

IRON AGE PIGS: NEW EVIDENCE ON THEIR ORIGIN AND ROLE IN FORMING IDENTITY BOUNDARIES

Lidar Sapir-Hen¹ • Meirav Meiri² • Israel Finkelstein³

ABSTRACT. This article reviews recent studies of pigs in the Iron Age in the southern Levant. The studies were carried out as part of the European Research Council–funded Ancient Israel project, with the aim of examining questions of identity and ethnic boundaries, with special emphasis on Philistia and ancient Israel. On the Philistine side, the results show a dichotomy in pork consumption between urban centers and the rural sector, and suggest that European domestic pigs were brought to the Levant by the Sea Peoples, most probably to secure the supply of meat. Reviewed with previous evidence, we suggest that economic motivation was the driving force for pork consumption and abandonment. Regarding ancient Israel, new studies show that avoiding pork was a widespread phenomenon of much of the Iron Age in both the highland and the lowlands outside of Philistia. They also point to a rise in pork consumption in lowlands sites of the Northern Kingdom in the Iron IIB and suggest a link between this phenomenon and the early consolidation of the taboo on pigs in Judah in late-monarchic times.

INTRODUCTION

Iron Age pig husbandry in the southern Levant has been studied extensively, primarily in order to understand the biblical prohibition on consumption of pork (Leviticus 11:7; Deuteronomy 14:8). Hesse's (1990) survey of numerous archaeozoological publications led scholars to propose that the absence or presence of pigs is the only way to distinguish between early Israelites and Philistines in the Iron I (Finkelstein 1997), and in fact throughout the Iron Age (Faust 2006:37–8). This notion led researchers to focus on pig frequencies at specific sites (e.g. Lev-Tov 2000, 2010, 2012; Raban-Gerstel et al. 2008; Kheati 2009), and to discuss issues of cultural and identity boundaries in the early phase of the Iron Age (e.g. Bunimovitz and Faust 2003; Killebrew and Lev-Tov 2008; Bunimovitz and Lederman 2011; Tamar et al. 2013), as well as cultural acculturation during later phases of the period (Faust and Lev-Tov 2011). Studies on pig husbandry and consumption also raise the question of the roots of the biblical taboo. For many years, a dominant theory pointed to the Sea Peoples as the “prime movers” behind a strong pig culture that was brought from the Aegean Basin. This became a symbol of their identity in the eyes of their neighbors—the early Israelites—who avoided pigs in general and pork consumption in particular in order to draw the identity line between the two groups, a typical “us” and “them” situation (Stager 1995; Finkelstein 1997). There were those who argued for a more cautious attitude, considering numerous reasons that could influence the decision to raise pigs (Hesse and Wapnish 1997, 1998). These include site function (e.g. Lev-Tov 2000), economic-political factors (Zeder 1996, 1998), and ecological issues (Harris 1987). Hesse and Wapnish (1998) also correlated the high frequency of pigs to the subsistence strategy of the newcomers' society, which opted for exploiting pigs as a fast source of meat until the migrating groups were efficiently settled in the new land.

The prevalent theory, according to which the Iron I Sea Peoples brought a strong pig culture from their homeland (e.g. Killebrew and Lev-Tov 2008) that caused the contemporary local highlanders—the early Israelites—to avoid pigs, has recently been challenged by new data regarding both sides of the Philistine/Israelite equation.

On the Sea Peoples side, since it is acknowledged that pork consumption played an important role in the diet of at least some of the Iron I migrants from the west and northwest (Yasur-Landau 2010), one may ask: how did these groups plan their voyage to the east? The strong trade connections

1. Institute of Archaeology, Tel Aviv University, Tel Aviv 697801, Israel. Corresponding author. Email: lidarsap@post.tau.ac.il.

2. Steinhardt National Natural History Museum and Research Center and the Institute of Archaeology, Tel Aviv University, Tel Aviv 697801, Israel.

3. Institute of Archaeology, Tel Aviv University, Tel Aviv 697801, Israel.

between the Aegean and the Levant during the Late Bronze Age (manifested mainly by transfer of ceramic vessels) must have provided the migrants with information about the target lands for their migration. Still, what did groups of Sea Peoples know about the availability of pigs in the Levant? Did they plan to bring pigs with them from their homeland? Was there an advantage to bringing pigs from the Aegean? And what was the process of growth of pig consumption in Philistia? What were the dietary lines between the new migrants and the local groups within Philistia?

On the Israelite side, the taboo on pigs comes from biblical literature that dates not earlier than the late 7th century BCE, that is, several centuries after the migration of the Sea Peoples and the rise of ancient Israel in the highlands. How, then, do we bridge between the realities in the Iron I and the emergence of the biblical law in the late Iron II?

These questions led us to focus our interest on pig husbandry and consumption, and the current paper offers a review of our results. A detailed description of the research can be found at Sapir-Hen et al. (2013) and Meiri et al. (2013). The following two tracks were pursued:

1. Advances in archaeological and archaeozoological research were deployed to better understand patterns of pig husbandry and pork consumption in the region. For this purpose, Sapir-Hen et al. (2013) created a comprehensive database of published and unpublished reports on faunal remains. In order to achieve a fine resolution analysis, they considered only assemblages that could be assigned to one of eight ceramic subphases of the Late Bronze and Iron Ages: Late Bronze II and III, early and late Iron I, early and late Iron IIA, Iron IIB, and Iron IIC (for the ceramic phases see e.g. Zimhoni 1997; Herzog and Singer-Avitz 2004, 2006). Pig frequency levels were based on Grigson (2007) and defined as follows: insignificant <2%, significant 2–7%, and highly significant >7%.
2. Ancient DNA was extracted from pig bones, covering periods from the Middle Bronze Age to the present. The results were then compared to published data from across Eurasia. The aim was to verify the genetic origin of the Philistine pigs. In other words, the team attempted to check whether the Philistines brought pigs from their homeland or merely enhanced the raising of local pigs (Meiri et al. 2013).

These studies were made possible by methodological advances such as progress in fine-tuning the chronological phases of the Iron Age, accumulation of new data on pig frequencies and their exploitation (full list in Sapir-Hen et al. 2013), and progress in molecular methods that enable the extraction of DNA from ancient specimens (e.g. Shapiro and Hofreiter 2012 and references therein).

THE PHILISTINES

The Philistines constituted one group among the Sea Peoples who probably migrated to the Levant from various locations in the eastern Mediterranean—the Aegean Basin, Cyprus, and/or southern Anatolia (e.g. Lev-Tov 2006; Yasur-Landau 2010). Identifying immigrants' culinary behavior can shed light on patterns of their movement and early history in the new land. As pig husbandry and pork consumption are major characteristics of the main urban Philistine sites (see below), the question of whether they brought their pigs (and their kitchen traditions) with them, or relied on the local fauna, is crucial for understanding the nature of their migration in particular and the migration of ancient groups in general. A genetic study (Meiri et al. 2013) demonstrated that pigs from Late Bronze Age sites in Israel (until ~1150 BCE) depict haplotypes of modern and ancient Near Eastern pigs, meaning that they were of local origin. European haplotypes (foreign pigs) became dominant in the Iron IIA (~900 BCE; Figure 1). During the ~250 yr between the two periods, pigs could have

been brought to the region in multiple events. As the archaeological evidence points to growing amounts of pig consumption in the Philistine urban centers, specifically during the early Iron Age (see below), it is reasonable to attribute a significant part of this translocation of domestic European pigs to the Sea Peoples in general and the Philistines in particular. Currently, ancient DNA information from Iron Age Philistine sites is still missing, and the first European pigs identified thus far come from Megiddo, located about 150 km north of the main Philistine centers. The 250-yr gap can be explained as representing the time needed for the European pigs to expand northward, or it may imply that the data from the early phases of the Iron Age are insufficient. Future study of pig bones from Philistia may therefore “close” this gap. A similar pattern in genetic signature is observed in Anatolia, where the major transition to a European haplotype also took place during the Late Bronze–early Iron Age (Ottoni et al. 2013). The notion that the pigs were carried along with various immigrant groups to different locations suggests that the exploitation of this animal, also by the Sea Peoples, was not a unique cultural trait but rather motivated by economic factors (see more below).

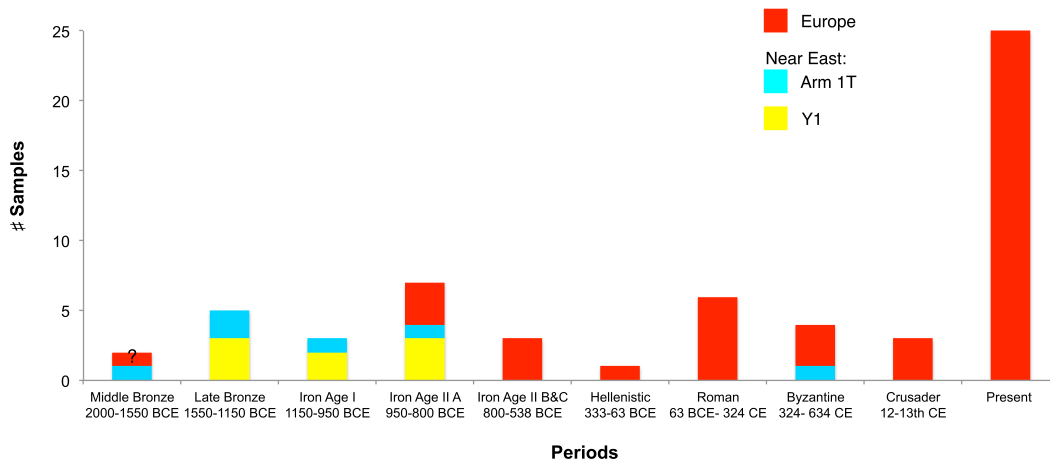


Figure 1 Pig samples with particular mtDNA genetic signature in Israel across the different time periods. This figure is from Meiri et al. (2013) © 2014 Nature Publishing Group.

If the Philistines did indeed bring their pigs with them, we are faced with questions regarding their motivation: Should pork consumption be attributed to cultural preferences (e.g. Faust and Lev-Tov 2011)? Looking at the data for Iron I sites in Philistia, Sapir-Hen et al. (2013) identified a pattern according to which the exceptionally strong appearance of pigs is characteristic of the main urban sites but not of the smaller settlements and the rural sector [Figure 2; note that data on the Iron Age fauna from Ashkelon has not yet been fully published and that the preliminary numbers (in Hesse 1990) are not correlated to strata]. This phenomenon was also observed by Maeir et al. (2013), who suggested that various unspecified factors (ecological, economic, or functional), rather than ethnicity, were responsible for this dichotomy. Faust and Lev-Tov (2014) argued otherwise; they maintained that the urban/countryside contrast may stem from the fact that the rural sector was inhabited by a number of groups rather than solely by Philistine immigrants (see also Uziel 2007; Gadot 2008). They suggested that the rural sites were under Philistine political control without having been inhabited by them, and thus ethnicity is the only factor contributing to the urban/rural dichotomy. However, Sapir-Hen et al. (2013) demonstrated that pig presence or absence cannot be used as an ethnic marker (see below).

Of all the aforementioned factors, ecological settings seem to be the least likely responsible for differences in pig frequencies. While raising pigs necessitates proximity to a water source, this is also

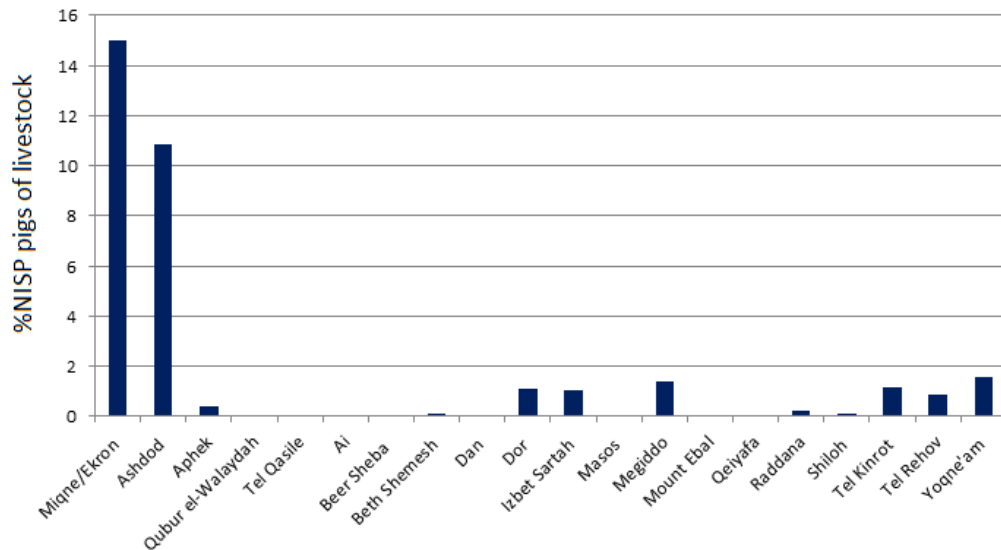


Figure 2 Pig frequencies (out of livestock) during the Iron I. Full data and references in Sapir-Hen et al. (2013:Table 1).

the case for cattle, whose frequencies differ between sites with no correlation to pig frequencies or climate [in terms of annual precipitation, which affects both water supply and available vegetation (Sapir-Hen et al. 2014)]. Moreover, as the Iron Age populations mastered herd management, it is less likely that (at least in the “green” parts of the region) local environmental factors had such an impact on domesticated animal frequencies (see also Sasson 2010; Sapir-Hen et al. 2014 for the discussion on climatic vs. social impact on animal husbandry decisions).

Thus, economic or functional factors seem more probable to explain the urban-rural dichotomy. Still, this dichotomy cannot stem from better economic conditions in the cities, as larger numbers of pigs are usually correlated with lower economic status (Hesse and Wapnish 1997) and with household economy rather than a centralized one (Zeder 1996). The difference must therefore stem from dissimilar economic motivations at different sites, as was suggested by Lev-Tov (2000:208, 2010) regarding Tel Miqne/Ekron. Note that the livestock economy of neighboring Beth Shemesh and Tel Miqne/Ekron differs both in terms of pig frequencies (Bunimovitz and Lederman 2011; Tamar et al. 2013) and relative frequencies of cattle and of sheep vs. goats (Sapir-Hen et al. 2014). Thus, the economies of these sites may be viewed as complementary to each other (Sapir-Hen et al. 2014). Trading between Beth Shemesh and Philistine sites is also evident in the pottery assemblages (Bunimovitz and Lederman 2011).

At the end of the Iron Age, Philistine sites—though not *all* the urban centers—show a decline in pork consumption (Lev-Tov 2010; Hesse et al. 2012; see discussion regarding Tell es-Safi/Gath in Lev-Tov 2012; Maeir et al. 2013). This change is considered as demonstrating an acculturation process, when the Philistines lost their “unique traits” (Faust and Lev-Tov 2011). However, an economic rather than cultural motive for the decrease in pork consumption was suggested by Owen (2005) and Lev-Tov (2010) regarding the Tel Miqne/Ekron assemblages. Owen (2005) proposed correlating the decrease in pork consumption with changing practices of pigs’ raising: preliminary isotopic evidence suggests that in the early Iron Age pigs were kept in the countryside, while later at least a portion of them were kept inside the city. City breeding may have posed a “threat” to the elite because it extends autonomy to the household economy (Zeder 1996, 1998), which, in turn, motivat-

ed the “elite” to encourage the abandoning of pork consumption. More data are needed to establish the validity of this proposal. An additional explanation, that pork consumption is discouraged in times of centralized power (Zeder 1996, 1998), was suggested by Lev-Tov (2010). He related the decrease in pork consumption, along with other observed changes in animal economy, to the city’s incorporation into the economic system of the Neo-Assyrian Empire.

ANCIENT ISRAEL

Sapir-Hen et al. (2013) showed that lack of pigs, or very low frequency of pigs, is a common feature of all Iron I sites outside of Philistia, sites that were inhabited by different cultural or ethnic groups. This continues traditional economic strategies that had been common in the Late Bronze Age (see also Tamar et al. 2013). This pattern puts into question the ability to differentiate between Canaanites/early Israelites and Philistines based on pig evidence alone, and suggests that significant consumption of pork can only serve to identify the population of the Philistine urban centers in the Iron I. In Jordan, Tell el-Umeiri (Field B, refuse pit; Peters et al. 2002) and Hesban (Strata 19; von den Driesch and Boessneck 1995) display significant (as defined in Grigson 2007) frequencies of pigs, though appreciably lower than the ones in the Philistine city centers—2.5% and 4.75%, respectively [2%, on the border of insignificance, in Kh. el Mudayna in Moab (Lev-Tov et al. 2011)]. More information is needed from Jordan in order to decide whether pig culture there is different from areas west of the Jordan River.

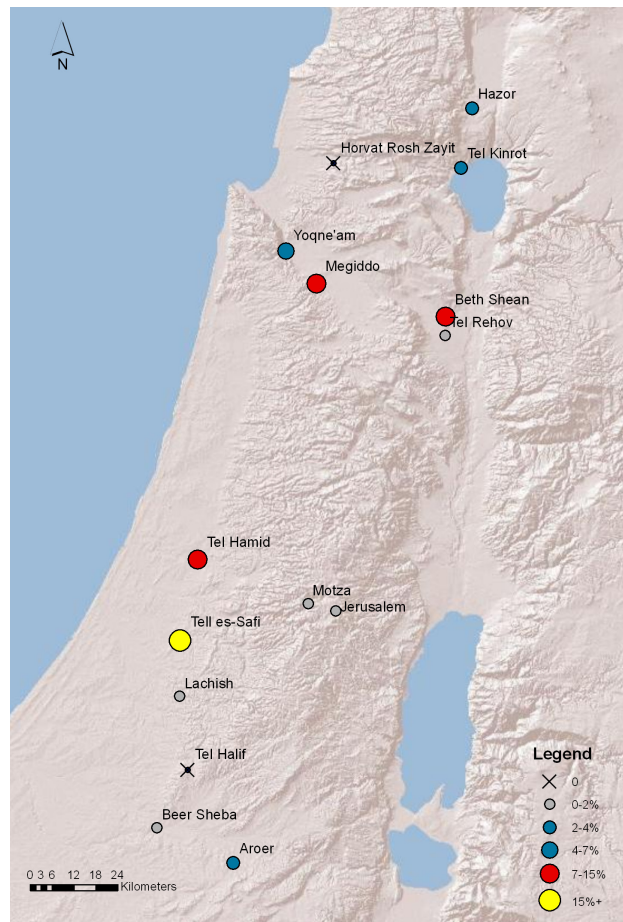


Figure 3 Pig frequencies (out of livestock) in the Iron IIB. Figure (and full data and references) first appeared in Sapir-Hen et al. (2013).

The fine chronology resolution study enables detecting changes within the Iron Age. During the Iron IIA, when the political landscape was characterized by emerging territorial kingdoms, a few sites in Israel show higher frequencies of pigs, though no explicit pattern can be detected (Sapir-Hen et al. 2013:Table 1). In Judah, the situation is similar to previous periods, with insignificant amounts of pig remains. In Tel Rehov, a site that exhibits Aramean characteristics, pork consumption is slightly over 2% in the late Iron IIA and is insignificant in the Iron IIB (Tamar et al., forthcoming).

An intriguing pattern appears in the Iron IIB (Figure 3). In this phase, a dichotomy is evident between sites located in the lowland territories of Israel and Judah. Pigs appear in significant frequencies in the former. Moreover, the pigs found in north Israelite assemblages reflect an important component of the local economy; they were raised and consumed on-site (Sapir-Hen et al. 2013). These changes in pig frequencies cannot be attributed to different environmental conditions, site function, or political and economic status; rather, they should be associated with economic motivation based on the need to provide a sufficient meat source to the growing population (because of diminishing open areas available for pasture) in the Northern Kingdom (discussion in Sapir-Hen et al. 2013). Interestingly, in the Iron II, European pigs appear at north Israelite sites such as Megiddo (Meiri et al. 2013). They either expanded naturally or were intentionally distributed from Philistia along trade routes, thus associating the increase in pork consumption in the Northern Kingdom with commercial contacts with Philistia. As suggested earlier, the population of Judah could have avoided pigs for cultural reasons throughout the Iron Age. For the Iron IIC, there is lack of data from northern lowlands sites; Judahite sites continued avoiding pork, while most Philistine sites show a decline in pork consumption (see above).

DISCUSSION

The results of the studies reviewed here raise new questions for understanding both the Philistine and ancient Israel cultures. In support of the previously suggested theory, based on the archaeological and genetic results, we propose that the Philistines brought pigs with them from their homelands. International connections in the eastern Mediterranean were common before and during the Philistines' arrival, and it is reasonable to assume that these connections were also exploited in the transit of animals and their products. The studied sample is insufficient to establish whether the phenomenon of pig movement should be attributed solely to the Philistines; in fact, we do not believe it should. However, combined with the archaeological evidence for the growing numbers of pigs in the Philistine urban centers, we believe it should be at least partly attributed to them. Still, pork consumption is not a characteristic of all contemporary assemblages in the Aegean Basin (Yasur-Landau 2010:295–9). The question remains, therefore, as to the driving force for this phenomenon. As the major transition to European haplotypes is also evident in other parts of the Ancient Near East (Ottoni et al. 2013), the movement of pigs may have been economically motivated. Rather than being a Philistine “traditional” food from home, pigs could have been put on the ships in order to provide meat during the dangerous voyage and a quickly reproduced meat supply in the target lands (see also Hesse and Wapnish 1997:247–8). The migrants may also have opted for taking their own pigs for a practical reason—to clean the ships. Economic motivation also seems to be the probable explanation for the difference in pork consumption between the Philistines' urban and rural sectors, and the driving force for the abandonment of this practice at the end of the Iron Age.

Additional studies are needed in order to decipher the precise patterns of pig frequencies in urban centers and rural sectors in Philistia. Furthermore, acknowledging that the autochthonous population in Philistia was not annihilated, and that the Sea Peoples had come from a variety of lands, intrasite analysis of Iron I assemblages at the Philistine city centers may help monitor cultural if

not “ethnic” lines between different segments of their population (for the significance of intrasite investigation see Sapir-Hen et al., in press).

The emergence of a pig taboo in the southern highlands in the early Iron I as an “us” versus “them” boundary makes sense. But why do pigs not appear in assemblages from the northern part of the highlands, e.g. from sites that are bordering on the Jezreel Valley, far from Philistia? Was there a general Israelite (or highlands) identity as early as the early phase of the Iron I? To answer this question, additional data are needed from highlands sites that border on the Jezreel Valley and the coastal plain of the Sharon and, even more important, from the highlands east of the Jordan River, which gave birth to other territorial kingdoms and hence identities a short while after the Iron I.

The newly detected pattern of dichotomy between Israel and Judah in the Iron II may hint at the reason (or one of the reasons) behind the emergence of the pork taboo. The biblical decree (Lev 11:7; Deut 14:8) comes from the world of Judah in late monarchic and early post-exilic times. Our work demonstrates that pork avoidance fits the reality in Judah in the Iron IIB–C, but does not reflect daily life in the Northern Kingdom, at least not in its lowland sites, in the Iron IIB. Also, pig frequencies in Philistia had already diminished considerably at that time. Thus, promotion of pig avoidance could have been directed not toward the Philistines, who already began losing this cultural trait, but towards the northern Israelites who moved to Judah in the decades after the collapse of the Northern Kingdom in 720 BCE (see further discussion in Sapir-Hen et al. 2013).

CONCLUSIONS

The new data and synthesis (Meiri et al. 2013; Sapir-Hen et al. 2013) shed light on the origin, husbandry, and consumption of pigs in the southern Levant in the Iron Age. They indicate that European pigs were introduced to the region not later than the beginning of the Iron IIA, probably by the Sea Peoples. They also put some common conventions in question. The first is that distinguishing between Philistines and other groups can almost automatically be achieved based on pig frequencies. The emerging picture is much more multifaceted than was previously perceived: it is evident that pork consumption is not indicative to all sectors of the population in Philistia, and that pork avoidance is not restricted to one group (or region). Our study seems to demonstrate that all pig-related decisions were economically driven. The second common notion challenged by our work is that the pig taboo in ancient Israel emerged from the “us” and “them” conflict with the Philistines. Rather, we suggest that this taboo stemmed from a conflict within Judah in the late Iron II—between local Judahites who avoided pigs as early as the Iron I (possibly because of conflicts with the nearby Philistines) and Israelites who moved to Judah in the late 8th and early 7th centuries BCE, bringing with them pig-culture traits.

REFERENCES

- Bunimovitz S, Faust A. 2003. Building identity: the four-room house and the Israelite mind. In: Dever WG, Gitin S, editors. *Symbiosis, Symbolism and the Power of the Past. Canaan, Ancient Israel, and Their Neighbors from the Late Bronze Age through Roman Palaestina. Proceedings of the Centennial Symposium, W. F. Albright Institute of Archaeological Research, Jerusalem, May 29–31, 2000*. Winona Lake: Eisenbrauns. p 411–23.
- Bunimovitz S, Lederman Z. 2011. Canaanite resistance: the Philistines and Beth-Shemesh – a case study from the Iron Age I. *Bulletin of the American Schools of Oriental Research* 364:37–51.
- Faust A. 2006. *Israel's Ethnogenesis: Settlement, Interaction, Expansion and Resistance*. London: Equinox.
- Faust A, Lev-Tov J. 2011. The constitution of Philistine identity: ethnic dynamics in twelfth to tenth century Philistia. *Oxford Journal of Archaeology* 30(1):13–31.
- Faust A, Lev-Tov J. 2014. Philistia and the Philistines in the Iron Age I: interaction, ethnic dynamics and boundary maintenance. *HIPHIL Novum* 1:1–24.
- Finkelstein I. 1997. Pots and people revisited: ethnic boundaries in the Iron Age I. In: Silverman N, Small D, editors. *The Archaeology of Israel: Constructing the Past, Interpreting the Present*. London: Academic Press. p 216–37.
- Gadot Y. 2008. Continuity and change in the Late Bronze to

- Iron Age transition in Israel's coastal plain: a long term perspective. In: Fantalkin A, Yasur-Landau A, editors. *Bene Israel: Studies in the Archaeology of Israel and the Levant during the Bronze and Iron Ages in Honour of Israel Finkelstein*. Boston: Brill. p 55–73.
- Grigson C. 2007. Culture, ecology and pigs from the 5th to 3rd millennium BC around the Fertile Crescent. In: Albarella U, Dobney K, Ervynck A, Rowley P, editors. *Pigs and Humans. 10 000 Years of Interaction*. Oxford: Oxford University. p 83–108.
- Harris M. 1987. *The Sacred Cow and the Abominable Pig: Riddles of Food and Culture*. New York: Touchstone.
- Herzog Z, Singer-Avitz L. 2004. Redefining the centre: the emergence of state in Judah. *Tel Aviv* 31(2):209–44.
- Herzog Z, Singer-Avitz L. 2006. Sub-dividing the Iron Age IIA in northern Israel: a suggested solution to the chronological debate. *Tel Aviv* 33(2):163–95.
- Hesse B. 1990. Pig lovers and pig haters: patterns of Palestinian pork production. *Journal of Ethnobiology* 10(2):195–225.
- Hesse B, Wapnish P. 1997. Can pig remains be used for ethnic diagnosis in the ancient near east? In: Silberman NA, Small D, editors. *The Archaeology of Israel: Constructing the Past, Interpreting the Present*. Sheffield: Academic Press. p 238–70.
- Hesse B, Wapnish P. 1998. Pig use and abuse in the ancient Levant: ethnoreligious boundary-building with swine. In: Nelson SM, editor. *Ancestors for the Pigs: Pigs in Prehistory*. MASCA Research Papers in Science and Archaeology 15. Philadelphia: University Museum. p 123–35.
- Hesse B, Fulton DN, Wapnish P. 2012. Animal remains. In: Stager LE, Schloen D, Master D, editors. *Ashkelon III: The Seventh Century B.C.* Winona Lake: Eisenbrauns. p 615–43.
- Kheati R. 2009. The faunal assemblage. In: Garfinkel Y, Ganor S, editors. *Khirbet Qeiyafa: Excavation Report 2007–2008*. Jerusalem: Israel Exploration Society & Institute of Archaeology. p 201–8.
- Killebrew AE, Lev-Tov J. 2008. Early Iron Age feasting and cuisine: an indicator of Philistine-Aegean connectivity? In: Hitchcock LA, Laffineur R, editors. *Dais: The Aegean Feast. Proceedings of the 12th International Aegean Conference, University of Melbourne, Centre for Classics and Archaeology, 25–29 March 2008*. Liege: University of Liege. p 339–46.
- Lev-Tov JSE. 2000. Pigs, Philistines, and the ancient animal economy of Ekron from the Late Bronze Age to the Iron Age II (Israel) [PhD dissertation]. Knoxville: University of Tennessee.
- Lev-Tov JSE. 2006. The faunal remains: animal economy in the Iron Age I. In: Meehl MW, Dothan T, Gitin S, editors. *Tel Miqne-Ekron Excavations 1995–1996: Field INE East Slope Iron Age I (Early Philistine Period)*. Tel Miqne-Ekron Final Report Series 8. Jerusalem: W.F. Albright Institute of Archaeological Research and Institute of Archaeology, Hebrew University. p 207–34.
- Lev-Tov JSE. 2010. A plebeian perspective on empire economies: faunal remains from Tel Miqne-Ekron, Israel. In: Campana D, Choyke A, Crabtree P, deFrance SD, Lev-Tov J, editors. *Anthropological Approaches to Zooarchaeology: Colonialism, Complexity and Animal Transformations*. Oxford: Oxbow Books. p 90–104.
- Lev-Tov JSE. 2012. A preliminary report on the Late Bronze and Iron Age faunal assemblages from Tell es-Safi/Gath. In: Maeir AM, editor. *Tell es-Safi/Gath I: Report on the 1996–2005 Seasons*. Wiesbaden: Harrassowitz. p 589–612.
- Lev-Tov JSE, Porter BW, Routledge BE. 2011. Measuring local diversity in early Iron Age animal economies: a view from Khirbat al-Mudayna al-'Aliya (Jordan). *Bulletin of the American Schools of Oriental Research* 361:67–93.
- Maeir AM, Hitchcock LA, Horwitz LK. 2013. On the constitution and transformation of Philistine identity. *Oxford Journal of Archaeology* 32(1):1–38.
- Meiri M, Huchon D, Bar-Oz G, Boaretto E, Kolska Horwitz L, Maeir AM, Sapir-Hen L, Larson G, Weiner S, Finkelstein I. 2013. Ancient DNA and population turnover in Southern Levantine pigs: signature of the Sea Peoples migration? *Scientific Reports* 3:3035.
- Otonari C, Flink LG, Evin A, Georg C, De Cupere B, Van Neer W, Bartosiewicz L, Linderholm A, Barnett R, Peters J, Decorte R, Waelkens M, Vanderheyden N, Ricaut FX, Rus Hoelzel A, Mashkour M, Karimlu AF, Seno SS, Daujat J, Brock F, Pinhasi R, Hongo H, Perez-Enciso M, Rasmussen M, Frantz L, Megens HJ, Crooijmans R, Groenen M, Arbuckle B, Bennecke N, Vidsarsdottir US, Burger J, Cucchi T, Dobney K, Larson G. 2013. Pig domestication and human-mediated dispersal in western Eurasia revealed through ancient DNA and geometric morphometrics. *Molecular Biology and Evolution* 30(4):824–32.
- Owen J. 2005. The rise and fall of the Philistine pig: an investigation of a pig assemblage from Tel Miqne-Ekron [MSc thesis]. Durham: University of Durham.
- Peters J, Pöllath N, von den Driesch A. 2002. Early and Late Bronze Age transitional subsistence at Tall al-'Umayri. In: Herr LG, Clark D, Geraty LW, Younker R, LaBianca ØS, editors. *Madaba Plains Project: The 1994 Season at Tall al-'Umayri and Subsequent Studies*. Berrien Springs: Andrews University. p 305–47.
- Raban-Gerstel N, Bar-Oz G, Zohar I, Sharon I, Gilboa A. 2008. Early Iron Age Dor (Israel): a faunal perspective. *Bulletin of the American Schools of Oriental Research* 349:25–59.
- Sapir-Hen L, Bar-Oz G, Gadot Y, 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, Gadot Y, Finkelstein I. 2014. Environmental and historical impacts on long term animal economy: the Southern Levant in the Late Bronze and Iron Ages. *Journal of Economic and Social History of the Orient* 57(5):703–44.

- Sapir-Hen L, Sasson A, Kleiman A, Finkelstein I. In press. Social stratification in the Late Bronze and early Iron Ages: an intra-site investigation at Megiddo. *Oxford Journal of Archaeology* 35(1).
- Sasson A. 2010. *Animal Husbandry in Ancient Israel: A Zooarchaeological Perspective on Livestock Exploitation, Herd Management and Economic Strategies*. London: Equinox.
- Shapiro B, Hofreiter H. 2012. *Ancient DNA: Methods and Protocols*. New York: Humana Press.
- Stager LE. 1995. The impact of the Sea People in Canaan (1185–1050 BCE). In: Levy TE, editor. *The Archaeology of Society in the Holy Land*. London: Leicester University Press. p 332–48.
- Tamar K, Bar-Oz G, Bunimovitz S, Lederman Z, Dayan T. 2013. Geography and economic preferences as cultural markers in a border town: the faunal remains from Tel Beth-Shemesh, Israel. *International Journal of Osteoarchaeology*. doi:10.1002/oa.2309.
- Tamar K, Marom N, Raban-Gerstel N. Forthcoming. The faunal remains from Tel-Rehov: 1997–2008 excavation seasons. In: Mazar A, editor. *Tel Rehov, Volume 1*. Jerusalem: Israel Exploration Society and Hebrew University.
- Uziel J. 2007. The development process of Philistine material culture: assimilation, acculturation and everything in between. *Levant* 39(1):165–73.
- von den Driesch A, Boessneck J. 1995. Final report on the zooarchaeological investigation of animal bone finds from Tell Hesban, Jordan. In: LaBianca ØS, von den Driesch A, editors. *Hesban 13. Faunal Remains: Taphonomical and Zooarchaeological Studies of the Animal Remains from Tell Hesban and Vicinity*. Berrien Springs: Andrews University. p 65–108.
- Yasur-Landau A. 2010. *The Philistines and Aegean Migration at the End of the Late Bronze Age*. Cambridge: Cambridge University Press.
- Zeder MA. 1996. The role of pigs in Near Eastern subsistence. A view from the Southern Levant. In: Seger JD, editor. *Retrieving the Past. Essays on Archaeological Research and Methodology in Honor of Gus W. Van Beek*. Winona Lake: Eisenbrauns. p 297–312.
- Zeder MA. 1998. Pigs and emergent complexity in the Near East. *MASCA Research Papers in Science and Archaeology* 15. Philadelphia: University Museum. p 109–22.
- Zimhoni O. 1997. *Studies in the Iron Age Pottery of Israel: Typological, Archaeological and Chronological Aspects*. Tel Aviv: Tel Aviv University.