Animal economy and social diversity in Byzantine Apollonia/Sozousa

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This article examines the faunal remains retrieved from two distinct refuse deposits dated to the Late Byzantine period (6th to early 7th centuries AD) at Apollonia. The refuse deposits were located on the southern (area M) and northern (area O) extremities of the Late Byzantine period occupation at the site, and are recognized as belonging to two different groups. Despite the sample size, a trend can be detected, shedding new light on social diversity at the site. Although both assemblages are dominated by domestic species, there are differences: mainly the relative frequency of domestic and wild game species, in addition to the frequency of skeletal elements and the mortality profiles of the main domesticates. These differences indicate that the inhabitants of the two areas may have employed different modes of economy. This may hint at their usage by different religious groups, Christians and Samaritans, which are known to have inhabited the site.

Keywords Apollonia/Sozousa, Late Byzantine, refuse disposal, social diversity, animal bones

Introduction

The choice of food, in addition to methods of production, preparation, consumption, and discard practices, is strongly related to the social diversity and identity of past societies (as reviewed in Gumerman 1997; Twiss 2012). Refuse deposits (especially pits) are a common feature in virtually every settlement of the Byzantine and Early Islamic periods in Palestine (Tal and Taxel 2012; Tal, Taxel and Jackson-Tal 2013). These centralized dumps offer an opportunity to study the remains of the meals of past populations, and through these to gain insight into the socio-economic structure of the community. Although Byzantine sites in the southern Levant are common, studies of their faunal remains are scarce (Cope 1999; Horwitz 1998; 2006; LaBianca and von den Driesch 1995) and often combine the faunal remains from the Byzantine with those from earlier or later periods (e.g. Dayan 1999; Horwitz *et al*. 1990; Sade 2007; 2012; Sasson 2009). Those focusing on the Byzantine period often discuss trends in animal economy on a chronological rather than contextual scale (that is, diachronic comparison with other periods, or synchronically with other sites, rather than a synchronic intra-site study). The current analysis is distinct, in that it focuses on an intra-site contextual analysis of faunal remains, and then discusses social diversity within an urban site inhabited by different religious groups, in this case Christians and Samaritans.

The social diversity at an urban site might be reflected in a few zooarchaeological characteristics: the identity of fauna consumed, their strategies of exploitation, the choice of which body parts to consume, as well as the methods of processing and cooking in preparation for consumption (Crabtree 1990; DeFrance 2009; Lev-Tov 2003; O'Day *et al*. 2004; Twiss 2007; Wapnish and Hesse 1988; Zeder 1991). These also testify to the social and economic relations between different parts of an urban centre, as it is indicative of the manner of distribution of meat products, i.e. whether meat is received directly through contact with herds or herders, or indirectly, perhaps a particular segment of the urban population, through specialized and regulated channels of distribution (O'Connor 2000: 160–74; Zeder 1991; for recent application of this model see Allentuck and Greenfield (2010) and Sapir-Hen *et al*. (2014)).

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Apollonia/Sozousa was the urban centre of the southern Sharon plain during the Byzantine period (for the historical sources, see Tal 2009: 320–21). The recent excavation of two distinct refuse deposits, found at the southern and western excavated extremities of the site (Fig. 1), both contemporaneous (in archaeological terms) and dated to the Late Byzantine period (6th to early 7th centuries AD), provides an opportunity to examine social diversity at the site as reflected in its animal remains. The fact that the site's Christian inhabitants lived side by side with a large and affluent Samaritan community (as indicated by the historical sources and archaeological evidence; cf. Tal (2009); and more below) promotes the study of the relationship and interaction between the two groups.

Large Late Byzantine-period off-site refuse dumps are not unusual in the archaeological record of the southern Levant, yet they are rarely studied for their impact on our understanding of dietary habits and animal economic diversity of the period. The two refuse deposits examined are located some 450 m apart, the refuse deposit from Area M on the south was excavated during an intense 4-week season in August–September 2006 (Tal 2010: 110–12), while that of Area O, on the north, was excavated in another intense 4-week season July–August 2009 (Tal 2010: 112–13). Area M exhibited a round refuse pit — completely excavated (*c*. 12 m maximum preserved diameter; 4.50 m in depth) and of Late Byzantine date (6th to early 7th centuries AD) — and containing substantial amounts of broken pottery (weighing some 15 tons in total), raw glass and fragmented glass vessels (Freestone *et al*. 2008), metal objects and animal bones that were intentionally accumulated in a recess in the ground in a series of superimposed layers. The refuse from area O was in fact intentionally accumulated inside the round collecting (fermentation) vat of a winepress (size *c*. 3×2.25 m), after it ceased to function, during the early 6th century (possibly in relation to the Samaritan revolt of AD 529) as indicated by the 6th (and possibly early 7th) century pottery and glass recovered with the bones (Tal 2009; Tal and Taxel 2012).

In this paper we wish to explore the animal economy at Byzantine Apollonia/Sozousa, and gain insight into the daily life and the identity of the inhabitants of the site as reflected in the animal remains. We compare the zooarchaeological characteristics of the two refuse deposits in order to shed light on the activity that took place in different areas, and the interaction between them. Studying the two contexts separately and then comparing them to each other better reflects the daily life at the site as both assemblages are derived from well-dated, relatively short-term, well-stratified and secured deposits, which in a sense compensates for their relatively small size.

Materials and methods

All animal remains were hand collected. Identification of skeletal elements and species was achieved using the comparative collections stored at the Institute of Archaeology and the Steinhardt National Collections of Natural History at Tel Aviv University. Distinguishing sheep (*Ovis aries*) from goats (*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 grouped in a sheep/goat (caprines) category. Determination of the domestic status of pigs (*Sus scrofa*) is based on measurements compared to wild boar measurements (Hongo and Meadow 1998). Bone fragments that could not be identified to species, such as vertebrae, ribs, and long bone shafts were assigned to one of four body size groups: A (cattle/deer/horse/donkey), B (caprines/gazelle), C (dog), and D (fox, cat, hare) size.

Identified long bone fragments were coded according to the completeness of five morphological zones (proximal epiphysis, proximal shaft, shaft, distal shaft, and distal epiphysis). Other bone fragments were coded according to their percentage of total completeness. The percentage completeness was used to calculate MNI and MNE (see below). Recorded elements were inspected for various macroscopic bone surface modifications such as butchery marks (typology according to Binford 1981) and signs of animal activity (e.g. rodent gnawing, carnivore punctures, scoring, and digestion; Lyman 1994), weathering (Behrensmeyer 1978) and pathologies.

NISPs (number of identified specimens) were used as a basic measure of taxonomic abundance (Grayson 1984). MNI (minimum number of individuals), as an additional measure of taxonomic abundance, was calculated on the basis of MNE (minimum number of elements) (see below) of the most abundant skeletal element of a specific species. The relative abundance of skeletal elements was quantified using MNE. MNEs were calculated based on the most abundant element zone (either: proximal epiphysis, proximal shaft, shaft, distal shaft, and distal epiphysis), to avoid overlap of specimens (Dobney and Reilly 1988).

The frequencies of skeletal elements were calculated by dividing the observed MNE values of skeletal element i (N_i) in the assemblage (per species), by the

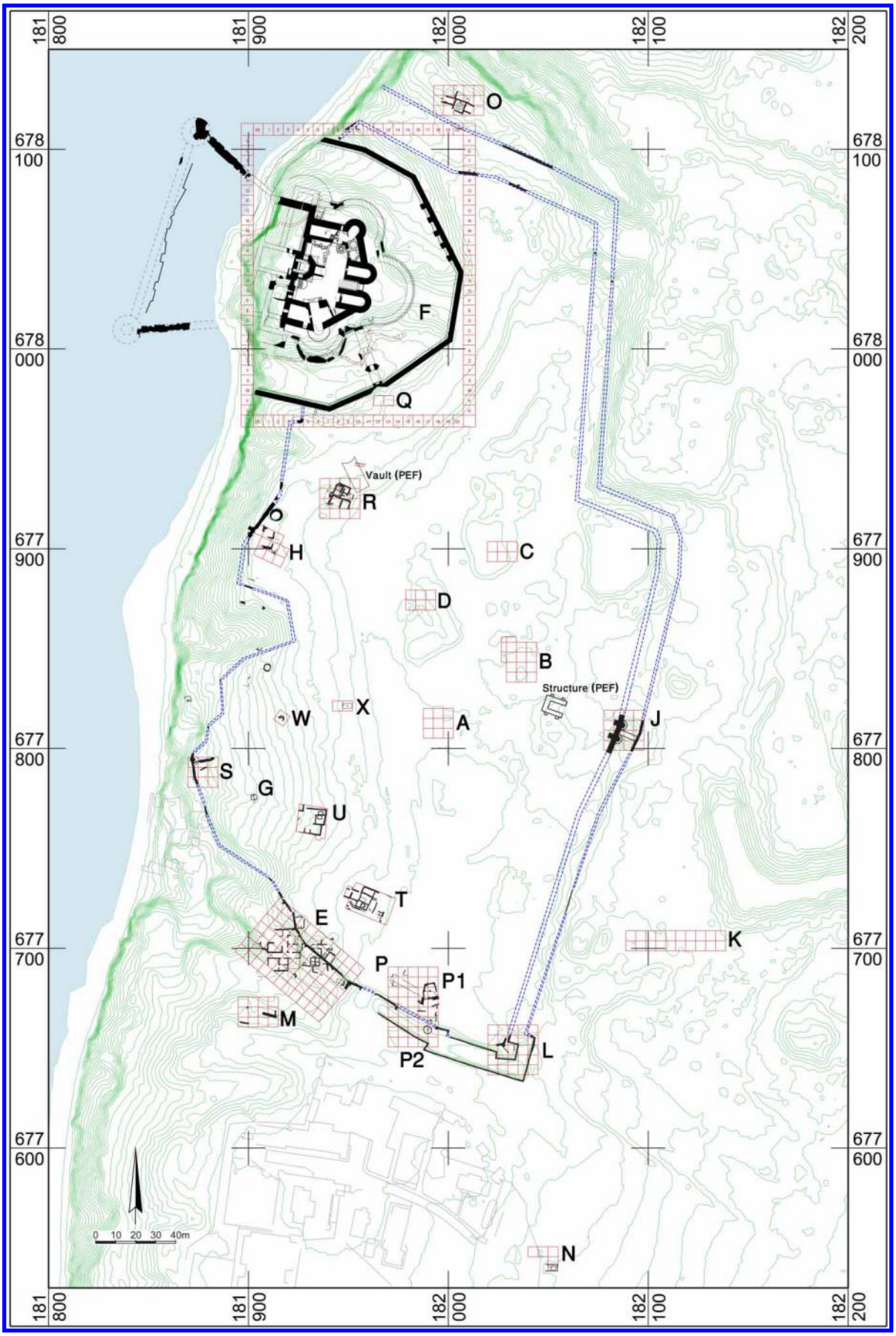

Figure 1 Site map of Apollonia (after the 2014 season).

Table 1 Frequencies of species by assemblage (NISP)

Species	Common name	Area M (L. 7061)		Area O (L. 8061)		Total
		NISP (MNI)	NISP%	NISP (MNI)	NISP%	NISP (MNI)
O. aries/*C. hircus*	Caprines	66 (4)	22.60	40 (4)	52.63	106 (8)
O. aries	Sheep	6 (1)	2.05	0	0	6 (1)
C. hircus	Goat	3 (1)	1.03	1 (1)	1.31	4 (2)
B. Taurus	Cattle	62 (3)	21.23	26 (5)	34.21	88 (8)
S. scrofa	Pig	23	7.88	1	1.31	24
Equus sp.	Horse/donkey	0	0	2	2.63	2
Canis sp.	Dog	10	3.42	0	0	10
G. gazella	Gazelle	3	1.03	0	0	3
C. elaphus	Red deer	1	0.34	0	0	1
U. arctos	Bear	1	0.34	0	0	1
G. gallus domestica	Chicken	63 (7)	21.57	2 (1)	2.63	65
Other birds		12	4.1	0	0	12
Rodents		1	0.34	0	0	1
Body size A		9	3.08	4	5.26	13
Body size B		24	8.22	0	0	24
Body size C		5	1.71	0	0	5
Body size D		3	1.03	0	0	3
Total		292		76		368

expected MNI value (the frequency of skeletal element i in one skeleton (E_i), multiplied by MNI) ($R_i = N_i/(\text{MNI})E_i$; adapted from Andrews (1990); method reviewed in Lyman (2008: 238)). This procedure normalizes the observed MNE to a model skeleton and enables the comparison between different assemblages. Frequencies of vertebrae, which are not often identified to species, were included in this analysis, when vertebrae from body size A are grouped with the cattle, and body size B grouped with the caprines. This was done with confidence as other species attributed to that body size are nearly absent from the assemblage. The age of death of caprines' was analysed in order to study their exploitation. It was based on the timing of epiphyseal fusion sequences (Zeder 2006), and tooth eruption and tooth wear (Payne 1973) of isolated mandibular teeth (M3, Dp4).

Results

A total of 775 bone fragments were collected, of which 368 (NISP) were identified to skeletal element and to the lowest taxonomic level possible. Both assemblages are dominated by livestock animals, but differ in their relative frequency (Table 1; Fig. 2). They include caprines (sheep [*O. aries*] and goat [*C. hircus*]; O: NISP = 41, 53%, M: NISP = 75, 25%) cattle (*Bos taurus*; O: 26, 34%, M: 62, 21%), pig (*S. scrofa*; O: 1, 1.3%, M: 23, 7.8%), and chicken (*Gallus gallus*; O: 2,

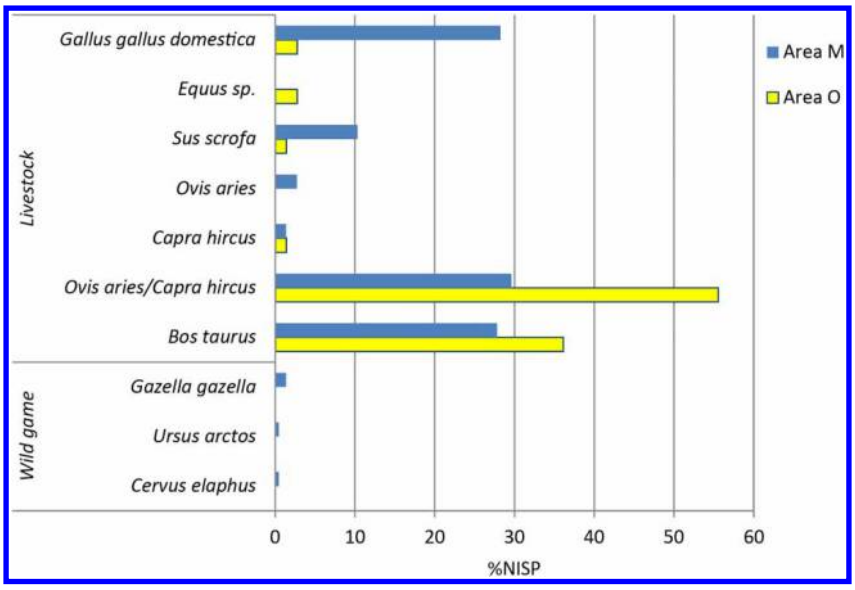

Figure 2 Species relative frequency (NISP%) in area M (L. 7061) and area O (L. 8061).

Table 2 Occurrence and typology of butchery marks (following Binford 1981)

Species	Element	Stage	Area M (L. 7061)	Area O (L. 8061)
Body size B	Pelvis: ilium	Dismembering	1	
	Tibia	Undefined	1	
B. taurus	Humerus	Filleting	1	
	First phalanx	Undefined	2	
	Tarsal: astragalus	Dismembering	1	
	Metatarsal	Dismembering	1	
	Metatarsal	Filleting	1	
	Vertebra: axis	Dismembering	1	
G. gazella	Tibia	Undefined	1	
Caprines	Mandible: mandibular hinge	Dismembering	1	
	Mandible: ramus	Dismembering		1
	Metatarsal	Dismembering	1	
	Rib	Filleting	1	
	Rib	Dismembering	1	
	Skull: parietal	Skinning		1
	Vertebra: sacrum	Dismembering		1
S. scrofa	Femur	Undefined	1	
	Tibia	Dismembering	1	
	Metatarsal	Dismembering	1	
Total			17 (5.82%)	3 (3.94%)

2.5%, M: 63, 21%). A few equid remains (*Equus* sp.; O: 2) were identified in area O, but could not be attributed to species (horse or donkey). Wild game was found in area M, and includes gazelles (*Gazella gazella*; M: 3) and red deer (*Cervus elaphus*; M: 1). A single first phalanx (toe bone) of brown bear (*Ursus arctos*) was also found in area M.

The state of preservation of bones is very good. All were recorded at weathering stage of 0–1, and no carnivore damage was evident, implying the bones were discarded quickly and not left exposed on the surface. No bones were burnt. Butchery marks (Table 2) are abundant in area M and represents all stages of preparing the animals for consumption (skinning, dismembering, and filleting). Only a few butchery marks were recorded from area O.

The mortality profiles of the caprines enable the examination of their strategy of exploitation. The age profiles of both assemblages were reconstructed based on tooth wear analysis (Payne 1973) and on the stage of long bones fusion (Zeder 2006). The two methods yielded different results, and it should be noted that the sample size of teeth and bones that could be aged is very small and could produce a bias. Based on the fusion stage, it seems that area M focused on slaughtering very young and very old individuals (Table 3), which fits the model of milk/wool production suggested by Payne (1973). Area O focused on slaughtering at prime age (Table 3), which fits Payne's (1973) model of meat production. However, age profiles based on tooth wear (Table 4) show that both areas exploited prime ages as well as adults. Assuming that the results overlap and complement each other, it seems that both areas focused on meat as well as on secondary products, but that area O reveals a greater emphasis on animals of prime age.

Only one pig bone (tibia) could be measured in order to define its status (domesticated or wild). It yielded measurements smaller than those for wild boar ($B_d = 28.61$ mm, $D_d = 24.5$ mm). Both assemblages yielded different frequencies of skeletal elements for both caprines and cattle (Fig. 3): although the sample size is small, caprine and cattle assemblages from area M display representation of all groups of body-parts; both those considered butchery waste and meaty parts. The caprines and cattle

Table 3 Fused and unfused elements of caprines (following Zeder 2006)

No. of months		Area M (L. 7061)			Area O (L. 8061)		
		Fused	Unfused	%Unfused	Fused	Unfused	%Unfused
6–12	Distal humerus	4	0		0	0	
6–12	Pelvis	2	1		2	0	
6–12	Scapula	5	1		2	0	
	Total	11	2	15.38	4	0	0
12–18	Second phalanx	3	0		0	0	
12–18	First phalanx	3	0		1	0	
18–30	Distal tibia	2	0		0	0	
18–30	Distal metacarpal	0	0		1	1	
	Total	8	0	0	2	1	33.33
30–48	Calcaneus	0	1		0	0	
30–48	Proximal ulna	2	0		0	0	
30–48	Distal radius	1	0		0	0	
30–48	Proximal tibia	1	0		0	0	
	Total	4	1	20	0	0	0

Table 4 Tooth wear stage of caprines (following Payne 1973), mandibular M_3, and dP_4

Tooth	Stage	Area M (L. 7061)	Area O (L. 8061)	Estimated age (years)
dp4	D	1		1–2
M3	D	1	1	1–2
	E		1	2–3
	F	2	1	3–4
	G/H		1	6
	I		1	8+

assemblages from area O do not include vertebrae or feet, the latter are the meat-poor parts (however, they do include some lower limb parts).

A few pathologies were found on the cattle mandibles from area O (Fig. 4). One of them displays resorption of the alveolar margin around most teeth exposing the top of roots, due to periodontal disease. The second displays a severe swelling of the mandible, beneath the tooth row; the swollen areas of the mandible are rounded and smooth. Most probably this is

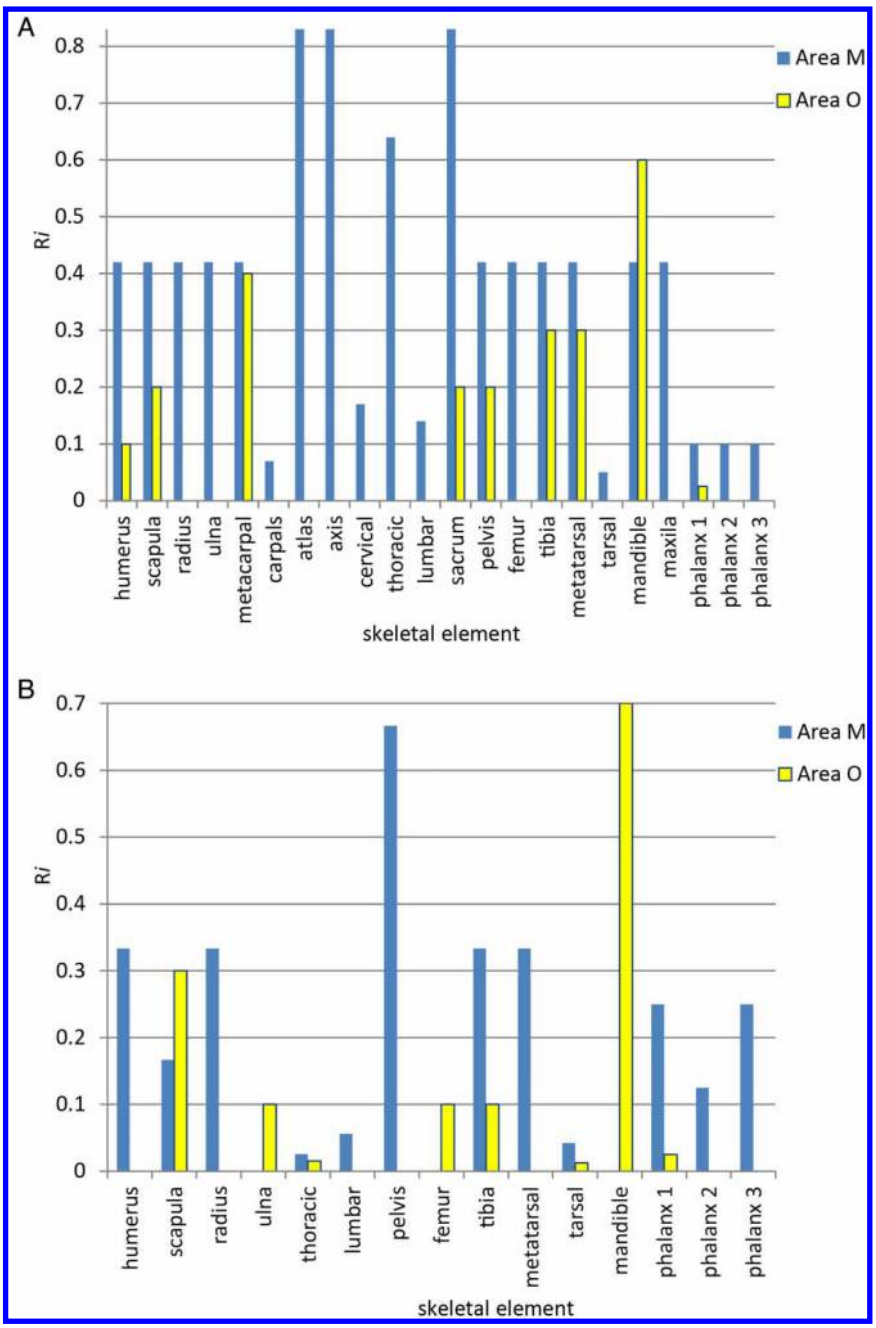

Figure 3 (A) Skeletal elements frequency (R_i) of caprines in area M (L. 7061) and area O (L. 8061). (B) Skeletal elements frequency (R_i) of cattle in area M (L. 7061) and area O (L. 8061).

Figure 4 Pathologies on cattle mandibles.

associated with an abscess in that region, resulting in inflammation of the gum. The third displays a deformation of the jaw, in an irregular angle.

Discussion

The Byzantine animal economy in Apollonia is based on livestock husbandry, supplemented with minor game hunting, as is common in other sites from that period (Cope 1999; Horwitz 1998; 2006; LaBianca and von den Driesch 1995). The present study of two distinct refuse deposits derived from the activities of, probably, two different groups (see below) sheds light on social diversity within the town of Apollonia/Sozousa. Considering that the both refuse deposits were excavated completely and that they are dated to a specific time frame (probably sometime in the mid–late 6th/early 7th century AD), we believe that the assemblages can be taken to represent the activity at the site at the time, and that a trend can be detected, despite the sample size. Moreover, the taphonomic analysis shows that bones were not left on the ground, but were discarded and covered quickly, suggesting that the remains were intentionally discarded as refuse. The refuse deposits in areas M and O differ on several points: the relative frequency of the livestock animals represented in each refuse pit, the identity of additional animals consumed/exploited, the representation of body parts of the major species, their strategies of exploitation as reflected in the mortality profiles.

Species frequency is the most significant difference between areas. The refuse pit in area M contains caprines, cattle, and chicken in relatively equal proportions, in addition to domestic pig and wild game remains. Poultry provides an available cheap meat source compared to cattle or caprines. The latter were also kept for their secondary products, making them even less available for early slaughter. The significantly lower quantities of richer meat (caprines and cattle) and the dominance of chicken remains suggest that the inhabitants of that area were of lower status when compared to those in area O (see below). The relatively high frequency of poultry is common at Roman–Byzantine sites in the southern

Levant (Horwitz 1998). Pig remains are also associated with the lower classes, as pigs have the advantage of being fed on an inexpensive diet of garbage, rather than needing to be driven to pasture. They also mature quickly and provide ample meat considering the low level of investment required (Cope 1999; Hesse and Wapnish 1998; Zeder 1996). Although the frequency of hunted game animals is very low, their presence in the area M assemblage and absence from that of area O might also stem from the different status. Diversifying the subsistence base, as seen in area M (diversity as a factor of richness and evenness, i.e. the number of species and their relative frequency; cf. Begon *et al*. 1996) is considered to be a strategy for minimizing risk; one practised by the lower classes (Allentuck and Greenfield 2010). It can also stem from direct contact with the herd or herder, as opposed to lower diversity that results from indirect distribution (Zeder 1991). Other than the species representation and frequency, the frequency of skeletal elements of caprines and cattle from area M indicate all body parts — meaty parts as well as butchery waste. In addition, all stages of preparing the animal for consumption are evident. These points argue that animals were raised and slaughtered on site. The exploitation of these animals was directed towards primary, as well as secondary products that may have been used in the market economy. That the inhabitants at area M raised their own livestock, implies that the urban population actively managed production and maintained herds.

The refuse deposit in area O, located in the northern edge of the site, is dominated by caprines, followed by cattle. Pig and chicken are nearly absent and wild game is completely absent. Therefore, the diversity of species in this area is low compared to area M. While the absence of rare fauna such as wild game may be related to the small sample size in area O (with a small sample you are less likely to find the rare species; Lyman 2008: 71–78), and the near-absence of pig remains may be attributed to their identity as Samaritans (see below), the near-absence of chicken remains is intriguing, as they constitute a significant part of the assemblage from area M. The cattle and caprines are considered the more luxury meat of the wealthier people (as suggested by Broshi (1986) regarding ancient Palestine in the Roman period; Dauphin 1989). Elites may consume expensive resources because the food symbolizes their wealth, i.e. they can 'afford' it (Gumerman 1997). Cattle and caprines are certainly more 'expensive' to raise than chickens and provide significantly higher quantities of meat. Considering the skeletal elements representation in area O, it appears less complete. This implies that, in contrast to area M, area O's inhabitants were supplied with meat. The mortality profiles also suggest an exploitation pattern more focused on animals of prime age in area O. Thus the inhabitants of area O, when compared to those of area M, appear to hold higher status, and are supplied with meat rather than having direct contact with the herd or herders.

The pathologies of the cattle mandibles reported above from area O most probably relate to types of fodder available to livestock and do not result from malnutrition (Davies 2005). Although pathologies are not often reported from archaeological sites (Sapir-Hen *et al*. 2008), it does not imply that they are not present, but rather demonstrates the inadequacy of the reports.

The differences between the refuse deposits of the two populations located on the southern and northern extremities of the site, testify to different modes of economy employed in those two areas, and may also have implications with regard to the relationship between them. Theoretically, a difference in species composition may be attributed to environmental constraints, but, dealing with a single site eliminates the influence of this factor. Cultural differences, rather than status, may also be responsible for a difference in the choice of food and its methods of preparation and consumption (see Gumerman 1997; Mintz and Du Bois 2002; Pearson 2003; Twiss 2007; 2012 and references therein). Still, in the current study, the difference in species frequencies cannot be attributed entirely to culture, as chicken is a common food source for all populations in the Byzantine period. The choice of body parts and their preparation for consumption, however, may well be culturally related: although studies of other assemblages from the period do not show a specific pattern that could originate from religious prescriptions. Moreover, while all the zooarchaeological characteristics of the northern refuse deposit (area O) testify to a higher (compared to area M) status population, which was probably not directly involved in agricultural production, those from the southern area (area M) imply a population of lower status. These differences between the assemblages imply that they are located at different points along the food distribution line. It seems that the population in area M was producing its own food, raising its own livestock or had direct contact with herders. It is possible that they were also the suppliers of meat to the inhabitants of area

O, rather than an external supplier, but this suggestion cannot be confirmed by the animal remains alone.

A previous analysis of area O (Tal 2009) suggested that the winepress complex, that bears a Greek inscription reading 'One God Only', attests to its Samaritan ownership given its *comparanda*. As stated above, the animal bones of area O studied here were intentionally accumulated inside the round collecting vat of the winepress, after its primary usage had ceased — by the early 6th century according to the pottery and glass recovered with the bones which can be dated to the 6th and early 7th centuries AD. The winepress did not suffer a clear destruction and its vat retains liquid to this day; hence we were inclined to consider the intentional filling of the vat with refuse as an act related either to Justinian's law (*c.* AD 527–531) prohibiting Samaritan gatherings of any kind, thus encouraging the destruction of Samaritan synagogues (*Samaritarum synagogae destruuntur*) and other productive operations of larger scales (Krueger 1877: 1.15.17), or to the edicts against the property rights of the Samaritans included in the *Novellae* enacted during the period of the Samaritan Rebellion (AD 529).

It is likely then that even after the winepress complex ceased to operate, Samaritans were still using their holdings, possibly having the winepress vat intentionally filled with refuse in order to avoid its use by others. Such refuse could have served as fertilizer for the agricultural crops that were cultivated in nearby territory. The fact that the only type of lamp recovered from this refuse was Samaritan (Tal 2009: 323, fig. 6) supports our attribution. Most of the pottery vessels recovered from the vat were storage jars (roughly equally divided between Palestinian bag-shaped types and Gaza amphorae). Following restoration it is clear that some were usable at the time they were discarded (Fig. 5), providing further evidence for the intentional filling of the vat.

At a later stage (in either the late 6th or early 7th century) when the vat was completely filled with refuse, the entire area of the winepress complex was covered with debris from furnaces for the production of raw glass, which when dismantled to allow the hammering out of the raw glass, left a layer of raw glass production refuse 0.6 m deep. Elsewhere we suggested that raw glass production at Apollonia/Sozousa may have been a monopoly of the Church, which as an administrative body, was involved in the economy and daily life of the town, not to mention the important role it could have played in trade, including the circulation of raw glass (Tal *et al.* 2004: 66). If this was indeed the case we may suggest that ownership over the area of the winepress complex was only then transferred from the Samaritans to the Christian community.

As for area M, its relative proximity to the Byzantine-period church at the site (area K) may suggest that it was used by a Christian population.

Figure 5 Discarded pottery vessels from area O (L. 8061) winepress complex vat.

This can also take support from the notable presence of pig bones.

The faunal remains studied here came from two well-defined contexts, representing the activities of two distinct, but broadly contemporaneous groups. Given the above reconstruction, it is very tempting to consider the bone material recovered from area O as originally used by members of the site's Samaritan community, while that recovered from area M in the south can be attributed to a part of the settlement's Christian inhabitants. Regardless of their religious identity the faunal remains represent two different social classes, probably connected through an economic relationship.

As mentioned above, the social stratification conclusion in this study is based on Zeder's (1991) model. However, while Zeder's study is concerned with the emergence of early states at around 3000 BC, it is drawn upon the study of modern states (Zeder 1991: 9–22). One of her main conclusions regarding the Ur III period in Mesopotamia is that the proposed model cannot always be used to predict the degrees of economic specialization (Zeder 1991: 245–48). It seems to us that the model can be applied to the evidence for the Byzantine period, by which point urbanism was well advanced. As the textual and archaeological evidence of historical periods in the southern Levant is vast, little attention is paid to the animal remains from these sites and their study is currently limited. In the current article we seek to demonstrate that the animal remains can testify to aspects of social stratification and complexity that are not always apparent through other finds. This calls for further studies of the Byzantine animal economy and the interaction between various religious groups. Analysing well-stratified and secured refuse deposits, which are common on Byzantine sites in Palestine, often located just outside the inhabited area, and which are probably short-lived because of their consistent use and overall frequency, provides an opportunity for thoroughly investigating the animal economy of the period. Ironically, it may be that these very same characteristics have lead researchers to neglect the systematic study of Byzantine refuse deposits, thereby failing to identify their potential to enhance our understanding of past societies.

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Bibliography

Allentuck, A. and Greenfield, H. J. 2010. The organization of animal production in an early urban center: the zooarchaeological evidence from Early Bronze Age Titriş Höyük, southeast Turkey. In, Campana, D., Crabtree, P., Lev-Tov, J., deFrance, S. D. and Choyke, A. (eds) *Anthropological Approaches to Zooarchaeology*: 12–29. Oxford: Oxbow Books.

Andrews, P. 1990. *Owls, Caves, and Fossils*. Chicago: University of Chicago Press.

Begon, M., Harper, J. L. and Townsend, C. R. 1996. *Ecology: Individuals, Populations, and Communities*. London: Blackwell.

Behrensmeyer, A. K. 1978. Taphonomic and ecologic information from bone weathering. *Paleobiology* 4: 150–62.

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

Broshi, M. 1986. The diet of Palestine in the Roman period. Introductory notes. *Israel Museum Bulletin* 5: 41–56.

Cope, C. R. 1999. Faunal remains and butchery practices from Byzantine and Islamic contexts (1993–94 seasons). In, Holum, K. G., Raban, A. and Patrich, J. (eds) *Caesarea Papers 2*: 405–18. *Journal of Roman Archaeology*, Supplementary Series 35. Portsmouth: J. H. Humphrey.

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.

Dauphin, C. M. 1989. Plenty or just enough? The diet of the rural and urban masses of Byzantine Palestine. *Bulletin of the Anglo-Israel Archaeological Society* 17: 39–65.

Davies, J. J. 2005. Oral pathology, nutritional deficiencies and mineral depletion in domesticates — a literature review. In, Davies, J., Fabis, M., Mainland, I., Richards, M. and Thomas, R. (eds) *Diet and Health in Past Animal Populations: Current Research and Future Directions*: 80–88. Oxford: Oxbow Books.

Dayan, T. 1999. Faunal remains: areas A–G. In, Beit-Arieh, I. (ed.) *Tel 'Ira: a Stronghold in the Negev*: 480–87. Tel Aviv: Emery and Claire Yass Publications in Archaeology.

DeFrance, S. D. 2009. Zooarchaeology in complex societies: political, economy, status and ideology. *Journal of Archaeological Research* 17: 105–68.

Dobney, K. and Reilly, K. 1988. A method for recording archaeological animal bones: the use of diagnostic zones. *Circaea* 5(2): 79–96.

Freestone, I., Jackson-Tal, R. E. and Tal, O. 2008. Raw glass and the production of glass vessels at Late Byzantine Apollonia-Arsuf, Israel. *Journal of Glass Studies* 50: 67–80.

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

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

Hesse, B. and Wapnish, P. 1998. Pig use and abuse in the ancient Levant: ethnoreligious boundary-building with swine. In, Nelson, S. M. (ed.) *Ancestors for the Pigs: Pigs in Prehistory*: 123–36. MASCA Research Papers in Science and Archaeology 15. Philadelphia: University of Philadelphia Museum of Archaeology and Anthropology.

Hongo, H. and Meadow, R. H. 1998. Pig exploitation at Neolithic Çayönü Tepesi (southern Iran). In, Nelson, S. M. (ed.) *Ancestors for the Pigs: Pigs in Prehistory*: 77–98. MASCA Research Papers in Science and Archaeology 15. Philadelphia: University of Philadelphia Museum of Archaeology and Anthropology.

Horwitz, L. K. 1998. Animal bones from Horbat Rimmon: Hellenistic to Byzantine period. *Atiqot* 35: 65–76.

— 2006. Mammalian remains from areas H, L, P and Q. In, Mazar, A. (ed.) *Excavation at Tel Beth-Shean 1989–1996, Volume I: The Late Bronze Age IIB to the Medieval Period*: 689–710. Jerusalem: Israel Exploration Society and the Hebrew University of Jerusalem.

—, Tchernov, E. and Dar, S. 1990. Subsistence and environment on Mount Carmel in the Roman-Byzantine and Medieval periods: the evidence from Kh. Sumaqa. *Israel Exploration Journal* 40: 287–304.

Krueger, P. (ed.). 1877. *Cod. Iust. Codex Iustinianus, Corpus Iuris Civilis 2*. Berlin: Weidmann.

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

Lev-Tov, J. S. E. 2003. 'Upon what meat doth this our Caesar feed…?' A dietary perspective on Hellenistic and Roman influence in Palestine. In, Alkier, S. and Zangenberg, J. (eds) *Studien auf dem Weg zu einer Archaeologie des Neuen Testaments*: 420–46. Tübingen: Francke-Verlag.

Lyman, R. L. 1994. *Vertebrate Taphonomy*. Cambridge: Cambridge University Press.

— 2008. *Quantitative Paleozoology*. Cambridge: Cambridge University Press.

Mintz, S. W. and Du Bois, M. 2002. The anthropology of food and eating. *Annual Review of Anthropology* 31: 99–119.

O'Connor, T. 2000. *The Archaeology of Animal Bones*. Texas: Texas A & M University Press.

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 Books.

Payne, S. 1973. Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 23: 281–303.

Pearson, M. P. 2003. Food, identity and culture: an introduction and overview. In, Pearson, M. P. (ed.) *Food, Culture and Identity in the Neolithic and Early Bronze*: 1–30. British Archaeological Reports, International Series 1117. Oxford: Archaeopress.

Sade, M. 2007. Faunal remains. In, Gophna, R., Taxel, I. and Feldman, A. (eds) *Kafr 'Ana: A rural settlement in the Lod Valley*: 103–7. Salvage Excavation Reports 4. Tel-Aviv: Emery and Claire Yass Publications in Archaeology.

— 2012. The Archaeozoological finds. In, Fischer, M. (ed.) *Horvat Mesad: A Way Station on the Jaffa–Jerusalem Road*: 263–72. Tel-Aviv: Emery and Claire Yass Publications in Archaeology.

Sapir-Hen, L., Bar-Oz, G., Hershkovitz, I., Raban-Gerstel, N., Marom, N. and Dayan, T. 2008. Palaeopathology survey of ancient mammal bones in Israel. *Veterinarija ir Zootechnika* 42(64): 62–70.

—, Bar-Oz, G., Sharon, I., Gilboa, A. and Dayan, T. 2014. Food, economy and culture at Tel Dor, Israel: a diachronic study of faunal remains from 15 centuries of occupation. *Bulletin of the American Schools for Oriental Research* 371: 83–101.

Sasson, A. 2009. Faunal remains. In, Taxel, I. (ed.) *Khirbet Es- Suyyagh: A Byzantine Monastery in the Judaean Shephelah*: 183–85. Salvage Excavation Reports 6. Tel-Aviv: Emery and Claire Yass Publications in Archaeology.

Tal, O. 2009. A winepress at Apollonia-Arsuf: more evidence on the Samaritan presence in Roman-Byzantine southern Sharon. *Liber Annuus* 59: 319–42.

— 2010. Notes and news. Apollonia-Arsuf, 2006 and 2009. *Israel Exploration Journal* 60: 107–14.

—, Jackson-Tal, R. E. and Freestone, I. C. 2004. New evidence of the production of raw glass at Late Byzantine Apollonia-Arsuf, Israel. *Journal of Glass Studies* 46: 51–66.

— and Taxel, I. 2012. Socio-political and economic aspects of refuse disposal in Late Byzantine and early Islamic Palestine. In, Matthews, R. and Curtis, J. (eds) *Proceedings of the 7th International Congress of the Archaeology of the Ancient Near East, 12th–16th April 2010, the British Museum and UCL, London, vol. 1: Mega-Cities and Mega-Sites, the Archaeology of Consumption and Disposal, Landscape, Transport & Communication*: 497–518. Wiesbaden: Harrassowitz.

—, Taxel, I. and Jackson-Tal, R. 2013. Khirbet al-Ḥadra: More on refuse disposal practices in Early Islamic Palestine and their socio-economic implications. *Strata: The Bulletin of the Anglo-Israel Archaeological Society* 31: 117–48.

Twiss, K. C. (ed.). 2007. *The Archaeology of Food and Identity*. Occasional Papers 34. Cambridge: Centre for Archaeological Investigations, Southern Illinois University.

— 2012. The archaeology of food and social diversity. *Journal of Archaeological Research* 20: 357–95.

Wapnish, P. and Hesse, B. 1988. Urbanization and the organization of animal production at Tel Jemmeh in the Middle Bronze Age Levant. *Journal of Near Eastern Studies* 47: 81–94.

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

— 1996. The role of pigs in Near Eastern subsistence: a view from the southern Levant. In, Seger, J. D. (ed.) *Retrieving the Past*: 297–312. Winona Lake: Eisenbrauns.

— 2006. Reconciling rates of long bone fusion and tooth eruption and wear in sheep (*Ovis*) and goat (*Capra*). In, Ruscillo, D. (ed.) *Recent Advances in Ageing and Sexing Animal Bones*: 87–118. Oxford: Oxbow Books.

— 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.