Integrating inter- & intra-site analyses of Epipalaeolithic faunal assemblages from Israel

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Abstract
Inter- and intra-site variability in faunal assemblages from Epipalaeolithic sites in the southern Levant are investigated to identify broad patterns of human hunting efficiency and specific human activities at individual sites. The examination of eleven assemblages from the Mediterranean phytogeographic zone of Israel indicates a decline in human hunting efficiency across the Epipalaeolithic period. This decline is part of an intensified hunting strategy driven by human-induced resource depression of high-ranked large game taxa (ungulates). More detailed analyses at the site level indicate distinct variation in the use of fauna within individual archaeological sites. At Hilazon Tachtit taxonomic representation differs substantially among features in the cave. The differential deposition of fauna reflects specific burial customs including the selection of particular body parts and taxa as grave inclusions and consumption events. At Hayonim Cave uneven body part representation reflects variation in the function of different avian taxa as food and raw materials as well as the curation of specific bones for ornamental functions. Together, the intra- and inter-site analyses show that although humans selected particular taxa for specific purposes, prey choice was constrained by resource availability and the impacts of Epipalaeolithic hunters on their animal resources. In combination the two scales of analysis shed light on multiple dimensions of human behaviour providing a more robust picture than either analysis could alone.

1 Introduction
The Epipalaeolithic faunas of the southern Levant are characterised by new patterns of game exploitation, in particular, the addition of numerous low-ranked, small game animals to human diets (Bar-Oz 2004; Binford 1968; Davis 1983, 2005; Flannery 1969; Munro 2004; Stutz et al 2009; Tchernov 1993a, 1993b). Given this change, it is not surprising that much Epipalaeolithic research has centred on the economic themes of intensification, specialisation and diversification. In particular, archaeozoologists have emphasised the implications of new hunting strategies for the transition to agriculture that followed (Bar-Oz 2004; Munro 2001, 2004; Stiner 2005; Stiner et al 1999, 2000; Stutz et al 2009). More detailed evaluation of Epipalaeolithic faunas reveals meaningful intra-site variation that reflects human activities and events at the site level. Intra-site analyses can be used to detect a number of economic, social and ideological behaviours including the performance of repeated tasks or activities and discrete events such as feasts and burials. Synthetic and particularistic studies of past human behaviour are complementary scales of analysis that provide a rich, multidimensional picture of Epipalaeolithic human behaviour when integrated. Integration enables a single researcher to pose economic, social and ideological questions about individual archaeological sites and to situate them within a broad regional context.

This paper presents both inter- and intra-site data from a series of Epipalaeolithic assemblages from the southern Levant to illustrate the multiple dimensions of Epipalaeolithic faunas. Data are presented at two analytical scales. First, data for 11 Epipalaeolithic sites from the Mediterranean phytogeographic zone of Israel are summarised to assess the degree of economic intensification, specialisation and diversi-
The inter-site portion of this study measures changes in human hunting efficiency to investigate the degree of intensification, diversification and specialisation in human hunting behaviour during the Epipalaeolithic in the southern Levant. Here, intensification is defined as an increase in the amount of energy extracted from a given environment per unit time. Intensification is thus synonymous with a reduction in hunting efficiency—more energy is invested for each unit of energy returned. Specialisation and diversification represent opposite ends of the spectrum of taxa exploited by human hunters. Specialised hunters target one or few taxa, while a diverse diet is comprised of many taxa. Diversification thus refers to an increase in dietary breadth, while specialised hunting is expressed as narrow dietary breadth. Intensification and diversification reflect an imbalance between human population size and available resources. Imbalances may be caused by the impact of climate change on the availability of prey or by human hunting which can depress high-ranked prey types, decreasing their availability to human hunters (Broughton 1994; Lyman 2003).

The intra-site analyses seek to identify behaviourally meaningful variability in faunal disposal patterns within specific archaeological contexts. Intra-site patterning can be detected using a number of zooarchaeological measures. This paper focuses specifically on the spatial patterning of fauna across sites and on the representation of prey body parts. First, spatial variability in the distribution of fauna at the Late Natufian site of Hilazon Tachtit is examined to identify differential use of site features. Secondly, the body part representation of avian prey taxa from the Early and Late Natufian layers from Hayonim Cave is presented to reveal human curation behaviours. These are only two examples from a range of analytical techniques that can be used to identify specific human behaviours. The interpretations presented here are particular to the Epipalaeolithic time period in the Levant, but this multiscale approach can be applied on any temporal and spatial scale.

2 The sample

In the southern Levant, the Epipalaeolithic spans the years 21,500 to 13,000 cal BP and is traditionally subdivided into four cultural periods—the Kebaran (21,500–17,000 cal BP), the Geometric Kebaran (17,000–14,500 cal BP), the Early Natufian (14,500–13,000 cal BP), and the Late Natufian (13,000–11,500 cal BP). The Epipalaeolithic was a period of substantial climatic change. It begins at the end of the Last Glacial Maximum, a particularly dry and cold period in the southern Levant. From ca 19,000 cal BP onward conditions gradually warmed and became wetter peaking with the Bølling-Ållerød Interstadial (14,500–13,000 cal BP) which corresponds with the Early Natufian period (Bar-Matthews et al 1999). Circa 13,000–11,500 cal BP, the Younger Dryas, a global drying and cooling event interrupted this warming trend and conditions typical of the last glacial period returned (Bar-Matthews et al 1999; Frumkin et al 2000; Rasmussen et al 2006). In the Mediterranean region this was expressed as lower temperatures and drier conditions.

The faunal sample for the regional analyses derives from eleven Epipalaeolithic datasets (table 1). Six of these were collected wholly or in part by the author and the others derive from data published by Mary Stiner (2005) and Guy Bar-Oz (2004). All assemblages were identified and analysed following similar protocols. Assemblages were examined from each of the four Epipalaeolithic periods with three dating to the Kebaran, two to the Geometric Kebaran, two to the Early Natufian and four to the Late Natufian period. All assemblages derive from sites located within the Mediterranean phytogeographic zone (figure 1; table 1). Please note that the Hilazon Tachtit assemblage includes only fauna analysed up to the end of the 2001 season. Thus the special faunal assemblage from the grave in Locus 1, in particular the remains of more than 50 tortoises intentionally placed in the grave (Grosman et al 2008), is not included in the inter-site comparisons presented here.

This paper seeks to identify broad patterns in taxonomic abundance across a 10,000 year time span. To do so it must compare data from a broad array of taxonomic groups and assemblages with variable taphonomic histories. Efforts have been made to minimise potential biasing effects—assemblages are limited to the coastal plain and Mediterranean Hills and similar protocols were used to collect all data presented here. In addition, only assemblages with large sample sizes were selected for analysis (NISP>1800; table 1). Nevertheless, it is expected that some fac-
Table 1  Site names, cultural phases and time ranges of Epipaleolithic assemblages included in the regional sample

<table>
<thead>
<tr>
<th>SITE</th>
<th>CULTURAL PERIOD</th>
<th>TIME RANGE (CAL BP)</th>
<th>NISP</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HILAZON TACHTIT</td>
<td>Late Natufian</td>
<td>13,000-11,500</td>
<td>3007</td>
<td>Munro 2001, 2004, nd</td>
</tr>
<tr>
<td>HAYONIM TERRACE</td>
<td>Late Natufian</td>
<td>13,000-11,500</td>
<td>9424</td>
<td>Munro 2001, 2004, nd</td>
</tr>
<tr>
<td>HATOULA</td>
<td>Late Natufian</td>
<td>13,000-11,500</td>
<td>3400</td>
<td>Munro nd</td>
</tr>
<tr>
<td>HAYONIM CAVE</td>
<td>Late Natufian</td>
<td>13,000-11,500</td>
<td>5692</td>
<td>Munro 2001, 2004</td>
</tr>
<tr>
<td>HAYONIM CAVE</td>
<td>Early Natufian</td>
<td>14,500-13,000</td>
<td>8509</td>
<td>Munro 2001, 2004</td>
</tr>
<tr>
<td>EL-WAD CAVE</td>
<td>Early Natufian</td>
<td>14,500-13,000</td>
<td>2572</td>
<td>Rabinovich 1998; Munro 2001, 2004</td>
</tr>
<tr>
<td>HEFZIBAH 7-18</td>
<td>Geometric</td>
<td>17,000-14,500</td>
<td>8499</td>
<td>Bar-Oz &amp; Dayan 2003; Bar-Oz 2004</td>
</tr>
<tr>
<td>NEVE DAVID</td>
<td>Kebaran</td>
<td>17,000-14,500</td>
<td>2489</td>
<td>Bar-Oz et al 1999; Bar-Oz 2004</td>
</tr>
<tr>
<td>NAHAL HADERA V</td>
<td>Kebaran</td>
<td>21,000-17,000</td>
<td>19,295</td>
<td>Bar-Oz &amp; Dayan 2002; Bar-Oz 2004</td>
</tr>
<tr>
<td>HAYONIM CAVE</td>
<td>Kebaran</td>
<td>21,500-17,000</td>
<td>3575</td>
<td>Stiner 2005</td>
</tr>
<tr>
<td>MEGED ROCKSHELTER</td>
<td>Kebaran</td>
<td>21,500-17,000</td>
<td>1810</td>
<td>Stiner 2005</td>
</tr>
</tbody>
</table>

Figure 1  Map of Israel indicating sites included in this study
tors such as site function and location (ie, cave versus open air) may affect inter-assemblage variability. Likewise prey processing strategies may cause differential fragmentation of prey taxa, creating biases among taxa. These factors, however, are not expected to have the same effect on all of the assemblages from any one of the four cultural periods. They should not, therefore, bias the results from a given period in one particular direction in comparison to others and are not expected to have a substantial effect on broad trends. Possible exceptions are raised in the discussion.

The intra-site level analyses focus on three of the Natufian assemblages included in the regional analysis—the Late Natufian component from Hilazon Tachtít, and the Early and Late Natufian components from Hayonim Cave. Detailed taphonomic and quantitative data on these assemblages were recorded by the author.

3 Inter-site analysis

3.1 Methods

Human hunting efficiency in the Levantine Epipalaeolithic is measured using relative taxonomic abundance indices and prey mortality profiles. The data are summarised for each of the four Epipalaeolithic periods to highlight trends in hunting efficiency over time. Relative abundance indices compare the frequency of high- to low-ranked prey as a measure of hunting efficiency. Prey species are most often ranked according to their relative returns (body size) (Broughton 1994; Butler 2000; Cannon 2000; Madsen & Schmitt 1998; Winterhalder 1981) or in the case of similarly sized animals (small game), by their relative cost of capture (escape strategy; Stiner 2001; Stiner et al 1999, 2000). Technology may impact the relative capture costs of small prey taxa. In particular, nets, traps and bows and arrows can significantly reduce the capture costs of low-ranked fast small game animals such as hares and partridges (Jones 2006; Madsen & Schmitt 1998). Nevertheless, hunting technologies are costly to maintain and operate. Nets for example, require investment into the gathering of materials, manufacture and repair which usually occurs after every use (Bailey & Auger 1989; Lupo & Schmitt 2002). Despite increased yields, it is still more costly to capture fast-moving small game than a tortoise that can be captured by hand (Lupo & Schmitt 2002; Munro 2004).

In the Epipalaeolithic faunas the ungulates are the largest and thus the highest-ranked animals. Within the ungulate category the large ungulates (wild cattle) are ranked highest, followed by the medium (red deer, hartebeest, fallow deer, wild boar, wild goat) and small ungulates (gazelle, roe deer) The largest small game taxa are substantially smaller than even the smallest ungulate in the sample and are thus all small game are ranked below the ungulates. In contrast, the most common small game animals do not differ substantially in body size and thus are ranked by escape strategy. The slow-moving tortoise is ranked higher than the more difficult to catch and thus costly, small mammals (primary hares) and birds (primarily partridges).

Here, three relative abundance indices comparing taxa of different ranks are presented as independent measures of hunting efficiency. The first index compares the relative abundance of small ungulates to medium and large ones. The small ungulate category comprises nearly exclusively mountain gazelle (Gazella gazella), while the medium ungulate category is dominated by fallow deer (Dama mesopotamica) and smaller quantities of red deer (Cervus elaphus), wild boar (Sus scrofa) and wild goat (Capra aegagrus). The large ungulates include aurochs (Bos primigenius), and occasionally equids (Equus sp) and hartebeest (Alcelaphus bucephalus). Specimens assigned to genus and species were combined with specimens assigned to general body size categories (small, medium and large ungulates) for these analyses. The second index compares the abundance of ungulates to small-bodied game. The small game category includes prey less than 5 kg in weight, most importantly, hares (Lepus capensis), game birds (Alectoris chukar; medium bird), waterfowl (Anas sp, Anser sp [large birds] Fulica atra [medium bird] and others) and tortoises (Testudo graeca; see Appendix 1). The final index compares the abundance of small game taxa with different escape strategies—the slow-moving tortoise versus fast-moving prey (hares, game birds, waterfowl) types.

The examination of multiple indices that consider prey of different body sizes provides a more nuanced picture of economic change by reconstructing hunting efficiency at both regional and local scales. For example, the relative abundance of large- to small-bodied ungulates reflects hunting efficiency on a regional scale since these ungulates have larger home
ranges and lower population densities than the small-bodied taxa commonly captured by Epipalaeolithic hunters. In contrast, the relative abundance of small prey types illuminates human hunting efficiency at the local scale since small prey populations tend to have small home ranges, live at higher densities than their large prey counterparts, and are captured closer to home. Small game indices thus reflect hunting pressure and dietary stress on a local scale and provide good markers of site occupation intensity.

Prey mortality profiles provide an effective independent measure of human hunting efficiency for two primary reasons. First, because human hunting increases prey mortality, it releases a prey population from the constraints of carrying capacity and allows the populations to grow (Caughley 1977). Population growth heightens the relative proportions of juvenile animals in a population and translates to reduced availability of high-ranked adult gazelles for human hunters. Secondly, hunting efficiency should be reflected in the relative abundance of high-ranked (adult animals with greater meat and fat yields) to low-ranked (juvenile animals that yield less meat and fat) individuals within a single population (Broughton 1994; Stiner 1994). Decreased hunting efficiency should thus be expressed as an increase in the proportion of young individuals in the hunted assemblage. The abundance of gazelle fawns (<6 months of age) in relation to adults is presented here to examine changes in Epipalaeolithic hunting efficiency. The abundance of fawns is measured as the proportion of unfused first phalanges out of the total number of gazelle first phalanges (based on MNI). The gazelle first phalanx fuses by the age of 6 months (Davis 1980; Munro et al 2009).

3.2 Results

The ungulate index indicates a gradual increase in the relative abundance of small ungulates at the expense of medium and large ungulates throughout the Epipalaeolithic in the study region (Spearman’s rho=1, n=4; p=.1, n=4; figure 2; this is the minimum p value for this sample size). The largest ungulates never make more than incidental appearances throughout the sequence (8.1% maximum; see also Stutz et al 2009). In contrast, medium ungulates decline steadily in frequency over time (from 28.9% in the Kebaran to 4.7% in the Natufian), offsetting the increase in small ungulate abundance.

There is a substantial leap in the proportion of young gazelles in the Natufian, indicating a reduction in hunting pressure and dietary stress. The increase in small ungulate abundance suggests a shift in hunting strategy, possibly due to changes in environmental conditions or population dynamics.

![Figure 2](image-url)

*Figure 2* The proportion of small ungulates out of all ungulates (small, medium and large body-size groups); see Appendix 1 for data and sample sizes. Averages and standard deviations are provided for each cultural period. The ascending trend in the data is statistically significant (Spearman’s rho=1; p<.001; n=4).
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**Figure 3** The proportion of small game in each assemblage (ungulates, carnivores, and small game; see Appendix 1 for data and sample sizes). Averages and standard deviations are plotted for each cultural period. The proportion of small game in the Early and Late Natufian periods is significantly higher than the proportion in the Kebaran and Geometric Kebaran periods combined ($t=2.262; df = 9; p < .001$).

**Figure 4** The proportion of slow small game (tortoises) out of the total number of small game (small mammals, birds, tortoises etc; see Appendix 1 for data and sample sizes). Averages and standard deviations are plotted for each cultural period. The proportion of slow small game is significantly higher in the Kebaran period than it is in the Geometric Kebaran and Early Natufian periods combined ($t=2.57; df=5; p=.02$). The abundance of slow small game is significantly higher in the Late Natufian than in the Geometric Kebaran and Early Natufian periods combined ($t=2.57, df=5; p<.001$).
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Low-ranked small game taxa beginning in the Early Natufian period (Kebaran and Geometric Kebaran versus Early Natufian and Late Natufian- t=2.262; df=9; p<.001; figure 3). Small game abundance in both the Kebaran and Geometric Kebaran periods is low, but variable, ranging from 2.1 to 32.5% of the faunal assemblages. High proportions of small game however, are characteristic of both the Early (55.3%) and Late Natufian (49.6%) periods (figure 3). The heightened abundance of small game is largely caused by the capture of higher numbers of tortoises in both periods (see also Stutz et al 2009).

Pronounced changes in relative taxonomic abundance are also found within the small game fraction itself. Figure 4 depicts a significant leap in the abundance of fast small game between the Kebaran (28.2%) and the Geometric Kebaran (78.4%) and Early Natufian (71.9%) periods (Kebaran versus Geometric Kebaran plus Early Natufian- t=2.57; df=5; p=.02). Unlike the preceding two indices however, the trajectory of this measure is not unidirectional. The increase in fast small game reverses (20.3%) in the Late Natufian period, when slow-moving tortoises again dominate the small game assemblages (Geometric Kebaran plus Early Natufian versus Late Natufian- t=2.57; df=5; p<.001).

Finally, figure 5 shows the relative abundance of gazelle fawns aged six months and under based on the fusion of the first phalanx (based on MNI: Davis 1980; Munro et al 2009). Again, despite some variation, there is a statistically significant increase in the proportion of gazelle fawns in the archaeological record starting in the Early Natufian period (38.4% compared to 5.0% in the Kebaran; Kebaran and Geometric Kebaran versus Early and Late Natufian- t=2.31; df=8; p=.01). These high proportions are maintained through the Late Natufian period (22.7%). The high proportion of juveniles in the Natufian assemblages is of special interest given that juveniles often do not preserve as well as adults given their porous bone structure (Lyman 1994 and references therein; Munson 2000). Given the taphonomic bias against juvenile bones, if anything the proportion of juvenile gazelles will be underrepresented in comparison to adults. The high proportion of juvenile gazelles in both Natufian open air and cave sites suggests that this pattern is not substantially biased by preservational factors.

![Figure 5](image)

Figure 5 The proportion of gazelle fawns (<6 months) of all gazelle. Averages and standard deviations are plotted for each cultural period. The proportion of juvenile gazelles is significantly higher in the Early and Late Natufian periods than in the Kebaran and Geometric Kebaran (t=2.31; df=8; p=.01)
3.3 Discussion

Multiple lines of compelling evidence point to a decline in human hunting efficiency across the Epipalaeolithic period in the southern Levant. The evidence shows that decreasing availability of high-ranked prey forced hunters to accept lower-ranked taxa into their diet. Hunters thus invested more to obtain each unit of animal energy than they had previously. Together, the taxonomic abundance indices suggest that the drop in foraging efficiency was caused by human-induced depression of large game taxa rather than a climatically-driven shift in prey availability.

Human-induced resource depression is indicated first by the decline of the largest game animals (large and medium ungulates). The most common large ungulate, the aurochs, makes only rare appearances in the Epipalaeolithic assemblages, though it was quite abundant in Levantine Middle Palaeolithic assemblages (Stiner 2005; Speth & Clark 2006). Their low frequencies in the Epipalaeolithic assemblages indicate that their populations were probably depressed before this period even began (see also Stiner 2005; Speth 2004; Speth & Clark 2006). Active depression of medium-sized ungulates is apparent during the Epipalaeolithic (Munro 2009; Stutz et al 2009). Medium ungulates suffer steep declines in their abundance over time, although they are still well represented in the Kebaran and Geometric Kebaran periods, they make only small contributions to Natufian assemblages. The fact that the decline in large and medium ungulate taxa crosscuts major climatic events, in particular the Younger Dryas, confirms that the drop in availability is not related to climatic or environmental fluctuations (Munro 2004; Stiner 2001, 2005).

By the Natufian period, the dominant ungulate in human hunted assemblages is the small-bodied gazelle. Despite their abundance, gazelle populations were not spared the impacts of intensive human hunting. Unprecedented abundances of small game taxa and gazelle fawns, both of which provide substantially lower energetic returns than adult gazelle, point to the depression of gazelle populations by the Early and Late Natufian periods. Although the season of capture can affect the composition of prey age profiles, a purely seasonal explanation can not be accepted given the long-term directional nature of the shift in gazelle exploitation across the Epipalaeolithic. Furthermore, the wide range of ages represented in the gazelle assemblages (Munro 2001) and other archaeological indicators of long-term site occupation (Belfer-Cohen & Bar-Yosef 2000; Byrd 1989) indicates that the southern Levant was inhabited by residential populations of humans during the Natufian period. That high proportions of juvenile gazelles are found in sites of different size and functions during this period indicates that the pattern reflects a change in general foraging conditions.

Because of the high visibility of gazelle in Natufian assemblages, arguments have been made for a specialised gazelle hunting strategy in the Natufian period (Cope 1991; Crabtree et al 1991; Tchernov 1993b). Nevertheless, the preceding evidence indicates that intensive gazelle hunting is a response to declining availability of higher-ranked prey in the face of constant or potentially increased demand. That humans still took large ungulates when encountered is reflected in the consistent, though low representation of aurochs in Natufian assemblages. The Natufian strategy thus reflects one of intensification rather than of targeted specialised hunting. This intensified hunting regime persisted until the end of the Natufian period and into the early Neolithic when domestic sheep and goat were adopted in the region (Horwitz 1989, 1993; Horwitz et al 1999).

The diversification of human diets is also indicated by the expansion of dietary breadth across the Epipalaeolithic to include a variety of small-bodied taxa. This expansion in dietary breadth is not so much about the number of different taxa exploited, as it is about the types of prey and their frequency (Stiner et al 1999, 2000; Stiner & Munro 2002). In particular, an increase in the abundance of low-ranked, small game taxa beginning in the Geometric Kebaran attests to expanding dietary breadth. The magnitude of the increase in the proportion of fast small game taxa in the Geometric Kebaran may be exaggerated by the small samples of small game in the Geometric Kebaran assemblages and the location of both Geometric Kebaran sites in the sample on the coastal plain where small game taxa may have been less abundant than in the neighbouring Mediterranean Hills. This pattern becomes more pronounced in the Early Natufian. In summary, there is compelling evidence for widespread human-induced resource depression, intensified human hunting and expanded dietary breadth during the Epipalaeolithic peaking in the Early...
and Late Natufian periods.

There is one anomaly in the otherwise unidirectional intensification trend across the Epipalaeolithic sequence; the slow small game index (figure 4) suggests that there was a decline in site use intensity during the Late Natufian period. Although, the Late Natufians continued to capture large quantities of small game, the small game fraction is dominated by tortoises. The shift back to the reliance on this less costly species would not have been possible unless human demands on local small game resources declined suggesting a decrease in human site occupation intensity. Although people began to settle down into increasingly permanent villages starting in the Geometric Kebaran, and increasingly in the Early Natufian, they reverted to a more mobile settlement pattern in the Late Natufian period (Munro 2004). This return to a more mobile strategy is supported by several lines of archaeological evidence (Bar-Yosef & Belfer-Cohen 2002; Goring-Morris & Belfer-Cohen 1998, 2003). Together the ungulate and small game indices provide a more comprehensive view of human hunting pressures, by predicting hunting pressure on both regional and local (site use intensity) scales.

4 Intra-site analyses

4.1 Methods

Relative taxonomic abundance data from discrete spatial contexts (Locus 1, Locus 2 and Pit II) at the Late Natufian site, Hilazon Tachtit are compared to identify variability in the distribution of taxa across the cave. The features in Hilazon Tachtit were hewn out of the bedrock surface of the cave by humans. Locus 1 represents a slab-lined grave holding the remains of a middle-aged woman interpreted as a shaman (Grosman et al 2008); Locus 2 is a built structure that contains a dense trash deposit rich in cattle bones and capped by a primary human burial. Pit II is a deposit that is rich in miscellaneous bones representing a number of human individuals of different ages. Although some human body-parts (ie, hands and feet) are articulated, most are isolated (Grosman & Munro 2007). Relative taxonomic abundance data are examined for each 10 cm vertical spit within these three contexts to pinpoint where changes in taxonomic representation occur within the depositional sequence.

The relative frequency of avian (partridge and Falconiformes) body parts from both the Early and Late Natufian layers at Hayonim Cave are presented to evaluate the evenness of each taxa’s body parts and to compare representation among taxa. The analysis identifies the avian body parts that were preferentially transported to Hayonim Cave and interprets their primary function. Bar charts are used to depict the relative frequency of partridge and Falconiformes skeletal elements (MNE). This technique enables quick visual identification of anomalous representation. The Falconiformes category includes all birds identified to the Order Falconiformes, most commonly, Buteo buteo (buzzard) and Accipiter nisus (Eurasian sparrowhawk) (Munro 2001).

4.2 Results

4.2.1 Spatial analysis at Hilazon Tachtit

Significant differences in the spatial distribution of fauna exist among the three features examined from Hilazon Tachtit—Locus 1, Locus 2 and Pit II. The assemblage from Locus 1 for example, is nearly entirely comprised of tortoise fragments (figure 6)—77.3% of the assemblage compared to only 25.6% and 22.0% of the respective assemblages from Locus 2 and Pit II. In contrast, the gazelle is the most abundant species in Locus 2 (52.8%). All other taxa with the exception of the tortoise (25.6%) are rare in this area. Locus 2 is also the only area at the site where wild cattle bones make more than an incidental appearance (84.8% of wild cattle at the site are concentrated in Locus 2). Finally, Pit II contains the most even distribution of prey taxa—gazelle, partridge, tortoise and hare each comprise at least 17.5% of the assemblage. Gazelle are the least well represented of the four groups. Most interestingly, the proportions of partridge and hare are at least five times greater in this area than in the two loci.

A closer examination of taxonomic abundance in Locus 1 (figure 7) indicates changes in the distribution of the fauna with increasing depth. The same is not true of Locus 2 where the relative proportions of taxa are similar throughout (with the exception of cattle). Sample sizes in Pit II are too small to perform a similar analysis. In Locus 1 tortoises rise steadily in abundance with increasing depth, reaching their highest frequency at the bottom of the Locus (figure 7). The peak abundance of tortoise remains coincides with a human grave buried in primary position in the bottom 40 cm of Locus 1 (Grosman et al 2008). The highest concentration of tortoises is directly associated with this grave.
4.2.2 Body-part analysis at Hayonim Cave

The skeletal part profiles of partridge and Falconiformes (figures 8 and 9) are of special interest for two reasons:

1) an uneven representation of body parts, and in particular the dominance of one specific body part; and

2) substantial differences in the distribution of body parts for the two taxa (see also Pichon 1983; 1984, 1987; 1989; Tchernov 1993a,b,c, 1994).

The tibiotarsus is by far the most common partridge element. In both the Early and Late Natufian deposits it is more than twice as common (Early
The remaining partridge skeleton is dominated by the breast bones including the coracoid, scapula, sternum as well as the proximal humerus. Like the partridge, the Falconiformes are dominated by a single body part, but in this case, the foot and lower leg bones. The third phalanx (the claw) is the most common element in both the Early (MNE=10) and Late Natufian (MNE=4) assemblages. However, the first and second phalanges, and the tarsometatarsus are also well represented. Unlike the partridge, the meat-bearing bones of the pectoral girdle are not common at Hayonim Cave, although they are represented in both Early and Late Natufian assemblages. The similarity in body-part distribution during the Early and Late Natufian, despite different sample sizes, attests to the strength of this pattern.

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Figure 8 Body-part representation of partridges (*Alectoris chukar*) from the Early and Late Natufian deposits from Hayonim Cave. EN – Early Natufian; LN – Late Natufian
4.3 Discussion

4.3.1 Spatial analysis at Hilazon Tachtit
The differential distribution of fauna across spatially discrete features at Hilazon Tachtit is related to the type of activities undertaken in each area. In particular, the distribution of faunal remains is influenced by the special role that the site played as a location for human burial. Although some domestic activities were undertaken in the cave, Hilazon Tachtit functioned first and foremost as a human burial site (Grosman 2003; Grosman & Munro 2007). The relationship between the distribution of fauna and human burial practices is most clearly demonstrated in Locus 1. The bottom half of the Locus holds the grave of an older woman who has been interpreted as a ritual practitioner (shaman; Grosman et al 2008). Several lines of evidence confirm that the high proportion of tortoise fragments in the vicinity of this woman reflect the intentional burial of more than 50 complete tortoise carapaces in her grave (Grosman et al 2008). First, more than 50 articulated tortoise carapaces were recovered in direct

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Figure 9 Body-part representation of Falconiformes from the Early and Late Natufian deposits from Hayonim Cave
association with her skeleton and her prepared grave in the lower half of the locus. Some of these were located directly under the woman’s head and pelvis. Secondly, numerous other articulated carapace segments were recovered from amongst the thousands of isolated segments of tortoise shell recovered from the fill. During decomposition, the keratinous sheath that protects the bony tortoise shell deteriorates first. Next, the tortoise carapace separates at the bony sutures. Carapace segments sometimes remain articulated if the sediments are undisturbed or if the sediments become concreted between excavation and burial, but even slight disturbances after burial can cause the segments to separate and become isolated in the fill. Most of these tortoise fragments were thus probably articulated at the time of deposition. The MNE for a variety of diagnostic carapace elements from Locus 1 indicate high and fairly even representation of different parts of the tortoise carapace (the diagnostic nuchal scute, anal scute and the second, third, ninth, tenth and eleventh peripheral all represent 35 individuals at minimum; fauna excavated in the 2008 season, not yet analysed). Thirdly, the proportion of tortoises in Locus 1 increases with depth and proximity to the grave (figure 7). The high proportion of tortoises in Locus 1 is thus closely related to the systematic and intentional burial of multiple tortoises with the woman in the grave.

The taxonomic representation in Locus 2 is more similar to other nearby Late Natufian sites such as Hayonim Terrace and Hayonim Cave. The most anomalous pattern in this locus is the high proportion of cattle remains concentrated between the depths of 3.4 and 3.6 m below datum. The concentrated nature of the cattle remains, and their rarity elsewhere at the site, probably indicates a discrete depositional event—potentially a communal consumption event suggested by the large size (Twiss 2008) and infrequent occurrence of this animal (Grosman & Munro in prep). Finally, in Pit II, the high proportions of small fauna, in particular hares and partridges, the absence of large ungulates, and the comparatively low proportions of gazelle remains, suggests that the assemblage may have been created by a trickle down effect. It is likely the elements from the pit were initially deposited on the periphery of the site outside the special contexts in Locus 1 and 2. The small elements from these less protected contexts may have then filtered down into the narrow and deep Pit II along with a number of small, in many cases juvenile, human remains. This hypothesis will be investigated further when the analysis of the 2008 material is complete.

4.3.2 Body-part representation at Hayonim Cave
The skeletal remains of Falconiformes and partridges from Hayonim Cave are strongly biased toward particular regions of the body. The bias is most obvious for partridge which is dramatically overrepresented by the tibiotarsus. The next most common partridge element in both Early and Late Natufian assemblages is less than half as frequent. After the tibiotarsus, the coracoid, scapula, sternum and humerus—elements associated with the meatiest parts of the partridge skeleton—are best represented. Partridges were clearly hunted for their meat. In contrast, the Falconiformes skeleton is dominated by the foot bones, in particular the third phalanx. Although some meaty body parts are represented, they are much less common—Falconiformes were most valued for products such as bones (for ornaments) and, perhaps, feathers rather than meat.

Despite differences in body part representation, the most common partridge and Falconiformes elements were curated because of their value as ornaments (Pichon 1984; Tchernov 1993c). At Hayonim Cave 17.1% of distal partridge tibiotarsi were cut across the distal shaft, so that the distal end could be used as a bead (Munro 2001; Pichon 1983; Tchernov 1993a). Partridge tibiotarsi beads have also been recovered from the site of Eynan (Ain Mallaha) and Erq-el Aqmar in the Judean Hills (Belfer-Cohen 1988). The distal tibiotarsus contains a natural foramen that was probably used to string the beads with no additional modification. Partridges are the only taxa used for this function. Falconiformes phalanges also frequently served as ornaments for Upper Palaeolithic and Epipalaeolithic peoples in the Levant (Kuhn et al 2006; Rabinovich 1997; Stiner 2005). The avian foot is tightly encased in a sheath of ligaments, skin and scales that makes disarticulation of the foot elements difficult. Given the high representation of all Falconiformes foot bones and tarsometatarsi, it is likely that complete lower legs were transported to Hayonim Cave. Once there, they were processed for select elements or used whole for ornamental or symbolic reasons.

Despite their known ornamental function, the partridge tibiotarsi and Falconiformes phalanges were
less often modified than not. The high frequencies of these elements indicates that the Natufians recognised the secondary importance of this bone. They specially collected them and then curated them for future use even if they ultimately did not use them. Two caches at Hayonim Cave, one of gazelle horn cores and another of large ungulate ribs (some modified, but most unworked), attest to the perceived value of particular bones by the Natufians, who stockpiled them for later use. Knowledge of the worked bone industry at these sites proved essential for understanding the anomalies in body-part representation in these two taxonomic groups.

5 Combining inter-site and intra-site approaches

The intra-site analyses presented here indicate that Epipalaeolithic people in the southern Levant made specific choices about what animals were captured and consumed, where their remains were deposited, and which parts should be curated for future use. In addition, the distribution of animal taxa and body parts across habitation sites often reflects discrete activities enabling a high-resolution look at particularistic Epipalaeolithic behaviours. Despite the variety of choices that humans made and resulting intra-site variability, the inter-site regional analyses indicate notable uniformity in animal use among sites. The dominant factor controlling inter-site variability in the Epipalaeolithic sites presented here is time (ie, time period), rather than space, indicating that the most important changes in faunal exploitation are occurring on a regional scale and probably reflect changing availability of prey. In combination the intra- and inter-site analyses demonstrate that although humans did select particular types of prey and prey body parts for specific purposes including ritual use, their choices were constrained by resource availability that was in turn impacted by their own hunting practices. The different scales of analysis shed light on different dimensions of human behaviour. Combining them provides a more robust picture of human behaviour than can be gained by investigating either scale of analysis alone.

Acknowledgements

I would like to thank Levent Atici, my co-editor, for initiating the organisation of the symposium in which these papers were originally presented. In particular, he envisioned the papers in this volume as a series that together summarise the state of research on Epipalaeolithic faunas across the Mediterranean region and beyond. Thanks to Guy Bar-Oz and Mary Stiner for sharing data and ideas at all stages of this research programme. I am indebted to Gideon Hartman for drafting the map in figure 1 and running the statistical software. Finally, a special thank you goes to two anonymous reviewers for providing especially thoughtful, detailed and helpful comments on the initial draft.
### Appendix 1

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**TOTAL**

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**Appendix 1:** NISP values for all taxa included in the regional analyses. Site abbreviations are as follows: MEGD – Meged Rockshelter; HAYC – Hayonim Cave; NHV – Nahal Hadera V; HEFZ – Hefzibah 7–18; ELWC – el Wad Cave; HAYT – Hayonim Terrace; HTLA – Hatoula; HLZT – Hilazon Tachtit. Period abbreviations are as follows: KEB – Kebaran; GKEB – Geometric Kebaran; ENAT – Early Natufian; LNAT – Late Natufian. Game codes refer to the category that taxa was included in when taxa were collapsed into broader taxonomic groups for calculation of indices. LU – large ungulate; MU – medium ungulate; SU – small ungulate; SSG – slow small game; FSG – fast small game.
References


Grosman, L & Munro, ND 2007. The Sacred and the Mundane: Domestic activities at a Late

Grosman, L & Munro, ND in prep. Communal feasting at the Natufian burial site, Hilazon Tachtit (Israel).


