

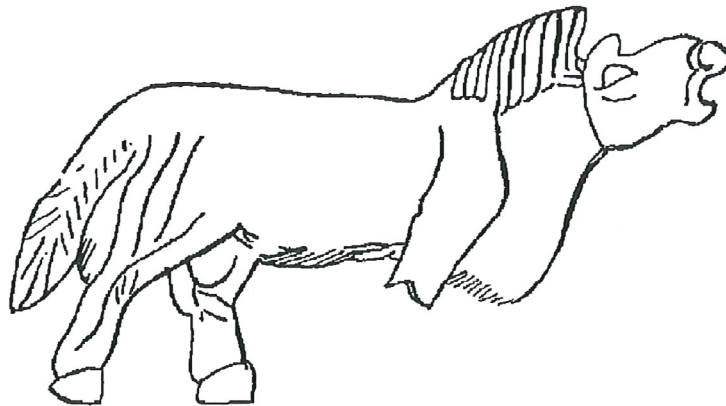


ARCHAEOZOOLOGY OF THE NEAR EAST IV A

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

edited by

M. Mashkour, A.M. Choyke, H. Buitenhuis and F. Poplin



ARC - Publicatie 32
Groningen, The Netherlands, 2000

Cover illustration:

Przewalski from Susa (nacre – mother of pearl)

Dated to 2500 – 2000 BC, identified by F. Poplin

copyright:

Centre for Archeological Research and Consultancy

Groningen Institute for Archaeology

Rijksuniversiteit Groningen The Netherlands

Printing: RCG -Groningen

Parts of this publication can be used if source is clearly stated.

Information: Centre for Archeological Research and Consultancy

Poststraat 6, 9712 ER Groningen, The Netherlands

ISBN 90 – 367 – 1243 - 2

NUGI 644 - 134

Contents

VOLUME A

Preface	A
Deborah Bakken Hunting strategies of Late Pleistocene Zarzian populations from Palegawra Cave, Iraq and Warwasi rock shelter, Iran	11
Daniella Zampetti, Lucia Caloi, S. Chilardi and M.R. Palombo Le peuplement de la Sicile pendant le Pléistocène: L'homme et les faunes	18
Sarah E. Witcher, Joel C. Janetski, and Richard H. Meadow Animal bones from Wadi Mataha (Petra Basin, Jordan): The initial analysis	39
Liora Kolska Horwitz and Eitan Tchernov Climatic change and faunal diversity in Epipalaeolithic and Early Neolithic sites from the Lower Jordan valley	49
Paul Y. Sondaar and Sandra A.E. van der Geer Mesolithic environment and animal exploitation on Cyprus and Sardinia/Corsica	67
Pierre Ducos The introduction of animals by man in Cyprus: An alternative to the Noah's Ark model	74
Jean-Denis Vigne, Isabelle Carrère, Jean-François Saliège, Alain Person, Hervé Bocherens, Jean Guilaine and François Briois Predomestic cattle, sheep, goat and pig during the late 9 th and the 8 th millennium cal. BC on Cyprus: Preliminary results of Shillourokambos (Parekklisha, Limassol)	83
Norbert Benecke Mesolithic hunters of the Crimean Mountains: The fauna from the rock shelter of Shpan'-koba	107
Hitomi Hongo and Richard H. Meadow Faunal remains from Prepottery Neolithic levels at Çayönü, Southeastern Turkey: a preliminary report focusing on pigs (<i>Sus</i> sp.)	121
Gulcin İlgezdi Zooarchaeology at Çayönü: a preliminary assessment of the red deer bones	141
Banu Oksuz Analysis of the cattle bones of the Prepottery Neolithic settlement of Çayönü	154
Nerissa Russell and Louise Martin Neolithic Çatalhöyük: preliminary zooarchaeological results from the renewed excavations	163
Alice M. Choyke Bronze Age bone and antler manufacturing at Arslantepe (Anatolia)	170
Ofer Bar-Yosef The context of animal domestication in Southwestern Asia	184
Cornelia Becker Bone and species distribution in late PPNB Basta (Jordan) - Rethinking the anthropogenic factor	195
Justin Lev-Tov Late prehistoric faunal remains from new excavations at Tel Ali (Northern Israel)	207
Daniella E. Bar-Yosef Mayer The economic importance of molluscs in the Levant	217
Daniel Helmer Les gazelles de la Shamiyya du nord et de la Djézireh, du Natoufien récent au PPNB: Implications environnementales	227
Maria Saña Seguí Animal resource management and the process of animal domestication at Tell Halula (Euphrates Valley-Sria) from 8800 bp to 7800 bp	241

Contents

VOLUME B

Chiara Cavallo, Peter M.M.G. Akkermans and Hans Koens	5
Hunting with bow and arrow at Tell Sabi Abyad	
Caroline Grigson	12
The secondary products revolution? Changes in animal management from the fourth to the fifth millennium, at Arjoune, Syria	
Barbara Wilkens	29
Faunal remains from Tell Afis (Syria)	
Margarethe Uerpmann and Hans-Peter Uerpmann	40
Faunal remains of Al-Buhais 18: an Aceramic Neolithic site in the Emirate of Sharjah (SE-Arabia) - excavations 1995-1998	
Angela von den Driesch and Henriette Manhart	50
Fish bones from Al Markh, Bahrain	
Mark Beech	68
Preliminary report on the faunal remains from an 'Ubaid settlement on Dalma Island, United Arab Emirates	
Jean Desse and Nathalie Desse-Berset	79
Julfar (Ras al Khaimah, Emirats Arabes Unis), ville portuaire du golfe arabo-persique (VIII ^e -XVII ^e siècles): exploitation des mammifères et des poissons	
Chris Mosseri-Marlio	94
Sea turtle and dolphin remains from Ra's al-Hadd, Oman	
Hervé Bocherens, Daniel Billiou, Vincent Charpentier and Marjan Mashkour	104
Palaeoenvironmental and archaeological implications of bone and tooth isotopic biogeochemistry (¹³ C ¹⁵ N) in southwestern Asia	
Sándor Bökönyi † and László Bartosiewicz	116
A review of animal remains from Shahr-i Sokhta (Eastern Iran)	
Ann Forsten	153
A note on the equid from Anau, Turkestan, " <i>Equus caballus pumpellii</i> " Duerst	
Alex K. Kasparov	156
Zoomorphological statuettes from Eneolithic layers at Ilgynly-depe and Altyn depe in South Turkmeniya	
László Bartosiewicz	164
Cattle offering from the temple of Montuhotep, Sankhkara (Thebes, Egypt)	
Louis Chaix	177
A hyksos horse from Tell Heboua (Sinaï, Egypt)	
Liliane Karali	187
Evolution actuelle de l'archéozoologie en Grèce dans le Néolithique et l'Age du Bronze	
Emmanuelle Vila	197
Bone remains from sacrificial places: the temples of Athena Alea at Tegea and of Asea on Agios Elias (The Peloponnese, Greece)	
Wim Van Neer, Ruud Wildekamp, Marc Waelkens, Allan Arndt and Filip Volckaert	206
Fish as indicators of trade relationships in Roman times: the example of Sagalassos, Turkey	
Ingrid Beuls, Bea De Cupere, Paul Van Mele, Marleen Vermoere, Marc Waelkens	216
Present-day traditional ovicaprine herding as a reconstructional aid for understanding herding at Roman Sagalassos	

Address List ASWA

LATE PREHISTORIC FAUNAL REMAINS FROM NEW EXCAVATIONS AT TEL ALI (NORTHERN ISRAEL)

Justin Lev-Tov¹

Abstract

Renewed excavations by Yosef Garfinkel (1989-1990) at the Neolithic and Chalcolithic site of Tel Ali in Israel have presented the opportunity to provide clearer data concerning the site's prehistoric economy. The original excavations by Prausnitz (1955-1959) left a very confused stratigraphic picture of the site, as the excavated strata contained rather mixed assemblages of pottery and flint tool types. Because the diagnostic artifacts were mixed, Jarman's 1974 report on the fauna is also problematic. The new areas excavated by Garfinkel produced three small but important faunal assemblages, dating to the PPNC, pre-Ghassulian Chalcolithic, and Ghassulian Chalcolithic. This faunal assemblage, when examined for evidence of dairying (a common hypothesis for the Chalcolithic) do not show such an industry. The faunal assemblage does show the usual trend across time, with wild species becoming less important from the Neolithic to the Chalcolithic. Finally, when the site's fauna are compared with that from contemporary sites in other areas of Israel, a north-south cline can be detected in terms of the importance of pigs and cattle.

Résumé

De nouvelles fouilles par Yosef Garfinkel (1989-1990) sur le site Néolithique et Chalcolithique de Tel Ali en Israël ont offert l'occasion d'une meilleure compréhension de l'économie du site. La fouille initiale par Prausnitz (1955-1959) a laissé une impression très vague de la stratigraphie du site du fait que les couches fouillées contenaient des types d'assemblages céramiques et d'industries lithiques plutôt mélangés. En raison du mélange de l'artefact diagnostique, le rapport de Jarman (1974) est aussi problématique. Les nouvelles aires fouillées par Garfinkel ont fourni trois petits mais non moins importants assemblages fauniques, datant du Néolithique précéramique C (PPNC), du Chalcolithique pré-Ghassulien et du Chalcolithique Ghassulien. Ces restes ont été étudiés dans l'objectif de mettre en évidence l'exploitation des produits laitiers (une hypothèse communément admise pour le Chalcolithique), mais ne révèlent pas cette pratique. Sur le plan diachronique, l'étude de faune montre la tendance la plus commune d'une diminution des espèces sauvages du Néolithique au Chalcolithique. Enfin, comparé aux assemblages d'autres sites contemporains de l'Israël, un gradient nord-sud semble se manifester quant à l'importance relative du porc et du bœuf.

Key Words: Chalcolithic, Northern Jordan Valley, Secondary Products, Regional Animal Economies

Mots Clés: Chalcolithique, La Vallée nord du Jourdain, Produits secondaires, Économies animales régionales

Introduction

Tel Ali is a small mound located approximately 1.5 km south of the Sea of Galilee, at the confluence of the Nahal Yavni'el and the Jordan River. Two separate excavation campaigns, the first by Prausnitz in the mid-to-late 1950's (Prausnitz 1970; Sussman 1990), and the second by Garfinkel from 1989 to 1990 have been carried out there (Garfinkel 1989-90; 1993:55). The excavations by Prausnitz were extensive but never fully published: there exist several brief communiqués concerning his excavations (cf. Prausnitz 1955, 1957, 1959, 1960), an extensive analysis of the lithic material (Prausnitz 1970:84-144), as well as a report on the animal bones (Jarman 1974). These excavations revealed a nearly continuous occupation sequence of the tel from the PPNB through the Ghassulian Chalcolithic. Nevertheless, the stratigraphy reported by him is problematic, since recent re-analyses of the pottery and flint tool assemblages for each stratum found them to be rather mixed (Garfinkel

¹ Adjunct Associate Professor, Department of Anthropology, 250 South Stadium Hall, University of Tennessee, Knoxville, Tennessee 37996-0720, U.S.A.

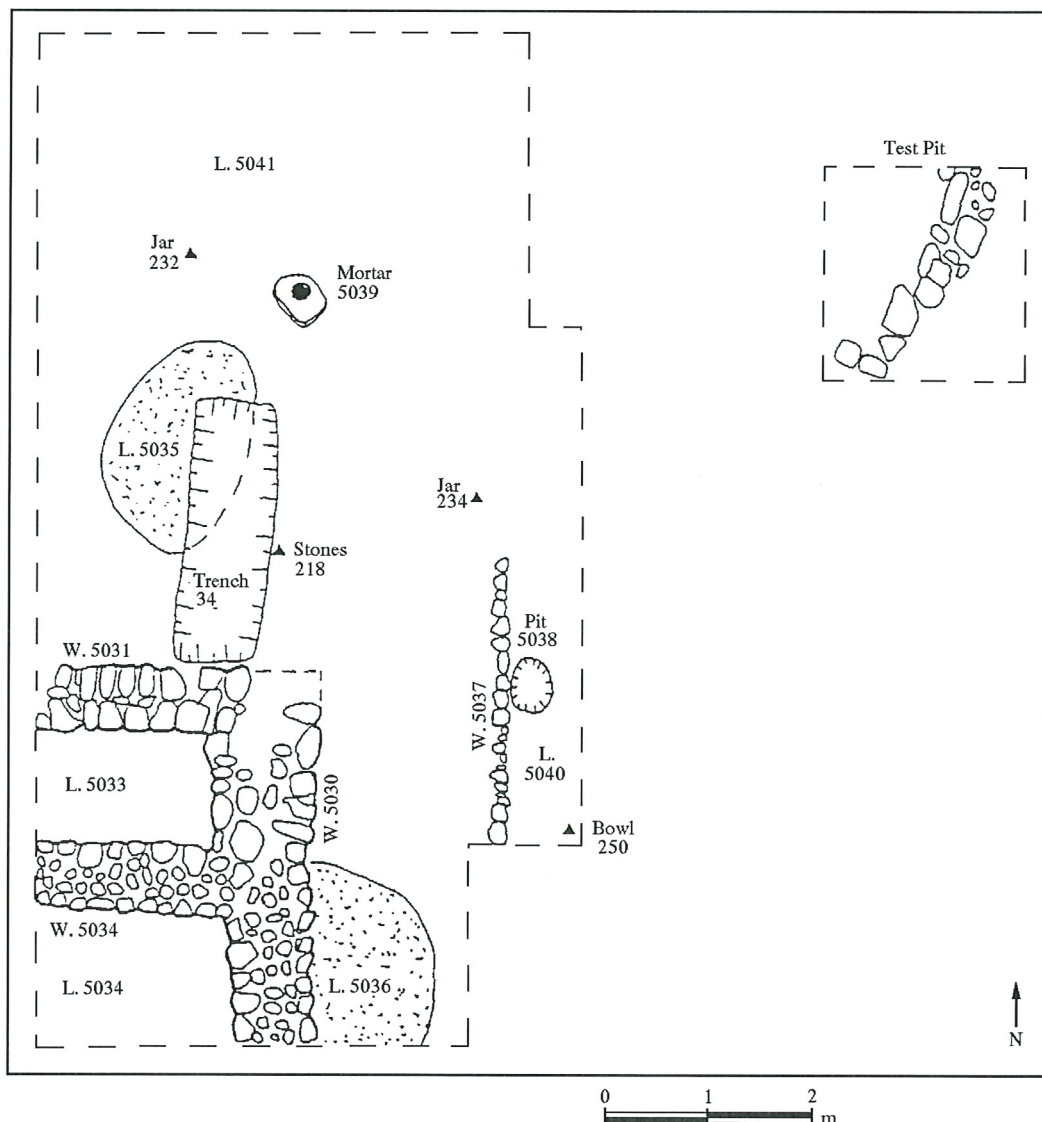


Fig. 1. Excavation area D, stratum 1b at Tel Ali (after Garfinkel 1992)

1993). Because Prausnitz never published the pottery, his stratigraphic assessments cannot be fully verified or reinterpreted. The new excavations of Garfinkel in 1989 and 1990 attempted to clarify the site's stratigraphy (Garfinkel 1993:53-55).

Analyses and results

The new excavations uncovered an area of 300 square meters in two excavation fields. Several of the occupation periods reported from the original campaign some 40 years ago were discovered in Garfinkel's recent campaigns (Table 1). The two areas, labeled D and E, were located on different parts of the tell, (see Figs. 1 and 2), and revealed three strata, belonging to the PPNC, pre-Ghassulian Chalcolithic, and Ghassulian Chalcolithic. The occupation sequence revealed by the new excavations' sequence does not, unlike Prausnitz' investigations, contain a Pottery Neolithic stratum. Oddly, the pottery attributed to that phase by Prausnitz differs completely from that of Sha'ar HaGolan, an important Pottery Neolithic site not far away (Garfinkel 1993:54). Prausnitz's excavation results do report the existence of a Wadi Rabah phase, assigned by modern archaeologists to either the final Neo-

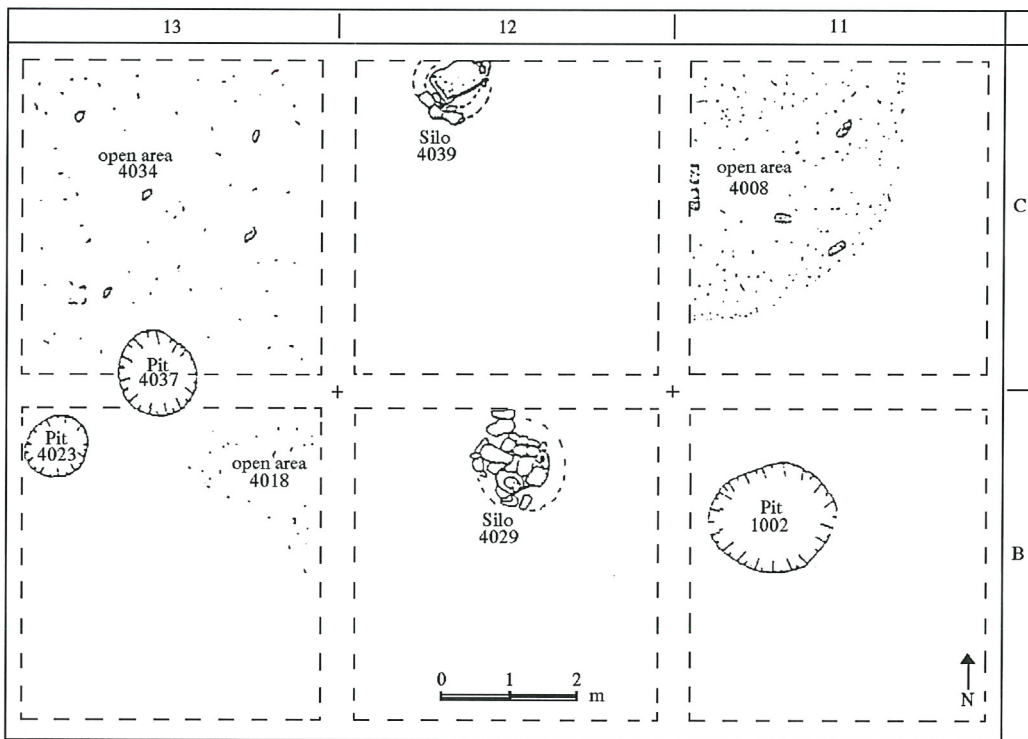


Fig. 2. Excavation area E, stratum 1b at Tel Ali (after Garfinkel 1992).

lithic or early Chalcolithic. The PPNC stratum was found only in area D, while the Ghassulian Chalcolithic stratum was only present in area E. Only the pre-Ghassulian Chalcolithic stratum was present in both places. Despite the fact that the two excavation areas shared the latter stratum, their architectural remains were quite different. Area D seems to have been an outdoor working and storage area: its only architectural features were several pits and some lined silos. In contrast, excavations in area E2 revealed the foundations of a carefully built, rectangular residence with two rooms and a basalt-paved courtyard (Garfinkel 1993). Similarly, a portion of Prausnitz's excavations (area B: Prausnitz 1970:100-104) revealed both rectangular structures and an unpaved courtyard containing pits and silos. The most likely explanation for the sets of architectural features is that the new excavations happened upon, in two distinct areas, what the original excavations stumbled upon in one: a house adjacent to an open working space.

The excavation of areas D1 and E2, with their apparent functional differences, provided the opportunity to briefly look at intrasite patterning in species distribution (Fig. 3). The most striking differences are apparent in the distribution of cattle and pigs. Cattle bones were much more common within the solidly built, rectangular structures of area E2, and relatively rare in the pits and silos of area D1. The spatial patterning of pig bones appears opposite to that of cattle; most of these were found outside the residential structure of E2, in the open working/storage area labelled D1. Just what these differences in deposition are due to, it is hard to know. At Middle Bronze Tel-el Hayyat in Jordan, a

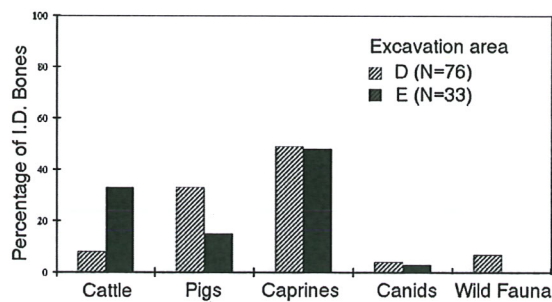


Fig. 3 Spatial distribution of species in stratum 1b

At Middle Bronze Tel-el Hayyat in Jordan, a

Table 1. The stratigraphy of Tel Ali (after Garfinkel 1993, and personal communications)

Stratum	Garfinkel's Excavation Areas	Cultural Phase	Absolute dates
1A*	E1	Ghassulian Chalcolithic	4900 – 3600
1B*	D1, E2	Pre-Ghassulian Chalcolithic	5500 – 4900
1C		Wadi Rabah	5800 – 5500
2*	D2	PPNC	7000 – 6400
3		PPNB	
4A		PPNB	8800 - 7000
4B		PPNB	

* indicates these strata are present in garfinkel's excavations, all others were reported only by Prausnitz

similar pattern was identified; sheep and goats dominated faunal assemblages from the temple precinct, but pigs were quite rare in that same area. Outside the temple, in domestic areas, all domestic species were present in similar numbers (Magness-Gardiner and Falconer 1994). Nothing in the other categories of artefacts recovered from Tel Ali suggested that area E2 was cultic in nature. Instead, the differences are probably due to different handling of the species' carcasses; the pits in area D, abundant in pig bones, could have been used for smoking or otherwise preserving the pork. Beef may have been consumed fresh and thus cattle bones were discarded near the houses rather than in the open area. All bones identified from wild animals, few though they were, came from the courtyard area D. The differences observed in cattle and pig bone distribution might be a product of activity area differences: food preparation versus consumption areas.

Analysis of species abundance over time (Fig. 4) demonstrated that the relative importance of the various domestic animals changed very little over time. With the exception of the Pottery Neolithic faunal assemblage (data from Jarman 1974), the diet of Tel Ali remained almost unchanged over a period of several hundred years. The Pottery Neolithic data is, however, quite divergent from the other periods present. According to that data, pigs accounted for about 50% of the identifiable bones, such that sheep and goats did not dominate the diet to the extent they did in other periods. Still, because of the problems associated with Prausnitz's excavations, all the data – including the bones – derived from that effort is questionable. Rather than derive interesting but shaky conclusions from Jarman's data, it is probably safer to ignore them and rely on the faunal pattern that preceded and followed the Pottery Neolithic bone assemblage. Given what has been written – mainly based on data from Negev Chalcolithic sites – about the rise in importance of secondary products (e.g., Levy 1983; Grigson 1995a:410, 1995b:257) in the Chalcolithic, one might have hypothesized that sheep and goats, and perhaps cattle as well, would have become more important in the diet relative to pigs. But that is not the case at Tel Ali: Even leaving aside the Pottery Neolithic data, it is clear that the dietary contributions of bovids remained nearly the same from the PPNC through the Ghassulian Chalcolithic.

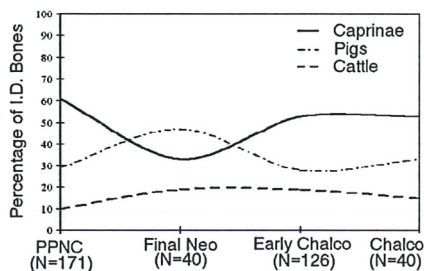


Fig. 4. Tel Ali: domestic mammal use over time

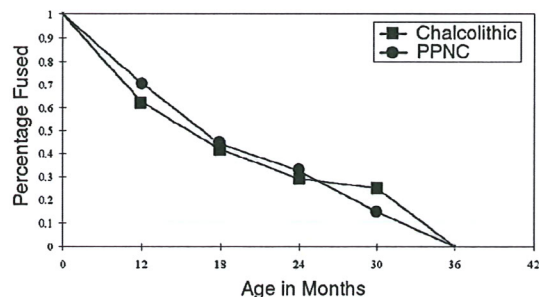


Fig. 5. Caprine mortality profile for Tel Ali

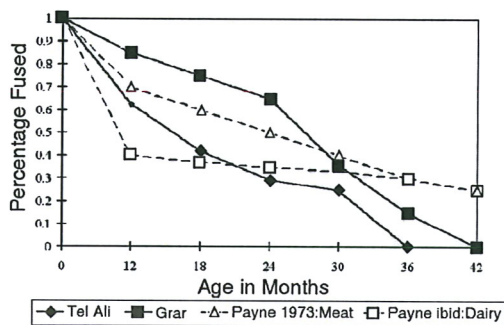


Fig. 6. Chalcolithic mortality profiles from Grar and Tel Ali

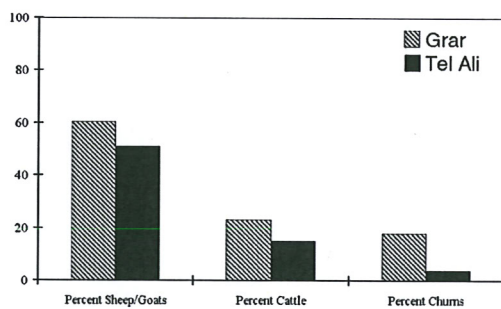


Fig. 7. Pastoral strategies in the Negev vs. Northern Jordan Valley

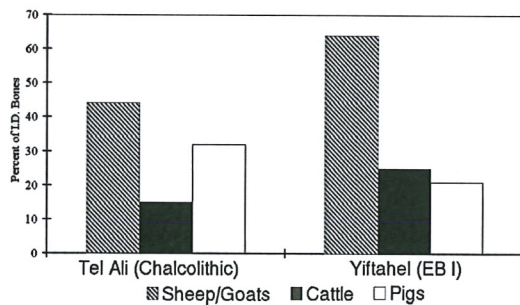


Fig. 8. Chalcolithic to EB transition in Galilee.

Mortality evidence from Tel Ali, based on long bone fusion estimates, indicates that the economy was primarily oriented toward meat, and that this strategy did not change between the PPNC and the Chalcolithic (Fig. 5). The kill-off patterns resemble Payne's (1973) mortality profile for a meat-oriented strategy, since young animals are not killed in numbers as high as would be expected for a dairy-based economy. What emerges from the latter graph is that Tel Ali's inhabitants seem not to have had a particular interest in dairy exploitation, an economic divergence from contemporary sites in the Negev desert. In that region, evidence for increased reliance on older animals has been interpreted as a by-product of dairying (Grigson 1988, 1995b: 257).

When one compares mortality profiles based on the percentage of fused long bones from both Grar (Fig. 6), a northern Negev Chalcolithic site, and Tel Ali, they appear somewhat different – at Grar, a larger portion of the flock was kept alive longer, resembling Payne's (1973) mortality profiles for secondary product-based economies (Grigson 1995a:390), while Tel Ali's seems closer to the classic meat economy. The differences in the herding economies between northern and southern Israel in the Chalcolithic are further demarcated by deviations in emphasis on domestic artiodactyls (Fig. 7). Grar had somewhat higher percentages of sheep, goats, and cattle in the faunal assemblages than did Tel Ali (Grigson 1995b). The latter result may be a consequence of the fact that, in the Jordan Valley, unlike the Negev, it was feasible to hunt or raise pigs in addition to herding sheep, goats, and cattle. A greater difference between the areas can be seen in the ceramic evidence, since churns at Tel Ali accounted for only 4 percent of the pottery assemblage, whereas they accounted for nearly 20 percent at Grar (Gilead and Goren 1995). Most archaeologists working in the Chalcolithic agree that

the function of the vessels was related to dairy product manufacturing, producing butter and various forms of yogurt. The vessels are elongated with loop handles on either end, and the larger specimens appear to have had rope designs painted onto them (Amiran 1969:33-34). The idea that this vessel was used as a churn is based on an ethnographic analogy with the goatskin churns used by Bedouin living in Israel and Jordan today, owing to a general similarity in shape. Churning in goatskins is done by filling the skins with milk and affixing it by ropes to a branch or tripod and swinging it back and forth (cf. London and Clark 1997:34). The general idea behind this interpretation is that ceramic vessels – still a relatively new technology at the time – were being manufactured to replace analogous containers made of leather or other materials (Kaplan 1954). Churns are generally common in the Chalcolithic sites of the Negev region. That a northern site like Tel Ali would not have many churns is not entirely surprising – the usual pattern is that southern sites have many and northern sites few. If the function of the so-called churns was truly related to dairy production, then there might have been some striking economic differences between the two areas. That said, it is important to note that these

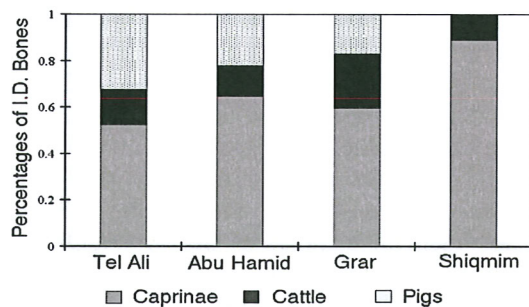


Fig. 9. North-South variation in Chalcolithic diets

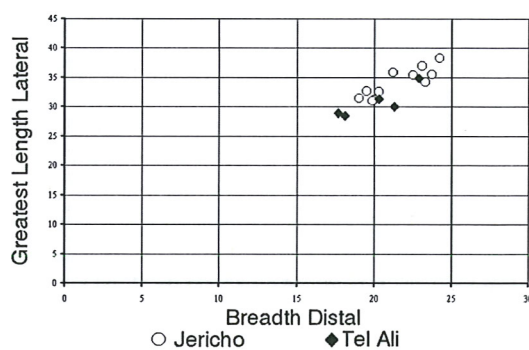


Fig. 10. PPNC Tel Ali vs. PPNB Jericho goat astragali

differences may also point to the disparity in the location of excavated Levantine Chalcolithic sites: by far most have been in the Negev desert and in the southern part of Jordan (Gonen 1992).

Perhaps, rather than in the Chalcolithic, it was not until the urban Early Bronze Age that secondary products became important. A comparison between the fauna from Tel Ali and Yiftahel, a large EB1 site in the Lower Galilee region some 35 km from Tel Ali (Braun 1997) suggests this later timing. The comparison between the two sites (Fig. 8) demonstrates that by the EB1 there was a significantly greater economic emphasis on sheep, goats, and cattle and a concomitant decrease in the abundance of pigs (Horwitz 1997). This hypothesis agrees with Smith and Horwitz's (1991) radiographic data, which suggest that the reduction in 'combined cortical thickness' – seen most strongly in EB period sheep bones – was due to a newly developed dairy economy in that era rather than previous to it. Along with this tendency between the Chalcolithic and Early Bronze periods de-emphasizing pigs, there is a general trend at Tel Ali and many other sites for the remains of wild fauna to decline in importance over time.

In general, Chalcolithic sites in the southern part of Israel have a greater proportion of caprines and cattle in the assemblages than do northern sites, perhaps reflecting interaction with nomadic pastoralists like the Bedouin of today (Levy 1983). Still, the principal economic difference, as others have pointed out (e.g. Hesse 1990), is the decline in pigs as one travels from north to south (Grigson 1995b: 251). The decline is apparent when faunal samples from several Chalcolithic sites in Israel and Jordan are compared from the northernmost – Tel Ali – to the southernmost – Shiqmim (Fig. 9).

The Ghassulian Chalcolithic data from Tel Ali suggest that the Galilee area of the southern Levant differed in economic orientation from the Negev. Perhaps the greater availability of wild game and the possibility of raising pigs in the marshy environment of the Jordan Valley allowed the people to have a more settled village existence, different from the transhumance patterns that characterized the northern Negev (Levy 1992). A more broad-based farming economy, less involved in nomadic pastoralism, may have placed less emphasis on dairy products. That would explain not only the differences in herd management between north and south, but also some of the differences visible in the pottery assemblages of the two regions.

Finally, there is the matter of the PPNC stratum at Tel Ali. The relative abundance of species present in the PPNC was reported on previously, so what is left is the issue of the domesticated or wild status of the animals in this period. Five measurable goat astragali were recovered from the PPNC stratum, whose measurements (Greatest Length Lateral and Breadth Distal) were plotted along with several data from Jericho (Fig. 10). The bones from both sites aggregate together into either two or three separate groups, depending on how tightly one defines the clusters. L. Horwitz (personal communication), who provided the Jericho measurements used in the comparison, believes that the PPNB goats at Jericho were wild. Therefore the astragali from Tel Ali must also be from wild goats (or at least all but the smallest two), given that they largely group together with those from Jericho. If the people of Tel Ali were hunting wild goats in the PPNC period, then just how much of their meat came from hunted, rather than domestic animals? The question is difficult to answer because the bone sample from the site produced only a small number of measurable elements (see Appendix I for a list of all measured specimens) from a relatively small assemblage (see Appendix II for a list of all species identified). A rough estimate of population dependence on wild fauna over the various occupation

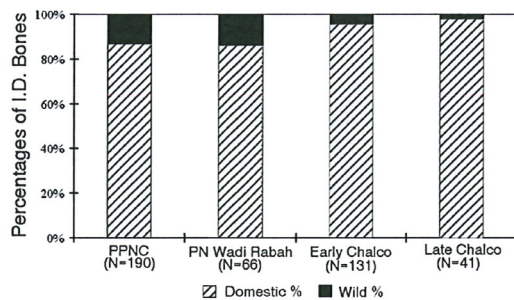


Fig. 11. Relative importance of domestic vs. wild fauna

eras is presented in Fig. 11, based on the number of identified elements both from species never domesticated (e.g., gazelle) and, in the case of the PPNC, from wild goats. What is apparent from the comparison is that, during the Neolithic (both PPNC and PN periods) people hunted wild animals more often than in the subsequent Chalcolithic period.

Conclusions

The faunal sample from Garfinkel's renewed excavations at Tel Ali is small but significant. The assemblage adds a body of faunal data from a well-stratified site to our limited database of late prehistoric subsistence strategies in the Galilee area of the southern Levant. Tel Ali's faunal assemblage, among other things, demonstrates a logical interest among the inhabitants in either hunting or raising pigs in the relatively lush environment of the northern Jordan Valley. The general lack of change in diet over time provokes questions concerning the timing and geographic origin of the 'secondary products revolution' (Sherratt 1981). Some archaeologists (e.g. Levy 1983) have proposed that this economic shift took place at once, either in the Chalcolithic or in the Early Bronze in more or less the entire Levant. Evidence is beginning to emerge now from mortality profiles – which show no sudden shift to secondary products either in the Galilee or the Negev (Grigson 1995b) – that the shift was neither rapid nor uniform. More likely, the emergence of full-fledged secondary products industries, rather than household activities, only came about with the emergence of the early urban era and marketing opportunities in the Early Bronze Age, an idea supported to an extent by the faunal data from Yiftahel (Horwitz 1997).

References

- Amiran, R., 1969. *Ancient pottery of the Holy Land: From its beginnings in the Neolithic period to the end of the Iron Age*. Jerusalem-Ramat Gan: Massada Press Ltd.
- Braun, E., 1997. The Setting. In: E. Braun. (ed.), *Yiftah'el: Salvage and Rescue Operations at a Prehistoric Village in Lower Galilee, Israel*, Jerusalem, Israel Antiquities Authority: 1-4
- Desse, J., 1988. Animaux Sauvages...Animaux Domestiques. In: *Abu Hamid: Village du 4e millénaire de la vallée du Jourdain*. Amman, Centre Culturel Français et Département des Antiquités de Jordanie: 20-21
- von den Driesch, A., 1976. *The measurement of animal bones from archaeological sites*. Peabody Museum Bulletin 1, Peabody Museum of Archaeology and Ethnology, Harvard University.
- Garfinkel, Y., 1993. 'Ali, Tel. In: E. Stern, A. Lewinson-Gilboa, and J. Aviram (eds.), *The new encyclopedia of archaeological excavations in the Holy Land*, Jerusalem: The Israel Exploration Society: 53-55
- Garfinkel, Y., 1992. *The material culture in the Central Jordan Valley in the Pottery Neolithic and early Chalcolithic periods*. Unpublished Ph.D. Thesis. Jerusalem, Hebrew University. (in Hebrew)
- Gilead, I. and Y. Goren, 1995. Pottery assemblages from Garar. In: I. Gilead (ed.), *Garar: A Chalcolithic site in the Northern Negev*. Beersheva, Ben-Gurion University of the Negev Press: 137-222.
- Gonen, R., 1992. The Chalcolithic period. In: A. Ben-Tor (ed.), *The archaeology of ancient Israel*, Yale University Press, New Haven and London: 40-80.
- Grigson, C., 1995a. Plough and pasture in the early economy of the Southern Levant. In: T.E. Levy (ed.), *The archaeology of society in the Holy Land*. London, Leicester University Press: 245-268
- Grigson, C., 1995b. Cattle keepers of the Northern Negev: Animal remains from the Chalcolithic Site of Garar. In: Isaac Gilead. (ed.), *Garar: A Chalcolithic site in the Northern Negev*, Beersheva: Ben-

- Gurion University of the Negev Press. 377-452.
- Grigson, C., 1988. Different herding strategies for sheep and goats in the Chalcolithic of Beersheva. *Archaeozoologia* 1(2): 115-125.
- Grigson, C., 1987. Shiqmim: Pastoralism and other aspects of animal management in the Chalcolithic of the Northern Negev. In: T.E. Levy (ed.), *Shiqmim I: Studies Concerning Chalcolithic Societies in the Northern Negev Desert, Israel (1982-1984)*. Oxford, BAR International Series 356: 219-242
- Hesse, B., 1990. Pig lovers and pig haters: Patterns of palestinian pork production. *Journal of Ethnobiology* 10(2): 195-225.
- Horwitz, L., 1997 Faunal remains. In: E. Braun (ed.), *Yiftah'el: Salvage and rescue operations at a prehistoric village in Lower Galilee, Israel*. Jerusalem, Israel Antiquities Authority:155-171
- Jarman, M.R., 1974. The fauna and economy of Tel 'Eli. *Mitekufat Haeven* 12: 50-70.
- Kaplan, J., 1954. Two Chalcolithic Vessels from Palestine. *Palestine Exploration Quaterly*, 97-100.
- Levy, T.E., 1983. The emergence of specialized pastoralism in the Southern Levant. *World Archaeology* 15(1): 15-36.
- London, G.A. and D.R. Clark, (eds.), 1997. *Ancient Ammonites and Modern Arabs: 5000 Years in the Madaba Plains of Jordan*. Amman, Jordan: American Center of Oriental Research.
- Magness-Gardiner, B., and S.E. Falconer, 1994. Community, polity, and temple in a Middle Bronze Age Levantine village. *Journal of Mediterranean Archaeology* 7(2): 127-164.
- Payne, S., 1973. Kill-off patterns in sheep and goats: The mandibles from Asvan Kale. *Anatolian Studies* 23: 281-303.
- Prausnitz, M., 1955. Tel Eli. *Israel Exploration Journal* 5: 271.
- Prausnitz, M., 1957. Tel Eli. *Israel Exploration Journal* 7: 263-264.
- Prausnitz, M., 1959. Tel Eli. *Israel Exploration Journal* 9: 166-174.
- Prausnitz, M., 1960. Tel Eli. *Israel Exploration Journal* 10: 119-120.
- Prausnitz, M., 1970. *From Hunter to Farmer and Trader*. Jerusalem: Sivan.
- Sherratt, A. 1981. Plough and pastoralism: Aspects of the secondary products revolution. In: I. Hodder, G. Isaac, and N. Hammond (eds.), *Patterns of the past: Studies in honour of David Clarke*. Cambridge: Cambridge University Press: 261-305.
- Smith, P. and L. Horwitz, 1991. A case study in diachronic change in bone mass of sheep and goats from Jericho (Tell-es Sultan). *Archaeozoologia* 4(1): 29-38.
- Sussman, V. 1990. Sheikh Ali 1959. The section in area C. *Mitekufat Haeven* 23: 113-140.

Appendix I. List of all measured bones from Tel Ali

Stratum	Accession #	Taxon	Element	Measurements*
Ia	11	Pig	astragalus	GLI 43.3; Bd 21.6
Ia	9	Sheep	tibia	Bd 22.5; Dd 18.1
Ib	150	Cow	astragalus	GLI 59.9; Bd 40.3
Ib	122	Cow	phalange 3	MBS 23.8; Ld 53.9
Ib	130	Goat	calcaneus	GL 64.5; Hmal 24.6
Ib	123	Goat	radius	Bp 25.3; GH 15.5
Ib	123	Goat	radius	Bp 25.3; GH 15.5
Ib	106	Sheep/Goat	astragalus	GLI 32.2; Bd 20.2
Ib	106	Sheep/Goat	astragalus	GLI 32.2; Bd 20.2
Ib	55	Sheep/Goat	calcaneus	Hmal 23.4
Ib	85	Sheep/Goat	humerus	Bd 34.0; GtHt 20.7
II	229	Goat	astragalus	GLI 30.0; Bd 21.3
II	284	Goat	astragalus	GLI 34.9; Bd 22.9
II	355	Goat	astragalus	GLI 31.4; Bd 20.3
II	356	Goat	astragalus	GLI 28.5; Bd 18.1
II	366	Goat	astragalus	GLI 28.9; Bd 17.7
II	178	Goat	calcaneus	Hmal 22.7
II	228	Goat	humerus	Bd 24.1; GtHt 16.9; MDp 22.0
II	253	Goat	phalange 3	MBS 5.0; Ld 22.0
II	240	Goat	tibia	Bd 24.5; Dd 18.5
II	268	Pig	astragalus	GLI 36.6
II	199	Pig	astragalus	GLI 39.6; Bd 23.2
II	302	Pig	astragalus	GLI 39.0; Bd 21.1
II	222	Pig	calcaneus	Hmal 32.1
II	223	Pig	calcaneus	Hmal 29.1
II	194	Pig	phalange 3	MBS 13.3; Ld 32.8
II	247	Sheep	astragalus	GLI 32.5; Bd 20.3
II	298	Sheep	radius	Bp 25.6; GH 13.4
II	204	Sheep/Goat	astragalus	GLI 26.6; Bd 18.5
II	190	Sheep/Goat	radius	Bp 38.9; GH 20.8

* All measurements follow von den Driesch (1976), except the following:

Dd = the distal depth of the tibia, taken on the medial side.

Hmal = the greatest height of the malleolar process of the calcaneus.

GH = the greatest height of the proximal end of the radius, taken on the medial side.

GtHt = the greatest height of the distal condyle of the humerus, taken on the medial side.

MDp = the greatest medial depth of the distal humerus, from the condyle to the posterior portion

Appendix II. List of species identified from each stratum at Tel Ali, with percentages based on the new excavations. [Numbers in brackets indicate the total number of bones identified, per species, from both the new and old excavations (Jarman 1974) at the site.]

Ghassulian Chalcolithic Stratum Ia		
Taxon	Number of Identified Specimens	Percentage (Percent of Identifiable Bones)
<i>Ovis aries</i> (domestic sheep)	2	12 (44)
<i>Capra hircus</i> (domestic goat)	1	1 (02)
<i>Ovis/Capra</i> (sheep or goat)	18	1 (05)
<i>Bos taurus</i> (domestic cattle)	6 [8]	4 (15)
<i>Sus scrofa</i> (domestic pig)	13 [14]	9 (32)
<i>Homo sapiens</i> (human)	1	1 (02)
unidentifiable mammal, large	15	10
unidentifiable mammal, medium	95	62
unidentifiable mammal, size indeterminate	1	1
unidentifiable bird, large	1	1
Total	153	

Pre-Ghassulian Chalcolithic Stratum Ib		
Taxon	Number of Identified Specimens	Percentage (Percent of Identifiable Bones)
<i>Ovis aries</i> (domestic sheep)	4	3 (03)
<i>Capra hircus</i> (domestic goat)	3	2 (02)
<i>Ovis/Capra</i> (sheep or goat)	60 [91]	41 (44)
<i>Bos taurus</i> (domestic cattle)	24 [39]	16 (18)
<i>Sus scrofa</i> (domestic pig)	35 [75]	24 (26)
<i>Gazella gazella</i> (mountain gazelle)	1 [8]	1 (01)
<i>Dama dama</i> (fallow deer)	1 [2]	1 (01)
<i>Lepus</i> sp. (hare)	2	1 (02)
<i>Homo sapiens</i> (human)	6	4 (04)
Rodentia (rodent)	1	1 (01)
unidentifiable mammal, large	1	1
unidentifiable mammal, medium	7	5
unidentifiable bird, size indeterminate	1	1
Total	146	

Pre-Pottery Neolithic C Stratum II		
Taxon	Number of Identified Specimens	Percentage (Percent of Identifiable Bones)
<i>Ovis aries</i> (domestic sheep)	8	2 (04)
<i>Capra hircus</i> (domestic goat)	12	2 (06)
<i>Ovis/Capra</i> (sheep or goat)	85 [97]	16 (43)
<i>Bos taurus</i> (domestic cattle)	17 [24]	3 (09)
<i>Sus scrofa</i> (domestic pig)	49 [60]	9 (25)
<i>Gazella gazella</i> (mountain gazelle)	6 [10]	1 (03)
<i>Dama dama</i> (fallow deer)	1 [2]	.2 (01)
<i>Lepus</i> sp. (hare)	1	.2 (01)
<i>Canis</i> sp. (dog, wolf, or jackal)	4	.7 (02)
<i>Vulpes</i> sp. (fox)	1	.2 (01)
<i>Homo sapiens</i> (human)	9	2 (05)
<i>Talpa talpa</i> (mole)	1	.2 (01)
Rodentia (rodent)	1	.2 (01)
Testudinata (turtles/terrapins)	1	.2 (01)
unidentifiable mammal, large	44	8
unidentifiable mammal, medium	279	52
unidentifiable mammal, size indeterminate	13	2
unidentifiable bird	3	1
unidentifiable fish	2	.3
unidentifiable specimens	3	1
Total	540	