Different manifestations of Neolithization in Northwest Anatolia? An archaeobotanical review from Barcın Höyük and Bahçelievler, Turkey

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ABSTRACT – *The Neolithic way of life was first established in Northwest Anatolia before the middle of the 7th millennium BC. The recently excavated sites of Barcın Höyük and Bahçelievler have yielded archaeological evidence for the earliest Neolithic levels in the region and provide new archaeobotanical datasets. To compare different adaptations to the changes brought on by the Neolithization processes, we studied 348 archaeobotanical samples from Phases VIe and VId1 at Barcın and 63 samples from the contemporaneous levels, Phase 6 and Phase 5, at Bahçelievler. The economic plants include hulled and naked six-row barley, einkorn, emmer, bread/hard wheat, small-sized naked wheat, lentil, bitter vetch, pea, chickpea, flax, hazelnut, bramble, and pistacia. Our analyses show small but significant differences between the sites in the selected economic plant ranges, among the cereals, pulses as well as gathered plants.*

KEY WORDS – *archaeobotany; Neolithization; Northwest Anatolia; Barcın Höyük; Bahçelievler*

Različne oblike neolitizacije v severozahodni Anatoliji? Arheobotanični pregled v Barcın Höyüku in Bahçelievlerju v Turčiji

IZVLEČEK – *Neolitski način življenja se je v severozahodni Anatoliji uveljavil pred sredino 7. tisočletja pr. n. št. Nedavno raziskani najdišči Barcın Höyük in Bahçelievler sta prinesli arheološke dokaze in arheobotanične zbirke podatkov o najzgodnejšem neolitiku v regiji. Primerjavo različnih prilagoditev spremembam, ki so jih prinesli procesi neolitizacije, smo opravili s pomočjo analiz 348 arheobotaničnih vzorcev iz naselbinskih faz VIe in VId1 v Barcınu in 63 vzorcev iz sočasnih faz 6 in 5 v Bahçelievlerju. Gospodarske rastline so oluščeni in goli šestvrstni ječmen, enozrnica, dvozrnica, krušna žita, drobnozrnata pšenica golica, leča, grenka grašica, grah, čičerika, lan, lešnik, robida in pistacija. Naše analize kažejo na majhne, a pomembne razlike med najdišči v izboru gospodarskih rastlin, tako med žiti in stročnicami kot tudi nedomesticiranimi rastlinami.*

KLJUČNE BESEDE – *arheobotanika; neolitizacija; severozahodna Anatolija; Barcın Höyük; Bahçelievler*

Introduction

Archaeological evidence indicates that sedentism, domesticated plants, and herded animals made their way from the Fertile Crescent and Central Anatolia towards the Aegean and the Marmara Region in the first half of the seventh millennium BC. How this spread occurred and how societies adapted to Neolithic lifestyles exhibit great variability. Studies on the Neolithization processes suggest that while some

DOI: 10.4312/dp.49.19

communities established Neolithic habits from the outset, others fused two diverse ways of life; a hunter-gatherer lifestyle with agriculture (for Europe see *Robb 2013; Zvelebil 2001*). Recent studies on modes of subsistence illustrate heterogeneous and complex processes and a mosaic of adaptations (*Ivanova* et al. *2018; Jovanović* et al. *2021; Kotzamani, Livarda 2018; Zeder 2011*). These data challenge the idea of the spread of a uniform 'Neolithic Package', but much remains to be done to understand how the processes took place from region to region. Macro-botanical and micro-botanical analyses can be important to understand the variability of Neolithic adaptations and subsistence strategies during this process of expansion and colonization.

How processes of expansion took place in Northwest Anatolia remains an important question given that this region was among the first territories that Neolithic pioneers coming from the core regions of Neolithization encountered (Fig. 1a). While all early settlements in the region display an established Neolithic way of life, it is still unclear whether these Neolithic societies incorporated Mesolithic foragers present in the region. Hypotheses have been formulated about a merging of forager and farmer groups in Northwest Anatolia (*M. Özdoğan 2013; 2014*), but the supporting evidence at hand is far from concrete. Differences in architectural styles and material culture have led to theories regarding the presence and continuity of local pre-Neolithic communities at some sites (*Düring 2013; Özbal, Gerritsen 2019; E. Özdoğan 2016*). While such a mosaic model in the Neolithization process is well-documented for Europe (*Zvelebil 2001*), Northwest Anatolia faces a general lack of data with regard to Mesolithic lifeways, except, potentially, Ağaçlı to the north of Istanbul (*Gatsov 2001; Gatsov, Özdoğan 1994; Özdoğan, Gatsov 1998*). Recent aDNA studies have shown that early Neolithic populations in West Anatolia and the first farmers in Europe belong to the same gene pool (*Hofmanova* et al. *2016; Lazaridis* et al. *2016; Mathieson* et al. *2015; 2018*). Much less clear at present is the genetic history of Anatolia before and during the period of initial Neolithization, but there are indications for complex processes during and after the Late Glacial that include genetic bottlenecks, admixture from outside the region and regional heterogenization (*Kılınç* et al. *2016; Marchi* et al. *2022; Yaka* et al. *2021*).

Botanical remains provide an important dataset through which the process of Neolithization can be studied. After all, what people cultivated and gathered must be viewed as a reflection of their lifestyle choices and could provide important insights on the Neolithization process. Botanical remains can act as a proxy, not only for the reconstruction of the local environmental or ecological situation but also for the incorporation and transmission of cultivated plants (*Balcı 2018; Gaastra* et al. *2019; Kotzamani, Livarda 2018; Krauß* et al. *2017; Marinova, Krauß 2014; Popova, Marinova 2007*). How much did people engage in and exploit their local environments, especially in the incipient phases of occupation? Is there a predominant dependence on farmed Neolithic founder crops or do we find evidence for the persistent utilization of local gathered resources? In what ways could the ratio between the wild and domesticated correlate with the habits of migrant farmers and local hunter-gatherers?

To explore these questions regarding Neolithization, this article makes use of two new Neolithic archaeobotanical datasets from the contemporaneous Northwest Anatolian sites of Barcın Höyük and Bahçelievler. These sites are less than 40km apart and appear to be in the same vegetational zone, making them ideal case studies for a comparative analysis of macro-botanical data. The site of Barcın Höyük (Bursa) was excavated between 2007 and 2015 (*Gerritsen, Özbal 2019*); Bahçelievler (Bilecik) between 2019 and 2021 (*Fidan 2020; Kolankaya-Bostancı, Fidan*

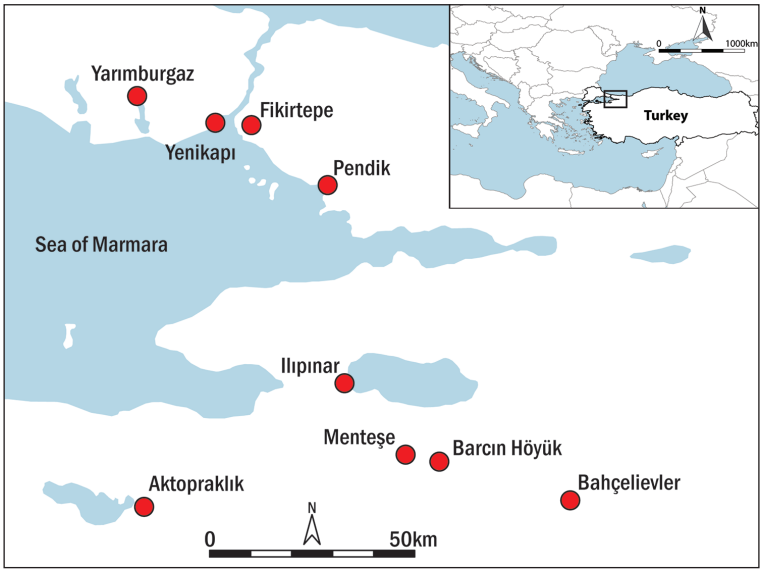

Fig. 1a. Excavated Neolithic sites in Northwest Anatolia.

2021). Both sites have levels dating to the first half of the seventh millennium BC and yield evidence for the earliest Neolithic communities in their respective sub-regions. Investigating the plant remains from the early and comparable levels of each site provides a first-hand way to observe similarities and differences in subsistence strategies. This, in turn, offers a window into their relative reliance on local resources and/or introduced founder crops. Our aim is to furnish our interpretation on the Neolithization process of Northwest Anatolia with new, first-hand data. What subsistence strategies did the inhabitants of each site adhere to, especially when it comes to plant use? When establishing Neolithic settlements where farming became the prominent form of subsistence, how much of the local flora was utilized?

Different manifestations in the same region? A case study of Barcın Höyük and Bahçelievler

Northwest Anatolia includes the region to the southeast of the Marmara Sea that extends from the Bosphorus to the Eskişehir Region. The latter provides direct access to the Anatolian Plateau. In the past, as today, this region represented a diverse vegetational, geographical, and palaeogeographical structure consisting of coasts, mountain thresholds, mountains, plains, and valleys irrigated by rivers (*Atalay, Mortan 1997; Clare, Weninger 2014; Kayan 2014; Roberts 2014*). Climatically, it has mild/Mediterranean conditions (*Clare, Weninger 2014*). Given the humid climate of Northwest Anatolia around 11 000 BC, the predominant tree species were birch, oak, pine, and juniper. These species also formed the main tree taxa during the Late Glacial period (*Roberts 2014.Fig.1a*).

A general vegetation history covering most of the Holocene indicates that the lowland hills and mountain slopes of this region were covered with woodlands dominated by deciduous oak from about 10 000 to 6500 BC (*Bottema, Woldring 1995; Bottema* et al. *2001; Kayan, Woldring 2002*). Pollen studies from a location in the Yenişehir lake basin near Barcın Höyük revealed that the vegetation was also comprised of fir (*Abies*), pine (*Pinus*), elderberry (*Sambucus*), hornbeam (*Carpinus*), hazelnut (*Corylus*), beech (*Fagus*), cedar (*Cedrus*), linden (*Tilia*), and elm (*Ulmus*) (*Bottema* et al. *2001*). A recent wood charcoal study by Schroedter and Nelle on data obtained from the Late Neolithic layers at the site of Aktopraklık – located near Lake Ulubat, fifty kilometres to the West of the Yenişehir Plain – yielded oak, pine, mock privet, and pistacia as well (*Schroedter, Nelle 2015*). Despite the geographical proximity, the latter two species are not documented in the pollen study from Lake Yenişehir (*Bottema* et al. *2001; Schroedter, Nelle 2015.92*).

Today, about a third of the region remains covered with forests (*Atalay, Mortan 2011; Roberts 2014*). Due to the felling of oak and red pine forests in historical times, dense maquis shrubland covers the landscape. Vegetation includes species such as rock rose (*Cistus creticus*), hazel (*Corylus*), tree heath (*Erica arborea*), prickly juniper (*Juniperus oxycedrus*), mock privet/green olive tree (*Phillyrea latifolia*), pistacia (*Pistacia terebinthus*), and plum (*Prunus*) (*Atalay, Mortan 2011.153*).

Archaeologically, the Istanbul region, the Yenişehir Plain, the foothills overlooking Lake Ulubat, and the Bilecik-Eskişehir region fall within what has traditionally been called the Fikirtepe Culture zone (Fig. 1a) (*Özdoğan 2014*). Evidence for agriculture and animal husbandry is most prevalent here, but minor amounts of hunting, gathering and fishing are also evident across the communities of the Neolithic and Chalcolithic in the Fikirtepe Culture zone at sites including Pendik, Fikirtepe, Yenikapı in Istanbul province, Barcın Höyük, Menteşe, Aktopraklık, Ilıpınar in Bursa province, and Bahçelievler in Bilecik and Keçiçayırı in Eskişehir provinces in Northwest Anatolia (*Arbuckle* et al. *2014; Balcı 2018; Balcı* et al. *2019; Boessneck, von den Driesch 1979; Budd* et al. *2013; 2018; 2020; Buitenhuis 2008; Cappers 2008; 2014; Çakırlar 2013; 2015; Galik 2013; Gourichon, Helmer 2008; İzdal Çaydan 2018; Karul 2011; 2017; Kızıltan, Polat 2013, Kızıltan 2013; Kolankaya-Bostancı, Fidan 2021; Özdoğan 1983; Sarı, Akyol 2019; Thissen* et al. *2010; Ulaş 2020; Würtenberger 2012*).

A noteworthy element with regard to the architecture is that we see variability across sites. While those like Barcın Höyük (*Gerritsen, Özbal 2016*), Menteşe (*Roodenberg* et al. *2003*), Ilıpınar X-IX (*Roodenberg 2008*), and Aktopraklık B (*Karul 2010*) display rectilinear architecture, others including Aktopraklık C (*Karul 2011; Karul, Avcı 2011*), and Bahçelievler (*Fidan 2020; Kolankaya-Bostancı, Fidan 2021*) yield evidence for round semi-subterranean structures. Both round and rectangular buildings have been discovered and excavated at Yenikapı (*Kızıltan, Polat 2013*) and Pendik (*Harmankaya 1983; Özdoğan 2013; Pasinli* et al. *1993*), while Yarımburgaz (*Özdoğan 2013*) stands alone as a slightly later cave settlement. If architecture is a phy-

sical manifestation of world views and lifestyles (*Lefebvre 1991*), then the variability observed across Northwest Anatolia in the seventh and sixth millennia BC may be noteworthy. The contrast that the sites of Barcın Höyük and Bahçelievler show with regard to architecture, with the former yielding rectangular and the latter round structures, juxtaposes these two pioneering Neolithic sites. This allows us to consider any notable differences in botanical remains in a larger context. We may ask whether divergences in assemblages may reflect indications of diverse representations of lifestyle preferences or whether they are, in fact, a result of micro-regional adaptations. Are there indications that we are dealing with immigrant farmers at one community and a representation of local hunting and gathering communities who adopted agriculture in another?

Barcın Höyük and Bahçelievler were inhabited partially contemporaneously, as demonstrated by both absolute dates and material assemblage comparisons (*Fidan 2020; Gerritsen, Özbal 2013a; 2013b; Özbal, Gerritsen 2019*). Bahçelievler Phase 6 is likely contemporary with Phase VIe at Barcın Höyük, while Bahçelievler Phase 5 corresponds timewise with Barcın Höyük Phase VId1. The later levels at both sites, beyond the scope of this paper, show parallelisms with the Fikirtepe culture (Fig. 1b).

Barcın Höyük general background

Barcın Höyük is located in the Yenişehir Plain, Bursa, and was excavated between 2005–2015. The Neolithic levels are separated into seven distinct phases from the uppermost VIa to the lowest VIe (*Gerritsen* et al. *2013a; Gerritsen, Özbal 2019*). The most important result of the Barcın Höyük excavations is possibly its contribution to the reconstruction of a continuous developmental sequence for the Neolithic of the Marmara Region. The stratigraphic sequence from the site, supported by 80+ radiocarbon dates, enables us to restructure the period from the first half of the seventh millennium to the beginning of the sixth millennium BC with associated material culture, architecture, and subsistence strategies (*Gerritsen, Özbal 2016; 2019; Özbal, Gerritsen 2019*).

Excavations at Barcın Höyük yielded rectangular houses. This article discusses Phases VIe and VId1, for which the botanical remains have been extensively studied (*Balcı* et al. *2019*). While two posthole structures dating to the earliest phase (VIe) were unearthed, excavations also brought to light a row of four slightly smaller structures dating to VId1, the overlying phase (*Gerritsen, Özbal 2016; Özbal, Gerritsen 2019; van den Bos 2021*). Courtyards were discovered north and south of the structures in both phases. Posthole architecture was the primary building technique in Phase VIe, but in VId1 considerably smaller posts set into foundation trenches were used instead (*van den Bos 2021.168*). Most notably, there are differences between the two phases with regards to material culture as well. The scarcity of archaeological materials in the earliest layers, including pottery, is noteworthy. By Phase VId1 the range of objects available increases both in quantity and variability (*Gerritsen, Özbal 2016; Özbal, Gerritsen 2019*).

Bahçelievler site general background

The site of Bahçelievler was discovered on an empty land parcel between apartment buildings in the city centre of Bilecik. The Neolithic settlement was located on the eastern bank of a small stream that has subsequently dried up. The Neolithic layers have been divided into seven different phases, from Phases 8 to 2. Preliminary radiocarbon dates suggest that the earliest levels of Bahçelievler correspond to the first half of the seventh millennium BC (*Fidan 2020*). The exact dates are difficult to ascertain given

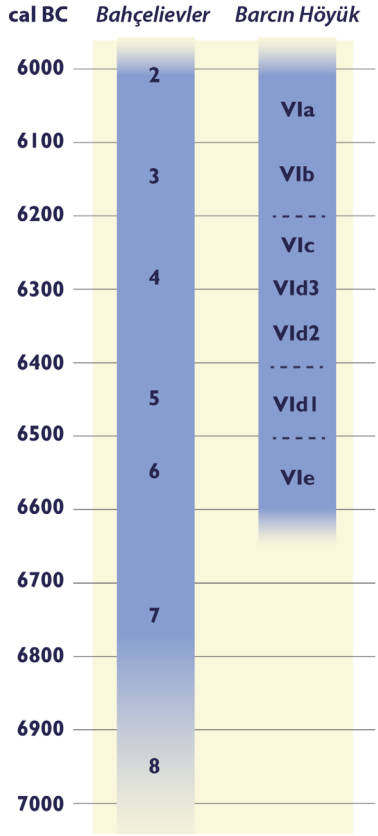

Fig. 1b. Comparative chronological table for Bahçelievler and Barcın.

the problems with the calibration curve, but the earliest dates fall between 7192–7052 BCE.[1] Excavations at Bahçelievler in Phases 3–8 yielded oval/round structures with diameters of 3–5m and walls up to 45–50cm thick in some structures. The walls were strengthened in some instances by mud or mudbrick, and post-holes traces are visible in some walls as well as clusters of small pebbles (*Fidan 2020.36*). Workshop and courtyard areas were discovered between the structures, yielding most of the artifact assemblages with the exception of stone tools, which for the large majority come from inside the buildings (*Kolankaya-Bostancı, Fidan 2021.102*).

Materials and methods

The macro-botanical samples collected at both sites were floated in water, not more than two litres at a time, by means of manual flotation in buckets. Chiffon fabric was used for drying the light material and a 1mm mesh was used for the heavy material during the flotation for collecting and drying. The dried samples were sifted through steel test sieves of 0.24<0.5<1.0<2.0<3.0mm and placed inside zipped plastic bags and centrifuge tubes for sorting. A triocular 0.6–4x stereo zoom microscope was used for identification and photography. The plant remains were compared with plant catalogues to aid with the determination of genus and species (*Bojnansky, Fargasova 2007; Cappers* et al. *2012; Cappers, Bekker 2013; Cappers* et al. *2016; Neef* et al. *2012*).

For Barcın Höyük, a systematic sampling strategy was applied to the site during the excavations. A total of 163 samples corresponding to 480 litres of soil from Phase VIe and 185 samples corresponding to 580 litres of soil from Phase VId1, all collected during the 2013–2015 seasons, have been analysed within the scope of this study. The samples represent different contexts including layers, surfaces, platforms, pits, foundation trenches, pyrotechnic features, postholes, and burials. The frequent burned contexts at Barcın Höyük facilitated excellent preservation of plant remains as well as substantial amounts of wood charcoal. There is no particular context in which we find a high percentage of plant remains in Barcın Höyük except a single burned store of lentils from structure 2a in level VId1 that yielded around 28 000 seeds. However, no special wild plant group was found among the samples (*e.g., Fairbairn* et al. *2007*). A large proportion of the wild plants consists of field grass/weeds. The wild plant group is part of another study (in prep.). The archaeobotanical samples were studied by the first author in several places including the Barcın Höyük Excavation House in Yenişehir, Bursa, the Netherlands Institute in Turkey in Istanbul, and the Koç University Archaeology Laboratory in Istanbul under the supervision of René Cappers of the University of Groningen.

For Bahçelievler, a total of 134 archaeobotanical samples corresponding to 650 litres of soil sampled from the Neolithic phases during the 2019, 2020, and 2021 seasons were analysed. Included here in this study are 40 samples (248 litres) from Phase 6 and 23 samples (108 litres) from Phase 5. The samples were taken from surfaces, courtyards, hearths, and burials, yielding great variability in the number of archaeobotanical samples for each phase. The preservation of the plant remains was notably poorer than at Barcın Höyük, probably due to the lack of burned deposits, but it may also reflect the circumstances of plant use at the site. Most of the cereal remains were fragmented, making species identification difficult and wood charcoal remains remain limited. The archaeobotanical samples have been studied in the Bilecik Museum by the first author.

Archaeobotanical results from Barcın Höyük and Bahçelievler

Overall, the crop range between the two sites is similar. Both sites display an increase in quantity and variety of plant remains from the earliest phases Barcın VIe and Bahçelievler 6 to the subsequent phases Barcın VId1 and Bahçelievler 5 (Fig. 2). This may be to some extent a result of factors like preservation and sample numbers, but despite these issues a remarkable increase in the variety of cereals and pulses at both sites is noted over time.

At Barcın Höyük Phase VIe, investigations yielded economic plants from the grass (Poaceae) family which constitute the main cereal group. This includes six-row barley – hulled and naked (*Hordeum vulgare* ssp. *vulgare* L.), einkorn wheat (*Triticum monococcum* ssp. *monococcum* L.), emmer wheat (*Triticum turgidum* ssp. *dicoccon* (Schrank) Schübl.) and bread/hard wheat (*Triticum aestivum* L./*durum* Desf.). Among the pulses (Fabaceae), lentils (*Lens culinaris* Medik.), peas (*Pisum sativum* L.) and bitter vetch (*Vicia ervilia* L.) were identified.

1 The ^{14}C results of the settlement are being prepared for publication by Erkan Fidan and TÜBİTAK MAM.

In this phase, excavations yielded only fifteen pulse fragments, while flax (*Linum usitatissimum* L.) was represented by a mere seven seed fragments (Fig. 2). In summary, barley (hulled and naked), einkorn, and emmer hulled wheats, bread/hard wheat (naked), lentils, bitter vetch, peas and flax represent the main documented economic plants from VIe at Barcın Höyük.

In Phase VId1, in contrast, we find an expansion of types and a greater variety than in VIe. The main cereals remain identical with the Phase VIe but we also begin to find a small-sized naked wheat type (not exactly defined wheat species between *Triticum* ssp. *aestivum*/ssp. *durum* and *T. turgidum* ssp. *dicoccon*) added to the cereal range in this phase. Likewise, we see a real presence of pulses – especially lentils – of the pulse family. Identified species are similar to those from Phase VIe, but we find that the chickpea (*Cicer arietinum*) begins to appear among the pulses range in this Phase. Flax is also present as observed in VIe in small quantities. Phase VId1 also yields species gathered from the surroundings including 22 fruits of hazelnut (*Corylus avellana* L.) and two fruitlets of bramble (*Rubus*).

As mentioned above, the plant preservation at Bahçelievler is poor compared to at Barcın Höyük, and many samples yielded hardly any remains. Phases 8 and 7 at Bahçelievler with a total of four and 21 plant remains, respectively, are not considered in this paper because the botanical yields are too low to make meaningful interpretations (Fig. 2). The lack of botanical remains in the two lowest phases at Bahçelievler may be a result of sampling sizes, preservation and restricted exposures of the excavations, but could potentially reflect the limited use of farming plants. Instead, this paper focuses on Phases 6 and 5 where the counts are not only adequate but the dates for these levels align well with Barcın Höyük's Phases VIe and VId1. Thirty-eight of the samples, mostly coming from Trench B3 and dating to Phases 6 and 5, show somewhat higher concentrations. In Phase 6, the cereals include six-row barley – naked/hulled (*Hordeum vulgare* ssp. *vulgare*), einkorn (*Triticum monococcum* ssp. *monococcum*), emmer (*Triticum turgidum* ssp. *dicoccon*), and bread/hard wheat (*Triticum* ssp. *aestivum/durum*). However, the einkorn wheat is only represented by two fragmented grains. Likewise, two seeds of lentil (*Lens culinaris*) have been identified for Phase 6 at Bahçelievler. Though minimal, this phase also yielded evidence for gathering with two fruits of pistacia (*Pistacia* ssp.).

In the subsequent Phase 5, however, six-row barley – hulled/naked (*Hordeum vulgare* ssp. *vulgare*), emmer wheat (*Triticum turgidum* ssp. *dicoccon*), and bread/hard wheat (*Triticum* ssp. *aestivum/durum*) were identified within the grass family among the main economic plants, while this time einkorn wheat (*Triticum monococcum* ssp. *monococcum*) was represented by a single grain. Pulses remain poorly represented and lentil (*Lens culinaris*) continues to be represented by no more than two seeds. While this points to the presence of the species, it may not effectively show that this species had a significant role in the diet, at least within the excavated contexts. At the same time, however, gathered plants may suggest a different exploitation strategy of the immediate landscape in this phase. Pistacia, which was found in negligible quantities in Phase 6, becomes represented by 77 fruits from five different samples from the courtyard areas of Trench B3, suggesting a much larger emphasis on gathering by Phase 5. The gathered plant remains also include two grape seeds.

Discussion

Comparing the results for Barcın Höyük and Bahçelievler

As at Barcın Höyük, the results also show an increase in botanical remains through time at Bahçelievler as well. While by Bahçelievler Phase 5 the variety of economic plants parallels that at Barcın Höyük, there are a few elements that show dissimilarity (Figs. 3–4). Barcın Höyük yielded small-sized naked wheat and flax, both of which were lacking at Bahçelievler, and the presence of einkorn wheat, represented by only two grains at Bahçelievler Phase 6 is debatable. In addition, the cereals remain the dominant group of edible plants at both sites when compared with other plant remains, where it comprised 95% of the assemblage at Barcın Höyük (Fig. 5a) and 72% at Bahçelievler (Fig. 5b). The pulse group comes second and retains a minor place, especially at Bahçelievler.

However, the most meaningful results that differentiate the sites derive from gathered plants. Though still preliminary, the results raise the question as to whether gathering at Bahçelievler contributed to the diet in a more substantial way than at Barcın Höyük. Pistacia, a gathered resource, comes second in quantity after the cereal remains, suggesting that it played a significant role at this site (Fig. 5b). Pistacia is represented in this area within a range of trees with edible fruits including pistacia/terebinth (*Pi-*

		BARCIN		BAHÇELİEVLER				
	phases	VIe	VId1	8	7	6	5	
	dates	(6600-6500 cal.BC)	(6500-6400 cal.BC)	(7000-6800 cal.BC)	(6800-6600 cal.BC)	(6600-6500 cal.BC)	(6500-6400 cal.BC)	
	sample number	163	185	12	20	40	23	
	liters of soil	480	580	55	84	248	108	
Economic Plants								**Economic Plants**
Poaceae	**plant parts**	**1833**	**3817**	**4**	**21**	**77**	**153**	**cereal**
Hordeum vulgare ssp. *vulgare*	fruit	60	239			3	5	six-row barley hulled-naked
Hordeum vulgare ssp. *vulgare*	rachis	0	33					six-row barley - rachis
Triticum monococcum ssp. *mon* .	fruit	75	157			2	1	einkorn wheat (hulled)
Triticum turgidum ssp. *dicoccon*	fruit	97	335	2	2	9	5	emmer wheat (hulled)
Triticum dicoccon /monococcum	rachis fragments**	905	631					einkorn/emmer - rachis frag.
Triticum aestivum/durum	fruit	37	359			6	19	bread/hard wheat (naked)
Triticum aestivum/durum	rachis	0	0					bread/hard wheat - rachis
Triticum turg. ssp.	fruit	0	59					small-sized naked wheat
Triticum/Hordeum	fruit	659	2004	2	19	57	123	wheat/barley (fragmented)
Fabaceae		**15**	**28186***		**7**	**5**	**3**	**pulses**
Fabaceae	seed					2	1	pulse unknown
Vicia ervilia	seed	6	88			1		bitter vetch
Cicer arietinum	seed	0	7		1?			chickpea
Lens culinaris	seed	8	28075		6	2	2	lentil
Pisum sativum	seed	1	16					pea
Linaceae		**7**	**24**					**oil/fibre plant**
Linum usitatissimum	seed	7	24					flax
Gathered plants		**1**	**24**			**2**	**77**	**gathered plants**
Corylus avellana	fruit	1	22					hazel
Rubus	fruitlet		2					bramble
Vitis	seed						2	grape
Pistacia ssp.	fruit					2	75	pistacia

Fig. 2. The quantitative comparison of crop plants between Phases VIe and VId1 at Barcın and contemporary Phases 6 and 5 at Bahçelievler, as well as the earliest Phases 8 and 7 at Bahçelievler. * represented as two samples, this total includes a lentil storage unit (which yielded around 20 000 seeds of lentil) and an associated collapse context (which yielded around 8000 seeds of lentil). ** rachis fragments include partly glume bases, spikelet forks, rachis, and rachis internodes.

stacia terebinthus L.). At Barcın Höyük, in contrast, gathering remains almost trivial, and hazelnut and bramble fragments, especially when compared to the high quantity of samples, remain negligible (Fig. 5a). On the other hand, it may not always be consistent to emphasize the importance of a species based on the number of remains discovered, given that a range of criteria including preservation, fruit morphology,[2] food preparation, and consumption, may affect the ultimate proportions. Nonetheless, the use of economic plants remains notably important at both sites in the earliest phases.

Local adaptation: pulses

Both Barcın Höyük and Bahçelievler yielded small quantities of pulses in their earliest phases, suggesting that pulses may be rare in general in the region in the first half of the seventh millennium BC. At Barcın Höyük, only fifteen pulse seeds were found in Phase VIe (Fig. 2), strikingly low, especially given the rich array of cereal remains recovered from the same contexts. However, we do see a significant increase in pulses by VId1 when we find a store of them *in situ* clustered in a lentil storage bin as well as from several other contexts. Bahçelievler, likewise, yields a similar picture with regards to pulses where they remain conspicuously lower in quantity when compared with cereals (Fig. 6). There may be

Plants	Barcın	Bahçelievler
Small-sized naked wheat	present	not present
Flax	present	not present
Gathered plants	hazelnut, bramble	pistacia, grape

Fig. 3. The differences in plant selection between Barcın Höyük and Bahçelievler.

several reasons underlying the near lack of pulses in the earliest phases of these sites. The earliest inhabitants, whether incipient pioneer settlers or descendants of local foragers, might initially have briefly experimented with pulses but may instead have chosen to target cereal cultivation during the first occupation Phase VIe.

On the other hand, the rarity of pulse species has also been interpreted as a result of preservation-dependent factors, and the scarcity of pulses might be a result of post-depositional processes specific to the species (*Cappers 2008; Kotzamani, Livarda 2018; Marinova, Popova 2008*). If taphonomic, the challenge is to explain the significant difference in the pulse ratio between Phases VIe and Vd1 at Barcın

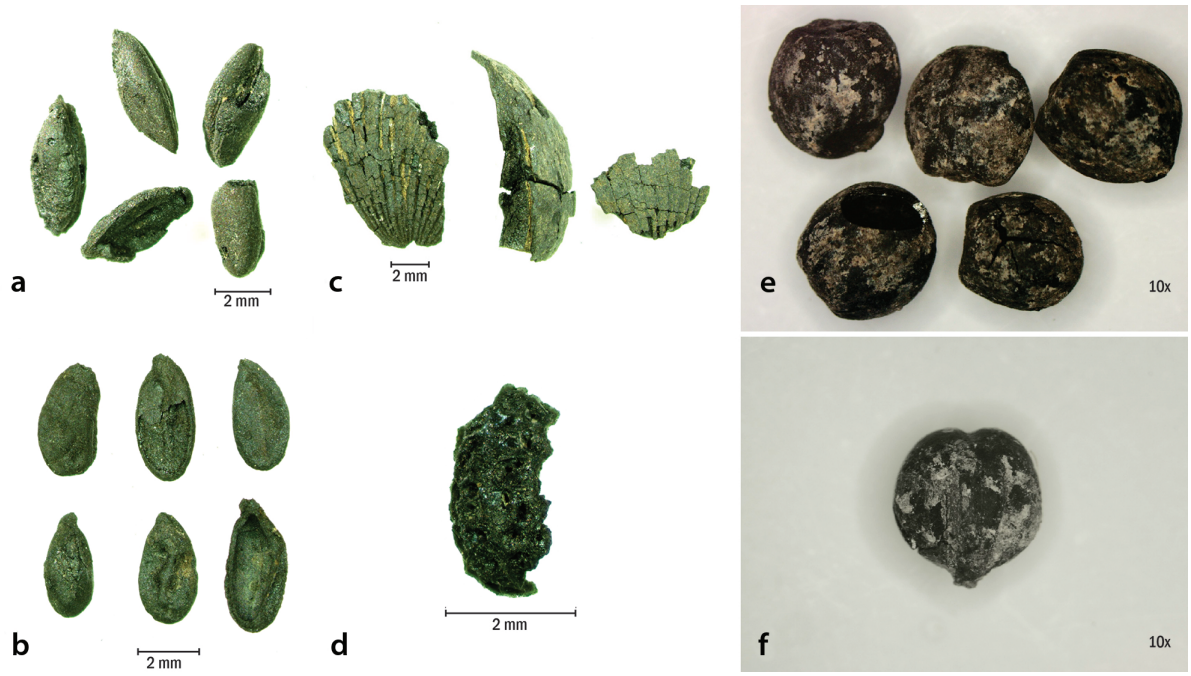

Fig. 4.* a *small-sized naked wheat;* b *flax;* c *hazelnut;* d *bramble (a, b, c, d from Phase VId1, Barcın Höyük),* e *pistacia,* f *grape (e, f from Phase 5, Bahçelievler).

2 For example, the number of fruitlet endocarps for someone who eats five brambles would be *c.* 300–350. Post-depositional dispersal might dilute the number concentrated in feces (personal communication with René Cappers).

Höyük. Except for the burned store of lentils in structure 2a in Barcın VId1, we know that there is no significant difference in terms of the preservation conditions across the site. Aside from the store, 182 pulse seeds were discovered in the 580 litres sorted for Barcın VId1 across a range of 35 different contexts. But only 14 pulse seeds were documented for the 480 litres analysed for Phase VIe. Preservation-related factors are often suggested to diminish the importance of pulses in the diet, but the discovery of a dense store of lentils in Phase VId1 questions the assumption that they were insignificant. The pulse spectrum at Barcın Höyük is paralleled at Bahçelievler, where we see an increase in quantities over time. A question that comes to mind is whether this increase is a result of the changes in social behaviour, the household structure, and/or the subsistence strategies of the inhabitants which may collectively have contributed to major shifts in the exploited species. Limited exposures and the low level of preservation of plant remains at Bahçelievler make it difficult to make a direct quantitative comparison, unlike at Barcın Höyük. However, it can be suggested that the first settlers of Barcın Höyük must have applied different strategies regarding the growing, storing and processing of pulses.

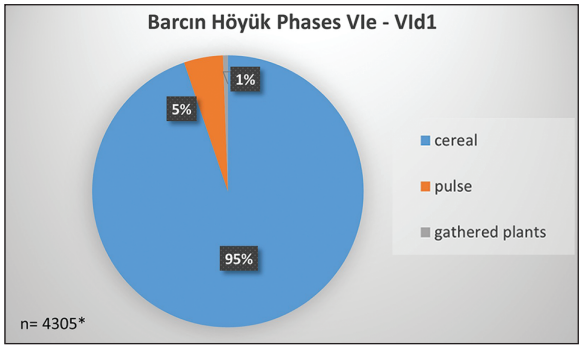

Fig. 5a. The proportions of economic plant groups in Phases VIe and VId1 at Barcın Höyük. * The 28 000 lentil seeds from Barcın Höyük are not represented in the pie chart.

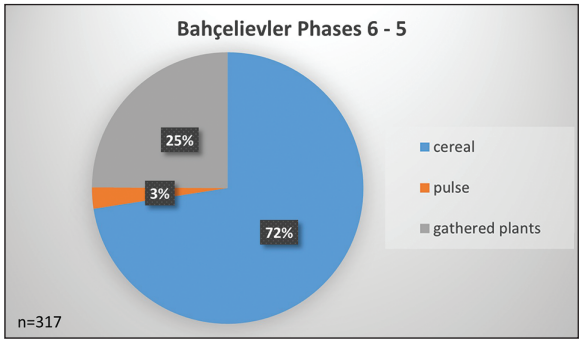

Fig. 5b. The proportions of economic plant groups in the Phases 6 and 5 at Bahçelievler.

Local adaptation: gathered plants

A major factor differentiating the sites of Barcın Höyük and Bahçelievler with regard to their subsistence strategies lies in the approaches that their inhabitants took with regard to gathered plants. Barcın Höyük lacks the general exploitation of edible fruits. Analyses only documented a single fruit of hazel in level VIe, though this number approaches 22 fruits by Phase VId1, which come from seven different contexts. The presence of hazelnut increases in the later levels of the site (*Balcı* et al. *in prep.*). This could be considered an indication of how people interacted with their immediate environment. At Barcın Höyük, the exploitation of gathered plants was quite limited, and instead, cultivated, and harvested agricultural plants were favoured. At Bahçelievler, on the other hand, as demonstrated by the courtyard area of Trench B3 in Phase 5, the gathered plant pistacia and most likely *Pistacia terebinthus* was collected, where it comprised 25% of the assemblage demonstrating definitive utilization of this species in the diet.

An interesting aspect of the gathered plant remains found at both sites is that they are typically from restricted numbers of contexts in comparison with economic plant groups such as cereals and pulses. This raises the question of full-time exploitation. Unlike cereals, which are particularly hardy and are exceptionally suited for long-term storage, gathered plants are typically seasonal, and thus collection and exploitation times must have been limited. In addition, the location of the consumption of gathered plants such as hazelnut/pistacia and bramble/grape show differences with regard to depositional processes. In this context, we can ask whether the lack of hazelnut at Bahçelievler, and, despite the large sample sizes, the complete absence of pistacia at Barcın Höyük, was a result of sub-regional vegetation boundaries. While pistacia was not documented in the pollen study from Lake Yenişehir (*Bottema* et al. *2001; Schroedter, Nelle 2015.92*), the presence of this species is well attested in the Late Neolithic layers at Aktopraklık (*Schroedter, Nelle 2015*) and in the early Chalcolithic layers from Ilıpınar X (*Cappers 2008*) which are 75 and 40km away, respectively. Tim M. Schroedter and Oliver Nelle (*2015*) suggest that pistacia is a plant that thrives in open Mediterranean type environments with shrub-like vegetation. Barcın Höyük was located in a valley bottom with ample potential for agriculture while Bahçelievler was in an upland region, so the differences in the setting may have contributed to the micro-en-

vironmental juxtaposition. On the other hand, we think that the nearby slopes along the edges of the Yenişehir plain could have been used for agriculture as well (*Balcı 2018*). Hazelnuts often thrive in open woodlands, which likely describes the situation for Barcın Höyük. We cannot rule out that the differences across the sites with regard to their reliance on gathered plants was a result of micro-climatic and vegetational aspects and hence different methods of adapting to the environment. The data from Barcın Höyük does not point to an intense reliance on other micro-climatologically suitable gathered plants. It is therefore possible that part of the divergence may be a result of the ways in which the residents of each site interacted with their immediate surroundings and exploited the local vegetation.

	Barcın		Bahçelievler				
	VIe	VId1	8	7	6	5	
sample number	163	185	12	20	15	23	sample number
Economic Plants							Economic Plants
pulse	15	28186*		6	6	3	Fabaceae
pulse unknown					3	1	Fabaceae
bitter vetch	6	88			1		*Vicia ervilia*
chickpea		7					*Cicer arietinum*
lentil	8	28075		6	2	2	*Lens culinaris*
pea	1	16					*Pisum sativum*

Fig. 6. The quantities of pulse remains from the early phases at Barcın Höyük and Bahçelievler.

A comparison of subsistence strategies in the region

Most of the Neolithic sites in Northwest Anatolia have levels dating to the end of the first half and second half of the seventh millennium, and yield evidence for what appears to be the earliest Neolithic inhabitants in their respective sub-regions, supporting our interpretation of the Neolithization process for Northwest Anatolia. Bahçelievler (*Balcı, in prep.*), Barcın Höyük (under study by Cappers, Balcı; *Balcı 2018; Balcı* et al. *2019*), Aktopraklık (*Karul 2017; Kabukçu* et al. *in prep.*), Menteşe, and Ilıpınar (*Van Zeist* et al. *1995b; Cappers 2008; 2014*), Pendik (*Ulaş 2020*), Fikirtepe, Yenikapı (*Ulaş 2020*), and Neolithic Yarımburgaz provide insights on the Neolithic way of life across the Eastern Marmara Region (Fig. 7). Even though not all excavations have yielded archaeobotanical data such as Fikirtepe, we do have ample data on their subsistence economies.

In general, a terrestrial diet, rather than an aquatic or wild game-based one, is predominant at the inland settlements of Bahçelievler, Barcın Höyük, Basal Menteşe, Aktopraklık C, and Ilıpınar X (*Arbuckle* et al. *2014; Balcı* et al. *2019; Buitenhuis 2008; Budd* et al. *2013; 2018; 2020; Cappers 2008; Galik 2013; Gourichon, Helmer 2008; İzdal-Çaydan 2018; Karul 2017; Kolankaya-Bostancı, Fidan 2021*). In addition, based on the presence of marine-based and hunted foods at coastal sites like Pendik and Fikirtepe, it is possible to interpret these subsistence practices as a continuation of Mesolithic customs (*Boessneck, von den Driesch 1979; Çilingiroğlu 2005; Düring 2011; Evershed* et al. *2008; Özdoğan 1983b; 2010; 2011; 2013; Röhrs, Herre 1961; Thissen 1999; Thissen* et al. *2010*). Burhan Ulaş' (*2020*) study on plant subsistence in Pendik also supports this suggestion. Though a coastal site, Yenikapı presents a different picture than the agricultural communities at Fikirtepe and Pendik, which also appear to have practiced fishing and hunting, probably because Yenikapı primarily represents the sixth millennium and is thus later (*Kızıltan, Polat 2013; Ulaş 2020*).

In Bursa province, archaeobotanical data has been obtained from Barcın Höyük, Aktopraklık, and Ilıpınar. At Neolithic Aktopraklık C, we know of the presence of six-row barley, emmer, lentils, bitter vetch, and flax (*Karul 2017*). At Ilıpınar, excavations yielded 24 samples from the earliest Phase X and 20 samples from the overlying Phase IX dating to just after the turn of the sixth millennium BCE. The data suggests that barley, emmer, small-sized wheat, einkorn, lentil, bitter vetch, grass peas, peas, flax, figs, and bramble were used as economic plant species in the two earliest phases. However, the earliest Phase X only yielded a single non-economic plant (*Cappers 2008*).

In Istanbul province archaeobotanical data has been obtained from both Pendik on the Asian side and Yenikapı on the European side. At Pendik, archaeobotanical analyses yielded limited results. These comprised only a few cereals including a single emmer grain, and a single barley grain as well as only a couple of pulses, including one-seed of a grass pea and one-seed of a pea. In addition, seven seeds of flax and two fruitlets of bramble were identified within the economic plant data. Other identified plant remains are included in the wild plant group (*Ulaş 2020.30–31*). At Yenikapı, there is a higher variety in the economic plant range. The cereal group includes emmer, einkorn, bread/hard wheat, and

		Northwest Anatolia										Central Anatolia	Western Anatolia	
		Bilecik		Bursa					İstanbul			Konya	İzmir	
Poaceae	**Plant Part**	**B.evler Phase 6**	**B.evler Phase 5**	**Barcın Höyük VIe**	**Barcın Höyük VId1**	**Menteşe**	**Aktopraklık C**	**Ilıpınar X-IX**	**Pendik**	**Fikirtepe**	**Yenikapı**	**Çatalhöyük VIII-VI**	**Ulucak VI-Vb-e**	**Cereal**
Hordeum vulgare ssp. *vulgare*	fruit	+	+	+	+		+	+	+			+	+	six-row barley (hulled-naked)
Hordeum v. ssp. distichon	fruit													two-row barley
Triticum monoc. ssp. monococcum	fruit	+	+	+	+			+			+	+		einkorn wheat
Triticum tur. ssp. *dicoccon*	fruit		+	+	+		+	+	+		+	+	+	emmer wheat
Triticum aestivum/durum	fruit	+	+	+	+						+	+	+	bread/hard wheat
Triticum ssp.	fruit				+			+						small-sized naked wheat
Triticum compactum	fruit										+			club wheat
Triticum spelta	fruit										+			spelt/hulled wheat
Scale cereale	fruit											+		rye
Fabaceae														**Pulses**
Lens culinaris	seed	+	+	+	+		+	+			+	+	+	lentil
Lathyrus sativus	seed							+	+		+	+		grass pea
Vicia ervilia	seed			+	+		+	+			+	+	+	bitter vetch
Pisum sativum	seed			+	+			+	+		+	+	+	pea
Cicer arietinum	seed				+						+	+		chickpea
Vicia faba	seed										+			faba bean
Linaceae														**Oil and fibre plants**
Linum usitatissimum	seed			+	+		+	+	+					flax
Gathered plants														**Gathered Plants**
Amygdalus	fruit											+		almond
Celtis	fruit/stone											+		hackberry
Prunus	fruit											+		plum/cherry
Ficus carica	fruitlet							+			+	+		fig
Rubus	fruitlet				+			+	+		+			bramble/blackberry
Vitis vinifera	seed		+?		+?						+			grape
Malus/Pyrus	seed													apple/pear
Corylus avellana	fruit		+?	+?	+									hazelnut
Quercus	fruit/seed											+		acorn
Pistacia ssp.	fruit		+					+				+		pistacia

Fig. 7. Comparative table of economic plant data in NW Anatolia and neighbouring regions.

new glume wheat, *T. spelta, T. compactum*, which is a species related to bread/hard wheat (*Ulaş 2020. 32*). Overall, this yields a different picture than the general regional crop range. The pulse group includes lentils, chickpeas, grass peas, bitter vetch, peas, and faba beans (*Vicia faba* var. *minor*, *Ulaş 2020*). In addition, a range of gathered plants including figs, grapes, and bramble have been documented (*Ulaş 2020.32–33*).

Consequently, we find notable dissimilarities in founder crops across sites. While it is possible to talk about a transition to farming and husbandry in the region, simply applying a universal 'Neolithic Package' idea does not embody the complexity that is present across different sites. From this point of view, inhabitants at most sites within the region knew and practiced agriculture, and some also seem to have had a keen understanding of the immediate environment. Overall, each settlement appears to have opted to apply individual behaviours at a small scale.

In addition, it has been shown that dairy products typically comprise a significant amount of the diet for many Marmara Region residents during the Neolithic Period (*Evershed* et al. *2008; Özbal* et al. *2013; Thissen* et al. *2010*). Meat would naturally also have contributed to the nutrition needs, but it is still generally thought that economic plants and mostly cereals formed the largest percentage of these communities' diets, because they were also intensive farmers. We know this especially from the carbon and nitrogen isotope analyses on bone collagen from individuals at Aktopraklık and Barcın Höyük from the work of Chelsea Budd *et al.* (*2013; 2018; 2020*). Fish consumption also seems to play a notable role at some sites, but it mostly appears as a supplementary food in the diet. Given this complex picture, our archaeological interpretation must, for the moment, remain incomplete and perhaps inaccurate until multi-proxy subsistence research is carried out for each settlement.

Conclusions

The main aims of this study have been to use the archaeobotanical datasets from Barcın Höyük and Bahçelievler to discern variability in Neolithization processes in Northwest Anatolia in the seventh millennium BC, and to compare local community-based adaptations with the macro-regional phenomenon of Neolithization. A careful study of the datasets from each site shows various nuances in the specific economic plant packages, which can be clustered under four groups. First, cereals such as barley, einkorn, emmer, and bread/hard wheat, are identified with certainty for Phase VIe at Barcın Höyük, but barley and einkorn are not favoured in the contemporaneous Phase 6 at Bahçelievler. Second, the data did yield some differences in the presence of flax and a small-sized naked wheat, which are both present in Phase VId1 at Barcın Höyük but have not been found at Bahçelievler. Third, the presence of pulses such as lentils, peas, chickpeas, and bitter vetch differs between phases at both sites. Although lentils, bitter vetch, and peas were identified in nearly negligible amounts in Phase VIe at Barcın Höyük, these pulses become common in the subsequent phase and chickpeas also emerge within the local inventory at this point. At Bahçelievler, on the other hand, lentils and a single seed of bitter vetch were identified in Phase 6, while lentils continue to be the only identified pulse species in the overlying Phase 5. Finally, the presence of gathered plants, conspicuously lacking from the earliest phases, appears in the subsequent levels of both Barcın Höyük and Bahçelievler. Hazelnut and bramble are found at Barcın Höyük while pistacia and grape occur at Bahçelievler. Despite the proximity of the two sites, the results show distinct local food practices and potential re-interpretations of the process of Neolithization.

Based on the current evidence, the pioneer settlers at Barcın Höyük appear to have brought their full subsistence package with them. The data from Bahçelievler also suggest a reliance on non-local economic plants. However, the inhabitants of Bahçelievler appear to show more readiness to exploit local wild resources and to integrate gathered plants into the local subsistence strategies in Phases 6 and 5. We observed that the economic plant range in both sites remains limited, especially when compared with the later levels. While some of the differences observed between Barcın Höyük and Bahçelievler may be related to sub-regional climatic variability, local geographical conditions, or vegetational differences and the particulars of the plant economies at each site were the outcome of the choices made by their respective communities, based likely on local cultural preferences and social practices.

Suggesting that this results from the divergent pathways that the inhabitants of these sites took in the process of Neolithization admittedly requires a large leap. Whether the reliance on gathering at Bahçelievler, with its semi-subterranean round houses,

was a remnant of a practice the inhabitants held onto since the pre-Neolithic periods is difficult to ascertain and cannot be addressed confidently with macro-botanical data alone. Nonetheless, we can at least propose that the behaviour that emerges from the choices that the inhabitants of each site made were due to a complex set of habits and environmental circumstances. This notion poses new questions about this region's transition to the Neolithic. Overall, though, at both sites the majority of the botanical remains, and hence the main subsistence strategy, remains one that is based on the cultivation and dominance of economic plants, yet there are clearly unique ways in which the inhabitants of each site perceived and incorporated wild resources within their diet.

ACKNOWLEDGEMENTS

The excavations at Barcın Höyük were funded by the Netherlands Organization for Scientific Research (NWO) and the Netherlands Institute in Turkey. The Bahçelievler excavations were funded by the Bilecik Municipality. Hüreyla Balcı conducted the macro-botanical analysis between the seasons 2013–2015 at Barcın Höyük, and between 2019–2021 at Bahçelievler. Our thanks go to Prof. Dr. René Cappers from the University of Groningen, the Netherlands, for his supervision of the analysis of the Barcın Höyük samples, and his corrections, suggestions, and comments on this paper. Other thanks go to Cavit Özcan and Mine Şanlı from Bilecik Şeyh Edebali University, and Ayşe Hacıbektaşoğlu from Istanbul University for helping with the flotation and preparing the samples at Bahçelievler. And final thanks go to Barcın Höyük and Bahçelievler Team Members for their hard work during the excavation seasons. This paper constitutes a part of HB's doctoral research.

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