Levant

Environment, seasonality and hunting strategies as influences on Natufian food procurement: The faunal remains from Shubayqa 1

--Manuscript Draft--

Manuscript Number:	LEV-2017-007R1
Full Title:	Environment, seasonality and hunting strategies as influences on Natufian food procurement: The faunal remains from Shubayqa 1
Article Type:	Original Research Paper
Keywords:	Natufian; Hunting; Younger Dryas; Gazelle; Southern Levant
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Additional Information:	
Question	**Response**
Author Comments:	Potential reviewers are Guy Bar-Oz, Melinda Zeder and Lionel Gourichon as zooarchaeologists and Gary Rollefson and Alison Betts for general archaeology of the area.
Funding Information:	Det Frie Forskningsråd (DFF-4001-00068) — Tobias Richter Det Frie Forskningsråd (11-116136) — Tobias Richter Danish Institute in Damascas — Tobias Richter H.P. Hjerl Mindefondet for Dansk Palæstinaforskning — Tobias Richter Leverhulme Trust (RPG-2013-233) — Louise Martin

RESEARCH

Environment, seasonality and hunting strategies as influences on Natufian food procurement: The faunal remains from Shubayqa 1

Lisa Yeomans, Louise Martin and Tobias Richter

Analysis of the faunal assemblage from Shubayqa 1 allows detailed discussion of food procurement through the sequence of occupation spanning the Early and Late Natufian. This enables examination of the influence of climate, season of occupation and hunting techniques on the subsistence economy. It is argued that targeted prey varied throughout the year with mass hunting methods providing a large proportion of the meat. In the Late Natufian a decrease in passage migrant birds is interpreted as evidence for gradual drying of the environment or less reliable rainfall from year-to-year. Availability of resources was different in the two phases of occupation which, despite preceding the Younger Dryas, suggest environmental conditions were changing. However, subsistence strategies were easily amended to maintain a plentiful supply of food.

Keywords Natufian, hunting, Younger Dryas, Gazelle, Southern Levant

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Introduction

Changing environmental conditions in the Younger Dryas have been suggested as a major factor in the shift from hunting and gathering to agriculture in southwest Asia (Bar-Yosef 2002, 2009, Bar-Yosef and Belfer-Cohen 2002; Harris 2003; Henry 2013; Moore and Hillman 1992; Munro 2004). It was within this period of climatic variation that the Natufian culture became established (14,7-11,5 kyr cal BP) and a change in settlement patterns is apparent in the archaeological record. Early Natufian groups inhabited larger, longer-term settlements than previously witnessed and invested significant labour in constructing permanent architecture. Production of art objects as well as burial customs have been interpreted as manifestations of increased social complexity. These developments have been well recorded in the Mediterranean zone of the southern Levant at sites such as Ain Mallaha, Wadi Hammeh 27 and Hayonim Cave to name a few (Bar-Yosef 1998; Samuelian *et al*. 2006; Edwards 2013; Bar-Yosef and Belfer-Cohen 1999). The comparatively warm and moist conditions of the Bølling-Allerød interstadial (~14,7-12,9 kyr cal BP) created an environment rich in resources believed to have facilitated these changes in human settlement. The Late Natufian (~13,6-11,5 kyr cal BP) saw an apparent reversion to a more mobile way of life as human groups were forced to cope with diminished resources as a result of the onset of the Younger Dryas (~12,9-11,7 kyr cal BP) when the environment was colder and dryer with increased seasonal variation (Bar-Yosef and Belfer-Cohen 2002; Bar-Yosef 1998; 2002; 2009; Stutz *et al.* 2009). Moore and Hillman (1992; Hillman *et al.* 2001) have argued that Younger Dryas conditions were directly responsible for groups taking up plant cultivation at Abu Hureyra during the Late Natufian, a claim now disputed (Colledge and Conolly 2010). There is clearly a discrepancy between the dating of climatic changes and the observed cultural shifts (Grosman 2013; Maher *et al.* 2011; Meadows 2004). Whilst the influence of the Younger Dryas is well documented at more northerly latitudes (Alley 2000), effects across the varied environments of the southern Levant are less well known. Recent research suggests that the environmental footprint of the Younger Dryas was not as severe as previously assumed. Analysis of carbon isotope values stored within the enamel of gazelle teeth from Hayonim and Hilazon Tachtit caves indicate that the Younger Dryas in the Mediterranean zone saw colder but not dryer conditions (Hartman *et al.* 2015). Recent research at Nahal Ein Gev II suggests that at some Late Natufian settlements the population did not revert to a more mobile lifestyle at all (Grosman *et al.* 2016). At Wadi Mataha 2, Baadsgaard *et al.* (2010) note a shift in the subsistence strategies employed at the site between the Early and Late Natufian even though the effects of the Younger Dryas appear to have caused minimal climatic stress.

Whilst there are significant numbers of Early and Late Natufian sites with published faunal assemblages in the Mediterranean zone, there is a paucity of sites beyond this ‘core area’. The large assemblage from Shubayqa 1 offers a dataset to address changing food procurement strategies in an area where the impact of changing environmental conditions is currently a largely unknown factor. The Shubayqa 1 faunal assemblage is just one source of information that can later be integrated with on-going geoarchaeological and archaeobotanical research from the site to produce a more complete picture. For now, the prime aim of this paper is to present the zooarchaeological analyses of the Early and Late Natufian faunal assemblages from Shubayqa 1 in order to explore variations and shifts in the animal-based subsistence economy between the two phases. No faunal assemblage of comparable size has so far been studied from this period in the eastern ‘marginal zone’ of the southern Levant. A recent review of the Late Pleistocene and Early Holocene from this region only serves to highlight the Natufian data gap (Martin *et al.* 2016). In contrast, a number of Natufian sites are known from the semi-arid regions in southern Jordan and the Negev. Evidence for subsistence strategies and hunting practices at these sites provide comparisons to Shubayqa and are also discussed in this paper.

In the following section the debates on hunting strategies in the Late Epipalaeolithic of the southern Levant are reviewed, highlighting the underpinning zooarchaeological evidence for interpretations. Subsequently a brief background to Shubayqa 1 is presented and zooarchaeological methodologies are outlined before details of the faunal assemblage from Shubayqa 1 are introduced. As will become clear, the results show a notable difference in animal exploitation *between* the Early and Late Natufian, whilst variation *within* these phases is negligible. This pattern raises questions as to the factors, or combination of factors, driving the observed changes. The objective of this paper is to use the zooarchaeological data to assess the varying influences, such as changing local resource bases and shifts in human mobility and foraging areas, on changes in hunting and food procurement strategies at Shubayqa 1.

Influences on hunting in the Natufian

Changes to the organisation of human groups in the Natufian had an impact on the prey hunted by these populations in a number of ways. Davis (1983) suggested that an increase in the proportion of juveniles of the main prey species, gazelle, was related to a shift to year-round occupation of sites (see also Lieberman 1991). At Mousterian sites, Davis (1983) reports that 17% of gazelle bones are from juveniles compared to 26% in the Upper Palaeolithic to Early Natufian and at Hayonim Terrace the frequency was 33%. According to this argument, animals born in spring were hunted in summer months as part of the yearly cycle. Earlier sites, when populations were more mobile, are believed to have been occupied for longer periods in winter months. In these months the herd structure of gazelle would have included a lower frequency of juveniles as the birthing season was approaching. Differences in herd structure resulted in different mortality profiles of gazelle at sites occupied year-round and those used only in winter months.

Another impact on hunted fauna suggested by Stiner *et al.* (2000) was a decrease in the proportion of slow, easy to hunt prey such as tortoises relative to small fast prey such as hares. The basis of this argument is that sedentary groups would quickly exhaust the first of these resources in the vicinity of their habitation site since these animal populations would not be able to recover quickly due to a low reproductive rate. Once these resources were depleted hunters had to seek out more elusive prey such as hare. The effort taken to hunt small, fast prey was argued to be not worth the return that these animals provided until other potential resources had been spent. Pressure on resources in the Natufian has also been argued to result in intensive use of gazelle carcasses and increase in the proportion of juveniles (Munro 2004). Since mature animals provide more body fat and are a larger size than juveniles, Munro (2004) suggests that hunters will preferentially target adult animals resorting to juveniles under conditions of resource stress.

In addition to increased sedentism and/or pressure on resources influencing prey composition, Henry (1975) suggested that Natufian groups started using traps to surround herds of gazelle or drive them into a killing area. In such a scenario gazelle would become more dominant amongst the prey as people focused their efforts on this activity that yielded a high return of one species. A change in the mortality profile of the prey would also be expected to include a higher proportion of juvenile animals as entire herds would be taken. Legge and Rowley-Conwy (1987) suggested that whole herds were hunted in this manner at Abu Hureyra, on the Syrian Euphrates, based on the mortality profiles reconstructed from the faunal remains. The fusion state of the calcaneum bones from Abu Hureyra suggested that 34% of the animals were juveniles (Legge and Rowey-Conwy 1987). Interpretation of the Natufian assemblage from Salibiya I similarly attributed the high proportion of gazelle and their mortality profile to the practice of mass hunting techniques resulting in nearly 50% of the gazelle remains being juvenile (Campana and Crabtree 1990).

For the Early Natufian site of Wadi Hammeh 27, Edwards and Martin (2013) presented another possible explanation for the high frequency (48.6%) of juvenile gazelle in the assemblage. The site was occupied during the Bølling-Allerød interstadial when increased rainfall and other environmental conditions may have enabled female gazelles to have two fawns a year. Gazelle from this site were probably mountain gazelle (*Gazella gazella*) which is not a migratory species like the goitered gazelle (*G. subgutturosa*). Edwards and Martin (2013) pointed out that mass hunting is best suited to those species that form herds during migration and suggest that the high proportion of juveniles is more likely to be related to double-birthing than being evidence of communal or selective hunting at Wadi Hammeh 27.

This brief review shows that variability in the composition of faunal assemblages during the period spanning the Natufian may have a number of potential and not mutually-exclusive causes. The influence of climate, degree of sedentism and hunting methods all need to be considered in interpretations of prey procurement.

Shubayqa 1

Shubayqa is located in the Harrat al-Sham (Black Desert) in northeast Jordan where several sites of Late Epipaleolithic to Early Neolithic date are located around the Qa' Shubayqa (Fig. 1). This Qa' is a 12km^2 shallow basin fed by a series of wadis including the Wadi Rajil which, draining from the Jebel Druze, directs significant quantities of rainfall into the playa. Today localised flooding occurs after winter rains between October/November until March/April.

Seven phases of occupation have been identified at Shubayqa 1 spanning the Early to Late Natufian. Radiocarbon dates (at 1 sigma or 68.5% probability) have dated these phases to three time horizons: ~14,400–14,100 cal BP, ~13,300–13,100 cal BP and one date obtained from a test trench to the north of the mound returned a date of ~12,083-11807 cal BP. The faunal remains discussed in this report derive from the first two of these timeframes as minimal bone was recovered from the last. A separate stratigraphic sequence in the southern end of the mound has not yet been tied into the sequence from the main part of the site. This comprised a large pit filled with midden deposits that had been dug into the natural and separate from a large cut to the north in which the earlier of two Natufian structures was built. Since the cuts did not overlap there is no stratigraphic link between the two areas of the mound. In the south, the large pit is overlain by several phases of heavily deflated architecture. No radiocarbon dates have been obtained from this sequence as yet and analysis of the lithic assemblage is still at a preliminary stage. Therefore, for the purpose of this paper we focus on the northern part of the site where a well dated sequence has been excavated. A total of 10,705 NISP (number of identified specimens) of mammal, amphibian and reptile bones have been recorded. The small number of reptile and amphibian bones are represented in Table 2 for completeness but not discussed further. Initial results of the avifauna from the Late Natufian part of the sequence have been already published (Yeomans and Richter 2016) but the assemblage from the full sequence has now been analysed increasing the number of recorded bones from 3090 to 6722.

More complete reports including a detailed description of the architecture and radiocarbon dates are forthcoming and some preliminary information is given in Richter *et al.* (2012; 2014) but phases of occupation need summarising here (Table 1).

Zooarchaeological methods

All faunal material was recovered by careful sorting of residue from sieving the archaeological deposits through a 4mm mesh. This collection process took place in the field lab allowing excellent recovery of remains with additional material deriving from the heavy residue from flotation samples. The faunal remains were exported to Copenhagen where identification was undertaken with comparison to the reference collection at the Zoological Museum, University of Copenhagen where necessary. Bones that could be identified were entered into a database recording element, species, bone part, fusion and dental wear as well as modifications such as burning, cutmarks, evidence of gnawing and digestion, and anatomical measurements. Identified bones usually consisted of those with parts of articular ends, mandibular, skull and dental fragments. Measurements were taken following von den Driesch (1976) for mammals and Cohen and Serjeantson (1996) for birds. Further analysis of data presented here will examine contextual distribution of the animal bone in future publications with the additional aim of integrating results from the analysis of ground-stone, lithic and botanical remains. This paper, however, examines general trends in prey procurement with the aim of trying to unravel some potential causes of chronological trends in faunal assemblage composition.

Species present

Table 2 provides the NISP for different taxonomic groups (excluding avifauna) according to traditional zoological designation of species. Percentages of main taxonomic groups of food mammals are shown in Fig. 2. Discussion of prey selection based on animal behavioural adaptations is presented later as this can be used in determining hunting strategies and pressure on resource abundance. Gazelle bones are assigned to the goitered gazelle (*Gazella subgutturosa*), since the male horncores from Shubayqa, where complete enough to assess, show a slight twist and lyrate morphology characteristic of *Gazella subgutturosa*. Other Epipalaeolithic sites in eastern Jordan have only yielded this gazelle species (Martin *et al.* 2010) which supports the Shubayqa attribution.

Equid remains are likely to be Asiatic half ass also known as onager (*Equus hemionus*) although occasional wild horse (*E. caballus*) cannot be discounted. Recent genetic studies have highlighted the similarity of *E. hemionus* and *E. hydruntinus* suggesting that they should even be considered the same species (Orlando *et al.* 2006; Orlando *et al.* 2009). The distribution of African ass (*E. africanus*) covered northeast Africa and is unlikely to have extended into the area where onager were common (Uerpmann 1981). Dentition has not preserved well amongst the Shubayqa 1 faunal assemblage but there are several teeth displaying enamel patterning (Fig. 3). Amongst the mandibular teeth (Fig. 3a-e, i) none of the examples have a buccal fold in the enamel that penetrates between the metaflexid and entoflexid – a deep penetration was seen as characteristic of *E. hydruntinus* with *E. caballus* showing some degree of penetration (Davis 1980). The lingual fold is V-shaped in these examples with a U-shaped lingual fold found in teeth of *E. caballus*. In the maxillary teeth (Fig. 3f-h), the protocone is small and fairly triangular in shape and asymmetrical – a characteristic associated with *E. hydruntinus* when *E.hydruntinus* and E. *hemionus* were thought of as as distinct species (Davis 1980). The protocone in Shubayqa 1 examples is not elongated and narrow as often found in *E. caballus* and therefore these seem to fit best with identification as onager. The sample is small and difficult to compare but it seems probable that many of the equids are onager especially given the similarity of *E. hydruntinus* to hemiones in the fossil record (Burke *et al.* 2003) as well as genetic evidence (Orlando *et al.* 2006; Orlando *et al.* 2009) implying that they should be considered as one species. Whilst the use of teeth for species identification has been questioned recently (Twiss *et al.* 2016), the use of geometric morphometrics may offer a fruitful avenue of future investigation (Cucchi *et al.* 2017) but the equid bones from Shubayqa 1 are tentatively assigned as *Equus hemionus* and images presented in Fig. 3 will allow comparison in the future. Few bones could be measured because of high fragmentation but there were none that were obviously from larger animals that could reflect the presence of wild horse.

Either red fox (*Vulpes vulpes*) or sand fox (*V. rupelli*) could be represented in the assemblage but hare are likely to be cape hare (*Lepus capensis*). Whilst species discussed above are typical of Epipalaeolithic sites in the region, presence of wild sheep in the assemblage was unexpected as their range was not previously considered to extend into this area (Uerpmann 1981). Despite high fragmentation, a significant number of bones can be identified as sheep as opposed to goat although more remain only attributable to the broader category of sheep/goat. A detailed publication on the identification of sheep is forthcoming, providing discussion of the known distribution of wild sheep and comparison of metrical data from other assemblages (Yeomans *et al.* in press). Standing water was available at Shubayqa 1 during the time of its occupation (see below) and this locality, together with the wadi courses leading off the Jebel Druze, provided the sufficient grazing and water requirements needed by sheep. Perhaps, as in the Negev (Gopher *et al.* 1982), the sheep were able to survive in these semi-arid environs but the extent of their distribution did not seem to extend further into limestone steppe (Martin *et al.* 2010).

Some additional species are only represented by a few bones at Shubayqa 1. These include wild boar, identified by a single bone; these animals would be capable of living in the reeds and thickets around water sources and have been identified in very low numbers at various Epipalaeolithic sites around Azraq and in Wadi Jilat (Martin *et al.* 2016). Of particular interest is the presence of cervids in the assemblage (Fig. 4). The two remains of cervids were a fragment of antler, either of red or fallow deer, but based on the flatness of the piece fallow deer seems more probable. There is an indication that the antler had been worked where a shallow depression may reflect an attempt to perforate the piece. The other cervid specimen is a metatarsal fragment of a red deer that may have been raw material brought to the site for working into a bone point or another item. Bone points are relatively common in the Shubayqa 1 assemblage with metapodia of gazelle and sheep often the bone of choice as they are thick-walled and, once split, one half of the distal condyles forms a good handle. Further analysis of the worked bone assemblage from Shubayqa 1 will be presented in a future publication. Presence of deer bone and antler is possibly additional evidence of exchange in materials occurring between the Mediterranean zone and the eastern desert with marine shells also travelling along this trade route between the coast and Shubayqa. In a recent review of faunal assemblages in the region across different phases, Tsahar *et al.* (2009) mention 17 Natufian sites, with red deer identified at only four. Those four sites are all located in the northern region where woodlands would have been present, and it is interesting to note that even there red deer are present in small numbers. At Ain Mallaha two red deer elements were identified in a total assemblage of 524, and although a further 43 were only identified as Cervidae, many are likely to belong to the more common fallow deer (Valla *et al.* 2004). At el-Wad cave 12 bones of red deer were identified but these formed only about 0.5% of the assemblage which included the unidentified ungulates (Munro 2004). Twenty-three and 21 bones of red deer were found at Hayonim cave in the Early and Late Natufian respectively forming an even lower percentage of the identified assemblage (Munro 2004). Most remains from Iraq ed-Dubb of Late Natufian date were rodents and birds but of 103 food mammal bones, two were from red deer (Edwards and Martin 2007). Since the review by Tsahar *et al.* (2009), two red deer have been identified at Wadi Hammeh 27 representing just 0.1% of the assemblage (Edwards and Martin 2013). Four bones, from an assemblage of 2240 including unidentified ungulates, were from red deer at Late Natufian Nahal Ein Gev II (Grosman *et al.* 2016). Considering the environment around Late Epipalaeolithic Shubayqa 1, it seems most likely that the red deer metatarsal was brought in as a raw material and does not represent local hunted stock. It is interesting that raw materials, not even common in other regions, were traded to the Natufian community at Shubayqa. The distal breadth (Bd) of the red deer metatarsal from Shubayqa 1 is 43.6mm but there is minimal osteometric data to compare with, and size variation might anyway be expected across different environments. Aside from the possibility of being traded in from wooded environs in the Mediterranean, the slopes of the Jebel Druze northwest of Shubayqa is an alternative location providing the wooded habitat requirements of fallow deer if not red deer. This location is not too far for raw materials to be traded from or for foraging and hunting trips to be undertaken to.

The NISP of bird bone is shown in Table 3. As in the Late Natufian midden assigned to Phase 2 and previously published (Yeomans and Richter 2016), birds represented are dominated by wetland species and similarities to species visiting the Arzaq wetlands in modern times can be noted (Nelson 1973). It is worth briefly summarising the evidence for major taxonomic groups of birds and their recent presence in the region to aid interpretation of the avifauna. Grebes are represented in the assemblage from Shubayqa 1 by the little grebe (*Tachybaptus ruflicollis*) and the black-necked grebe (*Podiceps nigricollis*). No fragments were identified to the larger great crested grebe (*Podiceps cristatus*) although its presence cannot be ruled out due to heavy fragmentation of bones. Although occasional recently breeding pairs of little grebe have been noted in Azraq, it is generally an uncommon winter visitor as is the black-necked grebe (Nelson 1973, Andrews 1995). The proportion of grebe within the Shubayqa 1 and Bawwab al-Ghazal assemblages (Kinzelman 2003) suggests the species was more common in the past. At Ohalo II grebes were the most common family so it seems possible that migration routes of these species may have altered in the more recent past (Simmons and Nadel 1998). At Shubayqa 1 only a few medium to larger species of Pelecaniformes are represented. Herons were similarly poorly represented at Bawwab al-Ghazal (Kinzelman 2003) but marginally better represented at Ayn Qasiyyah (Edwards forthcoming) close to the Azraq wetlands where these birds are still common throughout the year (Andrews 1995).

‘Azraq’s bird life is always amazing, none more so than its ducks’ (Nelson 1973: 278) and this sentiment is also true for the Late Epipalaeolithic of the Qa’ Shubayqa. In the winter months today wildfowl descend on Azraq inhabiting the permanent marsh and flooded Qa’ when possible. Dabbling ducks (*Anas* spp.) are by far the most common and of these the smallest species are teal (*A. crecca*) and garganey (*A.*

querquedula). These were noted as early arrivals before mid-September in the winter of 1968-9 (Nelson 1973) but Andrews (1995) notes that only garganey arrive in large numbers at this early time of the year as they are traveling onwards. Whilst a few garganey are reported as wintering in Azraq, the majority head further south leaving by the end of October and, on their return trip, pausing in Azraq sometime between March and early May.

Recently, ducks would continue to arrive at Azraq through October and November when other species also start to make an appearance. In December the influx is dramatic and dominated by four species – teal, pintail (*A. acuta*), wideon (*A. penelope*) and shoveler (*A. clypeata*) decreasing in this order of frequency (Nelson 1973). The mallard (*A. platyrhynchos*) and shelduck (*Tadorna tadorna*) arrive at the same time but in lower numbers. Other species of ducks are rarer but do winter in Azraq (Andrews 1995). Most of ducks have left Azraq heading back in a northerly direction by the end of February although a few linger into March and very rarely as late as early May. The representation of ducks in the assemblage from Shubayqa 1 suggests that the Qa' Shubayqa offered a similar habitat in the past as that presented to ducks at Azraq in recent history. Aside from ducks, other birds in the Anatidae family from the Shubayqa 1 assemblage are goose (*Anser* spp.) and swan (*Cygnus* spp.) but these are only represented sparingly.

Diurnal birds of prey include both members of the Accipitriformes and occasionally Falconiformes orders. Bones are often fragmentary and difficult to identify to specific taxa but a range of birds are represented. Whilst some birds of prey are migratory, there is insufficient evidence to determine if there is a seasonal pattern to the exploitation of them at Shubayqa. As previously discussed (Yeomans and Richter 2016) it is possible that remains of these birds are a result of humans collecting feathers and talons rather than hunting them for food. It is perhaps notable that several of the bones of raptors were from juveniles (Fig. 5) and it is possible that these inexperienced birds were easier to hunt.

Ground birds are represented by the occasional Phasianidae. The chukar (*Alectoris chukar*) and sand partridge (*Ammoperdix heyi*) are both resident in eastern Jordan today whilst quail is a fairly scarce migrant travelling though during spring and autumn. Andrews (1995) notes that quail is not recorded as breeding but it could do potentially in northern agricultural areas. Hunting in recent times has no doubt influenced the distribution of these birds. Ground birds could probably be trapped or snared using a similar approach to that possibly in use to capture hares.

Several species of Rallidae have been identified in the assemblage from Shubayqa 1. In modern times in Azraq the small number of a resident population of water rail (*Rallus aquaticus*) increases in all but the driest months by visiting migrants. Several species of crake (*Porzana* spp.) were also rare migrants to the marshes. The corncrake (*Crex crex*) occupies more diverse environments showing up in spring months. Very few moorhen (*Gallinula chloropus*) were present in the Shubayqa 1 assemblage and nowadays are more likely to be found in the Jordan valley. Coot (*Fulica atra*), on the other hand, were commonly identified. Whilst this species can be a very common winter visitor during recent wetter years, if the Qa’ at Azraq is not flooded these birds will find another place to over winter (Andrews 1995). Whilst some birds start arriving in late September the main corpus reaches the area in November remaining until mid-April with the last stragglers leaving by mid-July (Andrews 1995).

The only order of birds to outnumber the ducks are the Charadriiformes. This is a diverse order with many species. Few were identified at either Bawwab al-Ghazal (Kinzelman 2003), Ayn Qasiyyah (Edwards forthcoming) or Ohalo II (Simmons and Nadel 1998). There is a tendency for only bones that can be identified to exact species to be reported and, given diversity of Charadriiformes, this is clearly difficult. Therefore, it is challenging to assess if the frequency from Shubayqa 1 is unusual. A few bones could be positively identified as black-winged stilt (*Himantopus himantopus*) which today breeds at Azraq and also occurs as a spring migrant (Andrews 1995). Within the Charadriidae there are numerous species. These waders are generally more common in spring and autumn. Scolopacidae are diverse but a significant number were identified as *Calidris* spp. as well several other species. However, the number of ruff (*Philomanchus pugnax*) was remarkable and this is still true of these birds visiting Azraq in the recent past. As Nelson (1973: 214) describes ruff ‘passed through Azraq in an astonishing variety of sizes and leg colours.’ As with Charadriiformes in general, many of Scolopacidae are passage migrants to Jordan and this is the case for the ruff which is most common in spring between the late April and early May. Based on the frequency of different species of Sternidae present in the region today, it is likely that the white-winged black tern (*Childonias leucopterus*) are amongst the species identified in the Shubayqa 1 assemblage. Other species are uncommon or rare inland (Andrews 1995). Sandgrouse (Pteroclidiformes) is a ground bird feeding mainly on seeds but is relatively uncommon in the Shubayqa 1 assemblage. Two bones of doves (*Columbia* sp. and *Streptopelia* sp.) and occasional bones of Passeriformes (including Covidae but many are small species that have not been identified) form the rest of the assemblage.

Temporal shifts in faunal exploitation

Based on data in Tables 2 and 3 it is possible to trace shifts in faunal trends through the chronological sequence at Shubayqa 1. Fig. 6 also shows a phase-by-phase comparison of the representation of large mammal, medium ungulates (gazelle, sheep and sheep/goat), hare, fox and other small carnivores that are likely to have been trapped, and birds. The main shift is a reduction of small mammalian prey, compensated for by an increase in medium ungulates especially in the Late Natufian and throughout successive phases of the Early Natufian. The frequency of sheep (including sheep/goat category) increased compared to gazelle in the Late Natufian, although gazelle remains were still by far the most common. The proportion of neither large mammals nor birds varied significantly across phases and, more importantly, do not shown a continuous trend. Further discussion is given below alongside details of aging data, but it is pointed out that perhaps there is evidence for increasingly specialised hunting focusing on target prey.

Changing environmental conditions

In a study of chronological shifts in species representation from sites across the Azraq Basin, Martin *et al.* (2016) showed that relative frequency of equids varied according to climatic conditions. This analysis included just two sites from the Late Epipalaeolithic (Khallat Anaza and Azraq 18) which had been excavated before our work at Shubayqa 1. Both of these sites produced comparatively small samples sizes of faunal remains. Azraq 18 is dated to the Early Natufian (Garrard 1991) and Khallat Anaza to the Late Natufian (Betts 1991; Betts and Garrard 1998). Only avifauna from the Early Natufian site of Bawwab al-Ghazal has been studied (Kinzelman 2003). Therefore there is an absence of data covering the Late Epipalaeolithic part of the sequence. Due to lack of data it was not possible for Martin *et al.* (2016) to use frequency of equids during the Late Epipalaeolithic part of the sequence as a proxy for climate change over this period. The frequency of equids decreases at Shubayqa 1 between the Early and Late Natufian from an average representation of 3.2% in the earlier part of the sequence to an average of 1.6% in the Late Natufian phases. There is minimal variation between phases assigned to the Early and Late Natufian respectively. Onager need access to water regularly and additionally there is evidence for a decrease in the frequency of equids of a very young age. The first and second phalanges are the earliest fusing elements within the equid skeleton (Silver 1969). Although sample sizes are small, in the Early Natufian 29% (N=14) and in the Late Natufian 14% (N=21) of these bones were unfused. Studies of modern onager in Iran show that nursing females and their young rarely range more than 200m from a water source (Nowzari *et al.* 2013). The decrease in equid bones in general in the Late Natufian and also the decrease in number of very young equids may be evidence for the environment becoming drier or water sources less reliable throughout the year. This interpretation of the environment based on equid bones is tentative but there is more compelling evidence presented below which adds weight to this.

Initial interpretation of avifaunal remains from Phase 2 (Yeomans and Richter 2016) suggested that the Qa’ Shubayqa was at least a seasonal, if not year round, water source. This was based on the high frequency of waterfowl in the assemblage. However, we now have data to examine the changing frequency of different species of birds through the sequence and this shows a dramatic change between the Early and Late Natufian best explained by yearly water reserves becoming less reliable during the Late Natufian. In the Early Natufian a large proportion of the assemblage is represented by birds in the Charadriiformes order. These, where they can be identified, include huge number of birds from the Scolopacidae family known as waders or shorebirds. The most common species is ruff (*Philomanchus pugnax*) which, in the recent past, formed huge flocks on the Azraq Oasis as they passed though in autumn on their route to wintering grounds in Africa. In spring they once more pass through eastern Jordan resting at Azraq before continuing their journey to breeding grounds in Scandinavia, Russia and other parts of northern Europe. Most of the waders and species in the Charadriiformes order in general have similar migration patterns. Relatively few species will winter in Jordan nowadays. Whilst birds from the Charadriiformes order were present in the Late Natufian, numbers of these species was overshadowed by ducks. Of the ducks which visit Jordan currently, or more appropriately in the recent past when the Azraq wetlands retained more of their former glory, are species in the *Anas* genus. These were the most common duck species in the Shubayqa assemblage too. Identification beyond genus level is difficult with heavily fragmented bones but some could be classified to the size of a limited range of species. Amongst ducks, and the small number of ducks not in the genus *Anas*, there is only one that is a passage migrant travelling to wintering grounds beyond. All the rest of the ducks are very frequent wintering birds in Azraq timing their arrival mostly around December and heading back north by February or March. After Anseriformes and Charadriiformes, the next most frequent order of birds in the Shubayqa assemblage is Gruiformes and specifically Rallidae. Of the rails which migrate to Jordan there are three distinct size groups aiding identification of morphological differences: the smallest species are include *Porzana* spp., *Rallus aquaticus* and *Crex crex*; moorhen (*Gallinula chloropus*) are notably larger and the largest is coot (*Fulica atra*). It is the last of these species that is by far the most common in the Shubayqa assemblage. Coots are also winter in Azraq arriving and departing alongside the ducks. The coot is also more frequent in the Late Natufian.

When birds that are present in large numbers in the assemblage from Shubayqa and visit the region at different times of the year are compared (Fig. 7) there is clear shift away from autumn and spring species in the Late Natufian. Fig. 7 shows this very obviously when the proportion of the MNI (minimum number of individuals) between the three groups of birds that can be taken, for the most part, to represent wintering and passage migrants are compared. It is also necessary to show the overall representation of these birds and this is achieved by comparing their NISP to the overall NISP for each phase. This shows that ducks were present in all phases and relatively consistently. Therefore wintering birds are present throughout the sequence and the main difference is a reduction in passage migrants in the Late Natufian.

Explanation for differences in the representation of passage migrants could be offered by occupation of the settlement in different seasons. This seems unlikely as gazelle (see below) were probably hunted in the summer months in both the Early and Late Natufian and we have seen that wintering birds are also taken in both phases. A seasonal movement of people in the Late Natufian into the Qa’ Shubayqa in the summer, leaving for the autumn only to return in winter and leave again in spring seems illogical. If humans did leave the settlement at any part of the year it would be more likely to be in summer. Alternatively there is the possibility that hunting strategies changed. However, all these bird species would probably be caught by the same method whereby they are driven from water captured in netting set up on the shores. The capture of a large number of birds at one time was argued for using body-part representation of these three groups of birds which showed that large flight muscles were taken and, apart from bones selected for working, the rest of the carcasses were discarded at the kill-site (Yeomans and Richter 2016). This wasteful butchery practice only makes sense if a large number of birds were caught at one time. Very similar skeletal element representations have now been reconstructed for each phase of occupation (Fig. 8). This suggests that the hunting method did not change and it seems unlikely that if large flocks of birds were there, regardless of time of year when they gathered, that the resource would be overlooked. This leaves an interpretation that centres on a change in environmental conditions. If, in the Late Natufian, the pools of water were drying up quicker after winter rains, birds that were migrating through on their way to wintering grounds to the south may seek a better resting place than the Qa' Shubayqa. Maybe the level of rainfall varied from year-to-year and sometimes there was a suitable habitat in autumn or sometimes it was just in the spring.

Uniquely for birds in the Scolopacidae family, ruff are highly sexually dimorphic and this can be seen in measurements taken on the coracoid (Fig. 9). Fig. 9 shows two clear clusters when the Lm and GL measurements are compared and this is interpreted as male and female birds. The first of these measurements could be taken on more coracoid bones that the GL measurements because of damage. Using the Lm measurement alone, males and females could still be separated and therefore histograms showing the frequency of these measurements can also be used to infer proportion of males to females. Interestingly, males were more common in the Late Natufian. Ruff mainly migrate though Azraq in spring, in autumn they often stopover at different wetlands. Of importance here is the fact that male ruff return to Europe earlier than females (Wymenga 1999). If the environment is drying up quicker after winter rains in the Late Natufian then it is likely that more of the early returning birds (i.e. males) will have found the Qa' Shubayqa to still contain enough water to stop and break up the journey. Females who have left it longer to make the return trip are less likely to have found the Qa' Shubayqa sufficiently wet to stop and instead rested at other locations on their long migration to breeding grounds.

The faunal remains suggest that when Shubayqa 1 was reoccupied in the Late Natufian the climate was drier. Analysis of speleotherms from Soreq Cave (Bar-Matthews *at el.* 1999) has suggested that effects of the Younger Dryas in the Eastern Mediterranean spanned 1800 years from 13.2 to 11.4 kyr cal BP which is longer than the 1300 years recorded in ice-core records for northerly latitudes. The Late Natufian sequence from Shubayqa is dated 13.3-13.1 kyr cal BP and hence may have experienced early effects of the Younger Dryas.

Specialised hunting

Over the course of the occupation sequence at Shubayqa 1 there is an increase in the proportion of ungulates and especially caprines (of which only sheep have been identified). If bones that cannot be identified beyond small ungulates are discounted, the representation of gazelle increases from an average in Phases 7-4 of 72.4% to 78.7% in Phases 3-2. Caprines increase from 2.8% to 9.4% over the same phases of occupation and increase from 3.8% to 11.5% as a proportion of the identified medium ungulates. This shows that although an increase in gazelle might be related to a corresponding decrease in hare, the increase in sheep is clearly not a factor of a decrease in another species. Sheep are not as well suited to arid conditions as gazelle which could be evidence that the change in faunal representation in Late Natufian phase was not related to water sources drying quicker after the rains or being less reliable from year-to-year. However, from evidence presented above, it is argued that aridity of the environment had increased by the Late Natufian and other explanations should be sought. This discrepancy is discussed further below.

Reconstruction of mortality profiles of gazelle (Table 4) shows that the frequency of juvenile gazelle was very high throughout the sequence and greater than in any previously studied assemblage from Eastern Jordan from the Epipalaeolithic to PPNB (Martin *et al.* 2016 Table 6). Around 60% were juvenile (see Table 4) which is considerably higher than the 39% estimated to be the proportion of juveniles typically found in living gazelle herds with single annual birthing periods (Martin *et al.* 2016). Various explanations need consideration for these extremely high proportions of juvenile deaths, which at first glance seem unsustainable as a hunting strategy, if over half the juvenile population are culled before reaching adulthood. Alternative possibilities are i) overhunting pushing population structure down, ii) double-birthing producing higher number of young animals *in life* relative to adults; iii) twin-birthing having a similar result as ii) above; and finally iv) a hunting strategy specifically targeting juveniles. First, it seems unlikely that sustained hunting pressure explains the high juvenile predation pattern, since the proportions of gazelle within the assemblage actually increases through time. Had gazelle been over-hunted they would become harder for hunters to find, and presumably decline within the sequence. Second, is it likely that gazelle females were double birthing producing one fawn in spring and another in autumn, enabled by the lush local conditions around Shubayqa? Preliminary results of oxygen isotope analyses on the gazelle dentitions from Shubayqa 1 (Henton, forthcoming) suggest that double season birthing was not occurring given the caveat that sample sizes of results are very small. Regardless, when double births in gazelle populations have been observed, as in *Gazella gazella* in the Galillee, the resulting juvenile proportion is c52% (Martin 2000, p25, Table 12), which is still not as high as the Shubayqa 1 proportions. Twin birthing in spring, as observed in some *Gazella subgutturosa* populations in Central Asia (Martin 2000) also produce high juvenile proportions, c. 46%, but again, not reaching the 60% observed at Shubayqa 1.

There remains the possibility that even under circumstances of twin (or double-season) birthing – which might be enabled by good water and vegetation availability in the Shubayqa locality – a hunting strategy that targeted juveniles was in place. This might be the case, for example, if nursery herds consisting of clustered mothers and young foraged close to the ‘Qa and became easy prey in the inexperience of their first few months of life. This idea finds some support from the fusion evidence (Table 4) showing even the youngest age categories were culled. The picture is similar in many respects to the gazelle cull profile from the Late PPNB (Pre-Pottery Neolithic B) at Dhuweila, also in the Basalt Desert. This site is interpreted as a specialised seasonal gazelle hunting camp, with >90% gazelle present, indiscriminate culling of all age groups including infants and an overall juvenile proportion of 55% (Martin 1998; Martin et al 2016). Shubayqa 1 by contrast is a very different occupation type - not specialised, with a much wider resource base and not interpreted as showing strongly seasonal occupation (Yeomans and Richter 2016). It seems likely that the targeting of juvenile gazelle herds (nursery herds or bachelor herds?) created the extreme juvenile-heavy cull patterns observed with hunting techniques possibly including netting or drive hunting. It is also likely, however, that the gazelle herds in the landscape were already particularly juvenile-rich, either through twin-birthing or double-birthing, since the hunting strategy appears sustainable through the occupation phases and clearly doesn't send local populations into decline.

Explaining the increase in sheep is difficult but perhaps this is evidence, alongside gradual intensification of hunting on gazelle, that hunters may have been travelling further afield in pursuit of herds and perhaps into the region around the Jebel Druze. Hunting parties could have followed courses of wadi courses towards the areas where sheep were frequent. A number of Late Natufian sites such as Khallat Anaza and Murgharet al-Jawa are located overlooking the Wadi Rajil perhaps suggesting that people were more mobile in the landscape during the Late Natufian. The high frequency of caprines in the small assemblage from Khallat Anaza (Garrard 1985) suggests that there were more caprines in the areas upstream of Shubayqa leading towards the Jebel Druze. With hunter-forager groups more mobile in the landscape they would have encountered these animals more frequently and, based on the currently available evidence, this is offered as explanation for the increase in sheep during the Late Natufian which is otherwise at odds with evidence for water resources becoming less reliable.

Returning to gazelle, a shift in the ratio of males to female might also be expected with a development of different hunting strategies. Instead of selectively hunting the largest animals as suggested by Munro (2004), mass hunting would take whole herds. Fig. 10 summarises metrical and morphological data for different ratio of males and females. The measurements shown on the bivariate plots are those elements, for which there is sufficient data, that Horwitz *et al.* (1990), supported by Munro *et al.* (2011), found to be most sexually dimorphic in mountain gazelle (*Gazella gazella*). The sample of measurements from the scapula is small but this element is most sexually dimorphic (Horwitz *et al.* 1990; Munro *et al.* 2011) and the data does hint that more small animals were present in the Late Natufian. Munro *et al.* (2011) demonstrated that the GLl measurement of the astragalus was more sexually dimorphic than many of the anatomical measurements on this bone and the sample size from Shubayqa is larger. In this case both larger and smaller animals are present throughout but more of the smaller animals are present in the Late Natufian phase. It should be noted that only fused/adult bones are measured, so these results represent the smaller proportion of adults, which as discussed above are outnumbered by a higher proportion of juveniles. There is disagreement on the degree of sexual diamorphism of the distal humerus but smaller bones are again concentrated in the Late Natufian phase. Overall, there is a trend for the smaller animals, which could be adult females, to be more common in the Late

Natufian. None of the plots shown a clearly dimorphic pattern which could be argued to represent males and females as separate groups, but the interpretation of a slightly higher frequency of females in the Late Natufian is supported by the number of male and female horncores recovered. A sex ratio slightly in favour of females was documented at Tell Kuran in the 4th millennium BC where a well preserved deposit of bones from gazelles is argued to be the result of hunting using desert kites as a mass killing strategy (Bar-Oz *et al.* 2011). Bar-Oz *et al.* (2011) argue that this ratio is consistent with the mixed herds that form for migration. Whilst inconclusive by itself, evidence of females and males being present and the high proportion of juveniles all point to intensive hunting of gazelle at Shubayqa.

Mobility

The relative proportions of tortoise to hare bones has been argued to reflect the longevity of occupation at a site, with those occupied for much of the year witnessing depletion of easy to catch tortoises without their populations recovering (Stiner *et al.* 2000). The Late Natufian phase at Shubayqa 1 does have an increase in the proportion of tortoise remains relative to hare. Whilst the evidence based on resources that are easily depleted in the vicinity of a site suggests that the human population may have been more mobile, the presence of wintering birds (Yeomans and Richter 2016) as well as the number of juveniles suggests that Shubayqa 1 was still occupied for much of the year. Additionally, whilst the architecture of Structure 2 of Late Natufian date is not as well preserved as Structure 1 dated to the Early Natufian, both structures must have taken considerable effort pointing to longer term occupation throughout the seasons. Large ground-stones (including boulder-mortars) were also recovered suggesting investment in tools that could not be taken away from the site. As suggested above, there is potentially evidence that longer ranging hunting trips may have been taking place and as people were ranging further they may have come across more easily collected prey. As Rosen and Rivera-Collazo (2011) point out, an increase in tortoise maybe related to increased exploitation of wild grasses in the Late Natufian as people found these animals whilst gathering plants.

Discussion

Natufian sites in the Mediterranean zone of the southern Levant are frequent but not ideally suited for comparison to Shubayqa 1 due to differing habitats resulting in varying animal species present. Wide-ranging comparisons are also beyond the scope of this paper and necessitate a dedicated publication. There are, however, Natufian sites in southern Jordan and the Negev in steppic and desert environments to which comparisons can be offered. Hatoula, for example, was occupied in the Late Natufian to PPNA periods. The site is located in the undulating hills of the Ayalon plain providing habitat for gazelle, which was by far the most commonly hunted prey (Davis 1985). Wild sheep were also present in very low numbers but goat or ibex were not identified in the assemblage fitting with the topography of the environment around the site (Davis 1985). The faunal assemblage from the Natufian sequence at Beidha is dominated by wild goat and ibex which would have been hunted in the rugged landscape whilst gazelle, the next most frequent species, would have been found in the Wadi Araba (Hecker 1989). The assemblage from the Natufian occupation at Beidha is limited in size and the only other species identified are aurochs and onager (Hecker 1989). The Natufian sequence at the nearby site of Wadi Mataha 2 can be divided into the Early and Late Natufian. Again the faunal assemblage is dominated by goat and ibex with lower numbers of gazelle, aurochs and onager. Wild sheep are also present but poorly represented (Janetski and Baadsgaard 2005; Baadsgaard *et al*. 2010). The faunal and architectural evidence suggested an increase in the level of residential mobility between the Early and Late Natufian which is argued to reflect changes in the subsistence strategies as a response to the climatic change of the Younger Dryas (Baadsgaard et al 2010). Tor Hamar, located in a deep narrow canyon, produced a faunal assemblage dominated by gazelle with frequent goat or ibex and a low number of aurochs, equid and hare bones (Henry and Garrard 1988). Wadi Judayid, dated to the Early Natufian, is set on a low sand ridge. The faunal assemblage recovered included gazelle, wild sheep and goat/ibex with smaller numbers of equid, aurochs, a hare and a leopard. In the steppe and desert regions of southern Jordan, Natufian hunting strategies are therefore clearly heavily influenced by the topographical setting of each site. Where steep cliffs and rugged ground prevail, hunting focused on the goat and ibex that are well-suited to this terrain. Where the sites are located close to open wadis and plains, gazelle and wild sheep were hunted. Direct comparisons between sites are somewhat problematic and only at Wadi Mataha 2 could the stratigraphic sequence be divided into Early and Late Natufian allowing a temporal comparison. The interpretation of a shifting subsistence strategy with decreased foraging intensity in the Late Natufian as the population increased mobility in response to climatic shifts, accords well with our interpretation of subsistence strategies at Shubayqa 1 between the Early and Late Natufian. At Shubayqa the evidence suggests that in the Late Natufian hunters were concentrating on gazelle and sheep hunting and covered more ground in their pursuit of prey.

In the Negev, the sites show evidence of an increased spectrum of fauna exploited between the Early and Late Natufian periods. At Upper Besor 6, occupied in the Early Natufian only gazelle, wild goat and equid bones were recovered (Horwitz and Goring-Morris 2000). At the Late Natufian site of Rosh Horesha a substantial assemblage of gazelle and goat/ibex was identified with low frequency of equids, aurochs, hare and fox. Further excavations added wild sheep to the list of exploited mammals (Gopher et al 1982). A near identical pattern of faunal exploitation was identified at Abu Salem in the Harifian period (Butler et al 1977; Gopher et al 1982). More humid conditions in the final stages of Pleistocene were argued to be the overriding force responsible for elevating the species diversity in the Negev at Late Natufian sites (Horwitz and Goring-Morris 2000). Overall, however, the range of potential resources was low compared to the Mediterranean zone, necessitating seasonal occupation of sites in the Negev compared to the year-round occupation evidenced in the Mediterranean zone (Horwitz and Goring-Morris 2000). An inverse pattern of faunal exploitation is found at Shubayqa 1 contrasting with Natufian sites in the Negev. At Shubayqa 1 there is a reduction in the faunal range with a greater focus on hunting ungulates in the Late Natufian. This is interpreted as a response to a drying of the environment or less reliable water sources on a year-to-year basis. Also the range of animals exploited at Shubayqa 1 is far much greater than at sites in the Negev that are interpreted as seasonally occupied. The Shubayqa 1 pattern is more consistent with exploitation strategies seen at permanently occupied sites with abundant and varied resources.

Summary and conclusions

In summary, for Shubayqa 1 the bird remains provide the best evidence of local environmental conditions. They suggest that winters were becoming drier or less reliable in terms of the quantity of rainfall in Late Natufian compared to the Early Natufian. This is supported by a decrease in the frequency of equids, which as Martin *et al.* (2016) also note, are sensitive to changes in environmental conditions. The decrease in equids and specifically the decrease in very young equids, since nursing mothers stay close to water, can also be taken as evidence that water was less readily available in the Late Natufian. Since sheep are not an arid adapted species, a decrease in the relative frequency of these animals would also be expected but the evidence does not show this pattern. An alternative explanation for the increase in sheep is needed and may relate to increased mobility of the hunter-foragers in the landscape, evidence for which is discussed below.

Aside from environmental factors it was suggested in the introduction that changes in hunting strategies could result in detectable differences in the faunal remains. Evidence presented above indicates that in the Early Natufian there was intensive hunting of gazelle resulting in a high proportion of juveniles in all age classes. In the Late Natufian, hunting further intensified and possibly more adult females were caught. This prey profile is suggested as representing the mass killing of gazelle herds but despite intensive hunting of these animals, the population does not seem to have been heavily impacted upon since gazelle remained the dominant prey. We argue that the environmental conditions offered a prime habitat for gazelle to the extent that they may have been double- or twin-birthing. This in combination with selective hunting of young animals resulted in the extremely high proportion of juveniles. Mass hunting of waterfowl also occurred throughout the Natufian. The intensification of hunting in inself does not explain the Late Natufian increase in sheep. One possibility is that, alongside intensive gazelle hunting activities, some hunters were venturing further afield perhaps into wetter environments towards Jebel Druze. The Late Natufian has previously been associated with an increase in mobility of human populations (Bar-Yosef 1998) and at Shubayqa 1 the increase in tortoise relative to hare could be considered evidence that this may have also been the case in the Late Natufian phase.

This currently is the most plausible explanation for the increase in sheep since other faunal evidence presented here suggests that Late Natufian conditions were drier.

The Late Natufian occupation at Shubayqa dates to the period before the Younger Dryas so the full impact of this climatic event is difficult to judge. However, on the basis of radiocarbon dates obtained from various sites around the Qa’ Shubayqa, the area appears to have still be occupied. In the so-called ‘marginal zone’ of eastern Jordan it would be expected that effects of climatic deterioration would be hardest felt. Results presented here of the faunal remains from Shubayqa 1 indicate minimal evidence for environmental change impacting on the overall prey availability between the Early to Late Natufian. Whether this was an important factor later on and the full effect of the Younger Dryas was felt remains to be seen and is a particularly relevant question to be born in mind when conducting further excavations in the region. Direct comparison between Shubayqa and other Natufian sites, mainly located in the Mediterranean zone where woodlands supported species such as cervids is problematic. Nevertheless, by the Natufian period hunting at Shubayqa witnessed intensive targeting of gazelle as well as waterfowl and is comparable to shifts in hunting practices in the Mediterranean zone. In conclusion it is suggested that change in the faunal assemblage between the Early and Late Natufian at Shubayqa resulted from rains being less reliable which led to a reduction in passage migratory birds which was compensated for by further intensification of gazelle hunting alongside increased mobility of hunters. Whilst there was a shift in the animal resources available to the hunter-foragers, there was evidently no problem in them shifting the focus of their hunting activities as there was sufficient prey that could more than sustain the human population. Compared to seasonally occupied sites in the Negev, occupation at Shubayqa seems to have been more or less year-round.

Shubayqa 1 provides the largest assemblage of Natufian faunal remains studied to date outside of the Mediterranean zone of the southern Levant and has an occupation sequence spanning the Early and Late Natufian transition. This area of eastern Jordan is proving to be more important in the discussion of Late Pleistocene and Early Holocene occupation than initially suspected. The faunal remains from Shubayqa 1 provide a baseline to which other sites in this eastern desert can be compared. The archaeological importance of the region at this stage in the juncture from foraging to agriculture is further attested by our excavations at Shubayqa 6 spanning the Late Natufian to Early PPNB periods. Ultimately the analysis of the faunal remains from this site will expand knowledge of the shifts in human subsistence strategies and the underlying causes.

Funding details

This work was supported by the Det Frie Forskningsråd under Grant DFF-4001-00068 and Grant 11-116136, the Danish Institute in Damascus and the H.P. Hjerl Mindefondet for Dansk Palæstinaforskning. LM would like to acknowledge and thank the Leverhulme Trust for support through Standard Research Grant RPG-2013-233.

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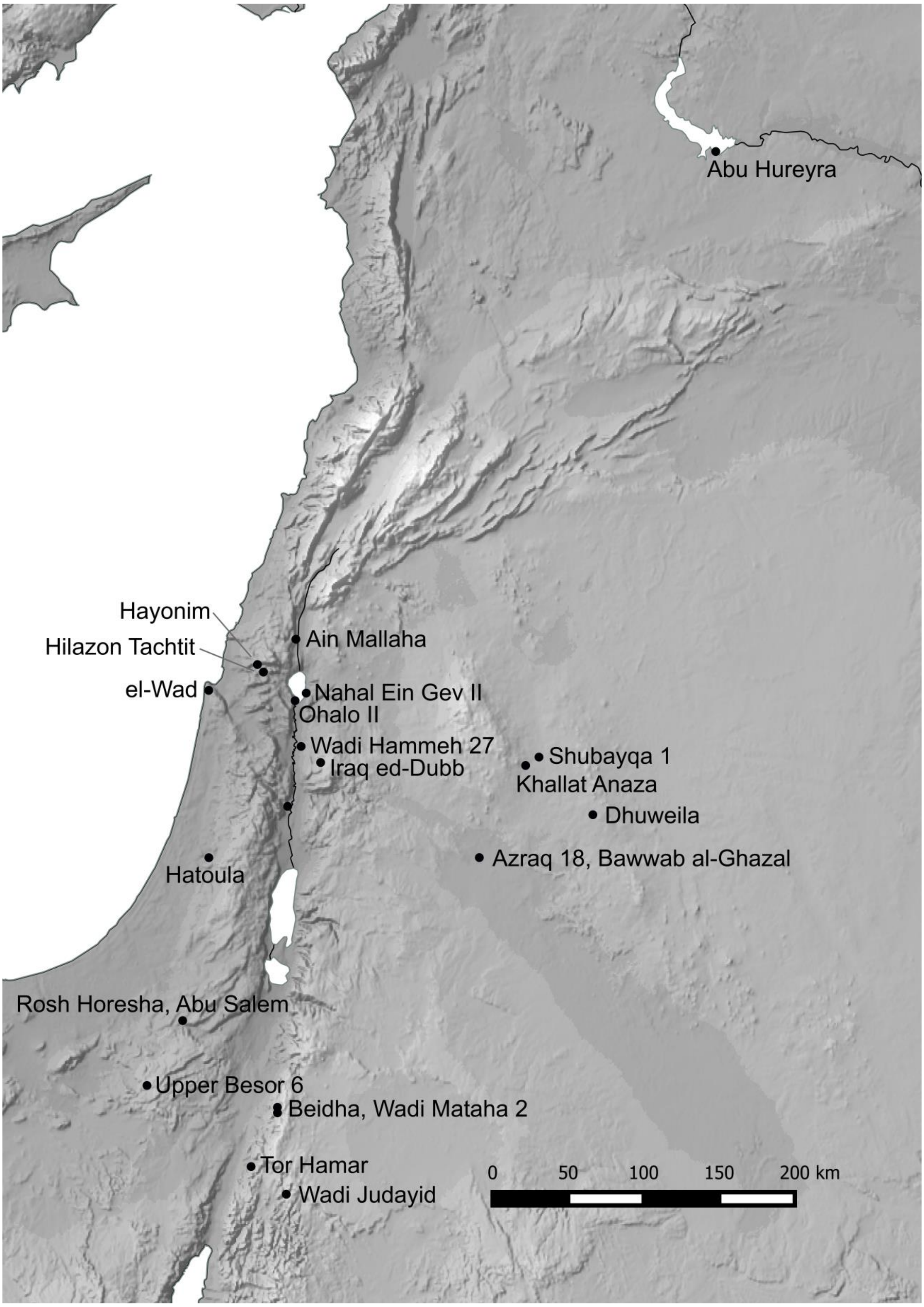


Figure 1 Location of sites mentioned in the text.

Phase	Period	Date range cal BP at 68.5% probability	Description
Phase 1	Final Natufian	~12,083-11,807	Occupation of the main mound excavated in sondage
Phase 2	Late Natufian	~13,300-13,100	A thick midden layer that accumulated above Structure 2 which had been abandoned. This was extremely rich in faunal material with nearly half the identified assemblage discussed in this report derived recovered from these deposits.
Phase 3			Construction of Structure 2 with paved flooring laid above infill of Structure 1. Burials were interred below this pavement and this represents the first use of the area in the Late Natufian after a hiatus in occupation.
Phase 4	Early Natufian	~14,400-14,100	Infilling of Structure 1 after Phase 5 but occupation still present in the area.
Phase 5			Construction and use of a large hearth within the partially infilled structure. A paved area outside was probably contemporary with this and a number of human burials were interred below this pavement.
Phase 6			A period of infilling of Structure 1 but occupation was continuing in the area.
Phase 7			Construction and use of large basalt built structure (Structure 1). Faunal material derives from backfill of construction cut with a smaller amount from occupation deposits on the floor and a significant assemblage from the use fill of large central hearth.

Table 1 Phases of occupation at Shubayqa 1.

	Early Natufian					**Late Natufian**		
	Ph. 7	**Ph. 6**	**Ph. 5**	**Ph. 4**	**%**	**Ph. 3**	**Ph. 2**	**%**
Bos primigenius	6	1		1	0.2	7	8	0.2
Cervus elaphus						1		<0.1
Cervus elaphus / *Dama mesopotamica*				1	<0.1			
Sus scrofa			1		<0.1			
Gazella cf. *subgutturosa*	894	808	537	742	68.6	659	3469	68.4
Gazelle/sheep/goat	114	37	27	34	4.9	54	761	13.5
Ovis orientalis / *Capra aegagrus*	22	12	21	37	2.1	69	349	6.9
Ovis orientalis	12		3	11	0.6	23	94	1.9
Equus spp.	36	49	23	39	3.4	15	84	1.6
Canidae	2			1	0.1		1	<0.1
Vulpes spp.	20	8	18	31	1.8	22	167	3.1
Lepus sp.	236	293	113	152	18.3	48	204	4.2
Felis sp.		1			<0.1			
Testudo graeca	10	21	10	9		11	51	
Erinaceus spp.	4	20	12	7		2	17	
Murinae	1			1		1	7	
Gerbillinae	22	4	8	8		4	10	
Arvicolinae	1	1				4	10	
Dipodoidae							1	
Soricidae		1	1			1		
Rodent		13	7	4		1	18	
Snake	1							
Lizard	1	1		4		1	4	
Amphibian	1	2		1		1	6	
Total	**1383**	**1272**	**781**	**1083**		**924**	**5261**	

Table 2 Number of identified specimens of mammalian, reptilian and amphibian bone from different phases of Shubayqa 1 showing overall percentages of main food mammals in the Early and Late Natufian.

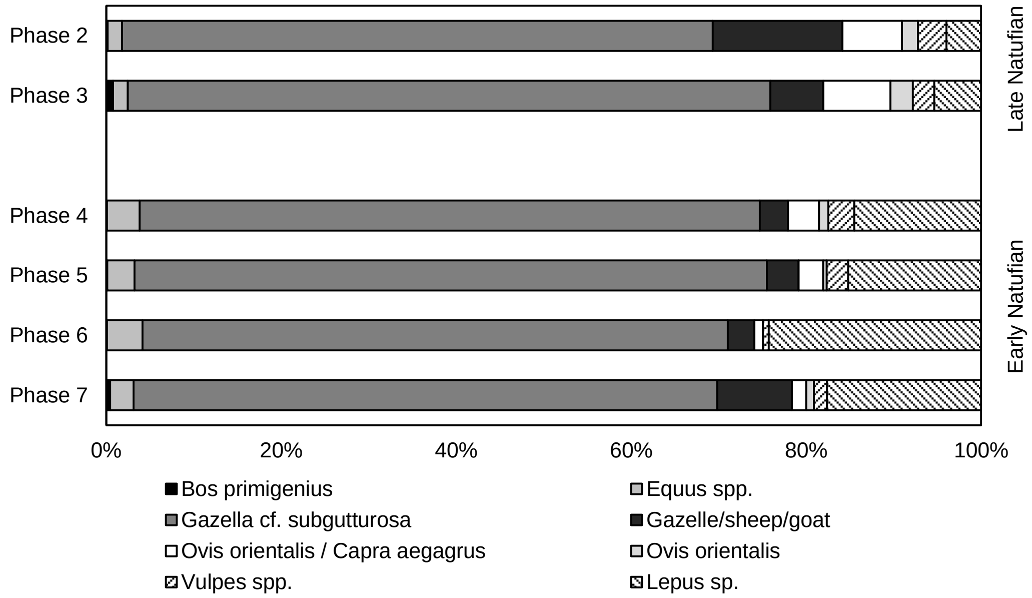


Figure 2 NISP Percentages of the main groups of food mammals by phase and grouped into Early and Late Natufian.

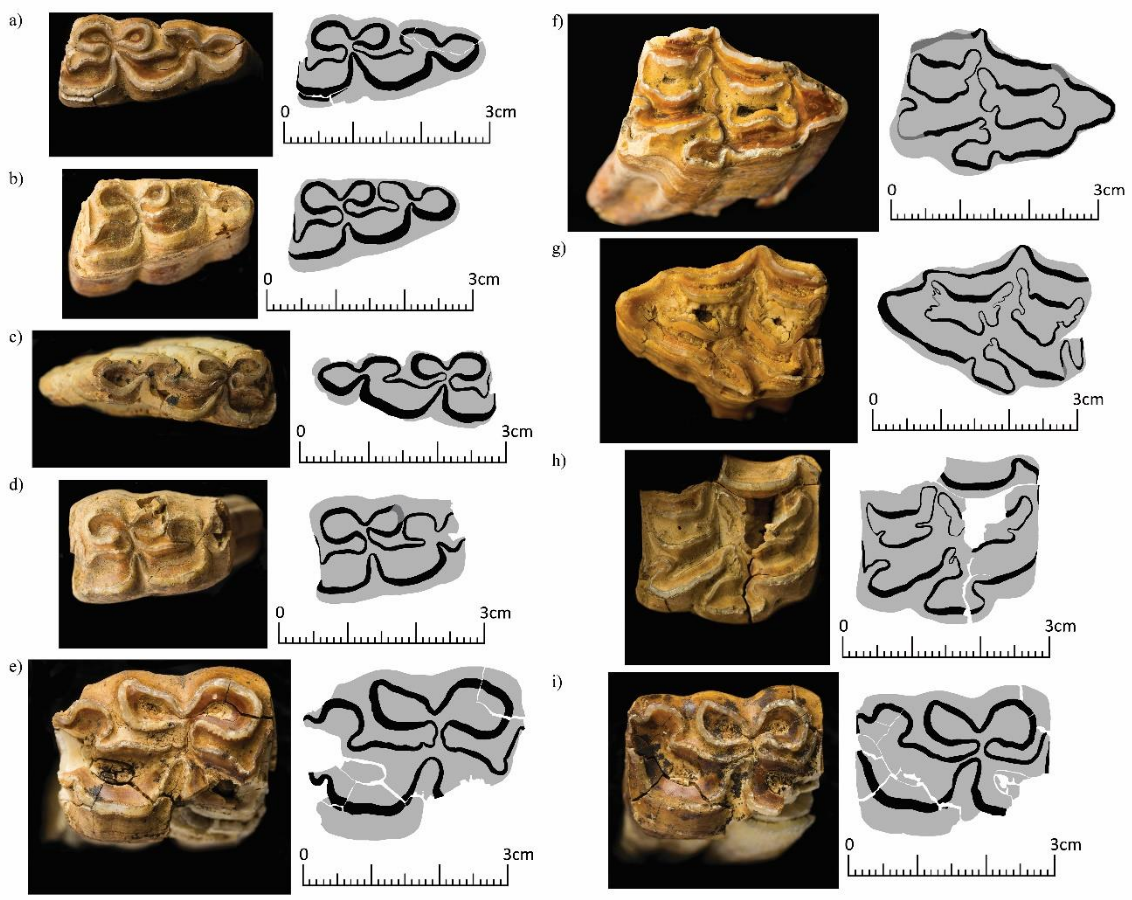


Figure 3 Equid teeth recovered from Shubayqa 1.

Figure 4 Red deer metatarsal and a possibly worked fragment of antler maybe from fallow deer.

			Early Natufian				Late Natufian	
Order	**Family**	**Species**	**Ph. 7**	**Ph. 6**	**Ph. 5**	**Ph. 4**	**Ph. 3**	**Ph. 2**
Podicipediformes	Podicipedidae	*Tachybaptus rufficollis*	3	5	1	1	1	33
Podicipediformes	Podicipedidae	*Podiceps nigricollis*	4	18	6	11	13	37
Podicipediformes	Podicipedidae	Unidentified Podicipedidae	5		3		2	3
Pelacaniformes	Ardeidae	*Ixobrychus minutus*		1				
Pelacaniformes	Ardeidae	*Ardeola* spp.				2		3
Pelacaniformes	Ardeidae	*Ardea* spp.						8
Pelacaniformes	Ardeidae	Unidentified Ardeidae				1	2	16
Anseriformes	Anatidae	*Cygnus* spp.	2					5
Anseriformes	Anatidae	*Anser* sp.		1		1		11
Anseriformes	Anatidae	*Anas* spp. large (cf. *A. platyrhynchos*)	6	3	2	11	14	
Anseriformes	Anatidae	*Anas* spp. medium (*A. platyrhynchos/acuta/penelope/clypeata*)	75	20	11	33	73	
Anseriformes	Anatidae	*Anas* spp. small (*A. querquedula/crecca*)	15	10	10	29	59	
Anseriformes	Anatidae	*Anas* spp.	60	14	53	27	71	835
Anseriformes	Anatidae	Unidentified Anatidae cf. *Anas* spp.	107	26	39	69	71	885
Anseriformes	Anatidae	*Aythya* spp.			4	3		46
Anseriformes	Anatidae	*Bucephala clangula*		1	1	1		7
Anseriformes	Anatidae	*Netta rufina*						3
Anseriformes	Anatidae	*Tadorna* spp.						9
Accipitriformes	Accipitridae	*Circus* spp.	3	1				
Accipitriformes	Accipitridae	*Accipiter* spp.	1				1	1
Accipitriformes	Accipitridae	*Buteo* spp.	1	1	1			6
Accipitriformes	Accipitridae	*Aquila* spp.	1	2			1	3
Accipitriformes	Accipitridae	Unidentified Accipitridae	45	9	5	12	7	22
Falconiformes	Falconidae	*Falco* spp.	1	1				1
Galliformes	Phasianidae	cf. *Alectoris chuckar*			1			
Galliformes	Phasianidae	*Ammoperdix heyi*		2		1		
Galliformes	Phasianidae	*Coturnix coturnix*	1	14	5	6	3	10
Galliformes	Phasianidae	Unidentified Phasianidae						7
Gruiformes	Rallidae	*Rallus aquaticus*		1				3
Gruiformes	Rallidae	*Porphyrio porphyrio*						1
Gruiformes	Rallidae	*Porzana* spp.	1	2	6	2	1	
Gruiformes	Rallidae	*Crex crex*	1	3		3	3	2
Gruiformes	Rallidae	*Gallinula chloropus*	2	1				2
Gruiformes	Rallidae	*Fulica atra*	30	9	12	32	41	363
Gruiformes	Rallidae	Unidentified Rallidae	4	4	3		1	3
Charadriiformes	Recurvirostridae	*Himantopus himantopus*	3			1		2
Charadriiformes	Charadriidae	*Charadrius* spp.	3	5	1	2	1	2
Charadriiformes	Charadriidae	*Pluvialis* spp.		1		2		
Charadriiformes	Charadriidae	*Vanellus* spp.	4	1		3		
Charadriiformes	Charadriidae	Unidentified Charadriidae	3	2	6	4		
Charadriiformes	Scolopacidae	*Calidris* spp.	25	43	13	34	13	2
Charadriiformes	Scolopacidae	*Philomachus pugnax*	513	295	244	264	123	143
Charadriiformes	Scolopacidae	*Limosa* spp.		1		2		
Charadriiformes	Scolopacidae	*Numenius* spp.	5	1	3	1	1	20
Charadriiformes	Scolopacidae	*Tringa* spp.	5			10	2	74
Charadriiformes	Scolopacidae	Unidentified Scolocidae	150	116	67	15	32	293
Charadriiformes	Sternidae	Unidentified Sternidae	10	33			4	
Charadriiformes	Unidentified	Unidentified Charadriiformes	41	47		18	15	11
Pteroclidiformes	Pteroclididae	cf. *Syrrhaptes paradoxus*	4	1	1	5	3	2
Columbiformes	Columbidae	*Columba* sp.				1		
Columbiformes	Columbidae	*Streptopelia* sp.		1				
Passeriformes	Corvidae	*Corvus* spp.	1				1	3
Passeriformes	Unidentified	Unidentified but small species	2	16	13	6	6	14
Large bird			3	1				1
Medium bird			18	12	5	18	10	169
Small bird			13	8	1	4	1	29
		Total	**1171**	**733**	**517**	**635**	**576**	**3090**

Table 3 Number of identified specimens of avian bone from the different phases of Shubayqa 1.

Figure 5 Juvenile raptor bones from Shubayqa 1.

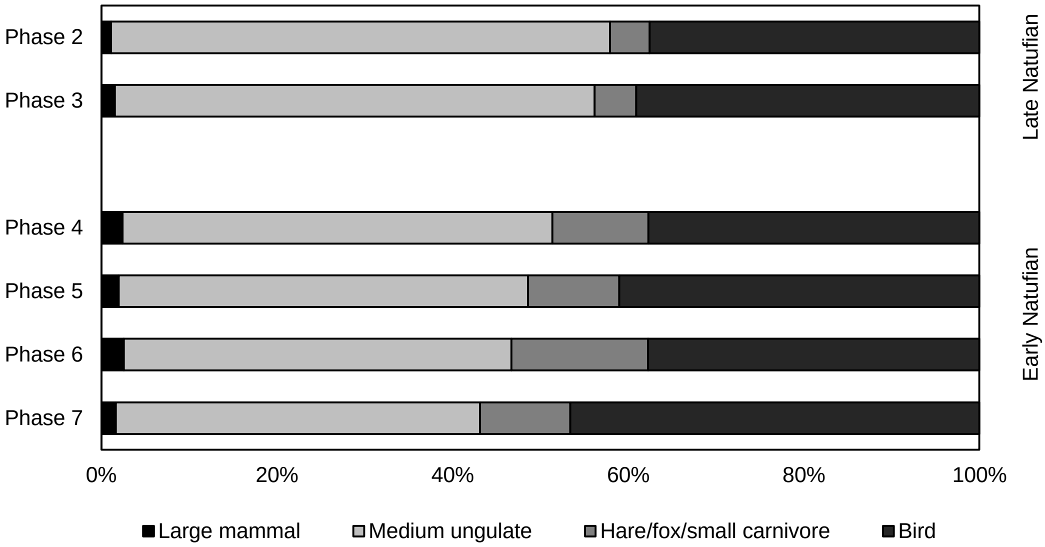


Figure 6 Relative frequency of the main groups of prey at Shubayqa 1 by Phase.

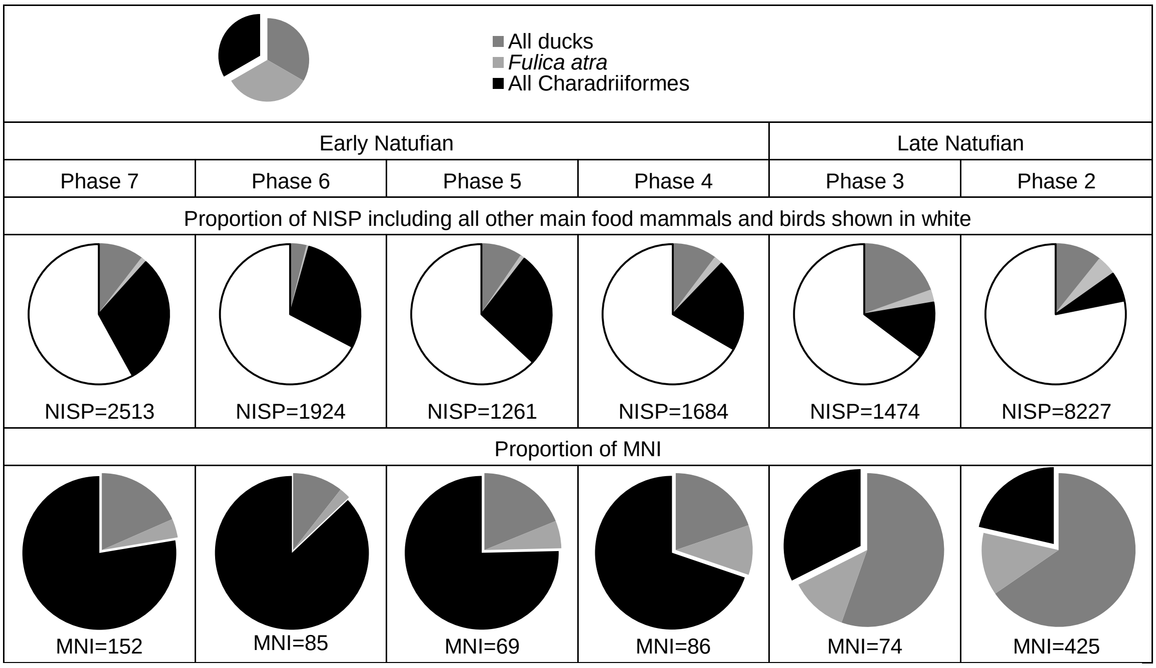


Figure 7 Comparison of the frequency of the mainly wintering birds (ducks and coots) and mainly passage migrants (Charadriiformes) in the Shubayqa 1 assemblage.

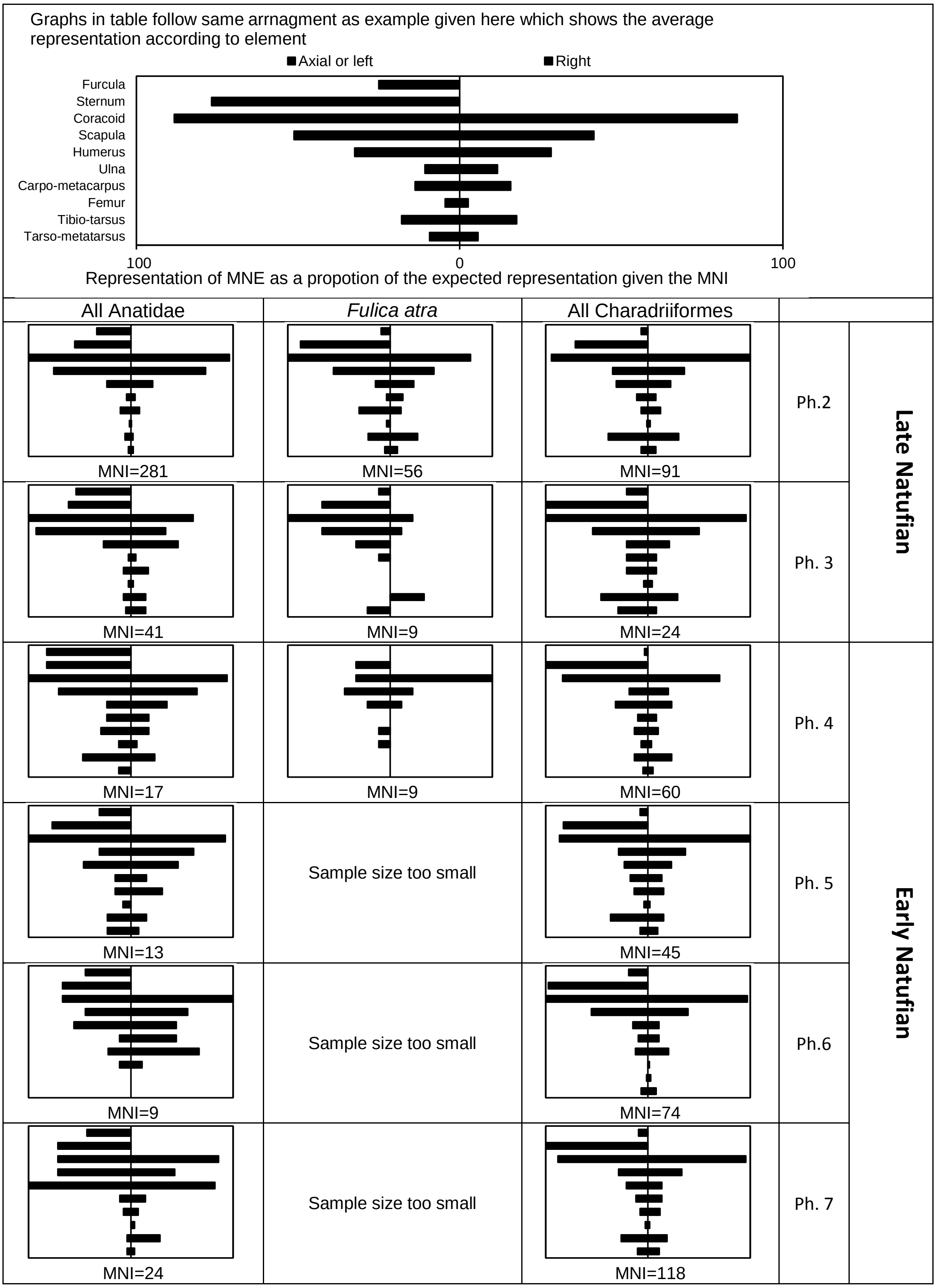

Graphs in table follow same arrnagment as example given here which shows the average representation according to element

Figure 8 Skeletal element representation of three groups of birds by Phase.

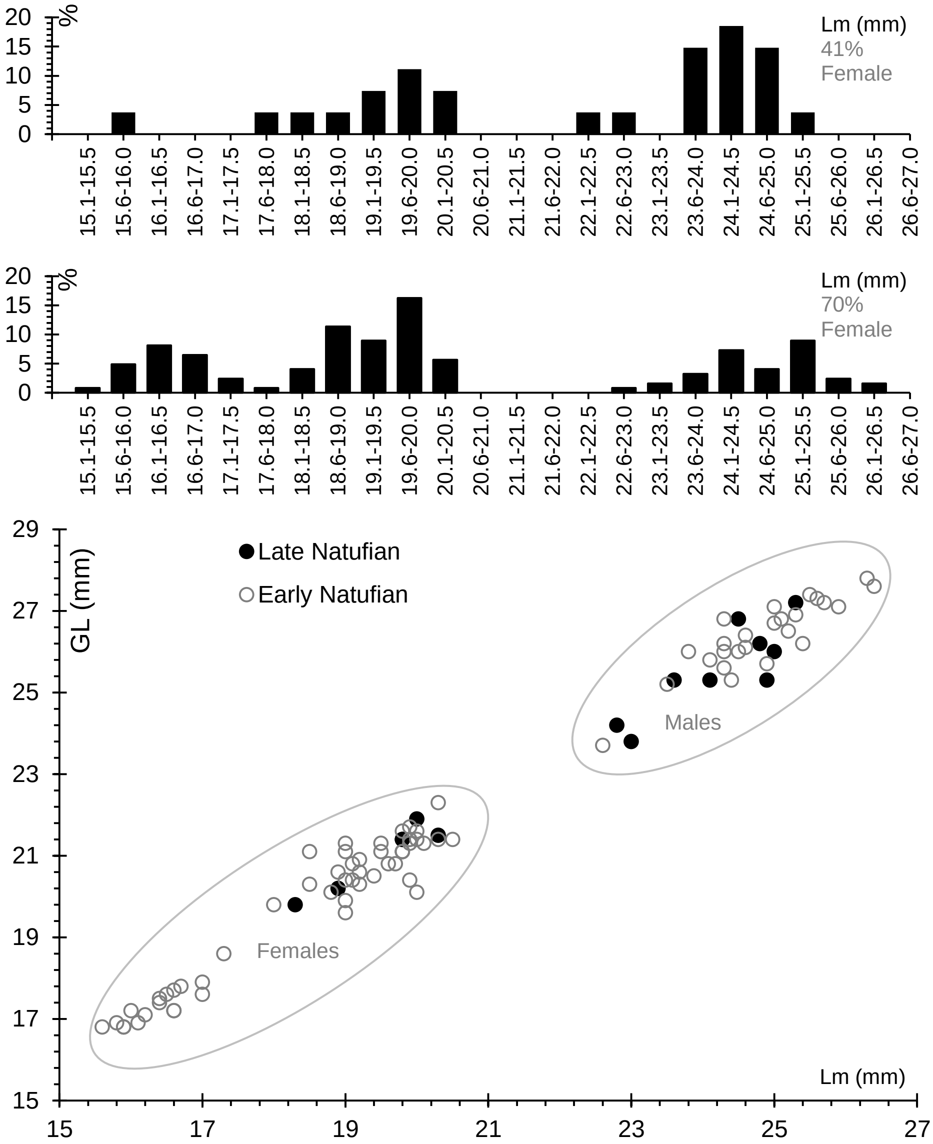
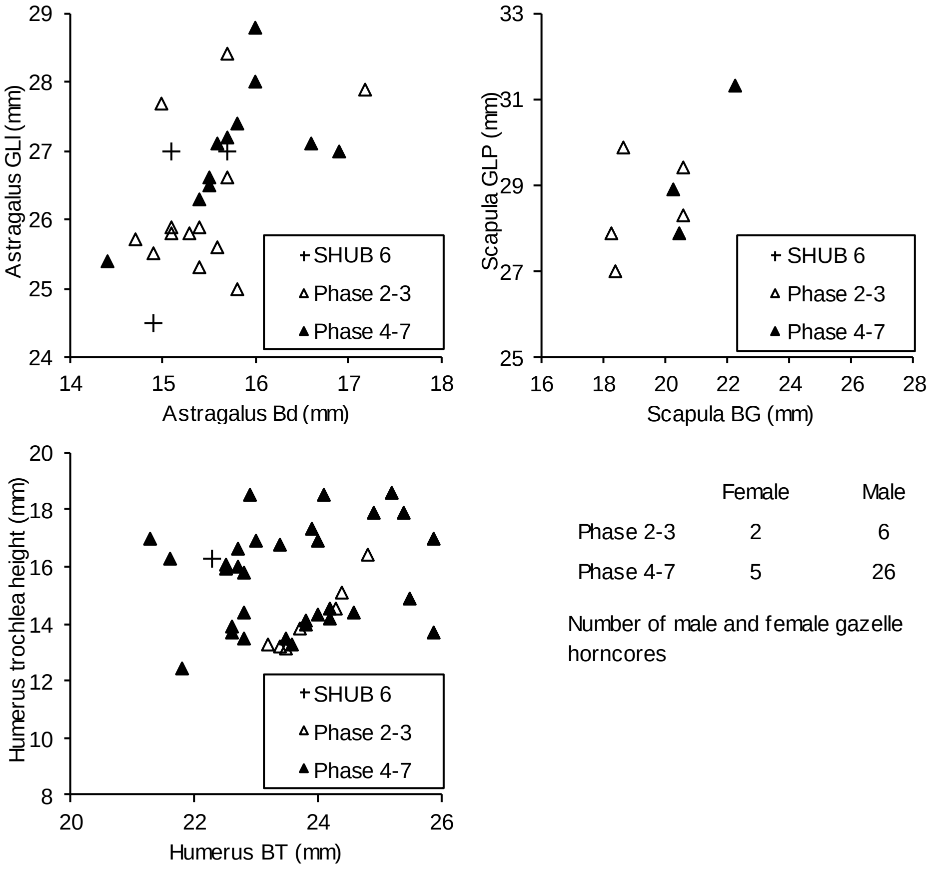


Figure 9 Measurements taken on coracoid of ruff (*Philomanchus pugnax*) highlighting the degree of sexual dimorphism and showing the potential unequal presence of males and females in the Early (lower histogram) and Late Natufian (upper histogram).

		Percentage unfused and just fusing				
	Phase	Proximal radius/phalanx 1 0-7 months	Distal humerus/scapula 3-7 months	Distal tibia 7-18 months	Other 7-18 months	Total with fusion data
Late Natufian	Ph. 2	26	15	39	56	1154
	Ph. 3	19	21	31	49	199
Early Natufian	Ph. 4	22	15	29	65	229
	Ph. 5	12	17	17	61	175
	Ph. 6	14	21	31	58	307
	Ph. 7	19	37	30	67	345

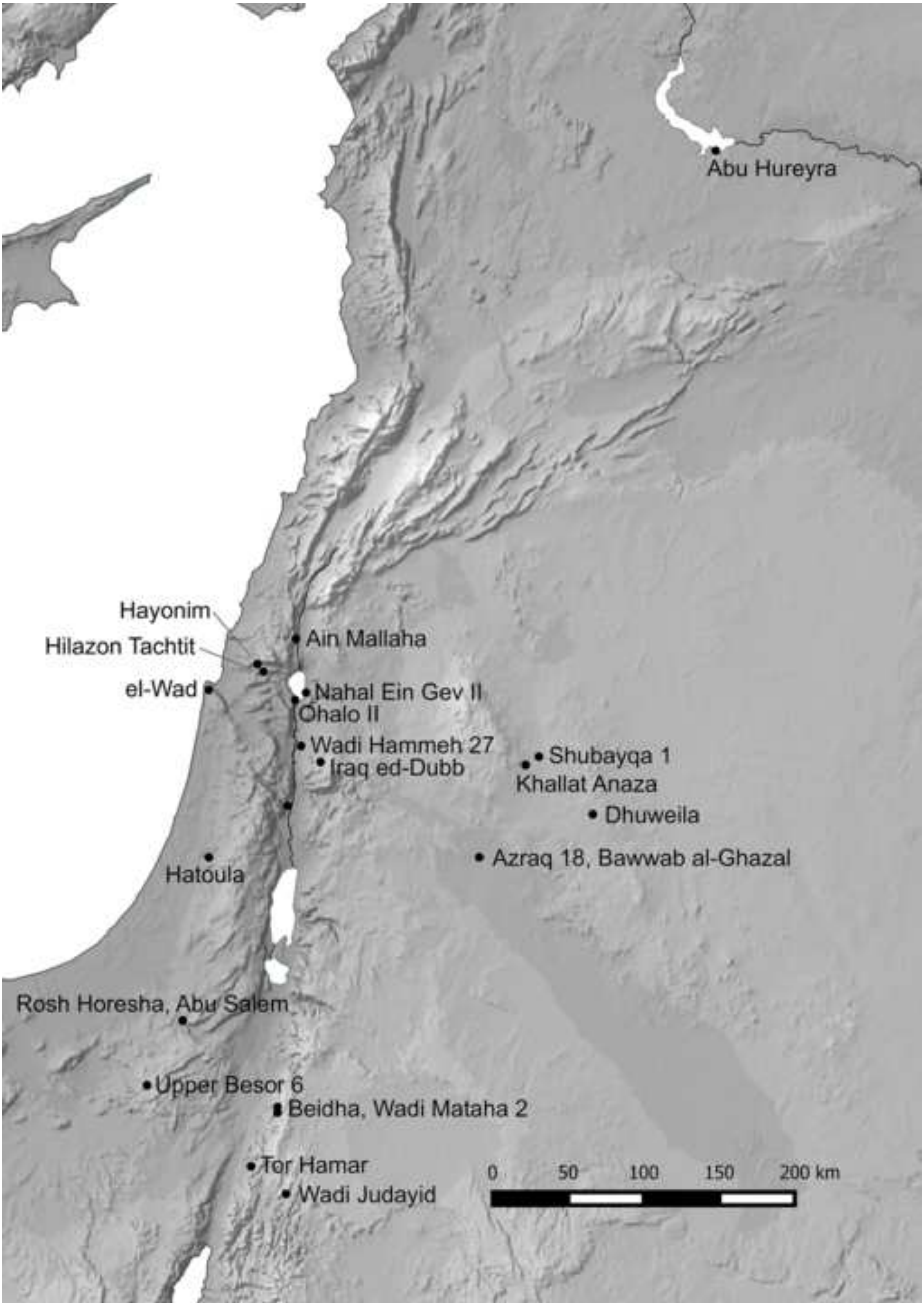
Table 4 Percentage of gazelle bones unfused or just fusing elements according to element groups that fuse in age ranges defined by Munro *et al.* (2009); other includes all elements fusing between 7-18 months, and right-hand column gives total number of elements with fusion data by phase.



	Female	Male
Phase 2-3	2	6
Phase 4-7	5	26

Number of male and female gazelle horncores

Figure 10 Bivariate plots of measurements taken on more sexually dimorphic skeletal elements (Horwitz *et al.* 1990; Munro et al. 2011) and number of horncores of male and female gazelle present in different Phases.


Abu Hureyra
Hayonim
Hilazon Tachtit
Ain Mallaha
el-Wad
Nahal Ein Gev II
Ohalo II
Wadi Hammeh 27
Iraq ed-Dubb
Shubayqa 1
Khallat Anaza
Dhuweila
Azraq 18, Bawwab al-Ghazal
Hatoula
Rosh Horesha, Abu Salem
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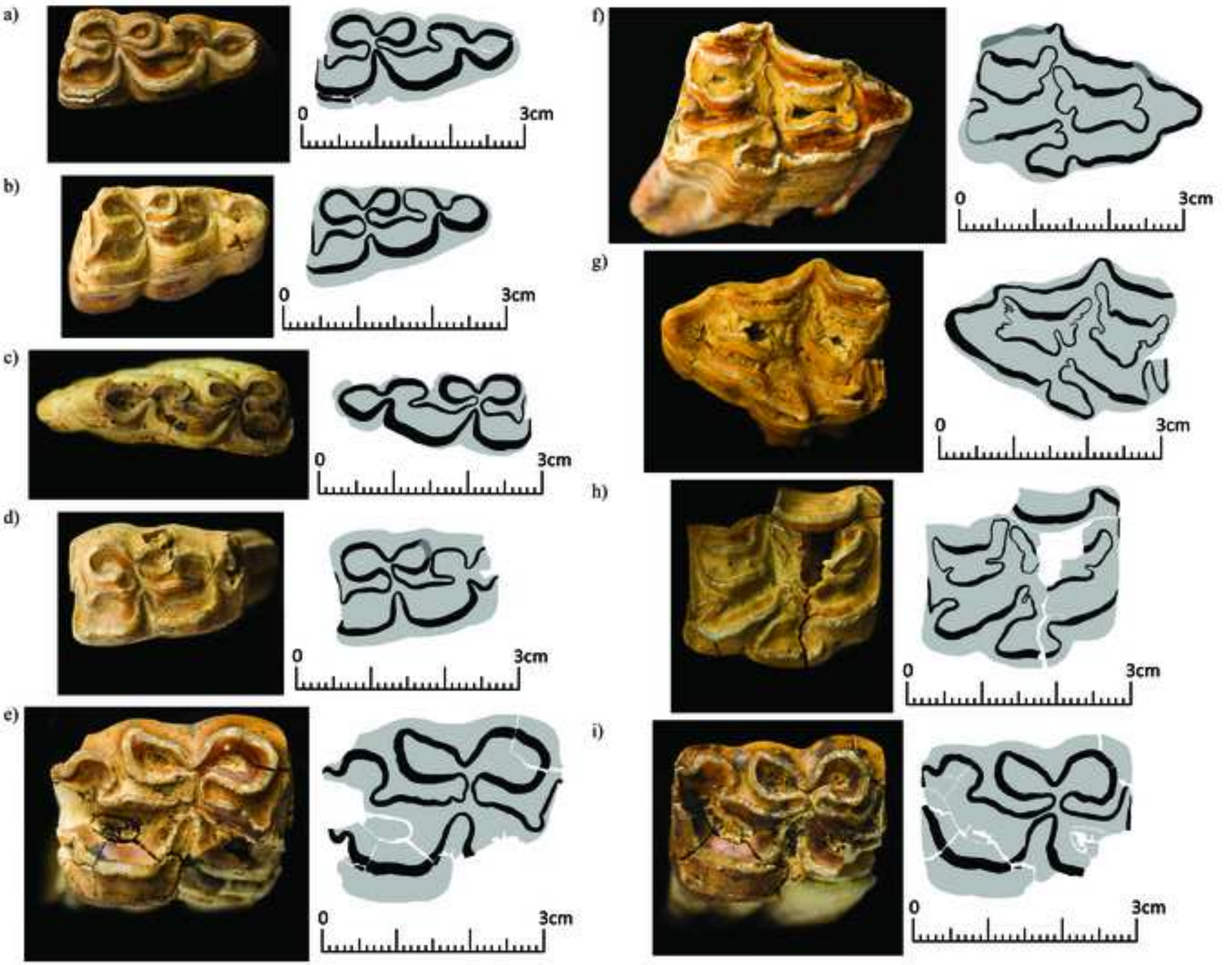
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