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Wet sieving a complex *tell*: Implications for retrieval protocols and studies of animal economy in historical periods

Lidar Sapir-Hen [a, b, *], Ilan Sharon [c], Ayelet Gilboa [d], Tamar Dayan [b, e]

[a] Department of Archaeology and Ancient Near Eastern Cultures, Tel-Aviv University, Tel Aviv 69978, Israel
[b] The Steinhardt Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, Tel Aviv 69978, Israel
[c] Institute of Archaeology, Hebrew University, Mt. Scopus, Jerusalem 91905, Israel
[d] Zinman Institute of Archaeology, University of Haifa, Haifa 31905, Israel
[e] Department of Zoology, Tel-Aviv University, Tel Aviv 69978, Israel

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ABSTRACT

The understanding that fine mesh sieving is the optimal procedure for the recovery of minute finds poses two challenges for archeologists of historical periods: it is costly and time consuming, and it puts into question the value of data collected in excavations where sieving was conducted minimally or not at all. That hand picking causes loss of data pertaining to microfaunal remains is indisputable, but the extent of information loss regarding larger fauna is not as clear. In order to evaluate these challenges for macrofaunal remains, we carried out, for the first time, a comprehensive sieving experiment at Tel Dor, a multi-layered complex site, the most prominent site type in historical periods. We examine the effects of wet sieving on the macro- and microfauna frequencies, and discuss its implications in terms of the interpretations of the faunal assemblages and the choice of excavations' collection protocols. We demonstrate that while sieving has a substantial effect on microfauna frequencies, it has a limited effect on those of the macrofauna. We also suggest that faunal assemblages of livestock animals that were hand collected or partially sieved, are valid for comparison with sieved assemblages. Finally, we call for an explicit presentation of the retrieval protocol in site reports and other studies, differentiating clearly between sieved and un-sieved material, and raise some points for future discussion.

1. Introduction

The impact of sampling procedures on perceived species richness, diversity, and skeleton representation of faunal remains has gained a voluminous interest in the last 50 years, and is at the heart of many studies (e.g. Clason and Prummel, 1977; Grayson, 1984; Orton, 2000; Payne, 1972; Shaffer, 1992; Shaffer and Sanchez, 1994; Watson, 1972; and see an updated list in Lyman (2012: Table 1)). The understanding that fine mesh sieving is the optimal procedure for the recovery of minute finds poses two challenges for archeologists of historical periods: first, this procedure is very costly and time consuming, both in the field and during the steps following retrieval – identification and analysis and even storage (Orton, 2000). Where large scale removal of sediments is necessary, it may prove prohibitive. The second challenge is that it puts into question the value of data collected in excavations where sediments were not sieved at all or only on a limited scale. It is indisputable that hand picking (only) of microfauna such as fish and rodent bones causes significant loss of data (e.g., Lyman, 2012; Zohar and Belmaker, 2005; Gordon, 1993). In contrast, the degree of information loss regarding larger fauna is not as clear. Most previous studies of the latter issue focused either on mammals fox size or smaller (Shaffer and Sanchez, 1994) or lumped into one category all mammals heavier than 25 kg (e.g., Thomas, 1969; James, 1997). In studies of historical periods, however, where livestock exploitation is the main economic component, the main issue is: what kind of bias might we expect *within* the over 25 kg category? Payne's (1972) study, the most extensively cited on this topic, in which cattle, caprines, and pigs were dealt with separately, focused on a small sample from one trench and was not bolstered by statistical analysis. In order to address these challenges, we studied, for the first time, the effects of wet sieving on frequencies of animal remains of different size categories in a large multi-

* Corresponding author. Department of Archaeology and Ancient Near Eastern Cultures, Tel-Aviv University, Tel Aviv 69978, Israel.
E-mail address: lidarsap@post.tau.ac.il (L. Sapir-Hen).

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Table 1
No. of sieved ("sampled deposits"; SD) and entirely hand-picked (HP) loci per period and deposition type.

Period	Primary			Secondary		
	SD	HP	%s	SD	HP	%s
Iron I	11	15	42.31	16	80	16.67
Iron I/II	7	13	35.00	11	53	17.19
Iron II	6	32	15.79	12	87	12.12
Persian	8	27	22.86	11	57	16.18
Hellenistic	13	14	48.15	16	182	8.08
Roman	2	10	16.67	17	112	13.18
Total	**47**	**111**	**29.75**	**83**	**571**	**12.69**

layered urban Levantine *tell*. The statistical analysis focused on the effects of both the retrieval and interpretation of the assemblages.

The imposing size of the Levantine *tells*, their multiple occupation cycles, and their complex architecture, dictate large-scale removal of sediments during excavation; otherwise no contextual understanding of the finds, including zooarchaeological finds, would be possible. Moreover, the principal factor in site-formation of the typical *tell* site is recurrent large-scale construction. The role of dirt deposits in site-formation processes as well as the stratigraphic sequence, are usually imputed by their relation to the surviving architecture. Arguably, one cannot correctly interpret these processes without understanding the superpositional relationships of architectural *strata* - and this requires broad exposures, producing enormous amounts of sediments, which cannot be sieved in their entirety without disrupting the process of archaeological exploration. Thus, some sort of balanced sample-sieving protocol is called for, if the objectives of excavation, on both macro and micro level, are to be achieved. To date, excavations of the larger *tells* of the southern Levant indeed employ only partial sieving, a fact seldom mentioned in reports (but see Lev-Tov, 2012a, 2012b).

Mammal assemblages of historical periods in the southern Levant are dominated by large species: cattle, sheep, goat, and sometimes pig, which together constitute more than 90% of most assemblages and their exploitation is the focus of intensive research. Studies focusing on these taxa, which seek a regional/periodical perspective, often compare assemblages produced by different retrieval methods (e.g. recently Lev-Tov et al., 2011; Sapir-Hen et al., 2014a; Marom et al., 2014). The basic assumption, as stated by the authors of these studies, is that when comparing only larger mammals and posing questions regarding livestock economy, the recovery bias is not detrimental, and thus does not impact data interpretation. However, this assumption is not based on any empirical data.

In order to test the effect of sediment sieving on economic reconstruction, we look at several characteristics of livestock management - those that are usually examined in studies of historical periods. These include relative frequencies of species and of skeletal elements per species, and aging profiles. As well, since comparing frequencies between sites across time and space reveals patterns that can be related to production, consumption and discard practices (e.g., Zeder, 1991; O'Connor, 2000), evaluating the possible impact of differing retrieval methods on the above characteristics is crucial for understanding major issues in animal economy, and for assessing the validity of intra-site comparisons.

Our test-case *tell* is the site of the ancient port-town of Dor, spanning over 15 centuries of nearly continuous habitation – from the Bronze Age through the late Roman period (a full bibliography of nearly 500 items is available at http://dor.huji.ac.il/bibliography.html). During excavation seasons 2005–2009, we carried out a rigorous wet-sieving protocol at the site, which involved close cooperation between the excavation team with the zooarchaeologist on a daily basis. The assemblages collected during these seasons comprise a wealth of faunal remains which forms the basis of the current study, and they were previously examined from the taphonomic (Sapir-Hen et al., 2012) and cultural (Sapir-Hen et al., 2014b) perspectives. Previous studies (Sapir-Hen et al., 2012; Sapir-Hen et al., 2014b; Raban-Gerstel et al., 2008; Bartosiewicz and Lisk, in press) have shown that the animal economy at Tel Dor is based mainly on livestock husbandry, supplemented by exploitation of the littoral environment for fish, and a limited reliance on hunting wild fauna. As previously demonstrated, bones were well preserved, thus data are not affected by preservation biases (Sapir-Hen et al., 2012). Considering the wide exposures and the lengthy occupation period, Tel Dor offers an ideal case study.

We examine the effects of retrieval protocols on the frequencies and identity of faunal remains, and the possible inferences for studies of animal economy. We ask: (1) What is the significance of the effect of sieving on macro- and microfauna retrieval in terms of total number of specimens, species and skeletal element frequencies, in various size categories and in various periods. (2) Based on the above analysis, is the comparison between assemblages that were hand collected, sieved and partially sieved legitimate? (3) Finally, we aim to estimate the cost-effectiveness of various methods of collection on the retrieved fauna. Macrofaunal remains are the main focus of the paper, with a limited discussion of the microfaunal remains.

2. Materials and methods

Our study focused on the material excavated during 2005–2009 in four sub-areas of Area D (Areas D1, D2, D4, D5/former D1 low; see Gilboa and Sharon (2008)). Remains spanning the beginning of the Iron Age to the Roman period were excavated in this area during the years of this study. Bones were recorded in a meticulous protocol outlined in Sapir-Hen et al. (2012, 2014b), enabling high-resolution study of the faunal remains.

2.1. Sieving protocol

During these five excavation seasons, each about six weeks long, a systematic sieving process was employed. Between 450 and 700 dirt buckets were sieved in each season. A total of 22,500 L of sediment were wet-sieved, originating from 130 loci (out of 811 excavated), representing various deposition types following the definitions outlined in Sapir-Hen et al. (2012). In all, 30% of the loci in primary deposition and 13% of those in secondary deposition were wet-sieved (Table 1).

Each morning, loci destined for sieving were chosen in consultation with the area supervisor, based on field-discussions of the nature of each deposit excavated. Each area sieved one, or sometimes two loci a day, depending on available labor for sifting and picking (see below). All periods, types of sediment and contexts (primary and secondary) excavated during these seasons were sampled, with the exception of deposits known - or strongly suspected - to be mixed or disturbed (e.g. topsoil loci).

When a locus was designated to be sieved (termed here a "sampled deposit"), all the dirt buckets excavated prior to the designation were disposed-of and all previously-active hand-picked bone-baskets were tagged as such and closed and new ones opened. Dirt-buckets destined for sieving were lined with a flexible 1 mm (1/25″) mesh. Excavators were instructed to put all the excavated sediment into the mesh-lined buckets, uniformly filling them with excavated sediment to about ¾ of their capacity, and *not* to collect bones manually anymore, so the sieved sample would contain all the bones in the sediment. Supervisors were