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"Founder crops" v. wild plants: Assessing the plant-based diet of the last hunter-gatherers in southwest Asia

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ABSTRACT

The Natufian culture (c. 14.6–11.5 ka cal. BP) represents the last hunter-gatherer society that inhabited southwest Asia before the development of plant food production. It has long been suggested that Natufians based their economy on the exploitation of the wild ancestors of the Neolithic "founder crops", and that these hunter-gatherers were therefore on the "threshold to agriculture". In this work we review the available data on Natufian plant exploitation and we report new archaeobotanical evidence from Shubayqa 1, a Natufian site located in northeastern Jordan (14.6–11.5 ka cal. BP). Shubayqa 1 has produced an exceptionally large plant assemblage, including direct evidence for the continuous exploitation of club-rush tubers (often regarded as "missing foods") and other wild plants, which were probably used as food, fuel and building materials. Taking together this data we evaluate the composition of archaeobotanical assemblages (plant macroremains) from the Natufian to the Early Pre-Pottery Neolithic B (EPPNB). Natufian assemblages comprise large proportions of non-founder plant species (>90% on average), amongst which sedges, small-seeded grasses and legumes, and fruits and nuts predominate. During the Pre-Pottery Neolithic, in particular the EPPNB, the presence of "founder crops" increases dramatically and constitute up to c. 42% of the archaeobotanical assemblages on average. Our results suggest that plant exploitation strategies during the Natufian were very different from those attested during subsequent Neolithic periods. We argue that historically driven interpretations of the archaeological record have over-emphasized the role of the wild ancestors of domesticated crops previous to the emergence of agriculture.

1. Introduction

The Late Epipaleolithic Natufian (c. 14.6–11.5 ka cal. BP) represents the last hunter-gatherer society in southwest Asia prior to the development of plant food production. The characterization of the plant-based subsistence during this time period is therefore key to understand the transition from foraging to farming. Until now, there has been an emphasis on the idea that Natufians relied on the intensive exploitation of large-seeded grasses such as cereals. "… Natufian communities practiced intensive and extensive harvesting of wild cereals …" (Bar-Yosef, 1998, p. 167), and they probably practiced small-scale wild cereal cultivation (Hillman et al., 2001; Ibañez et al., 2014). Ground-stone tools, sickle blades and threshing floors were "significant inventions of the Natufian culture, all essential for exploiting wild cereals" (Eitam et al., 2015, p. 7). The cereal-based plant diet has been directly connected to the conceptualisation of the Natufian as a complex hunter-gatherer society characterised by sedentism, incipient social complexity, and a delayed return-economy (Bar-Yosef and Belfer-Cohen, 1989; Bar-Yosef and Kislev, 1989; McCorriston and Hole, 1991). Unfortunately, however, the limited archaeobotanical evidence has hampered the understanding of the economic role that the wild ancestors of domesticated cereals and legumes played prior to the emergence of agriculture in southwest Asia.

In this work we review the available evidence for plant exploitation during the Natufian and we contrast this information with new data from Shubayqa 1, a Natufian settlement located in northeast Jordan (Richter et al., 2012, 2014, 2017; Richter, 2017a,b; Yeomans and Richter, 2016; Yeomans et al., 2017; Pedersen et al., 2016). The archaeobotanical evidence from Shubayqa 1 is

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currently unparalleled since it derives from well-dated, stratified deposits, and has yielded one of the largest plant macroremain assemblages dated to the Natufian. Moreover, the assemblage is unique in that provides solid evidence for the exploitation of underground storage organs, often regarded as "missing foods" due to their low archaeological visibility. Taking into account this new data, we evaluate the composition of archaeobotanical assemblages from the Late Epipaleolithic to the Pre-Pottery Neolithic B (c. 15–9.7 ka cal. BP), comparing the proportional representation of the wild ancestors of domesticated crops ("founder crops") and other wild plant species. We argue that the available data provides a very different perspective on Late Epipaleolithic plant-based subsistence strategies, which higlights the *broad spectrum* of plants exploited by Natufian hunter-gatherers. Historically driven interpretations of the archaeological record have therefore over-emphasized the economic role of the wild ancestors of domesticated cereals and legumes before the development of agriculture.

2. Characteristics of Epipaleolithic archaeobotanical assemblages in southwest Asia

Although more than 400 Natufian sites have been recorded in southwest Asia to date (see Fig. 1), only a handful have yielded plant macroremains (e.g. seeds, wood charcoal etc.), and yet fewer of these have produced substantial assemblages (e.g. >10000 remains) (see Table 1). In recent years phytolith analyses have started to provide new insights about Natufian plant use (Albert et al., 2003; Rosen, 2004, 2007, 2010, 2011, 2012, 2013; Portillo et al., 2010; Power et al., 2014, 2016), but our knowledge is still patchy. The reasons for this unsatisfactory situation can be summarised as follows:

1) Although plant remains are essential to address key research topics such as subsistence, they have, more often than not, been overlooked in many archaeological projects. Whilst archaeological sediments are commonly sieved thoroughly to retrieve flint and human/animal bones, systematic sampling for plant macroremains has less often been carried out (see Fig. 1). This is despite the fact that archaeobotanical recovery techniques such as flotation were implemented around the 1970s, and many Natufian sites have been excavated since then. If plant remains were not observed or recognised during excavation, it was commonly assumed that they were absent (e.g. Hole et al., 1969). The result has been that there are few Late Epipaleolithic sites, in comparison to the total number of excavated sites, in which thorough archaeobotanical sampling has been carried out. This has in turn led to a low overall numbers of sites with analysed and published archaeobotanical assemblages.
2) In some cases where plant macroremains were recovered, only those identified by naked eye during the excavation were retrieved (e.g. Hopf, 1983; Hopf and Bar-Yosef, 1987). Plant macroremains recovered this way commonly comprise large pieces of wood charcoal, nutshells or large seeds, such as those from legumes and cereals. But wild plant species are rarely represented in these assemblages, since many of them produce very small seeds (i.e. <1 mm) that can easily pass unnoticed. The use of dry-sieving alone may also result in biased archaeobotanical assemblages since the size of the meshes is rarely smaller than 0.5 mm (e.g. Melamed et al., 2008; Caracuta et al., 2014, 2015), and this may hamper the recovery of small-seeded plant species.
3) Another issue that archaeobotanists working on Epipaleolithic sites in southwest Asia often face is that even if samples are retrieved systematically and processed with machine-assisted flotation, low densities of plants are commonly preserved and recovered (see Table 1 for the total numbers of plant remains found at Late Epipaleolithic or Natufian sites). Poor preservation of plant remains has often been attributed to the consumption of raw plant resources or "missing foods" (Hillman, 1989; Hillman et al., 1989b). The "missing foods" may comprise raw vegetables (leaves, flowers, shoots), underground storage organs (tubers, rhizomes, corms and bulbs), fleshy parts of fruits and nuts, and edible pollen. If these plant remains come into contact with fire they are often too fragile to withstand charring and post-depositional processes. In the particular case of underground storage organs, which are primarily composed of parenchymatic tissue, several records indicate that they tend to disintegrate during the recovery with large-scale machine-assisted water flotation techniques (Hather, 2000 p.74; Hillman et al., 1989b). When parenchymatic tissue survives the recovery process, it is often fragmented and eroded, and it either passes unnoticed during the sorting process, or is regarded as unidentified parenchyma. Preserved parenchyma remains are often too small to be identified (Colledge, 2001) and very few people are specialised in their analyses (e.g. Hather, 1988, 1993, 2000; Kubiak-Martens, 2002, 2006, 2016).

It is important to be aware of these limitations to understand the nature of the available archaeobotanical evidence for the Epipaleolithic in southwest Asia. These issues call for the urgent need to apply systematic and intense recovery programs and combine different techniques (e.g. flotation and wet-sieving) to limit biases and obtain substantial archaeobotanical assemblages with which to characterise hunter-gatherer plant use.

3. The Natufian plant-based subsistence

The Natufian period is commonly divided into two main phases: the Early Natufian (~14.6–13.2 ka cal. BP) that developed during the wet and warm Bølling-Allerød interstadial (~14.6–12.9 ka cal. BP); and the Late Natufian (~13.6–11.8 ka cal. BP), which partially overlapped with the cool and dry environmental conditions of the Younger Dryas (12.9–11.5 ka cal. BP), (Maher et al., 2011; Grosman, 2013; Henry, 2013). Below we summarise the available evidence on Natufian plant exploitation based on the analyses of the material culture and the plant macroremains (see Power et al., 2016, for a recent review on Natufian plant microremains).

3.1. Review of the Natufian material culture linked to plant exploitation

Garrod (1932, 1957) first suggested that Natufians were the earliest agriculturalists in southwest Asia, and since then, the Natufian culture has been considered by many as threshold to the origins of agriculture (Henry, 1989; Bar-Yosef and Meadow, 1995; Bar-Yosef, 1998). It has been proposed that Natufian "affluent" economic systems were based on the abundance of wild cereals, and their subsequent domestication occurred as a response to their marked reduction in their natural availability (Flannery, 1969; Henry, 1989). Besides, the exploitation of cereals during the Natufian was said to be in direct relationship with the adoption of a sedentary way of life (Henry, 1985, 1989; McCorriston and Hole, 1991; Bar-Yosef and Belfer Cohen, 1992; Smith, 1994; Bar-Yosef and Meadow, 1995). Flannery (1969) argued that some degree of sedentism must have been necessary to process, store and manage cereal fields. However, assumptions regarding the relative importance of cereal exploitation during the Natufian have been so far primarily based on "indirect" evidence for plant exploitation, particularly on the analyses of the Natufian material culture.

Since its definition by Garrod (1931) the presence of sickle