can be ruled out, as the sites are all within a relatively small area, with similar geographic conditions. Also, excavations were carried out by the same team and the applied methods were identical at all four sites.

A problem in the investigation of diachronic changes often relates to the variable amount of unidentified specimens, as well as the number of species and the fragmentation grade. Also, the varying amounts of carnivores and raptors in the assemblage, that is, animals not usually hunted for their meat, make it difficult to detect changes that might be attributed to subsistence.

One possible way of overcoming these factors would be to define a set of animals, which are typical prey species found in the assemblages, and to treat the sum of their bone weight as 100%. As has been carried out before (see "Measures of abundance"), the bone weight reduces a possible bias by different fragmentation grades, and is best suited for the analysis of the former economic importance of certain species. Usually, there are no more than five taxa which comprise together 90% of any assemblage in an area. Taxonomic difficulties can be minimized by grouping similar species by genus or family.

As we are interested in the subsistence patterns of hunters and gatherers preceding the PPNB, domestic animals are generally excluded, since they are certainly the remains of younger site occupations. Stratigraphic problems, through the intrusion of younger materials especially in the upper layers, are at least somewhat reduced, as younger occupations would have accumulated wild mammals to a lesser extent than hunters and gatherers. Finds of unclear domestic status are incorporated in the analysis, because the majority of these are most likely from wild animals. As has been laid out in the respective chapters, the younger occupations of the sites (post-PPNA) contributed only minor amounts of faunal material.

In all the TDASP sites, the main groups of human prey are equids, caprines and gazelles, as well as the small game species hare and tortoise, which become relevant in the younger assemblages. No other wild animal species has a share of more than 5% in any of the assemblages (except for the single, but heavy aurochs phalange from Baaz AH III with slightly more than 5% of the total bone weight of this stratigraphic unit).

Subsistence changes will therefore be discussed on the basis of the relative frequencies of these taxa.

As we still do not have absolute dates for the Middle Paleolithic of Kaus Kozah (AH IV) and Wadi Mushkuna (AH IV), their chronological order remains uncertain. Based on preliminary technological impressions (BRETZKE & CONARD, pers. comm.), I will treat Kaus Kozah as the potentially older assemblage. It will therefore appear below Wadi Mushkuna in the chronologically ordered figures.

The barplot for the relative frequencies of the five main taxa mentioned above (fig. 35) shows strong similarities in most assemblages, despite the share of small game in the Natufian layers. Excluding the small game from the plot (fig. 36) emphasizes the similarities in the relative frequencies of equids, caprines and gazelles.

At first glance, the sites seem to be ordered somewhat geographically, with the sites in the Wadi Mushkuna, including the homonymous site and Ain Dabbour, and the sites in the limestone cliff, including Baaz and Kaus Kozah.

Preservation conditions somewhat bias the assemblage from Ain Dabbour, but the dominance of equids at this site cannot be neglected. The finds, sorted into size classes, indicate that gazelles and caprines originally comprised around 5-10% of the assemblage

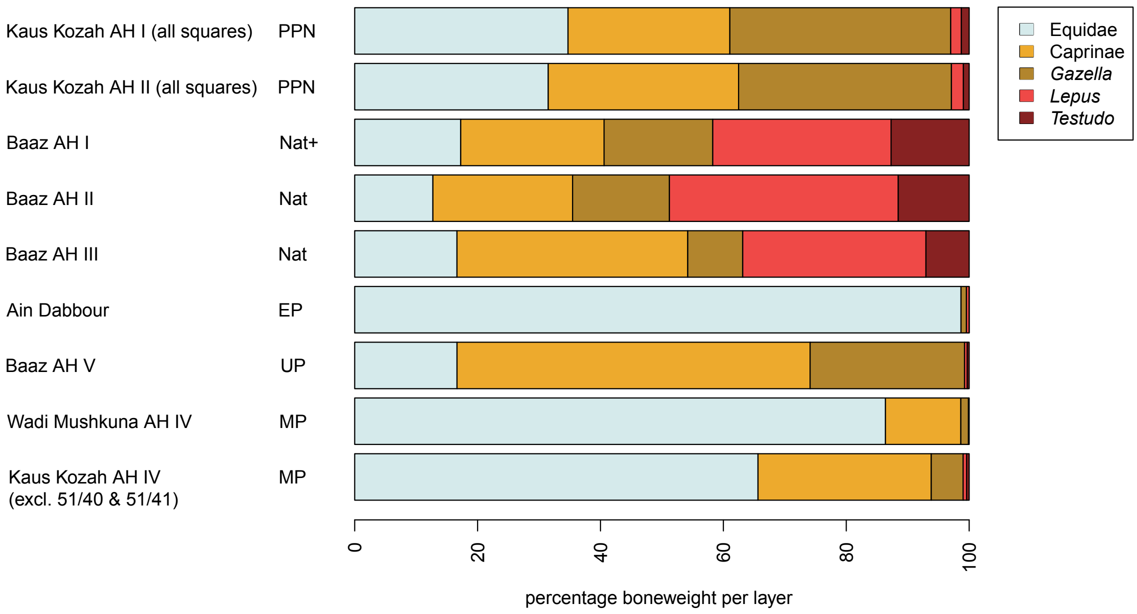

fig. 35. Relative frequencies of the five main taxa, by boneweight in chronological order.

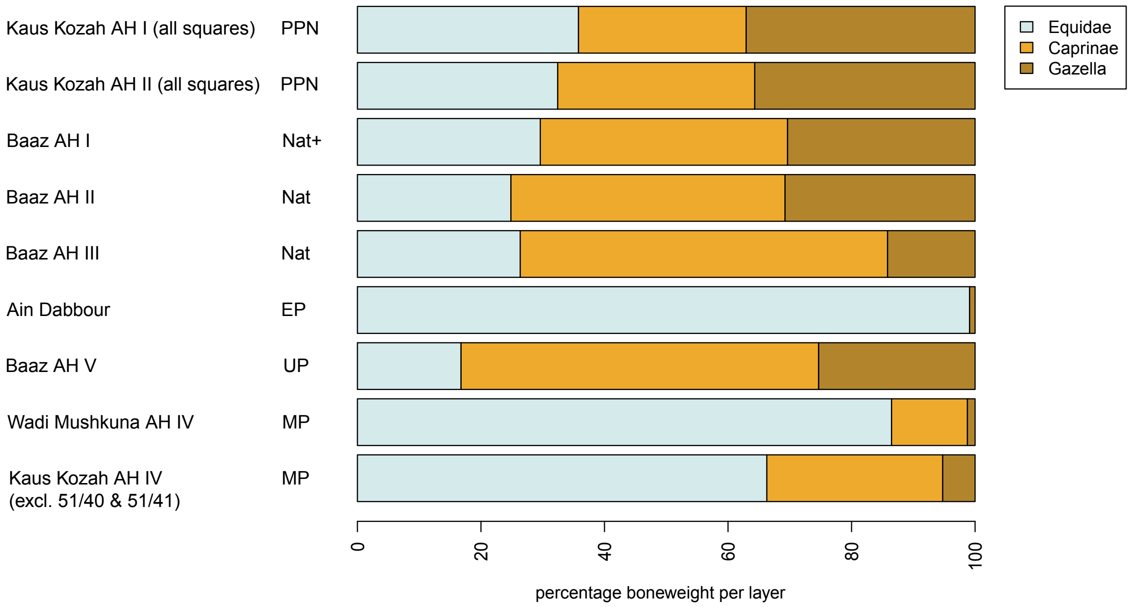

fig. 36. Same graph as in fig. 35, leaving out hares and tortoises.

at Ain Dabbour. This is remarkably similar to the much older layer of AH IV from Wadi Mushkuna.

With its permanent source of water, this wadi seems to have been an ideal hunting spot for equids, which have to drink at least every few days. Furthermore, both sites are situated near the wadi bottom, so that similar effort was required to carry the prey to the site.

The barplot indicates, therefore, that site location along with the environment, is among the most relevant factors influencing the composition of faunal assemblages.

The Upper Paleolithic of Baaz and all three assemblages from Kaus Kozah also show great similarities, as does the Natufian at Baaz, if the small game portion is excluded. Both sites are located high above the valleys, and large animals would have been carried up to the site a little less frequently than in the Wadi Mushkuna sites. The plotted ratio for equids in Kaus Kozah IV is probably a little too high, since the horse metacarpus was heavily encrusted, exaggerating its weight. The weight could well have been doubled by the encrustations.

The relative proportions within the unidentified portion of the assemblage classified by size better resemble the true ratios, which are then very similar among the different horizons at Kaus Kozah. Still a slightly higher proportion of large animals remain when we consider Baaz. The pattern is very evident if the finds classified by size (excluding carnivores and size classes related to small game) are plotted in a geographically ordered barplot (fig. 37).

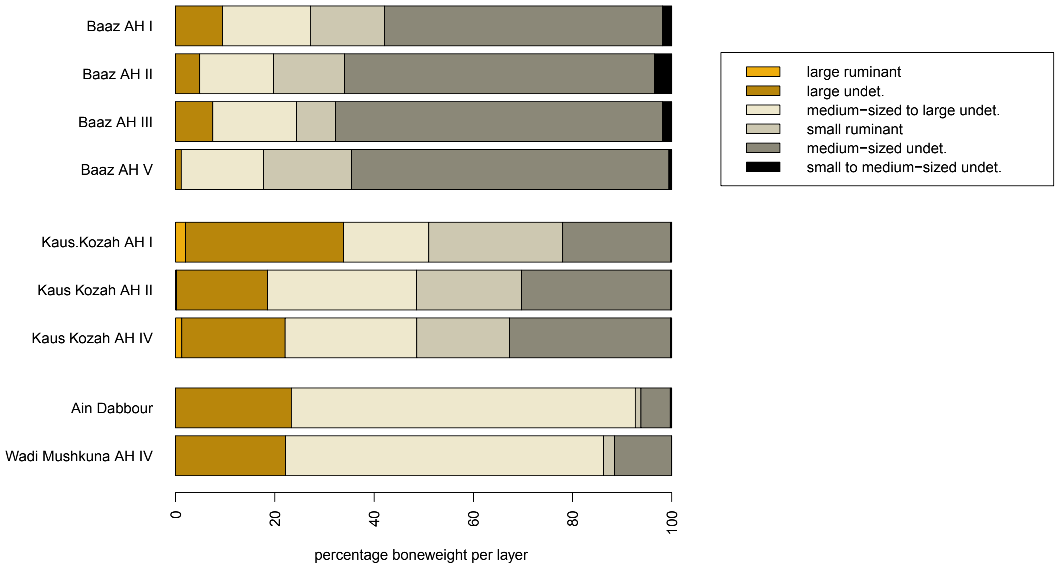

fig. 37. Plot of the boneweight of size-classified, unidentified finds. Excluded are carnivores, background fauna (amphibians, rodents) and size classes related to small game.

Generally speaking, all assemblages, despite the Natufian at Baaz, are remarkably similar. Despite a chronological span of up to more than 50,000 years, the assemblages within a single site always show a high consistency. As preservation conditions are very different from Kaus Kozah IV to Kaus Kozah II, or Baaz V to Baaz III, the preservation cannot be responsible for the observed pattern.

Since so little changed in prey acquisition despite changes in technology and culture (possibly even in the human species), I conclude that, above all, the natural surroundings must have determined the possibilities for human subsistence in our research area. Short climatic fluctuations might have had an effect on which equid species was dominant in the region, but this did not make a difference for Paleolithic people with regard to hunting techniques and nutrition.

Throughout time, hunters and gatherers opportunistically exploited the fauna within their reach, and this stayed relatively stable over time. An "Upper Paleolithic revolution" (BAR-YOSEF 2002) is not observable in regard to subsistence, which confirms the results by other researchers in the Levant (see chapter "Theories in prehistoric economy").

The findings also confirm that hunters opportunistically exploited the available fauna. That opportunism in prey acquisition is a necessity for hunters and gatherers has also been nicely illustrated in recent studies from Southern Africa (PETERS et al. 2009):

Although certain species are highly valued and therefore sought after, hunters usually take advantage of what is available to them, as they rarely enjoy the luxury of a food surplus, which allows them to select specific prey types, as regards species, age, or sex.

The relative frequencies of species in fig. 36 reveal a slight trend towards more equids and gazelles, and lesser amounts of caprines through time. The changes are slight and gradual, and some uncertainty exists as to whether these are true changes in prey acquisition. As caprines can be expected to be less mobile, this trend could reflect longer occupations and consequently a stronger impact on the more stationary local caprine populations. The "reservoir" of gazelles in the regions to the east must have been endless, and the danger of overhunting the species less probable. The rising amount of equids could then indicate that these animals also migrated to a certain degree, so that they were not greatly affected by hunting.

10.2. Some thoughts on small game exploitation

Despite the similarities among the large game proportions in the assemblages, Baaz shows a striking increase in small game towards the Natufian. Hares and tortoises make up a major part of the assemblages from AH III to AH I. Even though the bones of these animals are small and light, they together equal almost 50% of the bone weight of the defined “main species”-entity. Especially noteworthy is the fact that neither the preceding Geometric Kebaran at Ain Dabbour nor the succeeding PPN from Kaus Kozah has similar high amounts of small game finds. I also cannot interpret it as a special geographical feature of Baaz, as the Upper Paleolithic layers at Baaz contain only hints of small game.

The ”broad spectrum revolution“ (FLANNERY 1969), i.e., the trend towards the exploitation of formerly unimportant species, especially small game, is therefore also evident in the assemblage of Baaz. Flannery saw the ”broad spectrum revolution” as the initial phase of what was to become the Neolithic. It is therefore of major importance for us to understand this economic development at the end of the Paleolithic.

The sudden and strong increase in small game towards the Natufian has been observed before in the southern Levant (MUNRO 2004, STINER 2005). But also in Europe, almost contemporaneously to the Natufian, small game exploitation increases strongly.

Lagomorphs increase and take up unprecedented proportions in Late Upper- and Epipaleolithic assemblages from Central Europe (e.g. STAMPFLI 1983, COCHARD 2005, NAPIERALA, 2008, BOESSNECK & VON DEN DRIESCH 1973), Western Europe (e.g. FONTANA 2003, PÉREZ RIPOLL 1986) and Southern Europe (STINER, et al., 2000). A strictly cultural explanation can therefore be ruled out as the main reason for this occurrence, as such a large area was culturally heterogeneous.

Similarly, although technological innovations were made in the Late UP or EP, namely the bow and arrow, this alone can neither explain why small game, and particularly the lagomorphs, was exploited to such a great extent, because rates drop again in the PPN.

As simple interpretations fail to explain the immense increase of small game (and hare in particular), we need then to consider a complex interplay of factors as likely responsible for this occurrence.

Climatic influences cannot be ignored, and the spread of parkland as the first step of reforestation after the Pleniglacial most likely triggered an increase in the population density of leporids across Europe and the Near East.

The reforestation in the Levant saw the expansion of a pistacchio-almond steppe, accompanied, and somewhat preceded, by wild cereals. Although brown hares (*Lepus europaeus*) are generalists, and therefore do not serve as environmental indicators on the individual level, ecological studies for recent populations have shown that population densities are highest in managed arable land, in contrast to pastures or woodlands (SMITH et al. 2004) where densities are low. The widespread natural stands of wild cereals in the Late Pleistocene/Early Holocene of the Near East would have most likely created similarly favorable conditions, allowing the hare population to increase.

Although the exploitation of wild cereals allowed (and required) a more sedentary lifestyle for the Natufians, the need for animal protein still had to be satisfied through hunting (UERPMANN 1979).

The Natufian villages, and the resulting decrease in ungulate density in their vicinity, in combination with a flourishing hare population, might have indeed shifted the encounter rate of hunters strongly towards hares. The proximity to permanent settlements might also have had a protective effect on the hares, as carnivores would have avoided human areas. Tortoises were always easy prey, and could have been caught (or "collected") as a necessary addition to the diet.

In Europe, although leporid populations must have similarly benefitted from the Late Glacial rewarming, the trend was not as strong as in our study area, since reindeer and wild horse provided animal protein for most of the year. The sites with the highest rates of hares in the Magdalenian are sites with very strong seasonal confinements (NAPIERALA 2008), making use of the spring aggregations of hares in open terrain. Nevertheless, the hare ratios are never as high as in the Natufian of the Levant, probably due to the fact that wild cereals never occurred in Europe.

Although a broadening prey spectrum can be observed in the Late Pleistocene, I do not agree with Flannery's hypothesis that population pressure was the trigger for the exploitation of these species.

As has been demonstrated, hunters and gatherers would have hunted hares at any time the opportunity presented itself.

10.3. The Younger Dryas and the Natufian economy

For several Levantine sites Munro and Stiner (MUNRO 2004, STINER et al. 2000, STINER & MUNRO 2002) have also noted a diachronic change in the quantitative relationships of small game species. Although the small game portion stays relatively stable within complete assemblages, the quantitative relationship of tortoises versus hares shift over time.

This fact is explained by Munro and Stiner as a function of hunting effort and occupation intensity (the latter being defined as people per unit time). The researchers have used the same arguments to explain the economic shifts from the Paleolithic to Neolithic economy, basically in accordance with FLANNERY (1969) and COHEN (1977).

Munro and Stiner argue that hares are more difficult to capture, making them therefore less desirable prey and, in their terms, a "lower rank species" (see also "Prey ranking"). Hares will therefore only be hunted if need be, i.e., in times of high occupation intensity. As the relative frequency of hares towards tortoises decreased from the Early to the Late

Natufian, they argue that occupation intensity similarly decreased. This is then paralleled with the assumption that the Late Natufian was initiated by the "climatic crisis" of the Younger Dryas, which finally led to the abandonment of large coastal settlements (BAR-YOSEF 1987, BAR-YOSEF & VALLA 1990).

Although I agree with the general conclusion that occupation intensity might have decreased, the running capabilities of the prey species, as Munro and Stiner argue (MUNRO 2004, STINER et al., 2000, STINER & MUNRO 2002), are very unlikely to have had an influence (for a detailed discussion see "Prey ranking" and NAPIERALA et al. 2008).

Not only the beginning, but also the end, of the presumably more mobile Late Natufian adaption (BAR-YOSEF 1987) is commonly explained with an aridification during the Younger Dryas, which eventually became so marked that the region was almost depopulated. The findings of fish at Baaz have raised some doubt about the climatic deterioration during the Late Natufian (see "Fish remains"). Furthermore, there are cervids in the assemblages of Baaz and Kaus Kozah, which are also an indication against aridification.

But could we find another possibility for interpreting the data apart from the "aridification scenario"? In the following, I will discuss the available information on the climate of the Younger Dryas and I will evaluate whether the "aridification hypothesis" is at all probable. I also discuss a different approach, in which the development of vegetation was the main reason for the decline (or transition) of the Natufian.

In an early overview on Levantine pollen sequences, BOTTEMA & VAN ZEIST (1981) proposed a climatic amelioration after 14,500 BP, which lasted through the Natufian and into the PPN, where it reached its optimum at 10,000 BP. BOTTEMA (1995) later corrected this view somewhat, and concluded that the pollen diagram of Hula denotes a humid climate from 14,500 BP to 11,500 BP, with a decline in arboreal pollen only thereafter.

In contrast, it has also been argued that already the Younger Dryas is represented in pollen sequences by a marked reduction in arboreal pollen (BARUCH & BOTTEMA 1991). The differences in the interpretation of pollen data stems mainly from the problem of dating the different pollen zones in the profiles. Only few radiocarbon dates can usually be obtained from the pollen cores, and these dates might even be altered through the effects of hardwater. The sedimentation rate is then calculated from the vertical difference of the dated samples and the pollen zones, and then dated through correlation with this sedimentation rate and their vertical position (BOTTEMA 1995).

If we agree that the Natufian ended due to economic decline (in the Levant) or economic change (Upper Euphrates), then there are two principal explanations possible.

The first one is the more established explanation, arguing that conditions became too dry for wild cereals. The Younger Dryas first led to the abandonment of major basecamps, initiating the Late Natufian, and finally to the complete failure of Natufian economy.

I here want to suggest a second explanation, that it did not become dry enough to intercept the progress of vegetation development, and wild cereals were simply outcompeted by their successors, i.e., shrubs, tress and herbs, making it impossible to maintain the established Natufian economy.

The idea that humidity did not play a role during the Younger Dryas contradicts prevailing doctrine. Yet other lines of evidence point in a similar direction. Among the faunal remains of the Natufian assemblages from Baaz, the fish bones have already been mentioned, and are a clear indication for surface water.

Furthermore, all cervid species (*Dama mesopotamica*, *Cervus elaphus*, *Capreolus capreolus*) are represented in the assemblages of the Natufian at Baaz, although with only one find each. We then see a slight increase moving in time towards Kaus Kozah, where the fallow deer and the red deer are a little better represented, indicating an increase in higher vegetation. Any vegetation cover would have in turn reduced evaporation and erosion, holding back surface flow from seasonal rainfalls, and further increasing the available amount of water. Vegetation itself can have a feedback on climate and influence both temperature and precipitation, as shown by GANOPOLSKI et al. (1998).

Although I do not believe that there were dense woodlands covering our entire research area in the PPNA, it seems highly possible that the depressions, with dense stands of wild cereals in the Natufian, developed higher vegetation which by the time of the PPNA, had replaced the wild cereals.

In addition to bones, organic remains, including pollen, charred wood, phytoliths and seeds, were recovered during the TDASP excavations (DECKERS et al. 2009). These remains do not contradict the hypothesis outlined above concerning the Younger Dryas environment. The botanical samples show no major impact of the Younger Dryas on the environment, although the anthropogenic bias of these samples is hard to judge. The results from our surveys also show that settlement dynamics during the Epipaleolithic were less constrained by water availability than during other times (CONARD et al. 2009).

The speleothems from Soreq and Ma'ale Efrayim Cave are major climatic references for the Southern Levant. The isotopic signal from Soreq has been interpreted as denoting a considerable increase in precipitation after the Last Glacial Maximum, with a peak between 12,000-10,000 BP and estimated rainfall of 200 mm more than at present (BAR-MATTHEWS et al. 1997). The period of maximum precipitation was interrupted by a short period of higher isotopic values, which were interpreted as the climatic reversal of the Younger Dryas. BAR-MATTHEWS et al. (1997) assumed that precipitation and temperature both decreased at that time, but newer speleothem data from Ma'ale Efrayim Cave place the data in a different perspective. In Ma'ale Efrayim Cave, VAKS et al. (2003) were able to detect a relationship between the location of the desert boundary and temperature. They concluded that during cold phases, a decreased evaporation led to a deterioration of rainshadow effects, pushing the desert further east. Although precipitation might have decreased relative to the preceding and following periods in absolute measures, during the Younger Dryas the effective precipitation (precipitation vs. evaporation) might even have increased.

Other researchers also doubt a severe impact of the Younger Dryas on Neareastern climates:

BOTTEMA (1995) wrote that the Younger Dryas would not have been identified as a distinct period, "if palynological research had started in the Near East." He also stressed that pollen sequences in the Near East are hardly comparable, and that vegetation developed very differently in the various regions. For example, in the Hula pollen sequence, arboreal pollen is high after 14,500 BP, until it sharply declines from 11,500 BP to 10,000 BP (BOTTEMA 1995). If this holds true, the Late Natufian would have hardly experienced a drier climate. Interestingly though, the decline of arboreal pollen would coincide with the early PPNA, which is not well represented in the sites of the Southern Levant (BLOCKLEY & PINHASI 2011). This would indicate that the Natufian itself, and the changes therein, are not a consequence of increasing aridity, but the end of the Natufian (in the Southern Levant) might well be.

HENRY (in press) concludes, based on the above-mentioned isotopic records, that an aridification did occur, but that it occurred later than is commonly proposed (fig. 38), i.e., towards the end of the Late Natufian. The precipitation which Henry reconstructs for the time of this aridification is nevertheless higher than today.

LEV-YADUN & WEINSTEIN-EVRON (2005) analyzed pollen and charcoal from el-Wad and compared them with pollen cores and isotopic records from a wider geographic context. They detected inconsistencies and contradictions in older data and concluded that the Near East did not suffer a notable aridification during the Late Natufian and that the Younger Dryas was not the "drastic climatic change" that has been "enthusiastically" proposed (LEV-YADUN & WEINSTEIN-EVRON 2005).

Following this approach, the progressing Late to Post Glacial development of vegetation could be used to solve the difficulties in integrating the results from Munro and Stiner (MUNRO 2004, STINER et al. 2000, STINER AND MUNRO 2002) into the current study:

As vegetation recolonized the Near East from its glacial refuges near the coastline, the occurrence of wild cereals in high densities diminished. Since the coastal sites were clo-

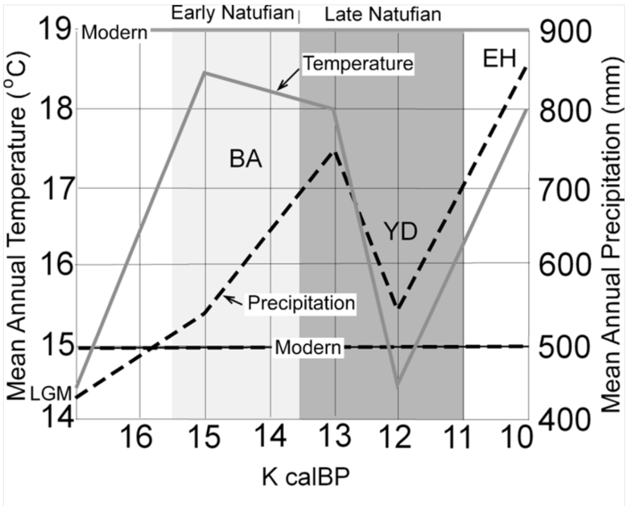

fig. 38. Correlation of archaeological cultures, their dating and climatic parameters (HENRY in press).

ser to these refuge areas, they experienced the changes earlier than sites further east, such as Baaz.

With decreasing wild cereal stands, hare populations declined and their frequency in the assemblages drops. We therefore see the decrease in hares at el-Wad, Hayonim and Hilzon Tachtit (MUNRO 2004) earlier than at Baaz. HENRY (in press) identified a tendency that the location of sites from the Early to the Late Natufian moved away from what today become the Mediterranean woodlands (fig. 39). Following BAR-YOSEF (1987, BAR-YOSEF & VALLA 1990), this would indicate that Late Natufians moved into climatically more hostile and economically less productive environments during an aridification event, which HENRY (in press) considers to be very unlikely.

According to the hypothesis outlined above, the Late Natufians then must have "followed" the wild cereals into these territories.

Rather than "inventing" a new subsistence strategy (and risking failure), these hunters and gatherers tried to continue their lifestyle by moving into areas where this was still possible. An aridification of the southern Levant might have finally terminated this effort.

Only in those parts of the fertile crescent, where the conditions stayed stable long enough to let people understand the possibility of cultivation (we can imagine this process as having occurred unintentionally as a "by-product" of storing wild cereals), the domestication of plants was possible through unconscious selection. Only in a surplus situation is the emergence of food production imaginable (UERPMANN 1979, 2007).

This obviously occurred in the northern part of the Fertile Crescent, where a humid phase in the early Holocene did not intercept the transition to agriculture. The PPNA, in its economic definition as a food producing economy, then "returned" to the Levant

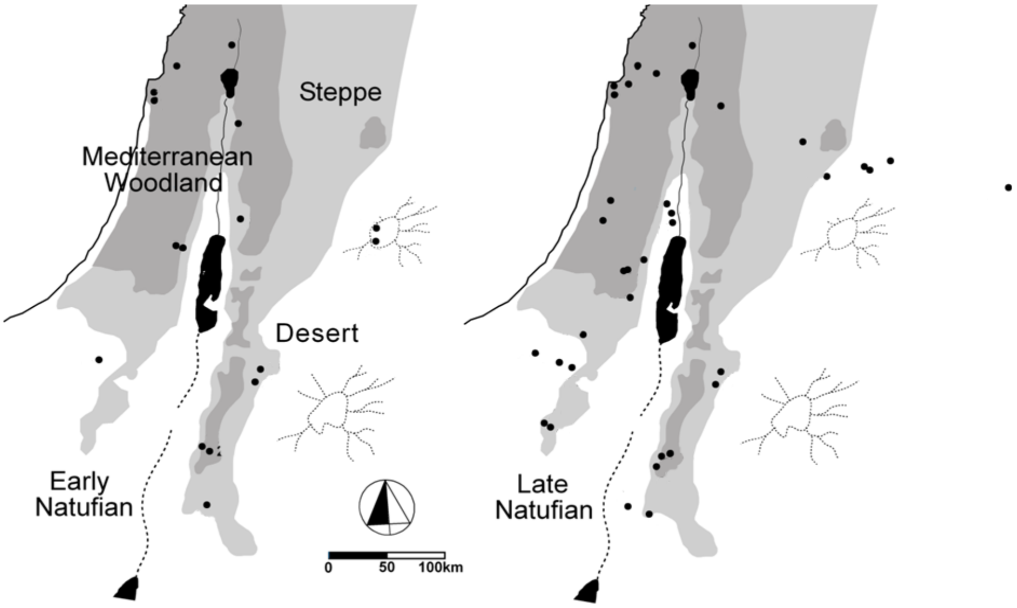

fig. 39. Comparison of Early Natufian and Late Natufian site distribution, indicating a spread away from the mediterranean woodland in the Late Natufian (HENRY in press).

shortly thereafter. The fact that hares are less frequent in these PPNA assemblages might be attributable to the fact that the area under cultivation is considerably smaller than the stands of wild cereals during the Natufian, thereby decreasing the hare population.

The "climatic crisis," which BAR-YOSEF & VALLA (1990) postulated for the Younger Dryas and which they thought then had triggered the Late Natufian adaptation (BAR-YOSEF 1987), is in my view not a matter of extreme aridification, but a time when the development of vegetation had reached a point where the large Natufian settlements had to be abandoned, as their economic foundation had receded. The Late Natufian adaption is therefore not another step towards food production, but a dead-end street, as people were trying to maintain established lifestyles in a situation of declining resources.

The hypothesis described above on plant succession and the development of the Natufian could be further tested, if well-dated environmental proxies were available for the Levant. Unfortunately, this is not the case, and the hypothesis has to remain a possible alternative to the established aridification scenario.

Both scenarios have their arguments, and further research is required to gain a higher chronological resolution in environmental proxies and archeological remains. The uncertainty of 300-800 years (BLOCKLEY & PINHASI 2011) in the dating of the Late Glacial and Early Holocene speleotheme record from Soreq (BAR-MATTHEWS et al. 1997, BAR-MATTHEWS et al. 2003, BAR-MATTHEWS et al. 1999) is still far too high to correlate archaeological "cultures" and economic innovations with climatic phases, as the cultural changes must have occurred within a time span equivalent to this standard deviation.

Researchers have demonstrated that reservoir effects have impacted pollen cores from Ghab and Hula , and MEADOWS (2005) concludes that there are still large uncertainties in the chronology of these pollen diagrams. Facing these problems, researchers are commonly using pollen zonation to correlate the diagrams to the marine record. In doing so, they are using circular reasoning: if the decline in arboreal pollen is used as a calibration point for the onset of the Younger Dryas, it will not be possible to objectively evaluate the effects of the Younger Dryas on vegetation and climate in the Levant. Similar methods are being used in speleothem isotopic records, as the standard deviation of Uranium-Thorium-dating is too high to relate them reliably to archeological assemblages.

11. Beyond Paleolithic subsistence

11.1. A prospect towards animal husbandry

The time in which animal husbandry was established is not well documented in any of the sites analyzed here. Furthermore, the TDASP research area lies beyond the presumed area of initial animal domestication. Nevertheless, this study, based on the analysis of the man-animal relationship in the Paleolithic, was initially conducted in order to create a better understanding of the economic turnovers that finally led to the domestication of animals.

An initial as well as important result from my analysis is the observation that the prey spectrum is above all determined by the environment. Indirectly, this indicates that hunters may not have a choice of what to hunt, but that they are grateful for whatever prey comes their way (as observed in modern hunter and gatherer groups; see PETERS et al. 2009). Therefore, a herd of domesticated animals in the base camp must have been desirable for all hunters and gatherers, but they did not domesticate animals until the PPNB.

Any explanation for the beginning of animal domestication, which sees the necessity of additional food resources as the motivation to change established subsistence patterns, must therefore be wrong (UERPMANN 1979).

The question as to where sheep, cattle and pig first became domesticates has already been roughly answered as occurring in the northern part of the Fertile Crescent, in such important sites as Aşikli Höyük (UERPMANN 1979), Nevalı Çori, Göbekli Tepe (PETERS et al., 1999) and Mezraa Teleilat (ILGEZDI 2008). The question of „why?“, though, is still unresolved. The first domestic animals in this area were sheep. Somewhat further east, and roughly at the same time, goats were domesticated in the Zagros (HESSE 1978). I will focus primarily on sheep in the discussion below, since wild goat was obviously always less frequent in our research area than wild sheep, and less data are therefore available from the assemblages.

The issues that will be addressed in the following include an evaluation of the possibilities for detecting domestication in its early stages, and the discussion of possible processes leading to it. The sites analyzed in the previous chapters and the data available from the literature will be integrated into this discussion in order to create a reference for "undomesticated" faunal assemblages.

11.2. Defining and detecting domestication

Two issues, still currently debated, are of major concern in domestication research: the question of what domestication is, and how it can be demonstrated. Both issues are closely interwoven. We need to keep in mind that archaeologists need a definition that is applicable to the archaeological assemblages (UERPMANN 1979).

Depending on the researcher's scientific background, the term "domestication" has been applied with multiple meanings and perceived by the various authors very differently. In HESSE's (1982) view, the term domestication had soon "developed fuzzy definitional boundaries". Some authors have tried to create new concepts describing the initial stages of (wild) animal husbandry as "selective hunting", "herd management", and intermediate states as "semi-domestication" (e.g., ZEDER & HESSE 2000). Concerning the results of this study, these concepts should be discarded, as the consistency of the assemblages indicates that intentional selection or any kind of prey management does not occur in hunter and gatherer contexts.

Nevertheless, the obvious terminological confusion has led DAVIS (2005) to suggest abandoning the term "domestication" in favor of the more open term "cultural control". The notion here involves finding one term to describe all the various stages and modes of domestication, including such difficult cases as the reindeer, the elephant or the house mouse. In fact, although this intention is comprehensible and although it solves some problematic cases, it also creates new difficulties, since almost any "wild" mammal population is somehow "controlled" today, and would otherwise be extinct. Furthermore, "cultural control" is nothing more than the natural relationship, which every carnivore exercises towards its prey (although the term "cultural" would require further discussion in this case).

Throwing together, for example, bison and sheep into the same category of culturally controlled species would also miss an important point: The "controlled" bison is morphologically indistinct from any "wild" bison. The domestic (wool-)sheep, though, is not to be confused with a wild urial (*Ovis orientalis vignei*), because its appearance is beyond the variability of the wild form.

The definition of domestication used here describes the process through which a population of animals from a wild species is transformed into a morphologically different population, living in the human sphere. For this to happen, the animals have to be exposed to shifted selective pressures, usually by removing them from their wild environment. Under human care, traits such as individual appearance and increased tameness, that is, traits which are selected against in a wild population, can develop into "evolutionary" advantages, since these animals (and their offspring) might be tended more carefully, slaughtered less often and consequently be able to reproduce more frequently.

Many authors have therefore included genetic isolation from the wild population in their definitions of domestication, while UERPMANN (1979) even considers this trait as the basic principle of domestication.

My perception of the term "domestication" closely follows the work of UERPMANN (1979), who also emphasized the uniqueness of this man-animal relationship in domestication: on the level of population, species profit from being domesticated: even though, for example, the wild aurochs (Bos primigenius) was exterminated in the wild, its domesticated form is today more numerous and widespread than its wild ancestor ever was.

Domestication is not to be confused with the further process of breeding, in which a domestic animal develops into a variety of forms, i.e., different "breeds" or "stocks". As domestication, I view only the initial transformation of a population from a wild species into a morphologically distinct population under human control.

For the archaeologist, animals can be considered domestic if they fall, in whatever respect, outside the variability of the local wild population. Unfortunately, this criterion is somewhat limited by preservation conditions. Only rarely can depictions of animals be found that might offer clues into fur color and general appearance. Even though the bones of these animals are often preserved, it depends upon taphonomy as to whether they can be aged, measured or biochemically analyzed and whether they are within or beyond the variability of wild animals.

11.3. Size decrease

In the research concerning the history of domestication, a widely applied assumption is that after the initial removal of animals from their natural habitat, the mean size of the animals decreases in the following generations. Several factors contribute to this phenomenon, the two most important being lower quality of food and shifting selective pressures. Among the latter we find a great variety of mechanisms, such as reduced mortality of weaker animals, removal of strong and aggressive animals, etc.

Since these alterations will first affect the body weight and muscle tension rather than the withers height of the animals, any analysis should focus on breadth and depth measurements of postcranial elements. This also excludes the high variation of skull and tooth measurements according to sex, age and race (UERPMANN 1979).

Disagreement exists as to whether bones from young individuals should be incorporated into any such analysis.

ZEDER & HESSE (2000) point to the fact that the bones of young, male wild animals are already larger than domestic females from their first year onwards, so that at least the extremes should be clearly identifiable. Excluding them from the analysis would, in their view, artificially reduce the statistical basis.

Although this should be kept in mind, this procedure will exaggerate the standard deviation, because the size of young animals towards adult individuals is not scaled proportionally. Unfused longbone epiphysis are wider, and would suggest a higher load in the statistics. Unfused elements could, though, be analyzed separately and compared with the analysis on fused elements to estimate whether any bias exists through the occurrence of a high number of very large (male wild) or very small (female domestic) individuals.

The direct, allometric comparison of identical skeletal elements from adult individuals would be the preferential method of metric analysis, since slight shifts in the applied load could be visible. The disagreement here exists mainly due to the fact that only rarely are assemblages preserved well enough to provide a representative number from any measurable skeletal element.

An established method in overcoming this problem is the application of logarithmic size indices (LSI), as described in the chapter on methods.

Not only are changes in size of interest, but also (and even more so) the variability of size. Theoretically, if a subpopulation is undergoing a size decrease in a human environment, while wild animals are continuously being hunted, the initial separation in size will first resemble an increase in variability. Over the course of time, the populations will further separate, until they are morphologically distinct.

These hypotheses are tested below. Climatic changes influencing animal size will be evaluated too see, among others, whether changes in size occur before neolithization. Also, geographic variability of sheep will be investigated in contrast to gazelle. Since gazelles were never domesticated, and considered impossible to domesticate, they should behave differently from sheep with the onset of the Neolithic. Subsistence patterns and their diachronic changes have already been discussed for the sites analyzed in the previous chapters. With regard to the processes leading to domestication, the observed patterns might help us to understand the circumstances under which the Neolithic economy emerged.

11.4. Metric comparisons

As previously understood, the comparison of animal size is crucial in the discussion on animal husbandry. Using the LSI (see paragraph on „Measures of size and age“), it was possible to compare different skeletal elements from the various units and sites. The species being analyzed are both sheep and gazelle. If domestication indeed results in a size decrease, the gazelles would be expected to stay relatively stable, while the sheep should experience a decrease shortly after initial domestication. As wild sheep would have been continuously hunted, the highest LSI values are also expected to stay unaltered over time, and through the addition of small animals in the assemblage, the overall size variability will increase. If climate or environmental deterioration is the main trigger behind size decreases, this should be evident in all the species in question.

The data provided by Hans-Peter Uerpmann proved a valuable addition to the material from the TDASP sites analyzed here, and the combination of the data sets produced a chronological depth from Middle Paleolithic to Neolithic times, and a geographic scope covering large parts of the Fertile Crescent. The osteometric data were plotted in a diagram of combined density estimation and boxplot.

The sites in the diagram are sorted chronologically. For the sheep, the chronological coverage spans from the Middle and Upper Paleolithic assemblage of Shanidar C and Shanidar D (which were combined to enlarge the sample), up to the Chalcolithic of Amuq E. Measurements from the goitered gazelle (*Gazella subgutturosa*) were available from fewer sites, but the available measurements similarly span a long time interval, as they extend into the Bronze Age of the Kaukasus.

The higher LSI values, from larger and heavier animals, are to the right of the plots, while smaller animals are plotted more to the left. The scale is identical in all diagrams, making it possible to compare directly and visually the results of the calculations and the animal sizes in the various sites. The standard (value of “0”) is a female wild sheep from Iran (see paragraph on „Measures of size and age“).

From all sites, all data for fully fused sheep bones were analyzed, ignoring the domestic or wild status assigned by the researchers. In most cases, no such decision had been made, and the finds had been classified as either wild or domestic sheep.

Also, the coefficient of variation was calculated as a measure of size variability. For empirical data sets such as the ones in this study, the equation is commonly defined as

$$c_v = \frac{\sigma}{|\gamma|}$$

where σ is the standard deviation and |γ| the absolute value of the arithmetic mean. By this division, contrary to the comparison of interquantile ranges or standard deviations, the coefficient of variation accounts for the mean size of the animals, as the standard deviation should be higher in larger animals. As we are dealing with both positive and negative values, this common function cannot be applied unchanged.

Through the application of the absolute value, smaller mean LSI values are no longer recognizable. They produce the same “relative standard deviations” as LSIs from large animals, if the standard deviation is similar. Populations of smaller animals should, though, also possess a smaller standard deviation, if the variation is similar.

To remove this error, a constant of 0.1 was added to the arithmetic mean, making negative values impossible. The resulting function therefore is:

$$c_v = \frac{\sigma}{\gamma + 0.1}$$

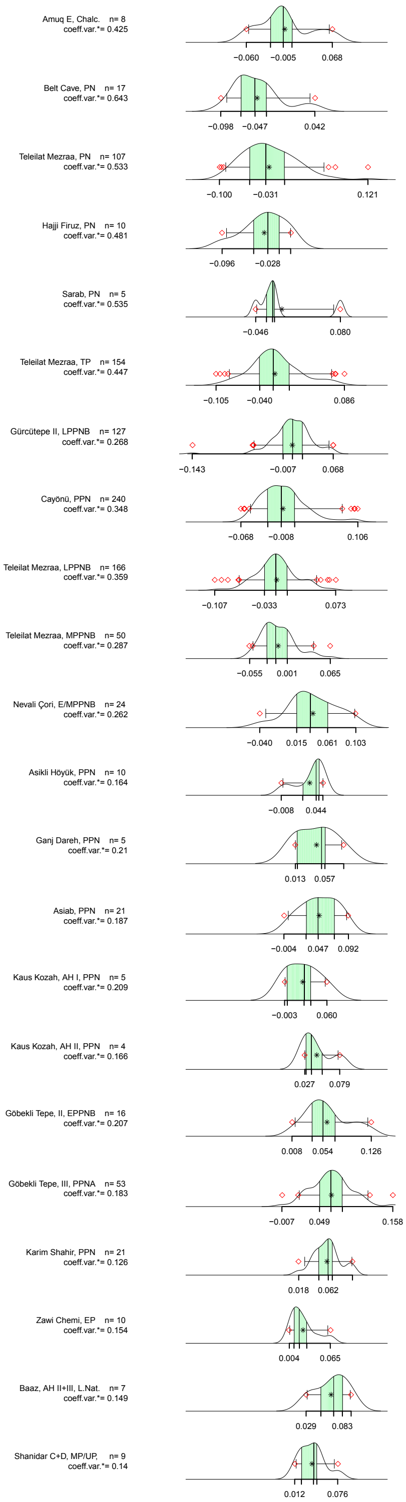

fig. 40. LSI-plots for wild sheep, in rough chronological order from bottom (oldest) to top (youngest).

Through this step, we no longer need to use the absolute value. The drawback is that the resulting cv is no longer interpretable as a percentage.

The diagram (fig. 40) shows relatively similar large animals from Shanidar to Kaus Kozah. The smallest animals from these older sites have LSI-values only very slightly below the standard Iranian wild sheep.

This is surprising, as large distances and a time depth of roughly 50 ka are involved. Also, the coefficients of variation are within the same range of roughly 0.15-0.2. Unfortunately, Shanidar is the only MP/UP site with at least five evaluable measurements for sheep.

Only one single measurable find from Kaus Kozah AH IV is from an undisturbed square. It is an almost complete talus. Calculating the mean LSI for all measurements of this specimen provides a result of 0.067, which is well within the range of all the pre-PN sites.

A shift towards considerably smaller minimum values and increasing coefficients of variation is visible from Aşikli Höyük to the LPPNB of Mezraa. The large animals remain relatively stable in the LSI-values, while the small animals decrease and the variation accordingly rises. The crucial period seems to be the MPPNB, were the first leftward shift in the diagram becomes evident in the assemblages from Nevalı Çori and Mezraa Teleilat.

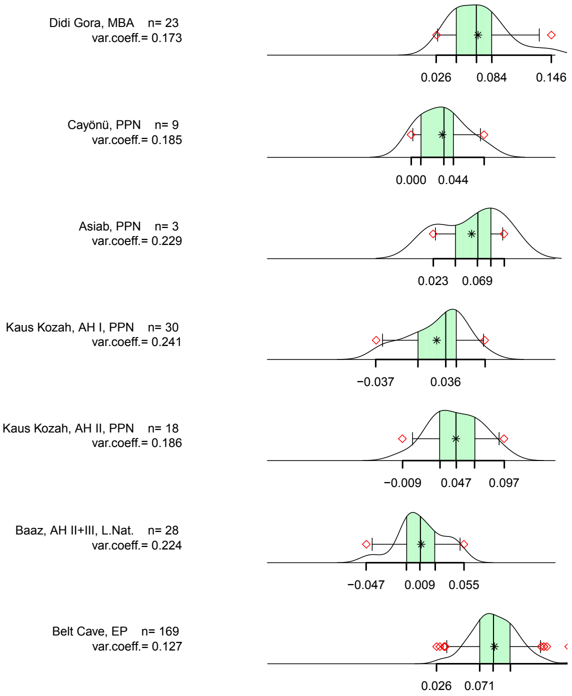

fig. 41. LSI-plots for goitered gazelle (*G.subgutturosa*), from oldest (bottom) to youngest (top).

The diagram looks different for gazelle (fig. 41). The single plots do show a size variability, which can best be explained by a geographic size gradient. Gazelles from the Kaukasus (Didi Gora) and the South Caspian region (Belt Cave) are very similar in size despite the 10,000 years separating the assemblages.

A chronological dependency of size is not visible. Most important, the coefficient of variation is quite stable and ranges only from around 0.13 to 0.24, which is considerably less variation than in the sheep assemblages. In fact it is very close to the variation in those sheep assemblages for which only wild animals can be expected.

To conclude, the size decrease in sheep, beginning in the early phase of the MPPNB, represented by assemblages from early Nevalı Çori and Mezraa Teleilat, is unprecedented. As gazelles are not experiencing any correlated size decrease, and since variation of the LSIs of both species were stable despite environmental changes in previous millennia, initial domestication remains the only possible explanation.

This result is not entirely unexpected, since much of the data presented here have been published and analyzed already by UERPMANN (1979), UERPMANN & UERPMANN (2008) and PETERS et al. (1999). Their work is once again confirmed through the addition of data from our recent TDASP excavations in Syria, and through the application of slightly modified display methods, statistic parameters and through the comparison of gazelle and sheep. The LSI as a tool is therefore proven to be a valuable method for enlarging the dataset and making things comparable which otherwise would not be.

12. Conclusion

The goals of this study were to identify and explain subsistence patterns in the faunal assemblages of Baaz, Kaus Kozah, Ain Dabbour and Wadi Mushkuna. These four sites are located in the mountains north of Damascus, Syria, and were excavated starting in 1999. They span a chronological sequence from the Middle Paleolithic (Wadi Mushkuna, Kaus Kozah AH IV) to the PPNA (Kaus Kozah AH I & II), with the Upper Paleolithic and Natufian layers of Baaz and the Geometric Kebaran of Ain Dabbour occurring in between.

The Natufian at Baaz and the question of whether the Natufian could (economically) be considered the initial step in the transition towards the Neolithic became the focus of the analysis presented above. The assemblages from Baaz and Kaus Kozah were analyzed in their entirety, while material from Ain Dabbour and Wadi Mushkuna was sampled. This included all individually recorded finds from Ain Dabbour, plus a sample of finds from the sieving, and all finds from AH IV and IVa from Wadi Mushkuna. Excavations are still in progress at Wadi Mushkuna.

The results show that gazelles, caprines and equids were the common prey animals throughout time. They constitute the majority of the assemblages with remarkably similar proportions, despite long chronological ″gaps“ between layers. Among the caprines, wild sheep (*Ovis orientalis*) are far more frequent than wild goat (*Capra aegagrus*). Additionally, there are the occasional finds of cervids, carnivores and some examples of small game species in the assemblages.

No change in subsistence occurs from the Middle Paleolithic to the Upper Paleolithic.

The exception among the sites is Baaz, where hares and tortoises are together providing more than 40% of the bone weight of the Natufian assemblages. Nevertheless, the large game species still resemble the relative amounts of the preceding periods, indicating that hunting strategies towards these species did not change. The assemblage is also noteworthy for its numerous fish remains, mostly the brown trout, Salmo trutta fario. Baaz is the first Levantine site where Salmonids have been identified. The fish have raised doubts on the common notion that the Late Natufian is contemporary with the Younger Dryas climatic episode, which is thought to have been an extremely dry period.

After briefly discussing the climatic proxies and the different interpretations for them that are found in the literature, I proposed a scenario arguing that the Late Natufian is not a consequence of aridification but of the progressing development of vegetation. The wild cereals, which flourished in the phase of initial rewarming after the glacial, could have been replaced gradually by higher vegetation in the course of the Natufian, making it necessary to abandon the large coastal settlements at some point in time. I also suggest that the expansion of wild cereals after the glacial was the main reason for the high amount of hares in the Natufian assemblages. Their relative decrease in the Late Natufian of the coastal sites could similarly be explained with the progressing development of vegetation.

A dry spell could have ultimately led to the end of the Natufian and could have prevented high occupation intensity of the Southern Levant in the early PPNA.

The climate in the North developed differently, and a humid phase in the early Holocene might have finally led to the cultivation and domestication of crops.

Neither the proposed scenario nor the established ″aridification scenario“ can yet be verified beyond doubt. The chronological resolution of paleoclimatic archives is currently not yet good enough, requiring the need for future research.

The subsistence patterns of the Paleolithic further indicate that hunters opportunistically exploited the animal species in their environment, keeping in mind the general notion that prey selection is hardly possible in a situation where humans are permanently on the edge of experiencing food shortages. The initial domestication of animals, which soon followed the domestication of plants, must have taken place in a situation of surplus, which could have only been created by plant cultivation.

In the final section of my analysis, the osteometry of wild sheep (*Ovis orientalis*) and gazelle (*Gazella subgutturosa*) in the sites under study is analysed. Data from the literature and measurements provided by Hans-Peter UERPMANN are then plotted against these. The data confirm that a marked decrease in size takes place with domestication and that this occurs in the early MPPNB. No size reduction is visible in the gazelles.

References

Bar-Matthews, M., Ayalon, A., Gilmour, M., Matthews, A., Hawkesworth, C.J., 2003. *Sea–land oxygen isotopic relationships from planktonic foraminifera and speleothems in the Eastern Mediterranean region and their implication for paleorainfall during interglacial intervals*, Geochimica et Cosmochimica Acta 67, 3181-3199.

Bar-Matthews, M., Ayalon, A., Kaufman, A., 1997. *Late Quaternary Paleoclimate in the Eastern Mediterranean Region from Stable Isotope Analysis of Speleothems at Soreq Cave, Israel*, Quaternary Research 47, 155-168.

Bar-Matthews, M., Ayalon, A., Kaufman, A., Wasserburg, G.J., 1999. *The Eastern Mediterranean paleoclimate as a reflection of regional events: Soreq cave, Israel*, Earth and Planetary Science Letters 166, 85-95.

Baruch, U., Bottema, S., 1991. *Palynological evidence for climatic fluctuations in the southern Levant ca. 15.000-8.000 years ago*, in: Bar-Yosef, O., Valla, F. (Eds.), The Natufian culture in the Levant, Ann Arbor.

Bar-Yosef, O., 1987. *Pleistocene conexions between Africa and Southwest Asia: an archaeological perspective*, The African Archaeological Review 5, 29-38.

Bar-Yosef, O., 2002. *The Upper Palaeolithic Revolution*, Annual Review of Anthropology 31, 363-393.

Bar-Yosef, O., 2004. *Eat what is there: Hunting and gathering in the world of Neanderthals and their neighbours*, International Journal of Osteoarchaeology 14, 333-342.

Bar-Yosef, O., Arnold, M., Mercier, N., Belfer-Cohen, A., Goldberg, P., Housley, R., Laville, H., Meignen, L., Vogel, J.C., Vandermeersch, B., 1996. *The Dating of the Upper Paleolithic Layers in Kebara Cave, Mt Carmel*, Journal of Archaeological Science 23, 297-306.

Bar-Yosef, O., Kuhn, S.L., 1999. *The big deal about blades: Laminar technologies and human evolution*, American Anthropologist 101, 322-338.

Bar-Yosef, O., Valla, F., 1990. *The Natufian Culture and the Origin of the Neolithic in the Levant*, Current Anthropology 31, 433-436.

Bennett, J.L., 1999. *Thermal alteration of buried bone*, Journal of Archaeological Science 26, 1-8.

Blockley, S.P.E., Pinhasi, R., 2011. *A revised chronology for the adoption of agriculture in the Southern Levant and the role of Lateglacial climatic change*, Quaternary Science Reviews 30, 98-108.

Boessneck, J., Müller, H.-H., Teichert, M., 1964. *Osteologische Unterscheidungsmerkmale zwischen Schaf (Ovis aries Linné) und Ziege (Capra hircus Linné)*, Kühn-Archiv 78, 1-129.

Boessneck, J., von den Driesch, A., 1973. *Die jungpleistozänen Tierknochenfunde aus der Brillenhöhle*, Müller & Gräff, Stuttgart.

Bordes, F., 1955. *Le paléolithique inferieur et moyen de Jabrud (Syrie) et la question du Pré-Aurignacien*, l'Anthropologie 59, 486-507.

Bottema, S., 1995. *The Younger Dryas in the Eastern Mediterranean*, Quaternary Science Reviews 14, 883-891.

Bottema, S., van Zeist, W., 1981. *Palynological evidence for the climatic history of the Near East, 50.000-6.000 BP*, in: Cauvin, J., Sanlaville, P. (Eds.), Préhistoire du Levant, CNRS, Paris, pp. 111-132.

Braidwood, R.J., 1952. *Book Review: Cave Explorations in Iran 1949 by Carleton S. Coon,* American Anthropologist 54, 551-553.

Braidwood, R.J., 1960. *The agricultural revolution*, Scientific American 203, 130-148.

Campana, D.V., 1989. *Natufian and Protoneolithic Bone Tools. The Manufacture and Use of Bone Implements in the Zagros and the Levant*, Oxford.

Carlson, L.A., 1999. *Aftermath of a feast: human colonization of the southern Bahamian archipelago and its effects on the indigenous fauna*, University of Florida, Gainesville, Florida.

Childe, G., 1934. *New Light on the Most Ancient East*, Kegan, Trench,Trubner & Co., London.

Childe, G., 1936. *Man Makes Himself,* London.

Childe, G., 1979. *Prehistory and Marxism*, Antiquity 53, 93-95.

Clark, J., Ligouis, B., 2010. *Burned bone in the Howieson's Poort and post-Howieson's Poort Middle Stone Age deposits at Sibudu (South Africa): behavioral and taphonomic implications*, Journal of Archaeological Science 37, 2650-2661.

Cochard, D., 2005. *Les lièvres variables du niveau 5 du Bois-Ragot: analyse taphonomique et apport paléo-ethnologique*, in: Chollet, A., Dujardin, V. (Eds.), La grotte du Bois-Ragot à Gouex (Vienne). Magdalénien et Azilien. Essais sur les hommes et leur environnement, pp. 319-337.

Cohen, M.N., 1977. *The food crisis in prehistory*, Yale University Press, London.

Conard, N.J., 2002. *An overview of the recent excavations at Baaz Rockshelter, Damascus Province, Syria*, in: Aslam, R., Blum, S., Kastel, G., Schweitzer, F., Tuhumm, D. (Eds.), Mauer Schau: Festschrift für Manfred Korfmann, Grainer Verlag, Remshalden-Grunbach, pp. 263-269.

Conard, N.J., 2006. *An Overview of the Recent Excavations at Baaz Rockshelter, Damascus Province, Syria*, in: Conard, N.J. (Ed.), Tübingen - Damascus Excavation and Survey Project, Kerns Verlag, Tübingen, pp. 5-23.

Conard, N.J., Bretzke, K., Deckers, K., Hillgruber, F.K., Kandel, A.W., Masri, M., Napierala, H., Riehl, S., Stahlschmidt, M., 2009. *Natufian lifeways in the eastern foothills of the Anti-Lebanon Mountains*, in: Bar-Yosef, O., Valla, F. (Eds.), 2nd Natufian Conference, Paris.

Conard, N.J., Bretzke, K., Hillgruber, F.K., Masri, M., 2006a. *Research in 2005 at Kaus Kozah Cave*, in: Conard, N.J. (Ed.), Tübingen - Damascus Excavation and Survey Project 1999-2005, Kerns Verlag, Tübingen, pp. 195-.

Conard, N.J., Dietl, H., Dodonov, A., Drechsler, P., Kandel, A.W., Masri, M., 2004. *Results from the 2004 TDASP Survey*, Report submitted to Directorate General of Antiquities and Museums of Syria.

Conard, N.J., Dodonov, A., Masri, M., 2007a. *The 2007 TDASP Survey in the Damascus Province, Syria*.

Conard, N.J., Kandel, A.W., Dodonov, A., Abdulrachman, A., 2000. *The 2000 Ma'aloula Paleolithic Survey*, Report submitted to Directorate General of Antiquities and Museums of Syria.

Conard, N.J., Kandel, A.W., Dyab, A., 1999. *The 1999 Ma'aloula Paleolithic Survey*, Report submitted to Directorate General of Antiquities and Museums of Syria.

Conard, N.J., Kandel, A.W., Masri, M., 2003. *The 2003 Ma'aloula Paleolithic Survey*, Report submitted to Directorate General of Antiquities and Museums of Syria.

Conard, N.J., Kandel, A.W., Masri, M., 2006b. *The 2004 Excavation at Baaz Rockshelter*, in: Conard, N.J. (Ed.), Tübingen - Damascus Excavation and Survey Project 1999-2005, Kerns Verlag, Tübingen.

Conard, N.J., Kandel, A.W., Masri, M., 2007b. *The 2006 TDASP Survey and Excavations at Ain Dabbour Cave, Damascus Province, Syria*

Conard, N.J., Masri, M., 2006. *The 2004 Excavation at Kaus Kozah Cave*, in: Conard, N.J. (Ed.), Tübingen - Damascus Excavation and Survey Project, Kerns Verlag, Tübingen, pp. 189-.

Conard, N.J., Masri, M., Bretzke, K., Napierala, H., Kandel, A.W., 2010. *Modeling Middle Paleolithic land use in the Damascus Province, Syria*, in: Conard, N.J., Delagnes, A. (Eds.), Settlement Dynamics of the Middle Paleolithic and Middle Stone Age, Kerns, Tübingen, pp. 123-144.

Conard, N.J., Masri, M., Bretzke, K., Stahlschmidt, M., Kandel, A.W., 2008a. *The 2008 TDASP Survey in the Damascus Province, Syria and the refinement of models of Paleolithic landuse*, Report submitted to Directorate General of Antiquities and Museums of Syria.

Conard, N.J., Walker, S.J., Kandel, A.W., 2008b. *How heating and cooling and wetting and drying can destroy dense faunal elements and lead to differential preservation*, Palaeogeography, Palaeoclimatology, Palaeoecology 266, 236-245.

Coon, C., 1951. *Cave explorations in Iran, 1949*, University of Pennsylvania, Philadelphia.

Copeland, L., 2003. *The Levantine Upper Palaeolithic: A commentary on contributions to the Philadelphia Sysmposium*, in: Goring-Morris, N., Belfer-Cohen, A. (Eds.), More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East, Oxbow, Oxford, pp. 242-248.

Crabtree, P.J., Campana, D.V., 1989. *The Contributions of Dexter Perkins, Jr. and Patricia Daly to Zooarchaeological Studies and their Implications for Contemporary Faunal Research*, in: Crabtree, P.J., Campana, D.V., Ryan, K. (Eds.), Early Animal Domestication and its Culturaln Context, University of Pennsylvania, Philadelphia.

Davis, S.J.M., 1982. *Climatic Change and the Advent of Domestication : The Succession of Ruminant Artiodactyls in the Late Pleistocene-Holocene in the Israel Region*, Paléorient 8, 5-15.

Davis, S.J.M., 2005. *Why domesticate food animals? Some zoo-archaeological evidence from the Levant*, Journal of Archaeological Science 32, 1408-1416.

de Graaff, G., 1961. *Gross effects of a primitive hearth on bones*, The South African Archaeological Bulletin 16, 25-26.

Deckers, K., Riehl, S., Jenkins, E., Rosen, A., Dodonov, A., Simakova, A.N., Conard, N.J., 2009. *Vegetation development and human occupation in the Damascus region of southwestern Syria from the Late Pleistocene to Holocene*, Vegetation History and Archaeobotany.

Desse, J., Desse-Berset, N., 2000. *Julfar (Ras al-Khaimah Emirats Arabes Unis), ville portuaire du golfe arabo-persique (VIIIe–XVIIe siècles): exploitation de mammifères et des poissons*, in: Mashkour, M., Choyke, A.M., Buitenhuis, H., Poplin, F. (Eds.), Archaeozoology of the Near East IV, ARC-Publikatie, Groningen, pp. 79-93.

Dodonov, A., Kandel, A.W., Simakova, A.N., Masri, M., Conard, N.J., 2006. *Geomorphology, Site Distribution and Palaeolithic Settlement Dynamics of the Ma'aloula Region, Damascus Province, Syria*, in: Conard, N.J. (Ed.), Tübingen - Damascus Excavation and Survey Project. 1999-2005., Kerns Verlag, Tübingen.

Ducos, P., 1968. *L'Origine des animaux domestiques en Palestine*, Delmas, Bordeaux.

Elliott, J.M., 1994. *Quantitative ecology and the brown trout*, Oxford University Press, Oxford.

Estes, R.D., 1991. *The behavior guide to African mammals. Including hoofed animals, carnivores, primates,* University of California Press, Berkeley & Los Angeles.

Farrand, W.R., 1970. *Geology, climate and chronology of Yabrud Rockshelter I*, in: Gripp, K., Schütrumpf, R., Schwabedissen, H. (Eds.), Frühe Menschheit und Umwelt, Böhlau Verlag, Köln, pp. 212-223.

Flannery, K., 1969. *Origins and Ecological Effects of Early Domestication in Iran and the Near East*, in: Ucko, P.J., Dimbleby, G.W. (Eds.), The Domestication and Exploitation of Plants and Animals, Aldine Publishing Co., Chicago, pp. 73-100.

GARROD, D.A.E., BATE, D.M.A., 1937. *The Stone Age of Mount Carmel. Excavations at the Wady El-Mughara*. Volume 1, Clarendon Press, Oxford.

GELDIAY, R., BALIK, S., 1996. *Türkiye tatlısu balıkları*, Ege Üniversitesi Basımevı, Bornova, Izmir.

GIATTI, A., 1943. *Jungle Mechanics*, Popular mechanics march, 66-72.

GORING-MORRIS, N., BELFER-COHEN, A., 2008. *A Roof Over One's Head: Developments in Near Eastern Residential Architecture Across the Epipalaeolithic-Neolithic Transition*, in: BOCQUET-APPEL, J.-P., BAR-YOSEF, O. (Eds.), The Neolithic Demographic Transition and its Consequences, Springer.

GORING-MORRIS, N., HORWITZ, L.K., 2000. *Fauna from the Early Natufian Site of Upper Besor 6 in the Central Negev, Israel*, Paléorient 26, 111-128.

GRAYSON, D.K., DELPECH, F., 2003. *Ungulates and the Middle-to-Upper Paleolithic transition at Grotte XVI (Dordogne, France)*, Journal of Archaeological Science 30, 1633-1648.

GROSMAN, L., 2003. *Preserving Cultural Traditions in a Period of Instability: The Late Natufian of the Hilly Mediterranean Zone*, Current Anthropology 44, 571-580.

GROSMAN, L., MUNRO, N.D., BELFER-COHEN, A., 2008. *A 12.000-year-old Shaman burial from the southern Levant (Israel)*, PNAS 105, 17665-17669.

GUILDAY, J.E., 1970. *Animal remains from archaeological excavations at Fort Ligonier*, Annals of the Carnegie Museum 42, 177-186.

HAZAN, N., STEIN, M., AGNON, A., MARCO, S., NADEL, D., NEGENDANK, J.F.W., SCHWAB, M.J., NEEV, D., 2005. *The late Quaternary limnological history of Lake Kinneret (Sea of Galilee)*, Israel, Quaternary Research 63, 60-77.

HEIERLI, J., 1907. *Das Kesslerloch bei Thaingen*, Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Zürcher & Furrer, Zürich, p. 214.

HELMER, D., 2000. *Étude de la faune mammalienne d'El Kowm 2 (Syrie)*, in: STORDEUR, D. (Ed.), Une île dans le désert : El Kowm 2 (Néolithique précéramique, 8000-7500 BP Syrie), CNRS Éditions, Paris, pp. 233-264.

HENRY, D.O., in press. *The Natufian and the Younger Dryas*, in: BAR-YOSEF, O., VALLA, F. (Eds.), 2nd Natufian Conference, Paris.

HENSCHEL, P., HUNTER, L., BREITENMOSER, U., PURCHASE, N., PACKER, C., KHOROZYAN, I., BAUER, H., MARKER, L., SOGBOHOSSOU, E., BREITENMOSER-WURSTEN, C., 2008. *Panthera pardus*, IUCN Red List of Threatened Species. Version 2010.4., 27 April 2011.

HESSE, B., 1978. *Evidence for husbandry from the early neolithic site of Ganj Dareh, western Iran*, Columbia University, Ann Arbor.

HESSE, B., 1982. *Slaughter Patterns and Domestication: The Beginnings of Pastoralism in Western Iran*, Man 17, 403-417.

HILLGRUBER, F.K., 2010. *The Last Hunter-Gatherers: The Epipalaeolithic In Southwestern Syria*, Geowissenschaftliche Fakultät, Eberhard-Karls Universität, Tübingen.

HOOIJER, D.A., 1961. *Fossil vertebrates of Ksar ,Akil, a palaeolithic rock shelter in the Lebanon*, Zoologische Verhandelingen Leiden 49, 4-67.

ILGEZDI, G., 2008. *The Domestication Process in Southeastern Turkey: The Evidence of Mezraa-Teleilat*, Geowissenschaftliche Fakultät, Eberhard-Karls Universität, Tübingen.

KADOSH, D., DORIT, S., HAIM, K., WEINSTEIN-EVRON, M., 2004. *A Late Quaternary paleloenvironmental sequence from Dor, Carmel Coastal Plain, Israel*, Palynology 28, 143-157.

KAUFMAN, D., 2002. *Re-evaluating subsistence skills of levantine Middle and Upper Palaeolithic hunters: a comparison of the faunal assemblages*, Oxford Journal of Archaeology 21, 217-229.

KRUPP, F., 1987. *Freshwater ichthyogeography of the Levant*, Beiträge zum Tübinger Atlas des Vorderen Orients A, Naturwissenschaften 28, pp. 229-237.

KUBASIEWICZ, M., 1956. *O metodyce badań wykopaliskowich szczątków kostnych zwierzęcych*, Materiały Zachodnio-Pomorskie 2, 235-244.

LACHER, T.E., WILLIG, M.R., MARES, M.A., 1982. *Food Preference as a Function of Resource Abundance with Multiple Prey Types: An Experimental Analysis of Optimal Foraging Theory*, The American Naturalist 120, 297-316.

LEHMANN, U., 1970. *Die Tierreste aus den Höhlen von Yabrud (Syrien)*, in: GRIPP, K., SCHÜTRUMPF, R., SCHWABEDISSEN, H. (Eds.), Frühe Menschheit und Umwelt, Böhlau Verlag, Köln, pp. 181-188.

LUBBOCK, J., 1865. *Prehistoric Times: As Illustrated by Ancient Remains and the Manners and Customs of Modern Savages*, Williams and Norgate, London.

LUPO, K.D., 2007. *Evolutionary Foraging Models in Zooarchaeological Analysis: Recent Application and Future Challenges,* Journal of Archaeological Research 15, 143-189.

MACCRIMMON, H.R., MARSHALL, T.L., GOTS, B.L., 1970. *World Distribution of Brown Trout, Salmo trutta: Further Oberservations*, Journal of the Fisheries Research Board of Canada 27, 811-818.

MCBURNEY, C.B.M., 1968. *The cave of Ali Tappeh*, Proceedings of the Prehistoric Society 34, 385-413.

MARKS, A.E., 2003. *Reflections on Levantine Upper Palaeolithic studies: Past and present,* in: GORING-MORRIS, N., BELFER-COHEN, A. (Eds.), More Than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East, Oxbow, Oxford, pp. 249-264.

MEADOW, R., 1981. *Early animal domestication in South Asia: a first report of the faunal remains from Mehrgarh, Pakistan*, in: HÄRTEL, H. (Ed.), South Asian archaeology, Dietrich Reimer, Berlin, pp. 143-180.

Meadows, J., 2005. *The Younger Dryas episode and the radiocarbon chronologies of the Lake Huleh and Ghab Valley pollen diagrams, Israel and Syria*, The Holocene 15, 631-636.

Merk, K., 1875. *Der Höhlenfund im Kesslerloch bei Thayngen / Originalbericht des Entdeckers*, Mittheilungen der Antiquarischen Gesellschaft in Zürich 19, 1-44.

Munro, N.D., 2003. *Small game, the younger dryas, and the transition to agriculture in the southern Levant*, Mitteilungen der Gesellschaft für Urgeschichte Blaubeuren 12, 47-71.

Munro, N.D., 2004. *Zooarchaeological Measures of Hunting Pressure and Occupation Intensity in the Natufian*, Current Anthropology 45, 5-33.

Munro, N.D., Bar-Oz, G., Stutz, A.J., 2009. *Aging mountain gazelle (Gazella gazella): refining methods of tooth eruption and wear and bone fusion*, Journal of Archaeological Science 36, 752-763.

Napierala, H., 2008. *Die Tierknochen aus dem Kesslerloch : Neubearbeitung der paläolithischen Fauna*, Kanton Schaffhausen, Kantonsarchäologie, Schaffhausen.

Napierala, H., Kandel, A.W., Conard, N.J., in press a. *Small game and the shifting subsistence patterns from the Upper Paleolithic to the Natufian at Baaz Rockshelter, Syria*, in: Mashkour, M., Beech, M. (Eds.), Archaeozoology of the Near East and adjacent areas, Al Ain, UAE.

Napierala, H., Van Neer, W., Kandel, A.W., Peters, J., Uerpmann, H.-P., Conard, N.J., in press b. *Fish in the desert? The Younger Dryas and its influence on the paleoenvironment at Baaz Rockshelter, Syria*, in: Bar-Yosef, O., Valla, F. (Eds.), 2nd Natufian Conference, Paris.

Niven, L., 2006. *The Palaeolithic Occupation of Vogelherd Cave: Implications for the Subsistence Behavior of Late Neanderthals and Early Modern Humans*, Kerns Verlag, Tübingen.

Nüesch, J., 1904. *Das Kesslerloch, eine Höhle aus paläolithischer Zeit / Neue Grabungen und Funde*, Neue Denkschriften der allgemeinen Schweizerischen Gesellschaft für die gesammten Naturwissenschaften, Zürcher & Furrer, Zürich, pp. 1-72.

Orlando, L., Metcalf, J.L., Alberdi, M.T., Telles-Antunes, M., Bonjean, D., Otte, M., Martin, F., Eisenmann, V., Mashkour, M., Morello, F., Prado, J.L., Salas-Gismondi, R., Shockey, B.J., Wrinn, P.J., Vasil'ev, S.K., Ovodov, N.D., Cherry, M.I., Hopwood, B., Male, D., Austin, J.J., Hänni, C., Cooper, A., 2009. *Revising the recent evolutionary history of equids using ancient DNA*, PNAS 106, 21754-21759.

Payne, S., 1973. *Kill-off Patterns in Sheep and Goats: The mandibles from Aşvan Kale* Anatolian Studies 23, 281-303.

Payne, S., 1983. *The Animal Bones from the 1974 Excavations at Douara Cave*, in: Hanihara, K., Akazawa, T. (Eds.), Paleolithic Site of the Douara Cave and Paleogeography of Palmyra Basin in Syria. Part III, University of Tokyo, Tokyo.

Pérez Ripoll, M., 1986. *Avance al estudio de los mamíferos de la Cueva de Nerja*, in: Jordá Pardo, J.F. (Ed.), La prehistoria de la Cueva de Nerja, Patronato de la Cueva de Nerja, Málaga, pp. 99-106.

Perkins, D., 1968. *The Pleistocene Fauna from the Yabroud Rockshelters*, Annales Archéologiques Arabes Syriennes 18, 123-130.

Perkins, D., 1973. *A critique on the methods of quantifying faunal remains*, in: Matolcsi, J. (Ed.), Domestikationsforschung und Geschichte der Haustiere, Akadémiai Kiadó, Budapest, pp. 367-369.

Peters, J., Dieckmann, U., Vogelsang, R., 2009. *Losing the spoor: Hai||om animal exploitation in the Etosha region*, in: Grupe, G., McGlynn, G., Peters, J. (Eds.), Tracking Down the Past. Ethnohistory Meets Archaeozoology, Marie Leidorf, Rahden/Westfahlen, pp. 103-186.

Peters, J., Helmer, D., den Driesch, A., Sana Segui, M., 1999. *Early Animal Husbandry in the Northern Levant*, Paléorient 25, 27-47.

Pidoplichko, I.G., 1998. *Upper Palaeolithic Dwellings of Mammoth Bones in the Ukraine. Kiev-kirillovskii, Gontsy, Dobranichevka, Mezin and Mezhirich.*

Porat, N., Schwarcz, H.P., 1991. *Use of signal subtraction methods in ESR dating of burned flint*, International Journal of Radioactivity Applied Instrumentation 18, 203-212.

Qumsiyeh, M.B., 1996. *Mammals of the Holy Land*, Texas Tech University Press, Lubbock.

Righter, E., 2002. *Background of research and sample collection at the Tutu site*, in: Righter, E. (Ed.), The Tutu Archaeological Village Site: A Multidisciplinary Case Study in Human Adaptation, Routledge Taylor & Francis Group, New York.

Rosendahl, G., Beinhauer, K.-W., Löscher, M., Krepil, K., Rosendahl, W., 2006. *Le plus vieil arc du monde? Une pièce intéressante en provenance de Mannheim, Allemagne*, l'Anthropologie 110, 371-382.

Rossel, S., Marshall, F., Peters, J., Pilgram, T., Adams, M.D., O'Connor, D., 2008. *Domestication of the donkey: Timing, processes, and indicators*, PNAS 105, 3715-3720.

Rust, A., 1950. *Die Höhlenfunde von Jabrud (Syrien*), Neumünster.

Rütimeyer, L., 1875. *Beurtheilung der Pferde der Quaternär-Epoche*, Abhandlungen der schweizerischen paläontologischen Gesellschaft, 1-34.

Saxon, E.C., 1974. *The Mobile Herding Economy of Kebarah Cave, Mt Carmel: An Economic Analysis of the Faunal Remains*, Journal of Archaeological Science 1, 27-45.

Shea, J.J., 2003. *The Middle Palaeolithic of the East Mediterranean Levant,* Journal of World Prehistory 17, 313-394.

Škrdla, P., 2003. *Comparison of Boker Tachtit and Stránská skála MP/UP transitional industries*, Journal of The Israel Prehistoric Society 33, 37-73.

Smith, R.K., Vaughan Jennings, N., Robinson, A., Harris, S., 2004. *Conservation of European hares Lepus europaeus in Britain: is increasing habitat heterogeneity in farmland the answer?*, Journal of Applied Ecology 41, 1092-1102.

Soffer, O., 1985. *The Upper Paleolithic of the Central Russian Plain,* Academic Press, San Diego.

Solecki, R.S., Solecki, R.L., 1986. *A Reappraisal of Rust's Cultural Stratigraphy of Yabroud Shelter I*, Paléorient 12, 53-59.

Speth, J.D., Tchernov, E., 2001. *Neanderthal hunting and meat-processing in the Near East. Evidence from Kebara Cave (Israel).* in: Stanford, C.B., Bunn, H.T. (Eds.), Meat-Eating and human evolution, Oxford University Press, Oxford, pp. 52-72.

Stahlschmidt, M., 2010. *Fundplatzgenese und eine prähistorische Bodenkonstruktion in Baaz*, Südwest-Syrien, Eberhard-Karls Universität, Tübingen.

Stampfli, H.R., 1983. *Rislisberghöhle / Archäologie und Ökologie einer Fundstelle aus dem Spätmagdalénien bei Oensingen im Solothurner Jura*. Band I, Paul Haupt, Bern.

Stehlin, H.G., Graziosi, P., 1935. *Ricerche sugli Asinidi fossili d'Europa*, Mémoires de la Société Paléontologique Suisse 56, 1-73.

Stiner, M.C., 2005. *The Faunas of Hayonim Cave, Israel. A 200.000-Year Record of Paleolithic Diet, Demography, and Society*, Peabody Museum of Archaeology and Ethnology, Cambridge, Massachusetts.

Stiner, M.C., Kuhn, S.L., Weiner, S., Bar-Yosef, O., 1995. *Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone*, Journal of Archaeological Science 22, 223-237.

Stiner, M.C., Munro, N.D., 2002. *Approaches to Prehistoric Diet Breadth, Demography, and Prey Ranking Systems in Time and Space*, Journal of Archaeological Method and Theory 9, 181-214.

Stiner, M.C., Munro, N.D., Surovell, T.A., 2000. *The tortoise and the hare. Small game Use, the broad-spectrum revolution, and palaeolithic demography*, Current Anthropology 41, 39-73.

Thouless, C.R., Grainger, J.G., Shobrak, M., Habibi, K., 1991. *Conservation status of gazelles in Saudi Arabia,* Biological Conservation 58, 85-98.

Turnbull, P.F., Reed, C.E., 1974. *The Fauna from the Terminal Pleistocene of Pelegawra Cave. A Zarzian Occuptaion Site in Northeastern Iraq*, FIELDIANA Anthropology 63, 81-146.

Uerpmann, H.-P., 1972. *Tierknochenfunde und Wirtschaftsarchäologie. Eine kritische Studie der Methoden der Osteo-Archäologie*, Archäologische Informationen 1, 9-27.

Uerpmann, H.-P., 1979. *Probleme der Neolithisierung des Mittelmeerraums*, Dr. Ludwig Reichert, Wiesbaden.

Uerpmann, H.-P., 1982. *Faunal remains from Shams Ed-Din Tannira, a Halafian Site in Northern Syria*, Berytus XXX, 3-52.

Uerpmann, H.-P., 1987. *The Ancient Distribution of Ungulate Mammals in the Middle East / Fauna and Archaeological Sites in Southwest Asia and Northeast Africa*, Dr. Luwig Reichert, Wiesbaden.

Uerpmann, H.-P., 2007. *Von Wildbeutern zu Ackerbauern - Die Neolithische Revolution der menschlichen Subsistenz*, Mitteilungen der Gesellschaft für Urgeschichte Blaubeuren 16, 55-74.

Uerpman, M., Uerpmann, H.-P., 2008. *Bronze and Iron Age animal economy at Didi-gora and Tqisbolo-gora (Kakhetia, Georgia),* Archäologische Mitteilungen aus Iran und Turan 40, 169-264.

Vaks, A., Bar-Matthews, M., Ayalon, A., Schilman, B., Gilmour, M., Hawkesworth, C.J., Frumkin, A., Kaufman, A., Matthews, A., 2003. *Paleoclimate reconstruction based on the timing of speleothem growth and oxygen and carbon isotope composition in a cave located in the rain shadow in Israel*, Quaternay Research 59, 182-193.

Van Neer, W., Wildekamp, R.H., Küçük, F., Ünlüsayin, M., 2008. *The 1997-1999 surveys of the Anatolian fish fauna and their relevance to the interpretation of trade at Sagalassos*, in: Degryse, P., Waelkens, M. (Eds.), Geo- and Bio-Archeology at Sagalassos and in its Territory, Leuven, pp. 299-323.

Winterhalder, B., Lu, F., Tucker, B., 1999. *Risk-Sensitive Adaptive Tactics: Models and Evidence from Subsistence Studies in Biology and Anthropology*, Journal of Archaeological Research 7, 301-348.

Winterhalder, B., 2001. *The behavioural ecology of hunter gatherers.*

Wright, W., 1895. *An Account of Palmyra and Zenobia with Travels and Adventures in Bashan and the Desert*, Thomas Nelson & Sons, New York, London and Edinburgh.

Yeshurun, R., Bar-Oz, G., Weinstein-Evron, M., 2007. *Modern hunting behavior in the early Middle Paleolithic: faunal remains from Misliya Cave, Mount Carmel, Israel*, Journal of Human Evolution 53, 656-677.

Zeder, M.A., Hesse, B., 2000. *The Initial Domestication of Goats (Capra hircus) in the Zagros Mountains 10 000 Years Ago*, Science, 2254-2257.

Acknowledgment

I owe many thanks to the TDASP teams that were involved in the many years of excavation and the Syrian General Directorate of Antiquities and Museums, namely Bassam Jamous, Michel Maqdissi, Mahmoud Hamoud and Sultan Muhesen.

My gratitude for financing the faunal analysis goes to the German Science Foundation (DFG) and to my colleagues in the DFG Project, "Ungulate domestication and early animal husbandry in the Upper Euphrates Basin" . For financial support of the publication of this work I thank the „Unibund Tübingen". Also, I particularly thank Diane Kerns from Kerns Verlag for the proofreading and the very friendly cooperation.

Most of all, I would like to express my gratitude to my advisors Hans-Peter Uerpmann, Joris Peters and Nicholas J. Conard for their constant support and confidence.