Food, Economy, and Culture at Tel Dor, Israel: A Diachronic Study of Faunal Remains from 15 Centuries of Occupation

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This paper presents the results of a study of the cultural and economic changes from a longue durée *perspective as reflected in the animal remains from a nearly continuous occupation spanning the early Iron Age through the Roman period at Tel Dor, a harbor town on Israel's Carmel coast. Such long-term zooarchaeological analyses are currently rare. Focusing on the choice of food, as well as on animal exploitation methods/strategies, the paper asks whether changes through time can be explained in economic or cultural terms, whether they can be correlated with changes in the site's material culture, whether they reflect some change in the site's population, or should be explained in terms of the adoption of new cultural norms. The results demonstrate that during a millennium and a half of Dor's existence, there was very little change in most patterns of animal exploitation and consumption. The only apparent change was in the increase in pig remains between the early Iron Age and the Hellenistic and Roman periods. In view of the constancy in all other exploitation characteristics, and in light of other data from Dor, the paper suggests that this change does not reflect a change in the site's population but rather the adoption of new norms.*

Introduction

The study of animal remains and their implications for elucidating diachronic changes of long duration in a single site may provide us with important insights regarding economic and cultural changes. Preconditions for such a study are adequate faunal assemblages from a single central site, from well-defined contexts, representing continuous habitation, excavated thoroughly and sampled systematically. In the southern Levant, studies of animal remains from the periods discussed here (Iron Age through Roman period; see below) are being conducted in an ever-accelerating pace and indeed have provided us with valuable knowledge regarding the economies of these periods and occasionally also of specific cultural affinities. However, most zooarchaeological studies focus on a specific period (e.g., recently, Iron Age: Lev-Tov 2000; Maher 2005; Raban-Gerstal et al. 2008; Marom et al. 2009; Persian period: Sade 2006; Hellenistic period: Cope 2006; Roman period: Bar-Oz et al. 2007). Thus, to

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date, discussions of possible long-term changes in faunal assemblages and their economic and cultural implications have per force been extremely limited. Several studies of the fauna of multilayered sites in Israel have been published, representing continuous occupations of these tells (e.g., recently Lachish in the Shephelah [Early Bronze Age through the Hellenistic period: Croft 2004] and Beth Shean in the Jordan Valley [Late Bronze Age through the Muslim period: Horwitz 2006], in addition to one site in Jordan, Hesban [Bronze Age to Byzantine period: LaBianca and von den Driesch 1995]) and discussing aspects of the animal economy. Although the animal economy as reflected in the faunal remains is the focus of these studies, the discussion of cultural implications of the economic changes in a diachronic perspective is relatively limited. Our study stands out in that it deals with these cultural implications, based on a wealth of faunal remains, derived from good contexts, which were collected systematically and studied with a unified research protocol.

The composition of livestock and the ways of exploiting it (see below) and the site food and food system sequence may also serve as a cultural indicator and may shed light on social aspects (see Gumerman 1997; Mintz and Du Bois 2002; Pearson 2003; Twiss 2007; 2012 and references therein). Apart from the immediate caloric value, the choice of what to eat may have symbolic and political-economic meanings and may even play a role in social construction of memory (Montanari 2006; see review in Mintz and Du Bois 2002; Twiss 2012). Our choice of food as well as the way we consume it have an important role in building individual and group identity (Pearson 2003). According to Mauss (1979: 97–123), differences among individuals and among societies will come into expression in "body techniques." These "body techniques" are exemplified, for example, in the ways people prepare food, cook, and eat; hence, such a model expects that the body techniques of immigrants or new inhabitants may differ from local ones (see also Dietler 1996 and Bray 2003 for the reflection of these aspects in the "culinary equipment," namely, the type of vessels). In terms of the zooarchaeological finds, differences in habits are expected not only in the choice of what to eat but also in the method of preparation for consumption (see below; also Nyerges 2004; Stein 2012). Therefore, we paid special attention to understanding the cultural decisions of a site's inhabitants regarding the choice of what to eat and how animals are exploited. The exploitation of animals can be inferred from a combination of several factors—for example, in the methods of processing and cooking the animals in preparation for consumption, by the location of butchery marks, the way body parts are fragmented, and the choice of which body parts to consume (Wapnish and Hesse 1988; Crabtree 1990; Zeder 1991; Lev-Tov 2003; O'Day, Van Neer, and Ervynck 2004; Twiss 2007; deFrance 2009).

We studied the faunal remains from the long sequence of habitation at Tel Dor, a port town on Israel's Carmel coast, spanning the early Iron Age to the Late Roman period, with one possible occupational gap (see below). During this time span, the world around Dor underwent fundamental changes, and Dor itself saw major transformations in its urban composition, the function of the settlement, its political affiliation, foreign domination, international relationships and, in certain periods, possibly also in the composition of its inhabitants (see recent summaries in Gilboa and Sharon [2008] for the Iron Age; Nitschke, Martin, and Shalev [2011] for the Persian to Roman period).[1] This (nearly) continuous occupation at Dor and the wealth of its faunal remains, coupled with modern systematic excavation and collection methods (see below), make Dor one of the best-studied tells in the Levant and hence an ideal locus for this type of study. It presents a unique opportunity to examine cultural and economic changes from a long-term perspective, as gleaned through the prism of animal bones.

It should be acknowledged at the outset that, in most cases, bones are derived from secondary contexts and cannot be used to identify functions of specific buildings and other activity areas (this situation is typical of stratified tells; Dor's specific case is demonstrated and discussed in Sapir-Hen et al. 2012). In addition, since the bones originate from several close-by subareas in one part of the tell (see below), there is very little chance that they will reveal possible patterns of intrasite variability. We return to this issue in our discussion.

A Brief Summary of the Tel Dor Excavations and Sequence

Tel Dor was first excavated in 1923–1924 by J. Garstang on behalf of the British School of Archaeology in Jerusalem. Most of the extant information regarding the mound (including zooarchaeological studies) derives, however, from two long and systematic excavation sessions: from 1980 to 2000, led by E. Stern of the Hebrew University, and from 2003 on, directed by A. Gilboa and I. Sharon. Although the town was established in the first half of the second millennium B.C.E., the earliest depos-

[1] A full bibliography of over 400 items is available at http://dor.huji.ac.il/bibliography.html, including annual interim reports for the relevant excavation seasons at http://dor.huji.ac.il/reports.html.

its excavated systematically (to a very limited extent and only in Area G in the center of the mound) date to the end of the Late Bronze (LB IIB), the 13th century B.C.E.

In the early Iron Age, a new town was established, which rapidly spread to occupy the entire extent of the tell—about 8 ha. From its inception, it was densely built and fortified. The *early* Iron Age sequence has been divided into four main chronological horizons—Ir1a (terminating in a site-wide destruction), Ir1b, the Ir1|2 transition, and Ir2a (Gilboa and Sharon 2003; with further subdivisions that do not concern us here). This sequence roughly spans the late 12th to the mid-9th centuries B.C.E. (depending on one's stance in the debate regarding the absolute chronology of the Iron Age in Israel—an issue we do not address here). Regarding the early Iron Age, there is a fundamental disagreement between Stern and the current excavators of the site. Stern (e.g., 1990; 2012) divides this period into three distinct cultural episodes: Ir1a, which he claims represents the "Sea People" town (the *SKL* of the Egyptian records); Ir1b, after the destruction of the town, which he defines as a Phoenician town, embodying a forceful takeover of people from Lebanon and a change in population; and Ir1|2–Ir2a—an Israelite administrative center. In contrast, Gilboa and Sharon view the entire Ir1a–Ir2a sequence as one cultural continuum (Gilboa 2005; Gilboa and Sharon 2008; Sharon and Gilboa 2013), gradually evolving from Late Bronze Age cultural antecedents. This scenario implies that the *SKL* of the Egyptian sources and what modern scholarship would define as "early Phoenicians" are practically synonymous. These differences of opinion notwithstanding, there is a general agreement that Dor's material culture during the early Iron Age attests to some population of Cypriot pedigree at the site (and possibly also from Syria; see Gilboa 2006–2007). During this entire time span, Dor is typified by extensive interregional bidirectional contacts, especially with Cyprus and Egypt but also with Philistia and other Phoenician sites.

At a certain late point within Ir2a, during the ninth century B.C.E., Dor undergoes a radical change in almost every respect—layout, architecture, interregional associations (or rather—the cessation thereof), and the regional affiliation of ceramic production. Most plausibly, all these concurrent changes should be associated with its transformation into an Israelite administrative center. Subsequently, in the second half of the eighth century B.C.E., this center is abandoned and its architecture made obsolete by numerous pits cut through it. Ceramically, these two later stages cannot be told apart, and both are defined as Ir2b. Over the pits, in the late eighth or early seventh century B.C.E., a new administrative center was constructed, serving the Neo-Assyrian administration (Ir2c).[2]

Following a partial or complete abandonment of the site after the Assyrian withdrawal around the mid-seventh century B.C.E. and through the sixth century, the site is reoccupied sometime around 480–450 B.C.E. Both the primary Phoenician sources (e.g., the Eshmunazar sarcophagus inscription) and Greek historians and geographers (e.g., "Pseudo-Scylax") agree that Dor is a Phoenician town at this phase (again), and a Phoenician affiliation is also borne out by Dor's material culture. Despite frequent political changes—conquest by Alexander the Great (332 B.C.E.), Ptolemaic Egyptian (until ca. 200 B.C.E.) and then Seleucid-Syrian control, wars with the Jewish Hasmonaean kingdom (136 B.C.E. and again in 104 B.C.E.), annexation by the Romans (63 B.C.E.), incorporation in Herod's kingdom (probably 30 B.C.E.), and finally, apparently after the Jewish revolt of 70 C.E., inclusion into the Roman province of Syria—the population of the town stayed essentially the same (but see more on this below). Throughout these periods, Dor resumed its commercial and maritime role, serving as a major interface between East and West. The population shows both local continuity and adoption of foreign (mainly Greek) goods and artistic styles as of the Persian period, and also of architecture of Greek (and later Roman) traditions as of the Hellenistic period (Nitschke, Martin, and Shalev 2011). Exactly from which point in time these phenomena merit a "Hellenization" epithet is a matter of debate (and definition) (Martin 2007). Disagreement also exists as to what extent the Greek traits can be attributed to foreign, mainly Greek, individuals residing at Dor (Nitschke, Martin, and Shalev 2011: 139; contra Stern 2000: 152–53).

Previous Analyses of Tel Dor Fauna

A wealth of zooarchaeological finds were revealed at Tel Dor. Raban-Gerstel et al. (2008) and Bartosiewicz and Lisk (in press) focused on a small Late Bronze faunal assemblage from Area G and a larger early Iron Age

[2] A priori, we must state the limitations posed by the nature and size of our database. For the Iron Age, most of the bones originate from the "Phoenician sequence" (Ir1a to Ir2a). No bones are related to the "Israelite center episode," and thus this important transformation cannot be investigated from the zooarchaeological point of view. Also, because of the relatively restricted size of the assemblages of the Ir2b pits dug through the Israelite center and the Ir2c contexts of the Neo-Assyrian period, these were lumped together, thus obfuscating another major occupational/cultural change. Therefore, possible small changes or breaks within the Iron Age can only minimally be gauged, and mostly longer-term changes within this period and between it and the later periods can be investigated.

sequence of assemblages from Areas G and D2. Both studies found independently that the Late Bronze/early Iron Age economy at Dor was based on livestock management, supplemented by exploiting the littoral environment for fish, with a very limited reliance on hunting wild (terrestrial) fauna. Below we refer to these studies when relevant, but the results cannot be directly (i.e., quantitatively) compared with those presented here, since retrieval methods of bones in the past were different from those implemented for this study (regarding which see further below).

Sapir-Hen et al. (2012) concentrated on contextual, depositional, and taphonomic aspects of the assemblages discussed in the current paper. We showed that the investigation of primary vs. secondary deposits may contribute significantly to our understanding of the site. While (rare) primary deposits represent specific, distinct activities, the secondary deposits, which constitute the majority of deposits excavated at Dor, represent the "main characteristics" of the site in terms of exploited species and their manner of exploitation. Thus, while we suggested that lumping zooarchaeological data into a single "assemblage" per period causes major loss of functional/systemic data, it does provide us with much information regarding the broader picture of what was eaten and how it was eaten, and also regarding the immediate environment of the site (Sapir-Hen et al. 2012: 598).

Scope and Goals of the Present Study

This study considers remains of mammals only. The main aspects investigated are herd management and exploitation patterns of livestock animals, methods of preparing the meat for consumption, and skeletal frequency and fragmentation of the bones. In view of Dor's lengthy cultural sequence, we asked: Are there any faunal changes at all? If changes occur in the range of exploited animals or in the ways they were exploited, can they be explained in economic or cultural terms? Can they be correlated with changes in the site's material culture, interregional associations, etc.? Might they reflect some change in the site's inhabitants, or should they be explained in terms of the adoption of new cultural norms? As mentioned above, this is one of the first studies in the southern Levant to examine such a long zooarchaeological sequence from all these aspects.

Methods

Our study focuses on the material excavated from 2005 to 2009 in four subareas of Area D on the southern edge of the tell, overlooking Dor's south bay (Areas D1, D2, D4, D5; **Fig. 1**). Remains spanning the beginning of the Iron Age to the Roman period were excavated in this area during the years of this study. All retrieved animal bone remains were analyzed. A meticulous sampling strategy method was employed, including a systematic sieving protocol (sieving samples from all types of depositional units using a 1 mm mesh) carried out in close cooperation with the different aspects of the archaeological excavation.

The assemblage was divided into six general periods: Iron Age I (Ir1 in Dor terminology); transitional Iron I/II (Ir1|2 in Dor terminology); Iron Age II (Ir2); and the Persian, Hellenistic, and Roman periods. Identified elements were coded according to their stratigraphic location and contextual deposition as defined by the excavators in the field. Assigning the remains to periods was based on stratigraphy and "pottery readings" of the specific loci in question. Loci with mixed-period pottery were not analyzed. Skeletal element portions (following Stiner 2002; 2004) were identified to the lowest possible taxonomic unit and recorded using Dobney and Rielly's (1988) diagnostic zones. Quantifying the elements and species was achieved using standard techniques: number of identified specimens (NISP) and minimum number of individuals (MNI) (Grayson 1984; Klein and Cruz-Uribe 1984; Dobney and Rielly 1988; Lyman 2008).

Bone remains were identified to bone element and species using the comparative collections of the Steinhardt National Natural History Museum and Research Center, Tel Aviv University, and of the National Natural History Collections at the Hebrew University of Jerusalem. Separation of sheep (*Ovis aries*) from goat (*Capra hircus*) was based on morphological criteria of selected bones (following Zeder and Lapham 2010). Sheep and goat skeletal elements that could not be identified to species were combined into a single sheep/goat category.

Mortality profiles of the caprines and cattle were reconstructed in order to study herd management, since different age profiles suggest different exploitation aims (Payne 1973; Helmer and Vigne 2004). This was based on the recording of the epiphyseal closure stage of different bone elements (Zeder 2006 for caprines; Silver 1969 for cattle). Dental age was not calculated, owing to the very small sample of ageable teeth. We note, however, that long-bone fusion rates are just as accurate as dental eruption and wear rates (Zeder 2006). The status of pig remains (domesticated or wild) was determined based on measurements of the mandibular M3 tooth: the domesticated pig is significantly smaller than its wild form (Payne and Bull 1988; Haber and Dayan 2004; Albarella, Dobney, and Rowley-Conwy 2006; Albarella et al. 2006).

The method of preparing meat for consumption was studied by recording the location and frequency of butchery marks, divided into three main carcass prepara-

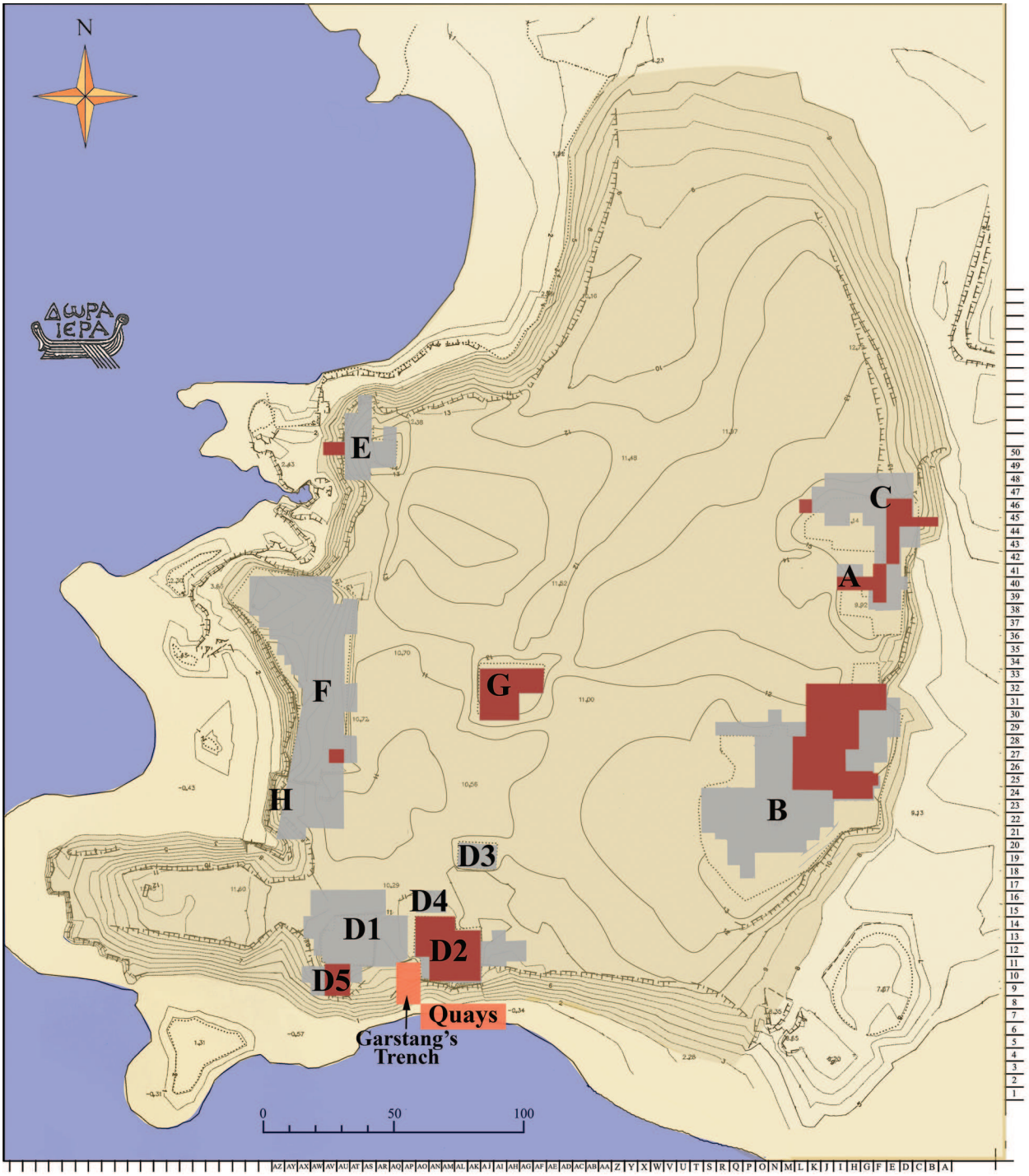

Fig. 1. Tel Dor excavated areas.

tion stages—skinning, dismembering, and filleting—using the typology in Binford (1981).

Both skeletal frequency and bone fragmentation were estimated in order to examine changes in those factors between periods. Choice of certain skeletal elements may reflect the status of the site's inhabitants (Zeder 1991) or different exploitation, and the manner of the fragmentation of bones can also attest to the exploitation method (though it is also correlated to various taphonomic factors affecting preservation; see Lyman 1994). The estimation

of bone fragmentation and representation was based on % Minimum Animal Units (%MAU; Lyman 2008).

Results

General

We identified ca. 20,000 bones (for the full list, see Sapir-Hen et al. 2012), of which 6,500 were (macro) mammal bones; these constitute the basis for the current study. A wealth of fish and smaller numbers of reptiles, birds, and rodents constitute the rest of the fauna, but they are not discussed here. Bone preservation is good and constant in all the studied periods (Sapir-Hen et al. 2012), enabling a meaningful diachronic comparison.

A list of identified macrofauna from all periods is provided in **Table 1**. Of the macrofauna, most dominant in all periods were livestock: sheep (*Ovis aries*) and goat (*Capra hircus*), followed by cattle (*Bos taurus*). Although the frequency of cattle is always lower than the frequency of caprines (**Fig. 2**), it rises gradually during the Iron Age and decreases again in the Persian period. Pig (*Sus scrofa*) is almost absent from the Iron Age and Persian-period contexts, but it becomes an important part of the economy in later periods: in the Hellenistic period, its frequency rises dramatically to 18% of the livestock and reaches 25% in the Roman period. Examining the Persian–Roman periods, it seems that while the relative frequency of cattle stays constant, pig gradually replaces the decreasing frequencies of caprines as a source of meat (**Fig. 2**).

Pack animals, found in low frequencies, are the horse/donkey (which could not be identified to species and hence are referred to as *Equus* sp.)—found in all periods—and the camel (*Camelus dromedarius*), which occurs only in the Hellenistic/Roman periods.

Livestock are dominant over wild fauna in all periods and constitute 96%–98% of eaten ungulates. The relative ratio of livestock to wild ungulates does not change appreciably between periods ($\chi^2 = 24.20$, df = 5, p = 0.02). Wild game, such as gazelle (*Gazella gazella*), red deer (*Cervus elaphus*), and fallow deer (*Dama mesopotamica*), are found in all periods; the majority are hunted as adults (only scarce bones are unfused). Fallow deer and red deer are found in woodland habitats, while gazelle inhabit open landscapes and shrublands. In addition, a single bone (distal femur, adult) of wild aurochs (*Bos primigenius*) was found in the Ir2 assemblage and a single bone (distal humerus, adult) of hippopotamus (*Hippopotamus amphibius*) in the Ir1. Hippopotamus remains, found also by Raban-Gerstel et al. (2008), represent the marshy surroundings of the site during the Iron Age (for the occurrence of wild aurochs and hippopotamus during these periods in the southern Levant, see Tsahar et al. 2009).

Predators include the dog (*Canis* sp.) in large numbers, in addition to several remains of red fox (*Vulpes vulpes*) and one bone (1st phalanx) of a lion (*Panthera leo*) from the Persian period. The dogs were found mainly in Persian-period contexts, mostly in articulation in burials (see preliminary data by Sapir-Hen in Nitschke, Martin, and Shalev [2011: 138]).

Caprines and Cattle Exploitation

About 20% of the caprine bones could be identified to species—sheep or goat (**Table 2**)—while the rest were lumped into a single group. The relative frequency of goats is lower than that of sheep in all examined periods, except for the Persian period, where goats are more common than sheep. However, this difference is not significant ($\chi^2 = 6.88$, df = 5, p = 0.22), and the relative frequency is constant throughout the periods studied.

Age structure was analyzed for the main domesticates based on epiphyseal fusion (**Table 3**). Due to the limitations of identification, we lumped goats and sheep into a single group, as is common in Levantine site studies; studying them separately minimizes the sample size significantly. We are aware that this may introduce a certain bias, since the exploitation of sheep and goat may be different (Smith and Horwitz 1984). In the Ir1 caprine herd, 37% were slaughtered before they reached the age of 2.5 years. In Ir1/2, this frequency decreases and stays rather low in the following periods, in the range between 21% and 27%, suggesting that animals were slaughtered at an older age. The frequency of young cattle under the age of 2 is constantly low in all periods, suggesting they were kept to an older age as well (**Table 3b**).

Similarly, the method of preparing animals for consumption as reflected in the butchery marks reveals no major diachronic changes. In all periods, all stages of preparing the animal for consumption are in evidence (**Table 4**). Moreover, the skeletal frequency of the caprines and cattle is similar in all periods, and all body parts are represented (**Fig. 3**).

Pig

The pig status (wild or domesticated) could not be determined for the Iron Age and Persian period due to the scarcity of finds. Mandibular M3 teeth from the Hellenistic period (n = 6) and Roman period (n = 9) were measured and compared with those of modern wild pigs (measurement from Haber [2001]), revealing a significant difference between the teeth from Dor and those of wild boars (Kruskal-Wallis, H = 14.66, p <0.001) (**Fig. 4**;

Table 1. NISP and MNI of Macromammal Remains from Tel Dor

Species/size class	*Common name*	*Ir1*		*Ir1/2*		*Ir2*	
		NISP	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**
Bos taurus	Cattle	118	3	178	5	271	5
Ovis/Capra	Caprines	408	10	308	12	338	9
Ovis aries	Sheep	69		38		50	
Capra hircus	Goat	52		35		37	
Sus scrofa	Pig	1	1	1	1	12	1
Equus sp.	Horse/donkey	2	2	1	1	2	1
Cervus/Dama	Deer	1		3		3	
Cervus elaphus	Red deer	1	1	8	1	2	2
Dama mesopotamica	Fallow deer	2	1	6	1	3	1
Gazella gazella	Mountain gazelle	2	1	5	2	4	1
Bos primigenius	Wild auroch					1	1
Large ungulate		24		21		36	
Medium ungulate		7		12		31	
Small ungulate						3	
Canis lupus	Dog	5	1	2	1	12	2
Vulpes vulpes	Red fox	1	1				
Vormela peregusna	Marbled polecat	49	1				
Crocidura sp.	Shrew	3	1				
Hippopotamus amphibius	Hippopotamus			1			
Small mammal		1				2	
Small predator		4					
Total		750		619		807	

Species/size class	*Common name*	*Persian*		*Hellenistic*		*Roman*	
		NISP	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**
Bos taurus	Cattle	162	4	561	10	239	5
Ovis/Capra	Caprines	304	13	828	25	381	13
Ovis aries	Sheep	46		120		49	
Capra hircus	Goat	60		91		36	
Sus scrofa	Pig	9	2	349	11	240	6
Camelus dormedarius	Camel			10	1	1	1
Equus sp.	Horse/donkey	36	6	153	3	53	2
Cervus/Dama	Deer	8		15		15	
Cervus elaphus	Red deer	1	1	1	1	3	2
Dama mesopotamica	Fallow deer	4	1	6	1	5	1
Gazella gazella	Mountain gazelle	10	1	72	3	18	1
Large ungulate		28		50		29	
Medium ungulate		7		11		12	
Small ungulate						5	
Canis lupus	Dog	692	18	143	6	22	2
Vulpes vulpes	Red fox	4	1	13	1	6	1
Vulpes/Canis		4					
Panthera leo	Lion	1	1				
Vormela peregusna	Marbled polecat	2	1	10	1	4	1
Crocidura sp.	Shrew	5	2	1	1		
Lepus capensis	Hare			1	1		
Small mammal		5		2			
Small predator		17		16		3	
Total		1405		2453		1121	

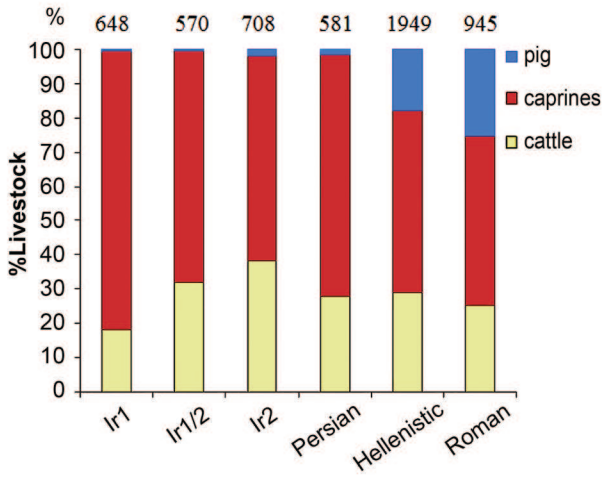

Fig. 2. Relative frequencies of the main livestock.

measurements of Dor's pigs are in **Table 5**). However, while all the teeth from the Hellenistic period are significantly smaller than the wild form ($p < 0.001$), suggesting they should be identified as originating from a domestic pig, the situation in the Roman period is less straightforward. Seven teeth in Roman contexts appear smaller (i.e., they originate from a domestic pig), and two are as large as wild boar teeth (**Fig. 4**), revealing no significant difference ($p = 0.18$). This suggests that the Roman-period inhabitants may have hunted wild boar in addition to raising domesticated pig (although large domestic pigs might overlap with wild boar in terms of molar size; Evin et al. 2013). The pigs' skeletal element frequency is constant in the Hellenistic and Roman periods (**Fig. 5**), with the majority of finds being upper forelimbs, which are meat rich, suggesting they were exploited in a similar manner (the frequency of head parts is skewed by the large numbers of isolated teeth).

Discussion

The most striking finding of our study is that during a millennium and a half of Dor's inhabitation, there is very little change in most patterns of animal exploitation and consumption, despite the major changes in the site's urban matrix over this long time span and the economic and political regimes within which it operated.

The most common animals in all periods are domesticated livestock, and therefore they are at the focus of our discussion. Since the negligible presence of wild game does not indicate a change in the site's surrounding environment, livestock animal use patterns are discussed from the cultural rather than the environmental perspective.

Table 2. Sheep/Goat Frequencies

Period	*Capra hircus*	*Ovis aries*
Ir1	52 (43%)	69 (57%)
Ir1/2	35 (48%)	38 (52%)
Ir2	37 (42.5%)	50 (57.5%)
Persian	60 (56%)	46 (44%)
Hellenistic	91 (43%)	120 (57%)
Roman	36 (42%)	49 (58%)

Sheep, goat, and cattle dominate the livestock assemblage in all periods, supplemented by a very few remains of pack animals. Indeed, the dominance of these livestock animals along with the few pack animals is the basis for all economies in the southern Levant since the Bronze Age (e.g., Hesse 1990; Tchernov and Horwitz 1990; Grigson 1995; Hesse and Wapnish 1998). The finds from all the periods considered at Dor are also in accord with those of several other sites from northern Israel in that they display a dominance of caprines over cattle (e.g., Iron Age: Wapnish and Hesse 1991; Horwitz 2000; Horwitz et al. 2005; Marom et al. 2009; Persian period: Hellwing and Feig 1989; Sapir-Hen, Wolff, and Bar-Oz in press; Hellenistic/Roman periods: Redding 1994; Sade 1999).

During all periods at Dor, the relative ratio of sheep vs. goat remains constant. Their age profiles suggest that in all periods they were exploited for their meat as well as for secondary products, since their age at slaughter fits the models of wool production (Payne 1973) and of milk production (type B milk; Helmer and Vigne 2004) as the main aims (although in Ir1 more animals were slaughtered younger than in later stages of the Iron Age and the Persian–Roman periods). Both these factors, sheep/goat ratios and age profiles, differ among sites in the region throughout the Iron Age (Sapir-Hen, Gadot, and Finkelstein in press). The more intensive use of caprines for secondary products after the Ir1 is in accord with the increase in relative frequency of cattle in those periods, and later with the introduction of pig into the economy in the Hellenistic period, thereby suggesting that the availability of other meat sources (pig and cattle) may have facilitated a shift in caprine exploitation from meat to secondary products (although cattle is also used for traction).

The scarcity of pig remains in the Iron Age is in accord with earlier studies of the Iron Age at Dor. Raban-Gerstel et al. (2008) found that pig (mostly wild boar) frequency in the early Iron Age was around 1%, in marked contrast to its very high frequency in contemporaneous Philistine sites (Raban-Gerstel et al. 2008: 50). This pattern is repeated in Bartosiewicz and Lisk's (in press) study of both the Late Bronze and early Iron Ages in Area G.

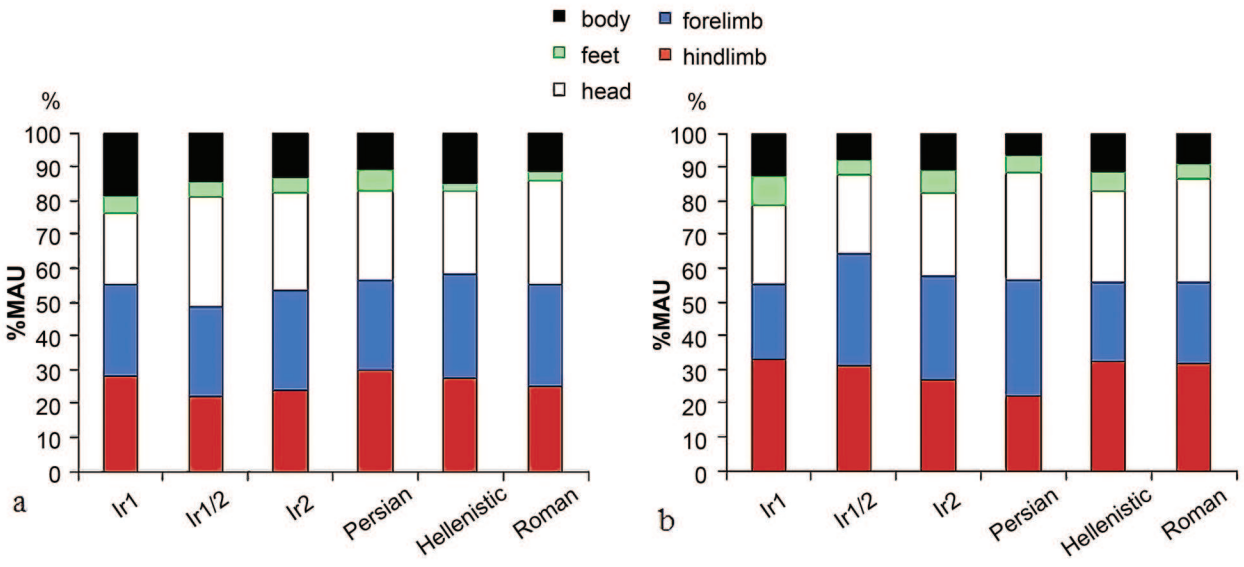

Fig. 3. Body parts frequency of the main livestock: (a) caprines; (b) cattle.

The taphonomic factors, some of which were previously discussed in terms of bone preservation and site formation processes (Sapir-Hen et al. 2012), also have implications for economic issues. The lack of correlation between the frequency of skeletal elements and their economic value (results in Sapir-Hen et al. 2012: table 3) implies that there was no intentional selection of high-calorie meat parts, suggesting on-site slaughter rather than import (see more on this below). Skeletal element frequency stayed constant; similarly, cut marks that represent all stages of preparing the animal for consumption were evident in all periods, and they do not differ qualitatively among periods. The fragmentation patterns of caprine long bones are also constant through time (results in Sapir-Hen et al. 2012: fig. 1).

Zeder (1991: 42–44) formulated a model to discern between different degrees of economic specialization in a site—such as a site being productive and consumptive or only consumptive—by focusing on specific variables that reflect human decisions: the range of species and their relative frequency, mortality profiles (age and sex ratios), and body-part distribution of the dominant animals. While Zeder states that these measures cannot always be used to predict the degrees of economic specialization, they are useful in monitoring changing patterns of animal production through time (Zeder 1991: 245–48). Hence, those measures could reflect the consistency (or lack of it) in site function. Studying these criteria, a consistency in site function (in the aspects investigated herein) is apparent (see **Table 6**). It seems that in all periods, the economy at Dor fits the model of a productive-consumptive site as suggested by Zeder (see Raban-Gerstel et al. 2008 for similar conclusions regarding the early Iron Age). The people at Tel Dor raised their own food throughout the periods we investigated, and did so in a similar manner. For the Iron Age, this conclusion gains support from geoarchaeological studies, which demonstrated, using phytolith and spherulite analysis, that livestock were frequently kept, probably penned, on the tell (Shahack-Gross et al. 2005; Albert et al. 2008). In periods later than the Iron Age, however, we might not have expected that the inhabitants of Dor would keep on producing their own food, considering the process of urbanism that is thought to have occurred there in those periods. Indeed, in large parts of the Old World, the periods following the Iron Age are usually thought to be typified *inter alia* by a more accentuated dichotomy between (food-producing) "villages" and "urban centers" (with other specializations and functions) (see discussion in Albert et al. 2008). At Dor, after the Iron Age, the rich deposits of phytoliths and spherulites discussed in the above-mentioned papers vanish, a fact that was considered to support such a dichotomy in the "late" periods. The patterns of animal exploitation that have emerged in the present investigation indicate that this assessment should be qualified. As mentioned, currently very few studies offer long-term faunal sequences that can be compared with ours. One such study site is Hesban, a major tell located on the Jordanian plateau—in a totally different environment (in proximity to the Arabian Desert). Hesban displays continuous habitation from the Bronze Age to the Byzantine period, and changes in animal economy over this

Table 3a. Aging of Caprines, Based on Bone Fusion Stage (following Zeder 2006)

		Iron I			*Iron I/II*			*Iron II*			*Persian*			*Hellenistic*			*Roman*		
Stage (age)	*Element*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*
A (0–6 mos.)	Proximal radius	14	2		11	2		15	1		9	2		39	1		12	3	
	Total	**14**	**2**	**13%**	**11**	**2**	**15%**	**15**	**1**	**6%**	**9**	**2**	**18%**	**39**	**1**	**3%**	**12**	**3**	**20%**
B (6–12 mos.)	Distal scapula	8	2		13	2		11	3		9	2		32	7		15	2	
	Distal humerus	15	6		17	1		15	3		10	5		32	6		21	4	
	Total	**23**	**8**	**26%**	**30**	**3**	**9%**	**26**	**6**	**19%**	**19**	**7**	**27%**	**64**	**13**	**17%**	**36**	**6**	**14%**
C (12–18 mos.)	Phalanx 1	24	12		19	5		22	7		24	7		48	7		12	6	
	Phalanx 2	16	8		14	1		10	1		16	5		12	5		7	4	
	Total	**40**	**20**	**33%**	**33**	**6**	**15%**	**32**	**8**	**20%**	**40**	**12**	**23%**	**60**	**12**	**17%**	**19**	**10**	**34%**
D (18–30 mos.)	Distal tibia	7	10		7	2		10	1		18	4		37	12		20	1	
	Distal metapod	23	11		11	6		7	9		11	9		39	13		9	5	
	Total	**30**	**21**	**41%**	**18**	**8**	**31%**	**17**	**10**	**37%**	**29**	**13**	**31%**	**76**	**25**	**25%**	**29**	**6**	**17%**
E (30–48 mos.)	Proximal ulna	1	2		0	2		4	5		3	1		7	7		1	1	
	Proximal femur	6	7		5	6		5	1		2	4		11	12		4	2	
	Distal radius	6	6		5	2		4	4		5	0		14	5		4	2	
	Distal femur	8	4		4	5		5	4		1	2		17	13		5	1	
	Proximal tibia	6	5		4	1		2	2		1	0		14	9		8	3	
	Calcaneum	24	5		2	4		3	6		7	5		17	8		6	3	
	Total	**51**	**29**	**36%**	**20**	**20**	**50%**	**23**	**22**	**49%**	**19**	**12**	**39%**	**80**	**54**	**40%**	**28**	**12**	**30%**
F (>48 mos.)	Proximal humerus	1	2		2	2		1	1		0	0		5	2		1	1	
	Total	**1**	**2**	**67%**	**2**	**2**	**50%**	**1**	**1**	**50%**	**0**	**0**	**0**	**5**	**2**	**29%**	**1**	**1**	**50%**

Table 3b. Aging of Cattle, Based on Bone Fusion Stage (following Silver 1969)

		Iron I			*Iron I/II*			*Iron II*			*Persian*			*Hellenistic*			*Roman*		
Age	*Element*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*	*Fused*	*Unfused*	*%UF*
Before birth	Proximal metapod	3	0		14	0		16	0		12	0		34	0		6	0	
7–10 mos.	Distal scapula	1	0		2	0		2	1		1	0		3	0		2	0	
12–18 mos.	Distal humerus	4	0		3	2		11	0		7	0		30	0		13	0	
12–18 mos.	Proximal radius	1	0		5	1		5	1		5	0		18	2		6	1	
	Total	**9**	**0**	**0%**	**24**	**3**	**11%**	**34**	**2**	**6%**	**25**	**0**	**0%**	**85**	**2**	**2%**	**27**	**1**	**4%**
18 mos.	Phalanx 1	9	3		11	1		18	5		5	1		38	6		17	2	
18 mos.	Phalanx 2	6	0		7	0		12	0		9	1		26	1		6	1	
2–2.5 years	Distal tibia	2	0		4	2		2	2		3	2		11	6		6	0	
2–2.5 years	Distal metapod	1	1		4	2		15	5		11	2		33	6		18	9	
	Total	**18**	**4**	**18%**	**26**	**5**	**16%**	**47**	**12**	**20%**	**28**	**6**	**18%**	**108**	**19**	**15%**	**47**	**12**	**20%**
3.5–4 years	Proximal humerus	0	0		1	0		0	1		1	0		5	2		1	0	
3.5–4 years	Proximal ulna	1	0		3	2		2	2		2	4		8	0		2	0	
3.5 years	Proximal femur	1	1		2	0		2	3		2	1		5	1		2	2	
3.5–4 years	Distal radius	0	0		2	2		3	1		5	0		7	2		0	1	
3.5–4 years	Distal femur	4	1		1	1		1	1		3	1		11	2		1	1	
3.5–4 years	Proximal tibia	0	0		1	1		1	1		0	0		7	4		7	2	
3–3.5 years	Calcaneum	2	2		6	2		6	5		1	0		9	6		4	3	
	Total	**8**	**4**	**33%**	**16**	**8**	**33%**	**15**	**14**	**48%**	**14**	**6**	**30%**	**52**	**17**	**25%**	**17**	**9**	**35%**

Table 4. Frequency of Cut Marks, Following the Typology of Binford (1981)

Period	*Species/size class*	*Dismembering*	*Filleting*	*Skinning*
Iron I	*Bos taurus*	6		3
	Capra hircus	4	1	1
	Large ungulate	2		
	Ovis/Capra	8		1
	Ovis aries	5		3
Iron I/II	*Bos taurus*	3	2	5
	Capra hircus	2		1
	Cervus elaphus			1
	Dama mesopotamica	2		
	Medium mammal	1		
	Ovis/Capra	7	1	
	Ovis aries	5		
Iron II	Medium aves	1		
	Bos taurus	9	5	8
	Capra hircus	3		
	Cervus/Dama	1		
	Dama mesopotamica			1
	Large ungulate	1		
	Ovis/Capra	9	2	1
	Ovis aries	2		
Persian	*Bos taurus*	5		3
	Canis sp.		1	
	Capra hircus	1		
	Large ungulate	1		
	Ovis/Capra	8	1	
	Ovis aries	1		1
Hellenistic	*Bos taurus*	16	3	3
	Capra hircus	2		1
	Equus sp.	1		2
	Large ungulate	2		
	Ovis/Capra	12	5	
	Ovis aries	2	1	
	Sus scrofa	2	1	
Roman	*Bos taurus*	5	2	2
	Capra hircus	1		
	Cervus/Dama			1
	Cervus elaphus	1		
	Equus sp.	1		1
	Large ungulate	1		
	Ovis/Capra	5	1	
	Ovis aries	1		1
	Sus scrofa	1		

long time have been attributed to cycles of sedentarization and nomadization (LaBianca and von den Driesch 1995: 214). Still, the periods contemporary with the ones at Dor (the Iron Age treated as one long period plus the Hellenistic/Roman periods) are attributed to the same phase in the cycle, and the relative frequency of all the livestock animals and their utilization (as reflected in the mortality profiles) stays constant. For lack of additional data, it is difficult to establish at this point whether the continuity in these habits through time is a common or unique feature.

However constant all food-related practices are at Dor (**Table 6**), a major change in the choice of meat is evident between the early Iron Age and the later periods, with pig

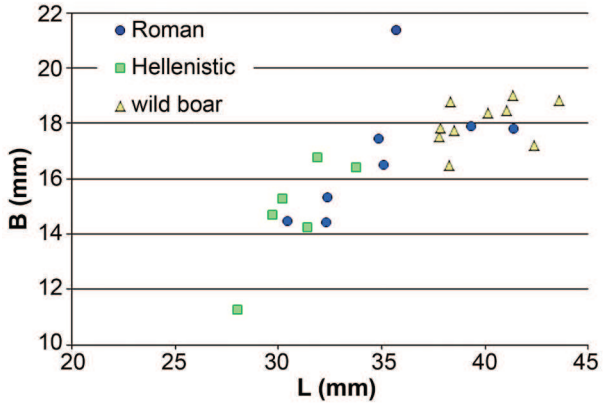

Fig. 4. Measurements of mandibular M3: Dor compared with modern wild boar.

Table 5. Pig Mandibular M3 Measurements, Hellenistic and Roman Periods

Period	*L (mm)*	*B (mm)*
Hellenistic	31.85	16.81
Hellenistic	33.7	16.45
Hellenistic	27.98	11.3
Hellenistic	30.18	15.31
Hellenistic	31.37	14.29
Hellenistic	29.67	14.72
Roman	41.35	17.85
Roman	29.44	/
Roman	39.28	17.93
Roman	35.07	16.54
Roman	32.31	15.34
Roman	32.27	14.45
Roman	30.39	14.51
Roman	34.8	17.47
Roman	35.69	21.42

remains rising from a total absence to 25% of the livestock. The presence or absence of pigs in archaeological sites in the southern Levant is usually considered to be an ethnic marker distinguishing Israelites from Philistines in "biblical" periods (e.g., Hesse 1990; Finkelstein 1996; Faust and Lev-Tov 2011; but see Lev-Tov 2012; Sapir-Hen et al. 2013), and in the Hellenistic–Roman periods differentiate Jewish sites from pagan ones (Horwitz and Studer 2005; but see Lev-Tov 2003: 440–41). It may, however, also reflect differences in site status (Zeder 1996; 1998; deFrance 2009) or a change in the site's surroundings (Grigson 2007).

Could the difference in pork consumption be attributed to environmental changes? During the Iron Age, inhabitants of nearby sites such as Megiddo (Sasson 2013) and Yoqneʿam (Horwitz et al. 2005) did consume pork to some extent (see Sapir-Hen et al. 2013 for a review of pork consumption during the Iron Age and discussion of the implications). Moreover, the range of other livestock animals or hunted game did not change in Tel Dor in a way that would suggest a drastic change in the site's surroundings. Thus, it seems that ecological factors should not be invoked as a cause for change in pig frequencies. Hence, the evident shift in the consumption of pig at Dor can be explained from a cultural perspective—either by a population change or a change in dietary preferences.

In the framework of the Late Bronze and Iron Age Levant, the extensive consumption of pigs in Philistia has been argued to stem from the dietary habits of the newcomers to this region, some of whom were of Aegean descent (Faust and Lev-Tov 2011). So the dichotomy is not between Philistines and Israelites but between Philistines and everyone else (Sapir-Hen et al. 2013). Regarding *SKL*/Phoenician Dor, for which neither the early Iron Age material culture nor the relevant texts betray any

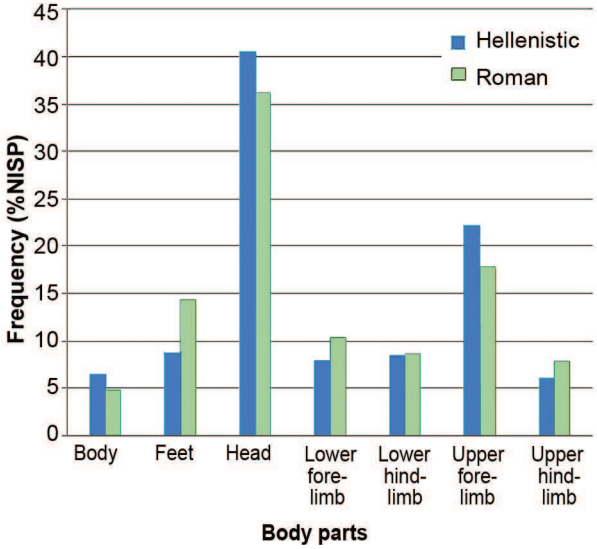

Fig. 5. Skeletal elements frequency of pig remains.

Aegean association (e.g., Gilboa 2005), the fact that pigs are absent should come as no surprise. Both material culture and dietary preferences largely continue those of the Bronze Age. Whether the newcomers from Cyprus had any impact on anything related with food at Dor is currently a moot question (see discussion in Raban-Gerstel et al. 2008: 31).

Regarding the Persian–Roman periods, artifacts and architecture, as mentioned, show both local continuity and adoption of foreign, mainly Greek, goods and artistic styles (Nitschke, Martin, and Shalev 2011). In the Persian

Table 6. Summary: Characteristics of Tel Dor Faunal Assemblages

Factor	*Tel Dor fauna: Iron Age–Roman periods*	*Index*
Livestock exploitation	Dominance of caprines over cattle in all periods	**Fig. 2**
Sheep/goat ratio	Equal contribution, constant through all periods	**Table 2**
Range of species	Increased exploitation of pigs in Hellenistic/Roman periods	**Fig. 2**
Age structure	Survival to older age of caprines and cattle; exploitation for primary and secondary products through all periods	**Table 3**
Preparation for consumption (butchery marks)	Constant	**Table 4**
Bone fragmentation	Constant	Based on percentage completeness (CN; Morlan 1994) of sheep/goat long bones; Sapir-Hen et al. 2012: fig. 1
Choice of body parts: 1. Skeletal elements frequency 2. Relationship to economic value	1. Does not change between periods. 2. Representation of all body parts with no relationship to economic value.	1. **Fig. 3** 2. No significant correlation between bone survivorship (%MAU) and Food Utility Index (following Metcalfe and Jones 1988); Sapir-Hen et al. 2012: table 3
Frequency of burn marks (cooking methods)	1%–2% in all periods (except for one specific destruction context)	Sapir-Hen et al. 2012: table 1

period, Dor is considered (by textual and archaeological evidence) to be a Phoenician town (Nitschke, Martin, and Shalev 2011: 137), and by the late Persian period, Dor—and Phoenicia in general—begin to undergo a process of "Hellenization." Again, the present excavators of the site consider this cultural reorientation to be a gradual evolution rather than the result of an influx of new populations. While Greek (mostly Attic) ceramics are prevalent in the Persian period, the fact that only specific types are present, rather than the entire corpus, suggests that they were imported to fit the tastes of local people and to satisfy a local market for luxury goods, rather than to serve the needs of an immigrant Greek community (Nitschke, Martin, and Shalev 2011: 139). In particular, food-preparation vessels are not imported at this stage. By the end of the Persian period but well before the military conquests of Alexander the Great, some pan-Hellenic (or pan-Mediterranean) ceramic forms are being manufactured in local workshops, alongside vessels in the local traditions. This pattern intensifies in the following Hellenistic period, when for the first time, we witness the importation of cooking vessels, which might indicate a change in foodways, such as Aegean-style frying pans and open casseroles, alongside a local production of such vessels. It is worthwhile noting, though, that even at this stage, the production of local-style pottery, including cooking vessels (e.g., the deep, closed, cooking pot) continues (Monnickendam-Givon 2011). This process of "globalization"—wherein the material culture becomes but a variant of a single cultural entity (or *koine*), which stretches around the Mediterranean and beyond—reaches its peak in the Roman period.

These processes match the results of the faunal analyses, which demonstrate gradual change in some food-related traditions (i.e., pork consumption), alongside marked continuity in others (i.e., exploitation patterns). These suggest that the inhabitants of the site were not "replaced" by other groups but changed their dietary preferences.[3]

Thus, we are faced with the question: Why did the cultural changes at the end of the Bronze Age (whatever they may have been) not bring about any visible changes in foodways, while those at the end of the Iron Age did? We suggest that a combination of economic and cultural factors may have been at work. The distaste for pigs in the

[3] This is not to say that there were no "ethnic" immigrants to the site in the periods under investigation. We already mentioned that in the early Iron Age, for example, ceramic and other evidence supports the possibility of newcomers from Cyprus and possibly from Syria as well. Moreover, at a busy port town such as Dor, one must a priori assume the presence of foreign traders, be they individuals, families, or larger groups, with possibly divergent food preparation and consumption patterns. Currently, after three decades of rather extensive excavations at Dor, no ethnic "enclaves" have been identified for any period, and thus the faunal evidence conforms to patterns emerging from other types of evidence. Likewise, at least for the Iron Age, analyses of other excavation areas (Area G and another subarea of Area D) reveal patterns that are nearly identical to the ones presented here. Therefore, for the time being, the ways that such (rather hypothetical in the Dor case) "ethnic" (or functional) synchronic differences may reflect on the broad diachronic picture illustrated here remain uncharted.

first place, as displayed by both Canaanites/Phoenicians and Israelites in the Bronze and early Iron Ages, may not have been a "taboo" but may have stemmed from other reasons. By the Persian period, if not earlier, this had solidified into a full-fledged cultural taboo for the Jews (that the early post-exilic period is a terminus ante quem for the writing of Leviticus and its dietary laws seems to be the consensus among biblical scholars; cf. Nihan 2007: 1–19). The Phoenician inhabitants of the coast, however, had always maintained a more open attitude to cultural influences from the west, which may have eased the ban (if there was one to begin with) on pork consumption. However, the lack of sufficient faunal data from other sites in Phoenicia limits research of this question. In the same vein, future studies of long-term developments in all aspects of animal exploitation, both in Phoenicia and beyond, will undoubtedly provide a hitherto largely unavailable context in order to evaluate all the results presented herein.

In conclusion, in our view, the marked continuity in exploitation, along with a change in the range of species, points to a change in dietary preferences. This change most probably stemmed from the adoption of foreign eating habits.

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References

Albarella, U.; Dobney, K.; and Rowley-Conwy, P.
2006 The Domestication of the Pig *(Sus scrofa)*: New Challenges and Approaches. Pp. 209–27 in *Documenting Domestication: New Genetic and Archaeological Paradigms*, ed. M. A. Zeder, D. G. Bradley, E. Emshwiller, and B. D. Smith. Berkeley: University of California.

Albarella, U.; Manconi, F.; Rowley-Conwy, P.; and Vigne, J.-D.
2006 Pigs of Corsica and Sardinia: A Biometrical Re-evaluation of Their Status and History. Pp. 285–302 in *Archaeozoological Studies in Honour of Alfredo Riedel*, ed. U. Tecchiati and B. Sala. Bolzano: Province of Bolzano.

Albert, R. M.; Shahack-Gross, R.; Cabanes, D.; Gilboa, A.; Lev-Yadun, S.; Portillo, M.; Sharon, I.; Boaretto, E.; and Weiner, S.
2008 Phytolith-rich Layers from the Late Bronze and Iron Ages at Tel Dor (Israel): Mode of Formation and Archaeological Significance. *Journal of Archaeological Science* 35: 57–75.

Bar-Oz, G.; Bouchnik, R.; Weiss, E.; Weissbrod, L.; Bar-Yosef Mayer, D. E.; and Reich, R.
2007 "Holy Garbage": A Quantitative Study of the City-Dump of Early Roman Jerusalem. *Levant* 39: 1–12.

Bartosiewicz, L., and Lisk, E.
In press Mammalian Remains. In *Excavations at Dor, Final Report*. Volume IIC*: Area G: The Late Bronze and Iron Ages: Artifacts, Ecofacts and other Studies*, ed. A. Gilboa, I. Sharon, and J. R. Zorn. Qedem Reports. Jerusalem: Institute of Archaeology, Hebrew University of Jerusalem.

Binford, L. R.
1981 *Bones: Ancient Men and Modern Myths*. New York: Academic.

Bray, T. L. ed.,
2003 *The Archaeology and Politics of Food and Feasting in Early States and Empires*. New York: Kluwer Academic/Plenum.

Cope, C. R.
2006 The Fauna: Preliminary Results. Pp. 169–74 in *The Tel Bet Yerah Excavations, 1994–1995*, ed. N. Getzov. IAA Reports 28. Jerusalem: Israel Antiquities Authority.

Crabtree, P. J.
1990 Zooarchaeology and Complex Societies: Some Uses of Faunal Analysis for the Study of Trade, Social Status, and Ethnicity. *Archaeological Method and Theory* 2: 155–205.

Croft, P.
2004 Archaeozoological Studies. Pp. 2254–348 in *The Renewed Archaeological Excavation at Lachish (1973–1994)*, Vol. 5, ed. D. Ussishkin. Monograph Series 22. Tel Aviv: Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv University.

deFrance, S. D.
2009 Zooarchaeology in Complex Societies: Political Economy, Status, and Ideology. *Journal of Archaeological Research* 17: 105–68.

Dietler, M.
1996 Feasts and Commensal Politics in the Political Economy: Food, Power, and Status in Prehistoric

Europe. Pp. 87–125 in *Food and the Status Quest: An Interdisciplinary Perspective*, ed. P. Wiessner and W. Schiefenhovel. Providence, RI: Berghahn.

Dobney, K., and Rielly, K.
1988 A Method for Recording Archaeological Animal Bones: The Use of Diagnostic Zones. *Circaea* 5: 79–96.

Evin, A.; Cucchi, T.; Cardini, A.; Vidarsdottir, U.S.; Larson, G.; and Dobney, K.
2013 The Long and Winding Road: Identifying Pig Domestication through Molar Size and Shape. *Journal of Archaeological Science* 40: 735–43.

Faust, A., and Lev-Tov, J. S. E.
2011 The Constitution of Philistine Identity: Ethnic Dynamics in Twelfth to Tenth Century Philistia. *Oxford Journal of Archaeology* 30: 13–31.

Finkelstein, I.
1996 Ethnicity and the Origin of the Iron I Settlers in the Highlands of Canaan: Can the Real Israel Stand Up? *Biblical Archaeologist* 59: 198–212.

Gilboa, A.
2005 Sea Peoples and Phoenicians along the Southern Phoenician Coast—A Reconciliation: An Interpretation of Šikila (*SKL*) Material Culture. *Bulletin of the American Schools of Oriental Research* 337: 47–78.
2006–2007 Fragmenting the Sea Peoples, with an Emphasis on Cyprus, Syria and Egypt: A Tel Dor Perspective. *Scripta Mediterranea* 27–28: 209–44.

Gilboa A., and Sharon, I.
2003 An Archaeological Contribution to the Early Iron Age Chronological Debate: Alternative Chronologies for Phoenicia and Their Effects on the Levant, Cyprus, and Greece. *Bulletin of the American Schools of Oriental Research* 332: 7–80.
2008 Between the Carmel and the Sea: Tel Dor's Iron Age Reconsidered. *Near Eastern Archaeology* 71: 146–70.

Grayson, D. K.
1984 *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas*. Orlando: Academic.

Grigson, C.
1995 Plough and Pasture in the Early Economy of the Southern Levant. Pp. 245–68 in *The Archaeology of Society in the Holy Land*, ed. T. E. Levy. New York: Facts on File.
2007 Culture, Ecology, and Pigs from the 5th to the 3rd Millennium BC around the Fertile Crescent. Pp. 83–108 in *Pigs and Humans: 10,000 Years of Interaction*, ed. U. Albarella, K. Dobney, A. Ervynck, and P. Rowley-Conwy. Oxford: Oxford University.

Gumerman, G., IV
1997 Food and Complex Societies. *Journal of Archaeological Method and Theory* 4: 105–39.

Haber, A.
2001 The Faunal Remains of Hagoshrim as a Study Case for Early Agricultural Villages. M.Sc. thesis, Tel Aviv University (Hebrew).

Haber, A., and Dayan, T.
2004 Analysing the Process of Domestication: Hagoshrim as a Case Study. *Journal of Archaeological Science* 31: 1587–601.

Hellwing, S., and Feig, N.
1989 Animal Bones. Pp. 236–47 in *Excavations at Tel Michal, Israel*, ed. Z. Herzog, G. Rapp, Jr., and O. Negbi. Publications of the Institute of Archaeology 8. Tel Aviv: Institute of Archaeology, Tel Aviv University.

Helmer, D., and Vigne, J.-D.
2004 La gestion des cheptels de caprinés au Néolithique dans le midi de la France. Pp. 397–407 in *Approches fonctionnelles en préhistoire: XXVe Congrès préhistorique de France, Nanterre, 24–26 novembre 2000*, ed. P. Bodu and C. Constantin. Paris: Société préhistorique française.

Hesse, B.
1990 Pig Lovers and Pig Haters: Patterns of Palestinian Pork Production. *Journal of Ethnobiology* 10: 195–225.

Hesse, B., and Wapnish, P.
1998 Pig Use and Abuse in the Ancient Levant: Ethnoreligious Boundary-Building with Swine. Pp. 123–35 in *Ancestors for the Pigs: Pigs in Prehistory*, ed. S. M. Nelson. MASCA Research Papers in Science and Archaeology 15: Philadelphia: Applied Science Center for Archaeology, University of Pennsylvania Museum of Archaeology and Anthropology.

Horwitz, L. K.
2000 Animal Exploitation—Archaeozoological Analysis. Pp. 221–32 in *Horbat Rosh Zayit: An Iron Age Storage Fort and Village*, ed. Z. Gal and Y. Alexandre. IAA Reports 8. Jerusalem: Israel Antiquities Authority.
2006 Mammalian Remains from Areas H, L, P and Q. Pp. 689–710 in *Excavations at Tel Beth-Shean, 1989–1996*, Vol. 1: *From the Late Bronze Age IIB to the Medieval Period*, ed. A. Mazar. Beth-Shean Valley Archaeological Project 1. Jerusalem: Israel Exploration Society.

Horwitz, L. K., and Studer, J.
2005 Pig Production and Exploitation during the Classical Periods in the southern Levant. Pp. 222–39 in *Archaeozoology of the Near East VI: Proceedings of the Sixth International Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, ed. H. Buitenhuis, A. M. Choyke, L. Martin, L. Bartosiewicz, and M. Mashkour. Groningen: ARC.

Horwitz, L. K.; Bar-Giora, N.; Mienis, H. K.; and Lernau, O.
2005 Faunal and Malacological Remains from the Middle Bronze, Late Bronze and Iron Age Levels at Tel Yoqneʿam. Pp. 395–436 in *Yoqneʿam III: The Middle and Late Bronze Ages: Final Report of the Archaeological Excavations (1977–1988)*, ed. A. Ben-Tor, D. Ben-Ami, and A. Livneh. Qedem Reports 7. Jerusalem: Institute of Archaeology, Hebrew University of Jerusalem.

Klein, R. G., and Cruz-Uribe, K.
1984 *The Analysis of Animal Bones from Archaeological Sites*. Chicago: University of Chicago.

LaBianca, Ø. S., and von den Driesch, A.
1995 *Faunal Remains: Taphonomical and Zooarchaeological Studies of the Animal Bones from Tell Hesban and Vicinity*. Hesban 13. Berrien Springs, MI: Andrews University.

Lev-Tov, J. S. E.
2000 Pigs, Philistines, and the Ancient Animal Economy of Ekron from the Late Bronze Age to the Iron Age II. Ph.D. dissertation, University of Tennessee, Knoxville.
2003 "Upon What Meat Doth This Our Caesar Feed…?" A Dietary Perspective on Hellenistic and Roman Influence in Palestine. Pp. 420–46 in *Studien auf dem Weg zu einer Archäologie des Neuen Testaments,* ed. S. Alkier and J. Zangenberg. Texte und Arbieten zum neutestamentlichen Zeitalter 42. Tübingen: Francke.
2012 A Preliminary Report on the Late Bronze and Iron Age Faunal Assemblages from Tell es-Safi/Gath. Pp. 589–612 in *Tell es-Safi/Gath I: Report on the 1996–2005 Seasons*, Vol. 1: *Text*, ed. A. M. Maeir. Ägypten und Altes Testament 69. Wiesbaden: Harrassowitz.

Lyman, R. L.
1994 *Vertebrate Taphonomy*. Cambridge: Cambridge University.
2008 *Quantitative Paleozoology*. Manuals in Archaeology. Cambridge University.

Maher, E. F.
2005 The Faunal Remains. Pp. 283–90 in *Ashdod VI: The Excavations of Areas H and K (1968–1969)*, ed. M. Dothan and D. Ben-Shlomo. IAA Reports 24. Jerusalem: Israel Antiquity Authority.

Marom, N.; Raban-Gerstel, N.; Mazar, A.; and Bar-Oz, G.
2009 Backbone of Society: Evidence for Social and Economic Status of the Iron Age Population of Tel Rehov, Beth Shean Valley, Israel. *Bulletin of the American Schools of Oriental Research* 354: 55–75.

Martin, S. R.
2007 "Hellenization" and Southern Phoenicia: Reconsidering the Impact of Greece before Alexander. Ph.D. dissertation, University of California, Berkeley.

Mauss, M.
1979 The Notion of Body Techniques. Pp. 95–123 in *Sociology and Psychology. Essays*, by M. Mauss. Trans. B. Brewster, from French. London: Routledge and Kegan Paul.

Metcalfe, D., and Jones, K. T.
1988 A Reconsideration of Animal Body-Part Utility Indices. *American Antiquity* 53: 486–504.

Mintz, S. W., and Du Bois, C. M.
2002 The Anthropology of Food and Eating. *Annual Review of Anthropology* 31: 99–119.

Monnickendam-Givon, B.
2011 Plain Ware of the Southern Carmel Coast during the Late Persian to Hellenistic Periods. M.A. thesis, Hebrew University of Jerusalem (Hebrew).

Montanari, M.
2006 *Food is Culture*. Trans. A. Sonnenfeld, from Italian. New York: Columbia University.

Morlan, R. E.
1994 Bison Bone Fragmentation and Survivorship: A Comparative Method. *Journal of Archaeological Science* 21: 797–807.

Nihan, C.
2007 *From Priestly Torah to Pentateuch: A Study in the Composition of the Book of Leviticus*. Forschungen zum Alten Testament, Series 2.25. Tübingen: Mohr Siebeck.

Nitschke, J. L.; Martin. S. R.; and Shalev, Y.
2011 Between the Carmel and the Sea—Tel Dor: The Later Periods. *Near Eastern Archaeology* 74: 132–54.

Nyerges, É. Á.
2004 Ethnic Traditions in Meat Consumption and Herding at a 16th Century Cumanian Settlement in the Great Hungarian Plain. Pp. 262–70 in *Behaviour behind Bones: The Zooarchaeology of Ritual, Religion, Status and Identity*, ed. S. J. O'Day, W. Van Neer, and A. Ervynck. Oxford: Oxbow.

O'Day, S. J.; Van Neer, W.; and Ervynck, A., eds.
2004 *Behaviour behind Bones: The Zooarchaeology of Ritual, Religion, Status and Identity*. Oxford: Oxbow.

Payne, S.
1973 Kill-Off Patterns in Sheep and Goats: The Mandibles from Asvan Kale. *Anatolian Studies* 23: 281–303.

Payne, S., and Bull, G.
1988 Components of Variation in Measurements of Pig Bones and Teeth, and the Use of Measurements to Distinguish Wild from Domestic Remains. *Archaeozoologia* 2: 27–65.

Pearson, M. P.
2003 Food, Identity and Culture: An Introduction and Overview. Pp. 1–30 in *Food, Culture and Identity in the Neolithic and Early Bronze Age*, ed. M. P. Pearson. BAR International Series 1117. Oxford: Archaeopress.

Raban-Gerstel, N.; Bar-Oz, G.; Zohar, I.; Sharon, I.; and Gilboa, A.
2008 Early Iron Age Dor (Israel): A Faunal Perspective. *Bulletin of the American Schools of Oriental Research* 349: 25–59.

Redding, R. W.
1994 The Vertebrate Fauna. Pp. 279–322 in *Tel Anafa I: A Final Report on Ten Years of Excavation at a Hellenistic and Roman Settlement in Northern Israel*, by S. Herbert. Journal of Roman Archaeology Supplement 10. Ann Arbor: Kelsey Museum of the University of Michigan.

Sade, M.
1999 Faunal Remains of the Persian and Hellenistic Periods. Pp. 262–68 in *Apollonia-Arsuf, Final Report of the Excavations I: The Persian and Hellenistic Pottery*, ed. I. Roll and O. Tal. Tel Aviv: Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv University.

2006 Archaeozoological Finds from Tel Mikhal (Tel Michal). *ʿAtiqot* 52: 121–25.

Sapir-Hen, L.; Gadot, Y.; and Finkelstein, I.
In press Environmental and Historical Impacts on Long Term Animal Economy: The Southern Levant in the Late Bronze and Iron Ages. *Journal of the Economic and Social History of the Orient* 58.

Sapir-Hen, L.; Wolff, S.; and Bar-Oz, G.
In press The Subsistence Economy at Tel Megadim (Carmel Coast): Animal Bones from Early Bronze to the Persian Period. In *Zooarchaeology of the Holy Land*, ed. G. Bar-Oz and L. K. Horwitz. Jerusalem: Israel Antiquities Authority.

Sapir-Hen, L.; Bar-Oz, G.; Gadot, Y.; and Finkelstein, I.
2013 Pig Husbandry in Iron Age Israel and Judah: New Insights Regarding the Origin of the "Taboo." *Zeitschrift des Deutschen Palästina-Vereins* 129: 1–20.

Sapir-Hen, L.; Bar-Oz, G.; Sharon, I.; Gilboa, A.; and Dayan, T.
2012 Understanding Faunal Contexts of a Complex *Tell*: Tel Dor, Israel, as a Case Study. *Journal of Archaeological Science* 39: 590–601.

Sasson, A.
2013 The Faunal Remains from the Iron Age Levels. Pp. 1131–1209 in *Megiddo V: The 2004–2008 Seasons*, Vol. 3, ed. I. Finkelstein, D. Ussishkin, and E. H. Cline. Monograph Series (Sonia and Marco Nadler Institute of Archaeology) 31. Winona Lake, IN: Eisenbrauns.

Shahack-Gross, R.; Albert, R.-M.; Gilboa, A.; Nagar-Hilman, O.; Sharon, I.; and Weiner, S.
2005 Geoarchaeology in an Urban Context: The Uses of Space in a Phoenician Monumental Building at Tel Dor (Israel). *Journal of Archaeological Science* 32: 1417–31.

Sharon, I., and Gilboa, A.
2013 The *ŠKL* Town: Dor in the Early Iron Age. Pp. 393–468 in *The Philistines and Other "Sea Peoples" in Text and Archaeology*, ed. A. E. Killebrew and G. Lehmann. Archaeology and Biblical Studies 15. Atlanta: Society of Biblical Literature.

Silver, I. A.
1969 The Aging of Domesticated Animals. Pp. 283–302 in *Science in Archaeology: A Survey of Progress and Research*, ed. D. R. Brothwell and E. Higgs. Rev. and enl. ed. London: Thames and Hudson.

Smith, P., and Horwitz, L. K.
1984 Radiographic Evidence for Changing Patterns of Animal Exploitation in the Southern Levant. *Journal of Archaeological Sciences* 11: 467–75.

Stein, G. J.
2012 Food Preparation, Social Context, and Ethnicity in a Prehistoric Mesopotamian Colony. Pp. 47–63 in *The Menial Art of Cooking: Archaeological Studies of Cooking and Food Preparation*, ed. S. R. Graff and E. Rodríguez-Alegría. Boulder: University Press of Colorado.

Stern, E.
1990 New Evidence from Dor for the First Appearance of the Phoenicians along the Northern Coast of Israel. *Bulletin of the American Schools of Oriental Research* 279: 27–34.
2000 *Dor, Ruler of the Seas: Nineteen Years of Excavations at the Israelite-Phoenician Harbor Town on the Carmel Coast*. Rev. and exp. ed. Jerusalem: Israel Exploration Society.
2012 Archaeological Remains of the Northern Sea Peoples along the Sharon and Carmel Coasts and the Akko and Jezreel Valleys. Pp. 473–507 in *The Ancient Near East in the 12th–10th Centuries BCE: Culture and History*: *Proceedings of the International Conference Held at the University of Haifa, 2–5 May, 2010*, ed. G. Galil, A. Gilboa, A. M. Maeir, and D. Kahn. Alter Orient und Altes Testament 392. Münster: Ugarit-Verlag.

Stiner, M. C.
2002 On *in situ* Attrition and Vertebrate Body Part Profiles. *Journal of Archaeological Science* 29: 979–91.
2004 A Comparison of Photon Densitometry and Computed Tomography Parameters of Bone Density in Ungulate Body Part Profiles. *Journal of Taphonomy* 2: 117–45.

Tchernov, E., and Horowitz, L. K.
1990 Herd Management in the Past and Its Impact on the Landscape of the Southern Levant. Pp. 207–16 in *Man's Role in the Shaping of the Eastern Mediterranean Landscape: Proceedings of the INQUA/BAI Symposium on the Impact of Ancient Man on the Landscape of the Eastern Mediterranean Region and the Near East, Groningen, Netherlands, 6–9 March 1989*, ed. S. Bottema, G. Entjes-Nieborg, and W. van Zeist. Rotterdam: Balkema.

Tsahar, E.; Izhaki, I.; Lev-Yadun, S.; and Bar-Oz, G.
2009 Distribution and Extinction of Ungulates during the Holocene of the Southern Levant. *PLoS One* 4/4: e5316.

Twiss, K. C.
2012 The Archaeology of Food and Social Diversity. *Journal of Archaeological Research* 20: 357–95.

Twiss, K. C., ed.,
2007 *The Archaeology of Food and Identity*. Occasional Paper 34. Carbondale: Center for Archaeological Investigations, Southern Illinois University Carbondale.

Wapnish, P., and Hesse, B.
1988 Urbanization and Organization of Animal Production at Tell Jemmeh in the Middle Bronze Age Levant. *Journal of Near Eastern Studies* 47: 81–94.
1991 Faunal Remains from Tel Dan: Perspectives on Animal Production at a Village, Urban and a Ritual Center. *Archaezoologia* 4: 1–98.

Zeder, M. A.
1991 *Feeding Cities: Specialized Animal Economy in the Ancient Near East*. Washington, DC: Smithsonian Institution.

1996 The Role of Pigs in Near Eastern Subsistence: A View from the Southern Levant. Pp. 297–312 in *Retrieving the Past: Essays on Archaeological Research and Methodology in Honor of Gus W. Van Beek*, ed. J. D. Seger. Winona Lake, IN: Eisenbrauns.

1998 Pigs and Emergent Complexity in the Ancient Near East. Pp. 109–22 in *Ancestors for the Pigs: Pigs in Prehistory*, ed. S. M. Nelson. MASCA Research Papers in Science and Archaeology 15. Philadelphia: Applied Science Center for Archaeology, University of Pennsylvania Museum of Archaeology and Anthropology.

2006 Reconciling Rates of Long Bone Fusion and Tooth Eruption and Wear in Sheep (*Ovis*) and Goat (*Capra*). Pp. 87–118 in *Recent Advances in Ageing and Sexing Animal Bones*, ed. D. Ruscillo. Oxford: Oxbow.

Zeder, M. A., and Lapham, H. A.

2010 Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeological Science* 37: 2887–905.