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İçindekiler / Contents

Investigating a Subsistence Model of Staple Finance for the Late 4th to Early 2nd Millennium BCE of the Greater Near East

Benjamin Irvine[a]

Abstract

Previous research into the dietary habits and subsistence practices of Early Bronze Age (3rd millennium BCE) Anatolian populations utilising stable isotope analyses ($\delta^{13}C$ and $\delta^{15}N$) demonstrated that there was a general homogeneity in isotopic values at both an intra- and inter-population level. This was also shown to be the case in relatively contemporary populations in the regions neighbouring the Anatolian Peninsula; Greece/the Aegean, and northern Mesopotamia. This isotopic homogeneity suggested that there was a dietary and subsistence strategy uniformity for the time period. In this study, adult human $\delta^{13}C$ and $\delta^{15}N$ values from the Early Neolithic to the Late Byzantine periods of the Greater Near East were collated and examined to further investigate dietary habits and subsistence strategies supra-regionally, as well as diachronically. This synthesis of the isotopic data is examined in conjunction with archaeobotanical and archaeozoological data to test the hypothesis of a distinctive model of staple finance. This holistic and big data approach demonstrates that, plausibly, there is a comparatively characteristic model of staple finance for the late 4th – early 2nd millennium BCE. However, the results also demonstrate that the isotopic homogeneity observed for Early Bronze Age Anatolia is not as ubiquitous across the larger region, although there are distinctive diachronic patterns.

Keywords: Palaeodiet, bioarchaeology, stable isotopes, agriculture, pastoralism

Öz

Geçmiş yıllarda yapılan araştırmalar Anadolu'da Erken Tunç Çağı'nda (MÖ 3. binyıl) $\delta^{13}C$ ve $\delta^{15}N$ sabit izotop analizi değerleri arasında genel bir homojenlik olduğunu göstermiştir. Söz konusu homojenlik beslenme alışkanlıklarının ve geçim uygulamalarının gerek topluluk içerisinde gerekse farklı topluluklar arasında benzerlik olduğuna işaret etmekte, bu benzerliğin

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Anadolu Yarımadası'na komşu bölgelerdeki topluluklarda da -Yunanistan/Ege kıyıları ve Kuzey Mezopotamya- görüldüğünü ortaya koymaktadır. İzotopik homojenlik aynı zamanda beslenme ve geçim stratejisinin zamansal bağlamda standart olduğunu önermektedir. Bu çalışma kapsamında Erken Neolitik Dönem'den Geç Bizans Dönemi'ne kadar Doğu Akdeniz coğrafyasındaki yetişkinlere ait $\delta^{13}C$ ve $\delta^{15}N$ izotop değerleri bir araya getirilmiş, toplulukların beslenme alışkanlıkları ve geçim stratejileri zamansal bağlamda incelenmiştir. İzotopik veriler arkeobotanik ve arkeozoolojik verilerin ışığında söz konusu dönem için önerilen ve *staple finance* olarak bilinen mahsule dayalı örgütlenme modelini test etmek için kullanılmıştır. Bu bütüncül yaklaşım MÖ 4. binyılın sonundan 2. binyılın başına kadar devam eden uzun soluklu ve *staple finance* sistemine dayalı olan bir örgütlenme modeline işaret etmekle birlikte Anadolu'nun Erken Tunç Çağı'nda gözlemlenen izotopik homojenliğin bölgeler arasında farklılıklar sergilediğini de ortaya koymaktadır.

Anahtar Kelimeler: Paleodiyet, biyoarkeoloji, sabit izotop, tarım, otlatıcılık

Introduction

Background to the Research

This study has developed from initial research into the dietary habits of Early Bronze Age (EBA) populations of Anatolia (Irvine 2017; Irvine et al. 2019). It was noted that the stable isotopic values ($\delta^{13}C$ and $\delta^{15}N$) in bulk bone collagen from human adults of these EBA Anatolian populations were, overall, very similar and there appeared to exist a general degree of homogeneity at both an intra- and inter-population scale. The $\delta^{13}C$ and $\delta^{15}N$ values of these sites were also compared with $\delta^{13}C$ and $\delta^{15}N$ values from relatively contemporary populations in geographical neighbouring regions (from Early Helladic sites in Greece and EBA sites in northern Mesopotamia) to examine if this was solely an Anatolian phenomenon. The initial comparisons revealed that there was also a homogeneity in $\delta^{13}C$ and $\delta^{15}N$ values beyond Anatolia, and, furthermore, that the $\delta^{13}C$ and $\delta^{15}N$ values in neighbouring regions' populations were similar to those of the EBA Anatolian populations – i.e., that a general degree of isotopic homogeneity was found at both an intra- and inter-regional scale (Irvine 2017; Irvine et al. 2019). Following these initial examinations, and further investigations into archaeobotanical and archaeozoological data from the same time period and region, the homogeneity in $\delta^{13}C$ and $\delta^{15}N$ values, and also dietary habits, exploited and consumed food resources, and subsistence and agricultural strategies resulted in this phenomenon being termed as an 'EBA package' (Irvine et al. 2019). This current study builds upon those initial observations and provides a large-scale holistic approach to examining dietary habits and subsistence and agricultural strategies of the Greater Near East. Stable isotopic ($\delta^{13}C$ and $\delta^{15}N$) values from populations across the Greater Near East, dated from the Early Neolithic to Late Byzantine periods are examined in conjunction with archaeobotanical and archaeozoological data from the late 4th to early 2nd millennium BCE.

Using stable isotopes to reconstruct and examine palaeodiet can reveal differences in dietary habits and access to food resources between individuals, populations, and diachronically (Quinn and Beck 2016; Pokutta 2017). Stable isotope ratios of carbon (C) and nitrogen (N) are the most commonly utilised for examining dietary habits and associated subsistence strategies (Walker and DeNiro 1986; Faure and Mensing 2005; Pollard et al. 2007; Lee-Thorp 2008; Schwarz and Schoeninger 2011; Fernandes et al. 2012). The theories, methodologies, and application of stable isotope ratio analysis of C and N, from human and faunal bone collagen, in order to reconstruct palaeodiets has been well established and previously described (see, amongst others, Schoeninger and DeNiro 1984; Walker and DeNiro 1986; Ambrose 1993; Ambrose and Norr 1993; Richards and Hedges 1999; Katzenberg 2000; Faure and Mensing 2005; Pollard et al. 2007; Lee-Thorp 2008; Schwarz and Schoeninger 2011; Richards 2020). Stable isotopic signals (and meta-data of them) are now becoming a common way to examine large-scale, diachronic and pan-regional, patterns in dietary habits and subsistence strategies, and changes in them (Papathanasiou 2015; Papathanasiou and Richards 2015; Pokutta 2017; Gamarra et al. 2018; Jovanović et al. 2019; Arena et al. 2020; Liu et al. 2021; Irvine forthcoming; Irvine et al. forthcoming).

As this study takes a large-scale, holistic approach it examines 'the woods, rather than the trees'. This is not to dismiss or ignore finer scale (i.e., at the intra-population and intra-temporal period scale) subtleties and differences, but this large-scale approach allows us to better examine an overview of possible diachronic and pan-regional patterns and changes. These are important not just for understanding past subsistence strategies, but also for gaining a better understanding of factors such as long-term political and social developments.

Outlining the 'Greater Near East'

This paper uses the Anatolian Peninsula as a focal point, and gathers its (immediate) neighbouring regions (the Aegean and Greece, the eastern/southeastern Balkans, North Mesopotamia, Cyprus, the South Caucasus, and north-western Iran/Zagros) to form a large geographical region termed the 'Greater Near East' from which the stable isotope data, archaeobotanical, and archaeozoological data examined in this study comes. Whilst this is not entirely un-problematic, due to varying cultural, chronological, political, climatic, and environmental entities across this large area in prehistoric and pre-modern times, it is deemed acceptable for the purpose of this study, and there are precedents and rationales for examining this large area as a whole. Basri and Lawrence (2020) and Gaastra et al. (2021) collated large datasets from across the Near East for their studies. Basri and Lawrence (2020) have even argued that "Despite its large size, it can be argued that the region was broadly coherent from the Neolithic onwards, when we can see the long-range circulation of raw materials, such as obsidian, and ideas, such as painted pottery. By the Iron Age, massive political entities such as the Neo-Assyrian Empire held sway over almost the entire region". Furthermore, Mesopotamian, Aegean, and Anatolian regions were increasingly connected, at least through trade and the circulation of raw materials and objects from the 4th millennium BCE onwards (Massa 2016; Şahoğlu 2016; Ünlüsoy 2016; Massa and Palmisano 2018; Yılmaz 2019; McMahon 2020).

Defining the 'EBA package'

What was initially termed as an "EBA package" (Irvine et al. 2019) was a brief and abbreviated, albeit notional and ineloquent, way of referring to a model of staple finance that was inferred by the homogeneity observed in the stable isotope data. This definition, and its elaboration in this study, focuses only on key domestic crops and animals that would have contributed the bulk of nutrition and food resources to human diet. Therefore, viticulture, olives, nuts, and fruits are not examined in any depth in this paper. The same is true for non-cereal crops and wild animals which were also likely to have been inconsequential food resources. This 'package' is economic in terms of being a model of staple finance, but in this paper, it is largely referred to with regards to human dietary habits. There are, of course wealth finance economic aspects and implications, in particular animals as commodities, but this in itself can also be related to the dietary aspect that some animals/species of animals were not always being principally reared for primary consumption.

Wild fauna (including marine and freshwater resources) recovered from excavations were not examined in this study as in the Late Chalcolithic (LCh) to Middle Bronze Age (MBA) periods it appears as though hunting played a very minor role in both the subsistence strategies, and dietary habits of the populations (Vermeersch et al. 2021a). Crops such as vines or olives were also excluded from analysis in this study as they should be considered as cash crops, and related to wealth finance rather than staple finance (Barjamovic 2020). There is no doubt that they were important parts of the prehistoric E-MBA agricultural economy, and were indeed consumed by people, but they would not necessarily have contributed in a significant and/or daily manner to their dietary habits. Additionally, whilst legumes are present at almost all sites during this time (E-MBA), their quantity varies considerably from site-to-site, and they are almost consistently a minor crop relative to cereals, and, consequently, unlikely to be as major a part of the hypothesised staple finance 'package'.

Materials and Methods

The stable isotope data ($\delta^{13}C$ and $\delta^{15}N$ values) utilised in this study comes from 69 sites in total across the Greater Near East region, as previously defined for this study, with populations ranging in date from the Younger Dryas through to the Late Byzantine and Islamic periods (see Table 1, and Fig. 1). The raw isotope data was collated from previously (by the end of

2021) conducted and (principally) published research studies. Only the $\delta^{13}C$ and $\delta^{15}N$ values obtained from the bulk bone collagen of adult human individuals was collated to enable comparability. Studies that reported only population means of $\delta^{13}C$ and $\delta^{15}N$ from sites (n=11 out of 69) were excluded from the statistical analyses and Figures 6 and 7, but have been included in Table 1 and Fig. 1 (where these sites/populations are identified as having only population means), and their means and standard deviations are also plotted in Figs. 8-10. Some $\delta^{13}C$ and $\delta^{15}N$ data from the publications was also excluded from examination in this study if the collagen quality criteria of the C/N ratio, %C, and %N were outside the commonly accepted ranges (DeNiro 1985; Guiry and Szpak 2021) or if they were from individuals that could not be firmly identified as adults in age. Data from a wide range of time periods was chosen so that diachronic patterns could be examined, particularly how the data from individuals and populations of the late 4th-early 2nd millennium BCE compared to others, and to further assess the preliminary observations about their apparent homogeneity.

Statistical analyses were also applied to the collated stable isotope data using Excel with the XLSTAT add-on. The data were first tested for normality using a Shapiro-Wilk test, with $p \leq 0.05$ as the level of statistical significance. None of the datasets displayed a normal distribution; the closest was the $\delta^{13}C$ data for the Neolithic ($p=0.08$). Therefore, to analyse differences between the groups of data ($\delta^{13}C$ and $\delta^{15}N$ from each time period) a non-parametric Kruskal-Wallis ANOVA test with a post-hoc Dunn's Procedure/two-tailed test were used.

As well as the adult human isotopic data, published archaeobotanical and archaeozoological data was compiled from 127 sites dated to within the range of the late 4th to early 2nd millennium BCE of the Greater Near East (see Table 2 for an overview and Fig. 2 for site locations). Whilst efforts were made to bring together as comprehensive an amount of data as possible, author error resulting in accidental omission of research, deliberate discriminatory exclusion of exceptionally small sample sizes, and the inability to access data (e.g., unpublished) mean that this compilation of archaeobotanical and archaeozoological data is not exhaustive. Furthermore, it is beyond the scope of this study to examine all the botanical and faunal data in the same expansive diachronic range as for the isotopic data. Therefore, as this study focuses on exploring staple finance of the late 4th to early 2nd millennium BCE, only botanical and faunal assemblages from sites dating to around this time range were included. As well as enabling this study to be more refined in its focus, only collating botanical and faunal data from this time range enables us to more clearly examine the possible subsistence, agricultural, and pastoral aetiologies for any patterns in the isotopic data. Additionally, as previously discussed, only key domestic crops and animals were examined in this study; namely cereals (wheat [*Triticum*] and barley [*Hordeum vulgare*]), sheep/goat (*Ovis/Capra*), cattle (*Bos taurus*), and pigs (*Sus scrofa*).

Table 1. Summary overview, in chronological order, of sites with stable isotope data ($\delta^{13}C$ and $\delta^{15}N$) used in this study. N.B. Sites that only have population means reported are marked with an *. Time periods refer to local regional chronologies used by the researchers, where possible absolute dates have been included. PPN = Pre-Pottery Neolithic; EN = Early Neolithic; LN = Late Neolithic; ECh = Early Chalcolithic; Ch = Chalcolithic; LCh = Late Chalcolithic; KA = Kura-Araxes; EBA = Early Bronze Age; EH = Early Helladic; MBA = Middle Bronze Age; MH = Middle Helladic; MM = Middle Minoan; LBA = Late Bronze Age; LM = Late Minoan

Site Name	Location	Time Periods with $\delta^{13}C$ and $\delta^{15}N$ data	Reference
Körtik Tepe*	South-east Turkey	Younger Dryas and Early Holocene (10400-9200 cal. BCE)	Benz et al. 2016
Hasankeyf Höyük	South-east Turkey	PPN (ca. late 10th millennium cal. BCE)	Itahashi et al. 2017
Nevalı Çori	South-east Turkey	PPN (ca. 8720-7470 cal. BCE)	Lösch et al. 2006
Aşıklı Höyük	Central Anatolia	PPN/EN (ca. 8350-7300 cal. BC)	Itahashi et al. 2021
Barcın Höyük	North-west Anatolian Peninsula	LN (6600-6200 cal. BCE)	Budd et al. 2020
Tell el-Kerkh	North-west Syria	LN (ca. 6400-6070 cal. BCE)	Itahashi et al. 2018
Çatalhöyük	South Central Turkey	LN (ca. 8000-7000 BP)	Richards et al. 2003
Hakemi Use	South-east Turkey	LN (6100-5950 cal. BCE)	Itahashi et al. 2019
Aktopraklık	North-west Anatolian Peninsula	LN to ECh (6400-5635 cal. BCE)	Budd et al. 2013 and 2018
Halai	South-east Greece	EN-LN (ca. 6000-5300 BCE)	Vaiglova et al. 2021
Durankulak*	Eastern Bulgaria	LN to Early/Mid. Copper Age (ca. early to mid. 6th millennium BCE)	Honch et al. 2013
Mentesh Tepe	North-west Azerbaijan	Neolithic (5933-5485 cal. BCE), Kura-Axe (2834-2471 cal. BCE), Martkopi (2480-2133 cal. BCE), LBA (911-804 cal. BCE)	Herrscher et al. 2018
Uğurlu	Gökçeada Island, North-east Aegean	Ch (5500-4900 cal. BC)	Pilaar Birch et al. 2021
Makriyalos	North Greece	LN (5500-4500 cal. BCE)	Vaiglova et al. 2018
Alepotrypa Cave	Southern Greece	LN (ca. 5000-3200 BC)	Papathanasiou et al. 2000
Tharrounia	Euboea, South-east Greece	LN (5300-3200 BCE)	Kontopoulos and Sampson 2015
Varna*	Eastern Bulgaria	Mid. to Late Copper Age (ca. 4660-4415 BCE)	Honch et al. 2013
Arslantepe	East Turkey	LCh (Period VII – 3800-3400 BCE)	Iacumin et al. 2020

Site Name	Location	Time Periods with $\delta^{13}C$ and $\delta^{15}N$ data	Reference
Çamlıbel Tarlası	North Central Turkey	LCh (3650-3375 cal. BCE)	Pickard et al. 2016
İkiztepe	North Turkey	LCh-EBA I (ca. late 4th millennium BCE)	Irvine et al. 2019; Irvine and Erdal 2020a
Tell Brak	North-east Syria	LCh to EBA (4200-2000 cal. BCE)	Styring et al. 2017
Gegharot	West Armenia	KA [EBA] (ca. 3500/3350-2900 BCE)	Herrscher et al. 2021
Chobareti	South Georgia	EBA (ca. 3300-2900 cal. BCE)	Messager et al. 2015
Souskiou-Laona Settlement	South-west Cyprus	Chalcolithic (ca. 3000 cal. BCE)	Goude et al. 2018
Tell Bakr Awa	North-east Iraq	EBA (3100-2200 BCE), MBA (2200-1600 BCE), Iron Age (1200-330), Islamic period (636-1500 CE)	Fetner 2016
Titriş Höyük	South-east Turkey	EBA I-III (3000-2100 BCE)	Irvine et al. 2019
Kvatskhelebi	North Central Georgia	KA [EBA] (ca. 2900-2800 cal. BCE)	Herrscher et al. 2021
Kalavan-1	North-east Armenia	KA [EBA] (2850-2490 cal. BCE)	Herrscher et al. 2021
Manika	Euboea, South-east Greece	EBA/EH (ca. 2900-2300 BCE)	Kontopoulos and Sampson 2015
Bakla Tepe	South-west Turkey	EBA I and II/III (ca. 3000-2800 and 2500-2300 BCE), Late Roman/ Early Byzantine	Irvine et al. 2019; Irvine and Erdal 2020b; Irvine unpublished data
Bademağacı	South Turkey	EBA II (ca. 2500 cal. BCE)	Irvine et al. 2019
Psematismenos-Trelloukkas	South Cyprus	EBA (3rd millennium BCE)	Goude et al. 2018
Tell Leilan	North-east Syria	EBA (2700-2200 cal. BCE)	Styring et al. 2017
Tell Barri	North-east Syria	EBA (2800-2000 BCE), MBA (2000-1500 BCE), LBA (1500-1200 BCE), Neo-Assyrian period (900-800 BCE), Achaemenian period (500-300 BCE), Parthian period (100-300 CE)	Sołtysiak and Schutkowski 2015
Thebes	South/South-east Greece	EH to MH (ca. 3000-2000 BCE), Classical (ca. 510-323 BCE), Hellenistic (ca. 323-31 BCE), Mid. Byzantine (13th-14th centuries CE)	Dotsika et al. 2018; Vika 2011 and 2015
Marki-Alonia	Central Cyprus	Middle Cypriot Bronze Age (ca. 2400-1850 BCE)	Scirè-Calabrisotto et al. 2020
Archontiko	North Central-East Greece	EBA III (ca. 2130-2087 BCE)	Nitsch et al. 2017

Site Name	Location	Time Periods with $\delta^{13}C$ and $\delta^{15}N$ data	Reference
Tell Ashara	East Syria	EBA-MBA (ca. 2300-1900 BCE), Old Babylonian period (ca. 1900-1700 BCE), Neo-Assyrian period (ca. 900-600 BCE)	Sołtysiak and Schutkowski 2018
Aspis	South Greece	MH (ca. 2100-1700 BCE)	Triantaphyllou et al. 2006 and 2008
Lerna	South Greece	MH (ca. 2100-1700 BCE)	Triantaphyllou et al. 2006 and 2008
Mycenae*	South Greece	MH (ca. 2100-1700 BCE)	Triantaphyllou et al. 2006 and 2008
Kouphovouno*	South Greece	MH (ca. 2100-1700 BCE)	Lagia et al. 2007
Asine	South Greece	MH (ca. 2100-1700 BCE)	Ingvarsson-Sundström et al. 2009
Kültepe-Kanesh	Central Turkey	MBA (ca. 1930-1720 BCE)	Yazıcıoğlu Santamaria 2015
Knossos (Ailias chamber tombs and Lower Gypsades tomb and ossuary)	North Crete	MM Ib-LM I (ca. 1900-1500 BCE)	Nafplioti 2016
Tell Masaikh	East Syria	Old Babylonian period (ca. 1900-1700 BCE), Neo-Assyrian period (ca. 900-600 BCE), Classical period (ca. 600 BCE-600 CE), Early Islamic period (ca. 600-1200 CE)	Sołtysiak and Schutkowski 2018
Thessaloniki Toumba	North Central-East Greece	LBA (ca. 1700-1050 BCE)	Nitsch et al. 2017
Boğazköy/Hattuşa	North Central Turkey	Iron Age (ca. 10th-9th centuries BCE), Hellenistic period (3rd century BCE), Roman period (ca. 2nd century CE)	Pickard et al. 2017
Gebel Mashtale	East Syria	Classical period (ca. 600 BCE-600 CE)	Sołtysiak and Schutkowski 2018
Kerameikos, Athens	South/South-east Greece	Late Archaic period (ca. 500 BCE), Classical period (475-336 BCE), Hellenistic period (ca. 320-100 BCE), Imperial Roman period (1st-3rd century CE)	Lagia 2015
Plateia Kotzia, Athens	South/South-east Greece	Late Archaic period (ca. 500 BCE), Classical period (475-336 BCE), Hellenistic period (ca. 320-100 BCE), Imperial Roman period (1st-3rd century CE)	Lagia 2015

Site Name	Location	Time Periods with $\delta^{13}C$ and $\delta^{15}N$ data	Reference
Mesebria	East Bulgaria	Classical (5^{th}-4^{th} centuries BCE), Hellenistic 4^{th}-2^{nd} centuries BCE), Early-Mid. Byzantine (5^{th}-7^{th} centuries CE), Mid. Byzantine (8^{th}-14^{th} centuries CE)	Moles 2012
Laurion, Athens	South/South-east Greece	Classical period (475-336 BCE)	Lagia 2015
Helike	South Greece	Hellenistic (4^{th}-2^{nd} centuries BCE), Roman period (ca. 1^{st}-8^{th} centuries CE), Late Byzantine period (14^{th}-15^{th} centuries CE)	Borstad et al. 2018
Sagalassos*	South/South-west Turkey	Classical-Hellenistic (400-200 BCE), Late Imperial Roman period (300-450 CE), Mid. Byzantine (800-1200 CE)	Fuller et al. 2012
Ephesus	West Turkey	Roman (2^{nd} and 3^{rd} centuries CE)	Lösch et al. 2014
Edessa	North Greece	Roman (2^{nd}-4^{th} centuries CE)	Dotsika and Michael 2018
Hierapolis	West/West Central Turkey	Roman-Early/Mid. Byzantine (1^{st}-7^{th} centuries CE), Mid. Byzantine (9^{th}-13^{th} centuries CE)	Wong et al. 2017
Sourtara*	Central Greece	Mid. Byzantine (6^{th}-7^{th} centuries CE)	Bourbou et al. 2011
Messene*	South Greece	Mid. Byzantine (6^{th}-7^{th} centuries CE)	Bourbou et al. 2011
Eleutherna*	Central Crete	Mid. Byzantine (6^{th}-7^{th} centuries CE)	Bourbou et al. 2011
Abdera	North-east Greece	Mid. Byzantine (6^{th}-13^{th} centuries CE)	Bourbou and Garvie-Lok 2015
Kovuklukaya	North Turkey	Mid. Byzantine (ca. 770-970 cal. CE)	Özdemir 2018
Kastella	North Central Crete	Mid. Byzantine (11^{th} century CE)	Bourbou and Richards 2007; Bourbou and Garvie-Lok 2015
Stylos*	North-west Crete	Mid. Byzantine (11^{th}-12^{th} centuries CE)	Bourbou et al. 2011
Petras	North-east Crete	Mid. Byzantine (12^{th}-13^{th} centuries CE)	Bourbou and Richards 2007; Bourbou and Garvie-Lok 2015
Servia	North Central-East Greece	Mid.-Late Byzantine (11^{th}-15^{th} centuries CE)	Bourbou and Richards 2007; Bourbou and Garvie-Lok 2015
Nemea	South Greece	Mid.-Late Byzantine (12^{th}-15^{th} centuries CE)	Bourbou and Richards 2007; Bourbou and Garvie-Lok 2015
Mitilini*	Lesbos, East Aegean	Late Byzantine (14^{th}-15^{th} centuries CE)	Bourbou and Richards 2007; Bourbou and Garvie-Lok 2015

Table 2. Dominant (by NISP and MNI) domestic faunal and botanical species at sites of the 4th-2nd millennium BCE in the GNE – time periods have been simplified and refer to regional chronologies. MCh = Middle Chalcolithic; LCh = Late Chalcolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age.

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Kythrea-*Ayios Dhimitrianos*	North Cyprus	MCh	Sheep/Goat	-	D. Reese personal communication 2020
Orman Fidanlığı	West Central Turkey	MCh-LCh	Sheep/Goat	-	Gündem 2012
Yumuktepe	South/South-east Turkey	Mid./LCh - LCh	-	Wheat	Fiorentino et al. 2014
Megalo Nisi Galanis	North/North-west Greece	MCh-EBA I	Sheep/Goat	-	Greenfield and Fowler 2005
Kuruçay Höyük	South-west Turkey	LCh	-	Wheat and Barley	Nesbitt 1996; Nesbitt and Samuel 1996
Çamlıbel Tarlası	North Central Turkey	LCh	Cattle	Wheat	Bartosiewicz and Gillis 2011; Bartosiewicz et al. 2013; Papadopoulou and Bogaard 2012
Çadır Höyük	North Central Turkey	LCh	Sheep/Goat	Barley	Arbuckle 2014a; von Baeyer 2018
Tepecik	East Turkey	LCh	-	Wheat and Barley	van Zeist and Bakker-Heeres 1975
Hacınebi	South-east Turkey	LCh	Sheep/Goat	Barley	Miller 1997a; Miller 2013; Stein et al. 1996
Lemba-*Lakkous*	South-west Cyprus	LCh	Pig	Barley	Croft 1991; Riehl et al. 2014a
Çayboyu	East Turkey	LCh	-	Wheat and Barley	Nesbitt 1996; Nesbitt et al. 2017
Mokhra Blur	South Central Armenia	LCh-EBA	Sheep/Goat	-	Piro 2009
Köhneh Shahar	North-west Iran	LCh - EBA	Sheep/Goat	-	Samei et al. 2013
Kumtepe	West Turkey	LCh - EBA I	Sheep/Goat	Wheat	Oybak Dönmez 2006; Sperling 1976; D. Reese pers. comm. 2020; Riehl 1999; Riehl et al. 2014a
İkiztepe	North Turkey	LCh-EBA I	Sheep/Goat	Wheat	Ioannidou 2011; Nesbitt and Samuel 1996; van Zeist 2003a
Areni-1 Cave	South-west Armenia	LCh-EBA I	Sheep/Goat	-	Wilkinson et al. 2012

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Sotk 2	East Armenia	LCh - EBA I-II	-	Barley	Hovsepyan 2013
Gegharot	North-west Armenia	LCh – EBA I/II	Sheep/Goat	Barley	Badalyan et al. 2008; Hovsepyan 2015
Natsargora	Central Georgia	LCh-EBA I/II	Cattle	-	Rova et al. 2010
Tell Hadidi	North Syria	LCh/EBA I-III	Sheep/Goat	Barley	Clason and Buitenhuis 1978; van Zeist and Bakker-Heeres 1988
Sos Höyük	North-east Turkey	LCh-EBA II/ III	Sheep/Goat	LCh: Wheat MBA: Barley	Howell-Meurs 2001; Longford et al. 2009; Marro 2011; Palumbi 2010; Piro 2009
Kul Tepe	North-west Iran	LCh-EBA II/ III	Sheep/Goat	-	Davoudi et al. 2018
Küllüoba	West Central Turkey	LCh-EBA III	Sheep/Goat	Wheat	Çizer 2015; Gündem 2012
Arslantepe	East Turkey	LCh-EBA III	Sheep/Goat	Barley	Balossi Restelli et al. 2010; Bartosiewicz 1998; Crisarà 2013; Marro 2011; Palumbi 2010; Persiani 2008; Sadori et al. 2006 Siracusano and Bartosiewicz 2012;
Kohneh Pasgah Tepesi	North-west Iran	LCh-EBA (III?)	Sheep/Goat	Wheat and Barley	Davoudi et al. 2018; Decaix et al. 2019
Yarım Höyük	South-east Turkey	EBA I	-	Wheat and Barley	Rothman et al. 1998
Zeytinli Bahçe	South-east Turkey	EBA I(b)	Pig	-	Siracusano in Frangipane et al. 2002
Bakla Tepe	West/South-west Turkey	EBA I and EBA II/III	Sheep/Goat	Wheat	Oybak and Doğan 2008; T. Maltas pers. comm. 2019; D. Reese personal communication 2020
Yenibademli	Gökçeada (West Turkey)	EBA I-II	Cattle	-	Çakırlar 2016
Beşiktepe	West Turkey	EBA I-II	Cattle	-	Çakırlar 2016

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Liman Tepe	West Turkey	EBA I-II	Sheep/Goat	Wheat	T. Maltas personal communication 2019; D. Reese personal communication 2020
Hassek Höyük	South-east Turkey	EBA I-II	Pig	Barley	Boessneck 1992; Boessneck and von den Driesch 1981; Miller 1997a
Tatıka	South-east Turkey	EBA I-II	Sheep/Goat	-	Silibolatlaz Baykara 2019a
Tell Hajji Ibrahim	North Syria	EBA I-II	Sheep/Goat	Barley	Miller 1997b; Weber 2006
Tell el-‘Abd	North Syria	EBA I-II	-	Barley	Riehl 2019
Habuba Kabira	North Syria	EBA I-II	Sheep/Goat	-	von den Driesch 1993
Tell Shiukh Fawqani	North Syria	EBA I-II	Sheep/Goat	-	Vila 2005
Tell Beydar	North-east Syria	EBA I-II	Sheep/Goat	-	van Neer and De Cupere 2000
Tell Karrana 3	North Iraq	EBA I-II	Sheep/Goat	-	Boessneck et al. 1993
Troy (I-II)	West Turkey	EBA I-II/III	Cattle	Wheat	Blum and Riehl 2015; Çakırlar 2016; Riehl 1999; Riehl et al. 2014a; Riehl and Marinova 2016
Tell Ziyadeh	North-east Syria	EBA I/II-II	Pig	-	Rufolo 2011
Tell al-Raqa’i	North Syria	EBA I/II-II/III	Sheep/Goat	-	Rufolo 2011 and 2015
Tsoungiza	North-east Peloponnese (Greece)	EBA I/II-III	Sheep/Goat	-	Halstead 2011
Lerna	East Peloponnese (Greece)	EBA I/II-III	Sheep/Goat	-	Gejvall 1969; Reese 2013a and 2013b
Tell ‘Atij	North-east Syria	EBA I/II-III	Sheep/Goat	-	Rufolo 2011
Ovçular Tepesi	Nakhchivan (Azerbaijan)	EBA I-II/III	Sheep/Goat	-	Davoudi et al. 2018
Demircihüyük	West Central Turkey	EBA I-III	Sheep/Goat	-	Gündem 2012
Mentesh Tepe	North-west Azerbaijan	EBA I-III	-	Wheat	Decaix et al. 2016

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Göltepe/Kestel	South Central Turkey	EBA I-III	Sheep/Goat	-	Okaluk et al. 2019
Titriş Höyük	South-east Turkey	EBA I-III	Sheep/Goat	Barley	Allentuck and Greenfield 2010; Greenfield 2002; Hald 2010; Trella 2010
Ziyaret Tepe	South-east Turkey	EBA I-III	Sheep/Goat	-	Greenfield-Jongsma and Greenfield 2013
Horum Höyük	South-east Turkey	EBA I-III	Sheep/Goat	-	Bartosiewicz 2005
Lidar Höyük	South-east Turkey	EBA I-III	Sheep/Goat	-	Kussinger 1988
Hayaz Höyük	South-east Turkey	EBA I-III	Sheep/Goat	-	Buitenhuis 1985
Tilbeşar	South-east Turkey	EBA I-III	Sheep/Goat	-	Berthon and Mashkour 2009
Mezraa Höyük	South-east Turkey	EBA I-III	-	Barley	Oybak Dönmez 2006
Gre Virike	South-east Turkey	EBA I-III	-	Barley	Oybak Dönmez 2006
Tell Apamea	West Syria	EBA I-III	Cattle	-	Gautier 1984
Umm el-Marra	North Syria	EBA I-III	Sheep/Goat	-	Weber 2006
Tell Brak	North Syria	EBA I-III	Sheep/Goat	Barley	Deckers and Riehl 2008; Dobney et al. 2003; Emberling and McDonald 2001; Hald and Charles 2008; Weber in Emberling et al. 1999; Weber 2001
Tell Knedig	North Syria	EBA I-III	Sheep/Goat	-	Vila 2005
Tell Chuera	North Syria	EBA I-III	Sheep/Goat	-	Vila 1995 and 2010
Kharab Sayyar	North-east Syria	EBA I-III	Sheep/Goat	-	Vila 2010
Tell Bderi	North-east Syria	EBA I-III	Sheep/Goat	Barley	Becker 1988; Omar 2017; van Zeist 2003b; Zeder 1998
Tell Khazna	North-east Syria	EBA I-III	Pig	-	Antipina 2004
Tell Arbid	North-east Syria	EBA I-III	Sheep/Goat	-	Koliński and Piątkowska-Małecka 2008; Piątkowska-Małecka and Smogorzewska 2010 and 2013

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Tepe Hasanlu	North-west Iran	EBA I-III	Sheep/Goat	-	Davoudi et al. 2018
Kohneh Tepesi	North-west Iran	EBA I-III	Sheep/Goat	-	Davoudi et al. 2018
Poliochni	Lemnos, North Aegean	EBA I-III/ MBA	Sheep/Goat	Wheat	Cultraro 2013; Sorrentino 1997
Kurban Höyük	South-east Turkey	EBA I-III/ MBA	Sheep/Goat	Barley	Miller 1986; Miller 1997a; Miller 2013; Wattenmaker 1987 and 1998
Tell es-Sweyhat	North Syria	EBA I-III - MBA	Sheep/Goat	Barley	Buitenhuis 1985; Miller 1997a; Miller 2013; van Zeist and Bakker-Heeres 1988; Weber 2006
Bademağacı	South-west Turkey	EBA II	Cattle	-	De Cupere et al. 2008
Gelinciktepe	East Turkey	EBA II	Sheep/Goat	-	Persiani 2008
Tell Mashnaqa	North-east Syria	EBA II	Sheep/Goat	-	Zeder 1998
Hamoukar	North-east Syria	EBA II/III	Pig	-	Grossman 2013
Korucutepe	East Turkey	EBA II-III	Sheep/Goat	Wheat and Barley	Boessneck and von den Driesch 1974 and 1975; van Zeist and Heeres 1974
Gritille	South-east Turkey	EBA II-III	Sheep/Goat	-	Stein, 1987 and 1988
Kazane Höyük	South-east Turkey	EBA II-III	Sheep/Goat	Wheat	Creekmore 2008; Nesbitt and Samuel 1996
Tell Halawa	North-west Syria	EBA II-III	Sheep/Goat	-	Boessneck and von den Driesch 1989
Tell Tuqan	North-west Syria	EBA II-III	Sheep/Goat	-	Minniti 2014
Ebla	North-west Syria	EBA II-III	Sheep/Goat	-	Minniti 2013
Ghanem al-Ali	North Syria	EBA II-III	Sheep/Goat	-	Omar 2010
Tell Mozan	North-east Syria	EBA II-III	Sheep/Goat	Barley	Deckers and Riehl 2008; Doll 2010
Tell Tuneinir	North-east Syria	EBA II-III	Sheep/Goat	-	Loyet 2003
Tell Taya	North Iraq	EBA II-III	Sheep/Goat	-	Bökönyi in Reade 1973
Eleusis	South Greece	EBA II-MBA	Cattle		Cosmopoulos et al. 2003

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Ulucak	West Turkey	EBA II/III	Cattle	-	Çakırlar 2016
Tell Rad Shaqrah	North Syria	EBA II/III-III	Sheep/Goat	-	Koliński and Piątkowska-Małecka 2008
Tell Leilan	North-east Syria	EBA II/III-III	Sheep/Goat	-	Rufolo 2011; Weiss et al. 1993
Marki-*Alonia*	Central Cyprus	EBA II/III-MBA	Sheep/Goat	-	Croft 2006
Haftavan Tepe	North-west Iran	EBA II/ III-EBA III/ MBA I	Sheep/Goat	-	Mohaseb and Mashkour 2017; Davoudi et al. 2018
Acemhöyük	South-central Turkey	EBA III	Sheep/Goat	-	Arbuckle 2013
Tilbaşar Höyük	South-east Turkey	EBA III	-	Barley	Kavak et al. 2018 and 2019
Tell Tayinat	South-east Turkey	EBA III	Sheep/Goat	-	Welton et al. 2011
İmamoğlu Höyük	East Turkey	EBA III	-	Barley	Oybak and Demirci 1997
Al-Rawda	West Syria	EBA III	Sheep/Goat	-	Vila and El Besso 2005
Tell Qarqur	West Syria	EBA III	Sheep/Goat	-	Arter 2003; Grossman personal communication in Price et al. 2017
Tall Al-Handaquq	North-west Jordan	EBA III	Sheep/Goat	-	Price et al. 2018
Selenkahiyeh	North Syria	EBA III	Sheep/Goat	Barley	Ducos 1973; Ijzereef 2001; van Zeist and Bakker-Heeres 1988
Emar/Tell Meskene	North Syria	EBA III	Sheep/Goat	-	Gündem 2010
Tell Afis	North Syria	EBA III	Sheep/Goat	-	Wilkens 2000
Ali Al-Hajj	North Syria	EBA III	Sheep/Goat and Cattle	-	Arai 2014
Tell Gudeda	North-east Syria	EBA III	Sheep/Goat	-	Rufolo 2011
Kashkashok IV	North-east Syria	EBA III	Sheep/Goat	-	Zeder 1998
Chagar Bazar	North-east Syria	EBA III(?)	-	Barley	Riehl 2018

Site	Location	Time Period	Dominant Domestic Faunal Species	Dominant Domestic Cereal Species	Reference
Asine	Northeast Peloponnese (Greece)	EBA III-MBA	Pig	-	Macheridis 2016
Politiko-*Troullia*	Central Cyprus	EBA III-MBA	Sheep/Goat	-	Metzger 2008
Zarko	Central Greece	EBA	Sheep/Goat	-	Becker 1991
Kastanas	North Greece	EBA	-	Barley	Riehl et al. 2014a
Sitagroi	North-east Greece	EBA	Sheep/Goat	-	Bökönyi 1986
Pevkakia	East Greece	EBA	Sheep/Goat	-	Amberger 1979; Hinz 1979; Jordan 1975
Kouphovouno	South Greece	EBA	Sheep/Goat	-	Gardeisen 2007
Tiryns	East Peloponnese (Greece)	EBA	Sheep/Goat	-	von den Driesch and Boessneck 1990
Emborio	Chios (Aegean)	EBA	Sheep/Goat	-	Clutton-Brock 1982
Phylakopi	Milos (Aegean)	EBA	Sheep/Goat	-	Gamble 1982
Zas	Naxos (Aegean)	EBA	Sheep/Goat	-	Halstead in Halstead 1996
Karataş-Semayük	South-west Turkey	EBA	Cattle	-	Hesse and Perkins 1974
Kaman-Kalehöyük	Central Turkey	EBA	Sheep/Goat	-	Atıcı 2005
Dilkaya	East Turkey	EBA	-	Wheat and Barley	Nesbitt and Samuel 1996
Tell Barri	North-east Syria	EBA	Sheep/Goat	Wheat and Barley	Sołtysiak and Schutkowski 2015
Shengavit	West Central Armenia	EBA	-	Wheat	Hovsepyan 2015
Aparan III	North Central Armenia	EBA	-	Barley	Hovsepyan 2010 and 2015
Tepe al-Atiqeh	Central Iraq	EBA	Sheep/Goat	-	Omar 2017
Salat Tepe	South-east Turkey	EBA-MBA	Sheep/Goat	-	Silibolatlaz Baykara 2019b
Panaztepe	West Turkey	EBA-MBA(?)	Sheep/Goat	-	D. Reese personal communication 2020
Tell el-Burak	South Lebanon	MBA I	-	Wheat	Riehl and Orendi 2019
Agia Paraskevi	Central Greece	MBA	Pig	Wheat	Gkotsinas et al. 2014

The common and standard method for recording faunal assemblages is the NISP (Number of Identified Species), and the MNI (Minimum Number of Individuals) for botanical assemblages (see Vermeersch et al. 2021a, 2021b and references within). Therefore, only this data was collated from the published research and used for creating Table 2 and Figs. 3-5 (i.e., weights were not examined in this study). To enable meaningful proportional comparisons, only faunal assemblage NISP counts with a minimum of 150 were included for creating the relative proportions of domestic fauna at sites (Fig. 5). For the botanical assemblages, only MNI counts with a minimum of 250 were utilised to examine relative proportions - unfortunately, as there was a paucity of sites in the published literature meeting this threshold for botanical assemblages, this information is not visualised in the same way. Furthermore, only the counts of specimens identifiable to species or genus (for both botanical and faunal assemblages) have been included in this study. However, due to the difficulties of identifying sheep or goat to species level, many archaeozoological reports groups them together as sheep/goat, *Ovis/Capra*, or ovicaprines, and this method was also employed for this study to provide some consistency and to increase the total comparable data (see also Vermeersch et al. 2021a, 2021b).

Results

Adult Human Isotope Data

From the collated stable isotope data there are ca. 1150 total data points from 58 sites (excluding the 11 sites that only reported population means) across all time periods, which equates to roughly the same number of individuals. For the E-MBA there are 384 data points from 28 different sites. Using a visual examination of where the majority of the E-MBA data points plot (Fig. 6), and following on from previous examinations of $\delta^{13}C$ and $\delta^{15}N$ means from Anatolia and relatively contemporary diachronic and geographic populations (see Irvine et al. 2019), an isotopic range for the E-MBA was arbitrarily suggested to provide an approximate indication. This subjective range was proposed as being from ca. -19‰ to -20.5‰ for $\delta^{13}C$, and ca. 7‰ to 10‰ for $\delta^{15}N$. However, several statistical analyses were performed for this study to better examine the dataset(s) beyond the arbitrary and visual. Although data was collated and examined for a multitude of time periods, the bulk of data can be assigned to three main periods; the Neolithic, the E-MBA, and Classical to Late Byzantine. Therefore, the statistical analyses focused on these grouped periods. The means, standard deviations, and ranges of $\delta^{13}C$ and $\delta^{15}N$ for the three main data populations are given in Table 3 and the means and standard deviations are plotted in Fig. 7. The 95% confidence of intervals for these $\delta^{13}C$ and $\delta^{15}N$ means and standard deviations are given in Table 4, and scatter plots with 95% confidence interval ellipses for each of the three main grouped datasets can be found in the Supplementary Information, Fig. 7.

Table 3. Means, standard deviations (SD), and ranges for $\delta^{13}C$ and $\delta^{15}N$ data from the Neolithic, E-MBA, and Classical-Late Byzantine periods of the Greater Near East.

Time Period	$\delta^{13}C$ mean and SD (‰)	$\delta^{13}C$ Range with Minimum and Maximum Values (‰)	$\delta^{15}N$ mean and SD (‰)	$\delta^{15}N$ Range with Minimum and Maximum Values (‰)
Neolithic (n=228)	-19.7 ± 0.8	3.9 (-22.1 to -18.2)	8.7 ± 1.8	7.8 (5.4 to 13.1)
E-MBA (n=384)	-19.6 ± 0.5	3.6 (-21.0 to -17.4)	9.2 ± 2.0	12.7 (5.3 to 18.0)
Classical-Late Byzantine (n=422)	-18.9 ± 0.7	4.9 (-20.5 to -15.6)	9.7 ± 1.2	10.5 (4.0 to 14.5)

Table 4. The 95% confidence intervals for the means and standard deviations (SD) of $\delta^{13}C$ and $\delta^{15}N$ data from the Neolithic, E-MBA, and Classical-Late Byzantine periods of the Greater Near East.

Time Period	95% Confidence Interval for $\delta^{13}C$ mean (‰)	95% Confidence Interval for $\delta^{13}C$ SD (‰)	95% Confidence Interval for $\delta^{15}N$ mean (‰)	95% Confidence Interval for $\delta^{15}N$ SD (‰)
Neolithic	-19.8 to -19.6	0.7 to 0.8	8.4 to 8.9	1.6 to 2.0
E-MBA	-19.7 to -19.6	0.5 to 0.6	9.1 to 9.2	1.9 to 2.1
Classical-Late Byzantine	-19.0 to -18.8	0.7 to 0.8	9.6 to 9.8	1.1 to 1.3

The Kruskal-Wallis test determined that, statistically, there is an overall difference between the three main sample populations (i.e., time periods – Neolithic, E-MBA, and Classical-Late Byzantine) for $\delta^{13}C$; p=< 0.0001. The post-hoc multiple pairwise comparisons using Dunn's Procedure identified statistically significant differences between all the time periods (i.e., three distinct groups), but in particular the Classical-Late Byzantine sample population was the most different (Table 5). For $\delta^{15}N$, the Kruskal-Wallis test also determined overall statistical differences between the groups; p=<0.0001. The Dunn's Procedure identified that for $\delta^{15}N$ the Classical-Late Byzantine populations were also the most different from the others (Table 6).

Table 5. p-values for pairwise comparisons for $\delta^{13}C$ between the three main time period sample populations. Statistically significant differences highlighted in bold.

	Neolithic	E-MBA	Classical-Byzantine
Neolithic	1	0.386	**< 0.0001**
E-MBA	0.386	1	**< 0.0001**
Classical-Byzantine	**< 0.0001**	**< 0.0001**	**1**

Table 6. p-values for pairwise comparisons for $\delta^{15}N$ between the three main time period sample populations. Statistically significant differences highlighted in bold.

	Neolithic	E-MBA	Classical-Byzantine
Neolithic	1	0.412	**< 0.0001**
E-MBA	0.412	1	**< 0.0001**
Classical-Byzantine	**< 0.0001**	**< 0.0001**	**1**

Overall, the stable isotope values from the region across all time periods are indicative of primarily terrestrial C_3 based mixed diets. However, in the later periods (from the LBA, but particularly from the Classical period onwards), the introduction of C_4 plants into agricultural, subsistence, and dietary systems can be witnessed in the stable isotope data (Fig. 6); some of the human values are higher than the $\delta^{13}C$ threshold of ca. -18‰ indicating an increased consumption (direct or indirect) of C_4 plants (Hedges 2003; Lee-Thorp 2008; Wang et al. 2019; Liu et al. 2021).

There are also some individuals from the E-MBA who have distinctively very high, and outlying $\delta^{15}N$ values (the E-MBA individuals with $\delta^{15}N$ values >12‰ as can be seen in Fig. 6). These individuals come almost entirely from the eastern Syrian settlements of Tell Ashara and Tell Masaikh (Sołtysiak and Schutkowski 2018), and will be discussed further below.

Botanical and Faunal Data

Of the 127 sites, collated in this study, with botanical and/or faunal data (Fig. 2), 109 have faunal data, 47 have botanical data, and 27 have information on both. Domestic faunal assemblages are generally dominated by sheep/goat with 89 (81.7%) of the sites with faunal data (n=109) having a dominance of ovicaprines in their domestic faunal assemblages, this is followed by cattle (n=10; 9.2%), and then pig (n=9; 8.3%) (Fig. 3). Regarding domestic cereals (Fig. 4), in general, barley is the most ubiquitous, with 24 (51.1%) of the sites' (n=47) botanical assemblages being dominated by this species. This is followed by wheat (n=14; 29.8%), and then settlements with an equal dominance (n=9; 19.1%). Proportional dominance of sheep/goat ranges from 35.8% to 96.7% of individual sites' domestic faunal assemblages (Fig. 5). However, the mean dominance is 72% ± 14.1 and, in general, when dominant they tend to account for >60% of a site's domestic faunal assemblage. The faunal assemblage dominance for cattle ranges from 42% to 71.8%, with a mean of 55% ± 12.6. For pigs, when they are the dominant domestic faunal species this ubiquity ranges from 35.5% to 56.8%, with a mean of 47.8% ± 8.3. In general, therefore, it can be said that sheep/goat are not only the most omnipresent domestic animals of the period, but, furthermore, they tend to dramatically dominate assemblages when they are the most ubiquitous. Only 9 of the 47 archaeobotanical studies collated during this study had a high enough Total MNI (≥250) to allow relative proportions to be examined. Ubiquity of barley in a site's archaeobotanical assemblage ranges from 56.1% to 98.8% with a mean of 74.7% ± 16, and for wheat the mean is 81.9% ± 20.7, with a range of 51.2% to 95.5% in dominance.

Whilst the data from the botanical and zoological reports can provide us with an indication as to the potential dominance of crops and animals, and thereby the importance of a particular cereal or species to a site and/or populations, in turn providing indications about their agricultural and subsistence strategies, and dietary habits, we should exercise a certain degree of caution. Archaeobotanical and/or archaeozoological assemblages rarely include the entirety of a site's botanical or faunal material, and this may be the result of sampling strategy (for example, biases from sampling storage contexts), or methodological limitations such as a lack of fine-mesh sieving or flotation (see Vermeersch et al. 2021a for an excellent summary of methodological challenges regarding botanical and faunal remains).

Discussion

Supra-regional and Diachronic Patterns in the Stable Isotope Values

The statistical analyses demonstrate that the three main periods analysed (Neolithic, E-MBA, Classical-Late Byzantine) are significantly distinct from one another; the Kruskal-Wallis and the Dunn's Procedure tests show this, as do the 95% confidence intervals and the means. The means and 95% confidence intervals also show that there was a diachronical increase in $\delta^{13}C$ and $\delta^{15}N$ values (for both points see Fig. 7 – mean $\delta^{13}C$ and $\delta^{15}N$ values of the three main time periods). For $\delta^{13}C$ this is particularly true for post-Bronze Age populations, which is likely related to the deliberate introduction and exploitation of C_4 plants in the arable agricultural systems. This dietary shift, witnessed in the move to more positive $\delta^{13}C$ values in the Classical period has previously also been noted for Mesopotamian populations (Sołtysiak and Schutkowski 2018). It has also been argued though that shifts in isotopic values over time may be related to climatic changes affecting the isotopic values of food resources at the base of food webs (i.e., plants); for example, increased $\delta^{13}C$ values from the Neolithic period onwards may be related to a general overall pattern of decreasing water availability in the GNE from the Neolithic onwards (see Ferrio et al. 2005; Araus et al. 2014; Riehl et al. 2014b; Gaastra et al. 2021). Anatolian populations show a reduction in $\delta^{15}N$ values from the (later) Neolithic to the EBA, followed by an increase in-post Bronze Age periods (see Irvine forthcoming; Irvine et al. forthcoming). This is not, however, observed in the overall data of the GNE, and instead there is an overall gradual diachronic increase in the mean $\delta^{15}N$ values. Also, according to the data examined in this study, the homogeneity of the E-MBA populations previously witnessed in the studied Anatolian (and also some of the Greek, and North Mesopotamian) populations (Irvine et al. 2019; Irvine forthcoming; Irvine et al. forthcoming) is not replicated across the GNE. The range of $\delta^{13}C$ values in the E-MBA period is lower than in the Neolithic and the Classical-Late Byzantine periods, but this is not true for $\delta^{15}N$ which actually has the greatest range.

However, when the means of individual temporally contemporaneous populations are plotted together (Figs. 8-10), it is clear that in the Neolithic (Fig. 8) there is consistent variability in the $\delta^{13}C$ and $\delta^{15}N$ values. Although not included in the collated stable isotope data or any of the figures due to being outside of the geographically defined zone examined in this paper, the $\delta^{13}C$ and $\delta^{15}N$ data from Neolithic Ganj Dareh in Iran (SW Zagros) demonstrate that the population consumed a terrestrial C_3-based diet with adult human means for $\delta^{13}C$ and $\delta^{15}N$ being ca. -20‰ and 10‰, respectively (Merrett et al. 2021). For the E-MBA (Fig. 9), the majority of the populations are within a relatively narrow range (very similar to the arbitrary range noted from initial observations, as described earlier: -19‰ to -20.5‰ and 7‰ to 10‰) with a few outlying points (populations). Interestingly, whilst one of these outlying points (Kültepe) is from Anatolia, three of the other outlying points are from the same region of eastern Syria (Tell Ashara and Tell Masaikh), five others are from the Caucasus, and the other two are from Cyprus. This may, therefore, be indicative of marginal regional conditions that result in divergent isotopic values (either by way of differing agricultural/subsistence strategies, dietary habits, or local regional baseline isoscapes), and this would certainly seem to be the case for Tell Ashara and Tell Masaikh. This, in turn, could suggest that there is a 'core area' of northern Mesopotamia, Anatolia, and Greece/the Aegean for the 'EBA package' and its associated isotopic ranges. Additionally, despite the proximity of some of the E-MBA settlements to coastal regions there is a distinct lack of evidence in the stable isotope data for marine (and even aquatic) resource consumption. This peculiarity has also been highlighted by other isotopic studies in the region (see Negari 2016; Goude et al. 2018; Irvine and Erdal 2020a). For the Classical-Late Byzantine populations, the majority also plot in a very tight cluster, but with more positive $\delta^{13}C$ and $\delta^{15}N$ values than in the Neolithic and E-MBA periods. Also, in contrast to the overall mean, most of the means of the discrete Classical-Late Byzantine populations (Fig. 10) are more negative than the -18‰ threshold which is accepted as being suggestive of increasing C_4 content in the diet, and, therefore, this actually points to a predominantly C_3-based diet for these populations. This perhaps suggests that the role of C_4 plants like sorghum and millet in these post-Bronze Age periods may not have been as important in agriculture, subsistence, and dietary habits as previously thought/expected?

So, overall, whilst the E-MBA homogeneity is not as ubiquitous as hypothesised, it still seems to exist in the main. Interestingly, after an admixture of genes in the Late Neolithic (ca. 6500 BCE), the Late Chalcolithic and EBA Anatolian gene pool is very homogeneous, much like the isotope signals and subsistence strategies (Skourtanioti et al. 2020). This may be a coincidence, but it would make sense to a certain degree as a general uniformity and homogeneity in all aspects of life is witnessed for the 4th-2nd millennium BCE of the GNE - see also later discussions in this paper. Furthermore, the different temporal periods, overall, exhibit very distinct isotopic signals which can be argued to be indicative of changes and particular patterns of subsistence and agricultural strategies. It is also possible that the isotope values and ranges may actually indicate a particular model of staple finance, for example, extensive farming based on wheat and/or barley, and mixed management strategies of sheep/goat, cattle, and pig and that it may not necessarily be temporally restricted.

Terrestrial C_3-based diets and a homogeneity in the isotopic values, (exhibited through narrow ranges in $\delta^{13}C$ and $\delta^{15}N$ values, and no significant differences between social groups), for E-MBA populations has been previously noted, not just in the GNE, but also in the wider Mediterranean region (e.g., Negari 2016; Varalli et al. 2016). However, these observations have, so far, been restricted to single populations or regions. Furthermore, not only has a homogeneity in isotopic values been noted, but the ranges in the $\delta^{13}C$ and $\delta^{15}N$ values are often similar to those observed in this study. For example, at the EBA site of Arano (Verona, Italy) the range is -19.7‰ to -20.9 for $\delta^{13}C$ and 6.9‰ to 8.9‰ for $\delta^{15}N$ (Varalli et al. 2016). This suggests that, whilst it is beyond the scope of this current paper to discuss it in more depth, a distinct and common model of staple finance may have had a wide(r) geographical range.

From visual examination of Figs. 6 and 9 it is clear that the individuals with high (>12‰) $\delta^{15}N$ values are deviations relative to the other $\delta^{15}N$ values from the same temporal dataset. The high $\delta^{15}N$ values from E-MBA Tell Ashara and Tell Masaikh make the E-MBA dataset less homogenous by producing a large range for $\delta^{15}N$ values (12.7‰). This range is higher than that of the Neolithic dataset (7.8‰) and the Classical-Late Byzantine dataset (10.5‰). At Tell Ashara and Tell Masaikh these high (>12‰) $\delta^{15}N$ values during the EBA and MBA periods (the $\delta^{15}N$ values become lower from Neo-Assyrian period onwards) are higher than expected for a terrestrial diet based on C_3 crops and domestic animals such as ovicaprids and cattle which have fed on C_3 plants (see Sołtysiak 2020). This may be to do with low water availability, being in a low rainfall area (outside of the limits for rainfed agriculture of the Upper Khabur and Jazira: see Wilkinson 1994; McMahon 2020), and with no irrigation from the Euphrates River being exploited. However, the authors suggest that it was more likely related to intensive plant cultivation and very high levels of manuring due to the increasing demands of a growing urban population (Sołtysiak and Schutkowski 2018; see also Bogaard et al. 2007 and 2013 for the effects of intensive crop cultivation and manuring on isotopic values). There are some individuals (those with lower $\delta^{15}N$ values) at Tell Ashara who, it is posited, may have consumed mostly grain imported from areas with higher precipitation (thereby requiring less intensive cultivation methods), perhaps northern Mesopotamia (Sołtysiak 2019). I would also further suggest that to achieve such high $\delta^{15}N$ values in the humans there would have also been the regular consumption of animals foddered/grazing on highly manured crop grains/

crop stubble. This agrarian strategy of intensive cereal cultivation with concentrated manuring is somewhat different to the general pattern of extensification witnessed for the time period in this region (see Araus et al. 2014, Styring et al. 2017). Therefore, not only are the Tell Ashara and Tell Masaikh populations isotopic 'outliers', but they are also subsistence and agricultural strategy outliers. Whilst most other populations in the region at this time were moving towards, or had already established, extensive agriculture, they are not. This may suggest that there were still some localised variations in subsistence and agricultural strategy that prove an 'exception to the rule'. To clarify some terminology, intensive agriculture refers to labour intensive, and labour-limited agriculture characterised by high levels of manually distributed manuring over a small area of agricultural fields, whilst extensive agriculture refers to land-limited agriculture over a larger area with lower labour intensity due to extensive methods such as an increased exploitation of animals for traction and draught labour (Wilkinson 1994 and Paul Halstead's comments in reply).

Whilst variation is undeniable on a smaller temporal or regional scale, when viewed on a larger scale there is still the suggestion of a distinctive pattern in the E-MBA of the GNE. It is, however, acknowledged that the perspective of this study may not identify subtleties that could have had an effect such as individual settlement size and structure/organisation, or more local environmental and climatic differences, and short-term changes. A study by Pokutta (2017) suggested global variability in $\delta^{13}C$ and $\delta^{15}N$ isotope values and therefore dietary patterns in the Bronze Age. The findings of this study also suggest that this is a likelihood, to a certain extent, and examining a larger geographical range provides more chance of varied subsistence, agricultural, and dietary strategies due to several factors such as local environment and climate as well as society and culture, to name a few.

It should also be emphasised here that any suggestion of an E-MBA model of staple finance in this paper, or indeed any comments on dietary habits and subsistence practices, does not refer to individual dietary habits (i.e., daily, weekly, or even monthly meals), or food preparation methods or techniques. The analysis of $\delta^{13}C$ and $\delta^{15}N$ values from bulk collagen analysis, and a broad investigation of archaeobotanical and archaeozoological assemblages does not allow for a fine enough examination of these types of aspects of dietary habits and subsistence strategies. Furthermore, the stable isotope analyses, at this scale, only allows for the examination of isotopically homogenous or heterogenous patterns in the data. In other words, for example, if two populations (separated by geography and/or time) both eat wheat grains, but one population consumes them exclusively as bread and the other population consumes them exclusively as gruel/porridge then the stable isotope values will not be able to make this distinction. A similar principle is applicable for the consumption of animal meat, the stable isotope data will not be able to determine whether an individual, or population, consumed good or poor cuts from an animal.

Crops and Arable Agriculture

In the Neolithic and Early Chalcolithic there was a greater range/diversity of exploited plants and crops, especially when compared to the later monoculture of the Mediterranean Quartet (Sarpaki 1992). For example, at Çatalhöyük, there was no fixed crop assemblage, with a diverse range of plants exploited (Fairbairn 2007; Fairbairn et al. 2007; Bogaard et al. 2017). The Neolithic and Early Chalcolithic periods were probably ones of ecological opportunism and experimentation (Liu et al. 2019). This greater range in exploited plants is also mirrored in the greater range of $\delta^{13}C$ and $\delta^{15}N$ stable isotope values for the Neolithic in Anatolia (Irvine et al. forthcoming).

As can be seen from Table 2 and Fig. 4, the two most ubiquitous crops in the late 4th to early 2nd millennium BCE (henceforth abbreviated to E-MBA to provide a simplified symmetry with the chronological grouping of the stable isotope data) are barley and wheat. It is also observed that there are some geographical differences, with wheat being the dominant crop largely in the western regions. This is likely related to rainfall and water availability, as wheat has a higher water requirement than barley, and also local climatic variability such as the length and severity of summers and winters, and therefore growing seasons. This agrees well with Riehl's (2014: Fig. 4) findings about the distribution of plants and vegetation in Anatolia, north Mesopotamia and the northern Levant, as well as modern yearly average rainfall data (Fig. 11). Vermeersch et al. (2021a) found that in the Levant, free-threshing wheat is mostly limited to sites in areas with 500-600 mm of precipitation. However, their study also indicated that most of the main domestic crop and faunal species in their study are not particularly restricted by precipitation, and furthermore, that economically important crops (e.g., free-threshing wheat) are likely to have been irrigated, and also that some settlements may have imported crops from elsewhere if their environmental conditions didn't allow for their cultivation (Vermeersch et al. 2021a; see also Sołtysiak 2019). Furthermore, although related to the previous point, is that the predominance of wheat and barley goes beyond these crops being a staple food. Their ubiquity may, hypothetically, also be related to the use of wheat and barley as capital in payments, interest on loans, and debts, as we know it was in early 2nd mil. BCE at Kültepe/Kanesh, for example (Dercksen 2008a, 2008b; Barjamovic 2020). One final interesting aspect, although perhaps related to 'environmental determinism', is that the distribution of wheat and barley in the E-MBA GNE quite closely mirrors the ranges of the initial founder crops (see Gopher et al. 2017).

The monoculture of domestic crops, and particularly wheat and barley, in the E-MBA period of the GNE is not a new revelation though, and it has been observed and stated by numerous researchers over the years. A cereal monoculture of wheat and barley was noted in the southern Jazira, with the inclusion of pulses, mostly lentils, (and vines) in the northern part of the Jazira (Wilkinson 1994). Riehl (2019) found that there is a predominance of barley at Tell el-'Abd and states that this is typical for Bronze Age sites in the Near East and in particular of the Euphrates sites. She suggests that a major reason for this may be due to the biology of barley with its short life-cycle which leads to fast ripeness of the grains, thereby reducing the risk of drought during the hot and dry summer season. Furthermore, these biological aspects of barley may also explain its extended use in economy and trade and its related socio-political importance (Riehl 2019). Nesbitt (1995) suggested that a plausible hypothesis for the shift to a dominance of wheat (particularly bread and macaroni wheat) was that the increasing demand from larger and more urban populations encouraged farmers to shift production to crops that responded better to manuring and were easier to process once harvested.

These kinds of observations are not restricted to Anatolia, Mesopotamia, and the Levant. In the South Caucasus changes in agriculture in the Early Bronze Age to a monoculture of cereals have also been noted. It has been suggested that the particular cultivation choices of particular plants by people of the Kura-Araxes culture, were related not only to climatic changes, but also to economic efficiency and the cultural choice of specific agricultural products and traditions (Hovsepyan 2015). Furthermore, it was human decisions which were the most likely cause for these changes in the agrarian economy between the Neolithic and the Bronze Age of the South Caucasus (Hovsepyan 2015). The dominance of cereals in the upper parts of the middle mountainous, and the entire high mountainous zones has been suggested to be related to the low yield and risks of crop failure in non-cereals (Hovsepyan 2015). Mountainous farming can be particularly risky and the cereals discovered at the Bronze Age centres and settlements of the South Caucasus are more resistant to severe bio-climatic conditions and require less intensive maintenance than most other field-crops, meaning that cereal cultivation required less effort and was less risky (Hovsepyan 2015). In the Erzurum region of north-east Turkey, they still today cultivate a *Triticum aestivum* landrace known locally as *Kirik* which is well adjusted to the mountain climate together with barley (Longford 2015; C. Longford personal communication July 2021). The Kura-Araxes culture is an interesting case with regards to arable agriculture and cereals. The dominant wheat in the Caucasus was free-threshing wheat and even when the Kura-Araxes people migrated to regions in northern Mesopotamia/eastern Anatolia and the Levant that had a dominance of barley and/or glume wheats they maintained a preference for free-threshing wheat (this can actually be seen to a certain extent in Fig. 4). Even if it wasn't always the dominant cereal crop at their centres, it is present, and usually in conjunction with an absence of glume wheats. There appears to be a link between the presence of free-threshing wheat and the Kura-Araxes culture (Longford 2015; C. Longford, personal communication July 2021). This kind of arable agricultural and dietary 'identity' can also be witnessed, to some extent, in Fig. 9 where the $\delta^{13}C$ and $\delta^{15}N$ means of the EBA/Kura-Araxes southern Caucasus populations form their own isotopic cluster. It seems, therefore, that free-threshing wheat was one particular part of the Kura-Araxes cultural identity and 'taste' which moved with them as they migrated, rather than the Kura-Araxes horizon being simply the diffusion of a socio-economic and ceramic tradition (C. Longford, personal communication July 2021). This last point is of particular interest to the discussions later in this paper about the mobility and transference of the 'EBA package'. It should also be noted here that this present study has not distinguished between different wheat types, but that this is something to be conscious of and an example of one of the finer details 'blurred' by this large-scale overview and holistic approach.

One slight exception to the rule of wheat/barley dominance is Cyprus, which, unlike the mainland of the GNE, was not grain-centric in terms of agriculture and archaeobotanical assemblages after the Cypro-PPNB. Instead, there is a dominance of 'cash crops', like olive, grape, and fig from the Chalcolithic onwards. Whilst the relative proportions of grain increase in the EBA, grain cereals likely only dominated (to the same levels of the Cypro-PPNB) in the LBA (Lucas and Fuller 2020). The extensification of agriculture is also noted for Cyprus from the Mid.-Late Chalcolithic and EBA, likely in parallel with the increasing importance of cereals (Lucas 2014; Lucas and Fuller 2020). This is quite similar to the period when the extensification of agriculture is also happening on the mainland, providing some weight to the idea of a pervasive and ubiquitous mode of staple finance (i.e., agricultural strategies) in the region.

Animal Management, Ante-mortem Product Exploitation, and Livestock as Wealth Finance

The findings of this study (see Table 2, Figs. 3 and 5) demonstrate that in the E-MBA period (more accurately the late 4th to early 2nd millennium BCE) the most ubiquitous domestic animal species in the GNE were sheep/goat. As with the distribution of dominant cereal crop species, there are also some geographic differences with cattle being more dominant in western Anatolia. This may be related to more humid conditions and the higher availability of rainfall (see Fig. 11), as cattle have higher water requirements than sheep or goats (Gaastra et al. 2020a). This was suggested to be the case at Kohneh Pasgah Tepesi, where the importance of cattle may have been related to the favourably moist climatic conditions in that part of Iran (Decaix et al. 2019). However, the data collected by Vermeersch et al. (2021a) in the Bronze and Iron Age Levant suggests that animal husbandry may not be as dependent on the environment as previously thought, and instead may be as a result of historical, political, social, and economic decisions. This is also supported by the work of Gaastra et al. (2021) for the entire Near East from 13.000-0 BCE who found that fluctuations in the proportion of sheep/goat, cattle, or pigs were not related to long- or short-term phases of aridity and/or Rapid Climate Change events. The dominance of cattle in western Anatolia may also not necessarily be related to environmental and climatic factors, but rather cultural ones (see Arbuckle 2014b). Gaastra et al. (2021) discovered that for the Middle Holocene period (ca. 4000-2250 BCE) proportions of domestic animals were variable between different regions of the Near East, and furthermore, between different landscape types and between urban and rural sites. Their results found that the proportions of domestic animals, and changes in them, are much more nuanced than presented here in this study. However, in general, the proportional variations that they observed are mostly of cattle and (particularly) pigs, and related to urban versus rural settlements, and that, overall, for this time period there is a consistent dominance of sheep/goat which consistently account for >60% of faunal assemblages (Gaastra et al. 2021). This agrees very well with the findings of this current study. Sites with a dominance of cattle, or relatively higher proportions of cattle, may indicate more 'urban' centres due to their role in farming (traction), movement of agricultural surplus, and trade (see Atıcı 2014; Kohler et al. 2017; Styring et al. 2017; Gaastra et al. 2020b, 2021). As with cereal crops, the animal husbandry economy on Cyprus was slightly different to that of the mainland, at least initially. Animals were not intensively exploited for their ante-mortem products on Cyprus until the LBA (Lucas and Fuller 2020). This may be to do with Cyprus being outside of, or at least not fully integrated into, the GNE market economy in the EBA as it was not fully integrated into the broader Mediterranean trade network until the LBA (Lucas and Fuller 2020). Cattle were only re-introduced to the island in the EBA, but this is likely to have stimulated a major shift in agricultural practices (milk, traction, and dung), and a reduction of pig in faunal assemblages coincides with an increase in ovicaprines from the LCh onwards (Lucas and Fuller 2020).

Previous $\delta^{13}C$ and $\delta^{15}N$ stable isotope analyses of EBA populations and their animals have demonstrated that it appears as if not all domestic animals were directly consumed (Varalli et al. 2016; Irvine et al. 2019). At LCh Tell Brak and EBA Tell Leilan the human stable isotope values suggest low animal protein consumption (Styring et al. 2017). Rearing, keeping, and managing livestock requires significant investment and organisation and, therefore, if the animals were not being reared principally for primary consumption, then the question arises, why were people keeping them? Although this will be discussed in more depth further below, to put it very simply and generally, animals were no longer reared just for their primary products (i.e., meat), or merely utilised in a secondary manner (dairy, traction, fibres). Rather, the secondary exploitation of their ante-mortem products (Vigne and Helmer 2007) had become vastly intensified, and they had now developed into having not just a practical value, but a commercial value as wool-bearers or beasts of burden and traction. For example, at Kültepe/Kanesh the textual sources reveal that "…out of 14 sheep received as payment, only 1 was slaughtered for immediate consumption, and the remaining 13 were sold for 31.16 shekels of silver; out of 11 sheep received as payment, 9 were sold for silver, while 2 were slaughtered for consumption" (Dercksen 2008b). This provides a prime example that livestock had become a commodity beyond primary consumption, and could even act as a means of direct or indirect exchange with a relatively stable value.

Furthermore, in EBA Anatolia it has been shown that domestic animals from the same site/settlement have a large range of $\delta^{13}C$ values (Irvine et al. 2019; Irvine and Erdal 2020b). Varied $\delta^{13}C$ (and $\delta^{15}N$) values indicate different sources of carbon in the animals' diets and have been suggested as evidence of differing animal management strategies, including; grazing on crop stubble and/or manured fields, the (seasonal) mobile herding of animals outside of the agricultural zone of a settlement, and stable foddering (Pearson et al. 2007; Makarewicz 2017; Middleton 2018; Irvine et al. 2019; Ventresca Miller et al. 2019; Irvine and Erdal 2020b; Sołtysiak 2020;). The implication being that there may have also been some movement of animals, not just differing management and feeding strategies. This has been supported for the EBA in Anatolia by $\delta^{34}S$ data which showed that whilst at Bakla Tepe the animals were all local but had different diets (sources of carbon in their dietary protein), at Bademağacı it was demonstrated that some of the animals were not local, with one hypothesis being that they had been imported to the site (Irvine et al. 2019; Irvine and Erdal 2020b). This may tentatively suggest a trade or supply chain of animals/animal products which may, consequently, also imply a wealth finance aspect of animal husbandry. For example, in the Ur III economy we know that wool producing herds of sheep were regulated by the state and that cattle herding and rearing were also regulated differentiating between edible and labour needs (meat, dairy, or draft animal use) (Zeder 1988). Different animal management strategies for sheep and goats are known from Tell Beydar following analysis of the texts. These revealed that grain-fed animals were rare and that large flocks were exclusively fed by grazing (Riehl 2006). However, some of the sheep and goats were kept separately and fattened by grain, and it was these animals which were later slaughtered for their meat. It is also very likely that these sheep and goats intended for slaughter were kept in stables. However, the regular flocks were so large (ca. seven thousand animals) which meant that they could not be kept in the city, or even sheared there (Riehl 2006). In some parts of northern Mesopotamia, there is a clear distinction between urban centres and their satellite towns and villages. In the Upper Euphrates region pigs were almost completely absent at Titris Höyük, but present in significant numbers at smaller settlements such as Hassek Höyük, Kurban Höyük, and Gritille Höyük. These differences in pig husbandry patterns may indicate an institutional presence within urban centres compared to the smaller settlements, whose inhabitants were rearing pigs as agricultural and pastoral resources were increasingly being redirected to support the growing cities (Price et al. 2017). Furthermore, the reduction in pig numbers at sites in the EBA would perhaps provide evidence for a shift to animals with an economical/financial value; pigs consume grain and do not provide ante-mortem products. They are also more likely to disrupt crop agriculture (if free-roaming) and, therefore, another reason for their demise may be the increased extensification of arable agriculture around settlements (Price et al. 2017).

Thus, a key aspect of the 'EBA package', as presented and elaborated on here in this study, is the intensification of the exploitation of animals' ante-mortem products from the late 4th millennium BCE. This resulted in the (re)organisation of animal husbandry, or at least parts/aspects of it, becoming part of the wealth finance economy which, in turn, had an impact on the staple finance economy including agricultural strategies, subsistence practices, and dietary habits. In many ways, it can be stated that the Near East and Eastern Mediterranean in the late 4th millennium BCE witnesses a 'Second Agricultural Revolution'.

Cattle

The lack of consumption of cattle (either primarily through meat consumption, or secondarily through milk/dairy products) may be related to cattle being mainly used for traction – especially related to grain production (i.e., ploughing), and the redistribution of grain surplus. Cattle were kept for as long as economically useful and productive, and then sold for meat. The pastoral economy was not one based around meat production and kill-off patterns also reflect this. Pathologies on some of the distal bones of cattle skeletons from Kohneh Pasgah Tepesi indicates that cattle were used as draught animals, most likely in agricultural activities (Decaix et al. 2019). At Salat Tepe cattle were kept to an old age suggesting the importance of exploiting their ante-mortem products such as milk and traction (Silibolatlaz Baykara 2019b). High prices for purchase, or rental, of cattle also reflect this importance. Cattle commanded a higher price range than sheep, and were rented as well as being bought and sold; 12 shekels of silver per animal for purchase and 0.8–3.5 shekels of silver for rental (Gökçek 2004). The textual evidence also shows that sheep, cattle, and pigs were brought to Assyrians for payment and that they were accepted in lieu of silver, which further demonstrates that the use of livestock for meat was not the primary focus (Atıcı 2014). This means that livestock should be considered as a commodity for exchange and that they "…functioned as a means of exchange with values dictated by supply and demand, which generated new economic opportunities and new markets for sale, purchase, and rent" (Atıcı 2014).

Sheep/Goats

We know from written texts that the woold trade was an important part of local and also pan-regional economies. Evidence for the importance of sheep raising and the presence of a highly developed and organised textile industry and, by implication, large-scale sheep husbandry for wool in Anatolia can be found in the Kültepe/Kanesh tablets, for example. There is frequent mentioning of various prized sheep breeds (e.g., *lakannūm*, *šallinum,* and *utharum*) that provided meat, fibre, and capital value, as well as palace functionaries such as the chief of shepherds and the shepherd of the queen (Gökçek 2004). The Kültepe/Kanesh tablets also reveal that there was a complex and selective pricing policy for sheep that involved the colour of the fleece, its place of origin, the quality of the meat, the animal's physical condition, and the breed (Gökçek 2004). For sheep, there was a price range from ca. 1.4 to 4.6 shekels of silver per sheep. (Gökçek 2004). One Assyrian cuneiform tablet from Kültepe/Kanesh describes the movement of 630 kg of wool from Kanesh to another city in Anatolia (Dercksen 2008a), and using other texts it has been estimated that over the course of 40-50 years 14.500 pieces of cloth and 100.000 textiles were shipped from Anatolia to Aššur (Larsen 1987). This shift to a highly specialised pastoral economy which focused on sheep and goat husbandry was driven by the commodification of textile production and had already commenced in the 3rd millennium BCE, if not even slightly earlier (Styring et al. 2017). Evidence for the importance of textile production from the 4th millennium BCE onwards at GNE settlements comes from changing herd composition to include more sheep, more sheep being kept to old age, and an increase in the number as well as changing dimensions and weights of spindle whorls. (Schoop 2014; McMahon 2020). In Anatolia, for example, from the LCh onwards there is a dramatic increase from earlier periods of the Anatolian Chalcolithic in the number of spindle whorls, loom weights, as well as the evidence of full looms (Schoop 2014).

Faunal isotope values from LCh Tell Brak and EBA Tell Leilan suggest the possible foddering of animals on cereal grains which not only provides another example of differing animal management strategies, but could also demonstrate the input and investment of labour and land/land management (such as water/irrigation etc.) that populations/institutions were willing to put in to sustain large sheep/goat herds due to their new economic value (Styring et al. 2017). Conversely, the widespread move to rearing wool-bearing sheep and the associated textile trade meant that large areas of land that previously could not reliably be used to support agriculture became productive, and land in more fertile areas that had formerly been used to grow flax (for textile production) was now available for the cultivation of other crops (McCorriston 1997; Lawrence and Wilkinson 2015). The production of textiles from flax required significantly more labour than that utilising animal fibres. Therefore, this transition to animal fibres allowed not only for the re-allocation of highly productive agricultural land to cereal crops, but also labour that had formerly been dedicated to flax cultivation could now be re-invested elsewhere - "Within households relying on marginal agricultural land, labour freed from producing fibre might have been diverted to producing surplus textiles for exchange. Such a strategy would have triggered specialization in textile craftsmanship" (McCorriston 1997). This also further demonstrates the impact that this (animal husbandry) aspect of the 'Second Agricultural Revolution' had on modes of both staple and wealth finance in the GNE. The intensified exploitation of animals' ante-mortem products and their 'commercialisation', although primarily economic in nature, affected participating societies in their entirety, triggering a wide range of interconnected changes from the economy and technology to social structure and ideology (Schoop

2014). In the Chalcolithic period of Anatolia (6th-4th millennium BCE), for example, there was chronological and regional diversity in pastoral strategy, but ovicaprines were always important components of herds. By the 3rd millennium BCE, though, sheep had more-or-less become the most ubiquitous species, together with a trend of increasing survivorship of adult sheep through the Chalcolithic and into the EBA (Schoop 2014).

Although there was undoubtedly a move towards a specialised animal economy based on sheep and goats and the resultant textile trade, many sites did employ a mixed strategy of animal exploitation. For example, at Salat Tepe *Ovis/Capra* demonstrated a mixed management strategy for meat and ante-mortem products such as milk and wool/hair (Silibolatlaz Baykara 2019b), and at EH Lerna, a mixed pattern of primary consumption (young culling) and ante-mortem product exploitation (older animals/older culling ages) has been noted (Reese 2013a; 2013b).

Mobility and Transference of the 'EBA package'

Following the arguments of Pauketat (2000), we may consider that an E-MBA model of staple finance and common agricultural practices of the late 4th to 2nd millennium BCE were the result of social compliance. Utilising Pauketat's (2000) proposal, it could be that smaller populations were 'coerced' into an economic food producing system, initially instigated by larger settlements with greater hierarchical systems and more prominent 'elites', that produced the greatest output whilst also allowing the greatest control over both resources and, thereby, the populations (see also, Frangipane 2018). Information about agricultural systems has the potential to be viewed within the semblance of power relations as a result of human land-use practices. It has been demonstrated that the Neo-Assyrian Empire (934-611 BCE) utilised agrarian systems, and the intensive production of surplus crops to exert political control over the landscape and its inhabitants, the subjects of this empire (Rosenzweig 2018). The expansion of the Neo-Assyrian Empire was founded on increased agricultural production and agrarian control enabled the Neo-Assyrians to exert political control over its subjects. For example, at Tuˇshan, the agrarian system which was imposed by the Neo-Assyrian empire "…bound subjects to the polity through a demanding program of intensive, surplus crop production that curtailed, but did not extinguish, agricultural diversity and independence." (Rosenzweig 2018). It is known that in the EBA of Anatolia, Greater Mesopotamia, and the Levant there was an emergence of settlement hierarchy and that the larger 'city-states' may have exerted an influence on their local regional environment, and also possibly, in some cases, some smaller cities, towns, and villages (Zeder 1988; Wilkinson 1994; Baird 1999; Matney 2012; Price et al. 2017; Gaastra et al. 2020b; Massa et al. 2020; Umurtak 2020). Some have also suggested that these peripheral satellite settlements may have been under the direct influence of larger centres to the extent of producing and providing crops and animals for them (Zeder 1988; Wilkinson 1994; Price et al. 2017; Gaastra et al. 2020b, 2021). It should be argued here that providing extra food resources for a larger settlement, does not always mean that these smaller, 'rural' settlements were necessarily coerced into this provisioning, although this may have been the case. Instead, it may have been a mutually beneficial arrangement based upon the principals of trade, barter, exchange, and a market economy. If one, tentatively, expands this theory it may provide one possible explanation as to why, to some extent, a monoculture of crops and domestic animals exists in the archaeological record, and thus also a relative homogeneity in the stable isotope values. In effect, the vast majority of EBA settlements were growing the same crops, and rearing the same species of domestic animals, and this may have been the result of regional political or economic control. Once this style of economic food producing system had been established and other smaller contemporary settlements had been "constrained by the spaces and practices" of these new systems, the ability to "objectively resist domination…would have been inhibited" resulting in those settlements at a certain point having no choice but to switch to, and become locked into, those economic agricultural systems (Pauketat 2000).

In the EBA the sites were often very close together; during the mid-EBA of Anatolia it has been estimated that the average distance between mounded settlements in the main valleys was 3-6 km (Massa 2016). A similar pattern has been noted for the Jazira, with sites ca. 5-20 km apart during the EBA (Wilkinson 1994). Settlements of the period, therefore, should not be viewed in isolation as they were (in the majority) far from isolated. The short distance between settlements suggests intensive interaction with their neighbours, with the transfer of technological knowledge and cultural behaviours mostly from one individual to another and one village/town/city to another (Matney 2012; Massa 2016; Ünlü 2016). Therefore, it is not so hard to imagine common patterns of agricultural subsistence as a local exchange of ideas, practices, and methods becoming regional and then pan-regional. Additionally, there were many common and shared cultural aspects of EBA settlements. Indeed, the material culture of the Anatolian EBA, for example, demonstrates a trend towards homogenisation (Bachhuber 2015). It has been shown that more culturally similar interacting groups are more likely to accept a particular innovation (Massa 2016). At Karataş (southwest Anatolia), for example, which shares many of the same cultural features of other EBA Anatolian settlements it is likely that wheel-made pottery and metallurgy was imported to the settlement (Massa 2016). In addition, the presence of 'colonies' at some EBA sites such as Kanlıgeçit, Kastri, Ayia, Photia, and Manika has been suggested (Heyd et al. 2016; Massa 2016). It is feasible to argue that the members of these colonies would have brought cultural and technological practices of their home with them to their new locations, possibly including agricultural practices. In the latter part of the 3rd millennium BCE especially, many basic commodities (copper, stone artefacts, some vessel types) start circulating in large(r) quantities and across larger distances reaching even relatively isolated locations/settlements demonstrating a wide range and permeability of material culture, goods, and technologies across EBA Anatolia (and further afield) (Massa 2016; Şahoğlu 2016; Massa and Palmisano 2018; Yılmaz 2019). Evidence for long distance trade, through the presence of exotic raw materials and objects, is also found in northern Mesopotamia from the 4th millennium BCE onwards (McMahon 2020). As with the exchange of material culture and technology (e.g., finished objects, wheel-made pottery, metals etc.) agricultural practices can potentially be considered to be as much a part of the (EBA) trade networks as those other goods and technologies. It has been attested archaeologically that this '[EBA] economic package' (wheat, barley, cattle, sheep, and goats) had begun to spread from the Near East through Central Asia and into northern China around 5000 BP and was established there by the 4th millennium BP (Li and Dong 2018; Liu et al. 2019; Zhou et al. 2020); therefore, its ubiquitous movement on a much smaller regional scale across Anatolia and the Greater Near East should be anticipated (see also Liu et al. 2019; Skourtanioti et al. 2020). Furthermore, the movement of economic/subsistence packages has already been confirmed in the region for the Neolithic (Brami 2019; Lucas and Fuller 2020).

It has been suggested that there would have been a movement of specialists (traders, builders, potters, weavers, and metal workers) in the EBA, although not necessarily over large distances (Massa 2016). This may also include the movement of farmers, pastoralists, or agricultural specialists. In the latter half of the 3rd millennium BCE western Anatolian sites such as Troy and Bakla Tepe intensified their contacts with communities to the east, from Mesopotamia and (likely via) Central Anatolia (Şahoğlu 2016; Ünlüsoy 2016; Massa and Palmisano 2018; Yılmaz 2019). Ünlüsoy (2016) has proposed that evidence for direct contacts with the Mesopotamian elite culture via inner-western Anatolian communities at Troy can be observed through the presence of tin bronzes, wheel-made pottery, and prestige goods produced with non-local materials. At Troy this change in focus affected all aspects of daily life and the social, economic, and political organisation were drastically transformed (Ünlüsoy 2016). It is therefore feasible to suggest that material culture (metals, ceramics etc.) were not the only things to be transported along this south east-north west vector. It is also very possible that agricultural and subsistence practices such as a narrow range of key (cereal) crops and an increased emphasis on herds composed of *Ovis/Capra* all controlled by a centralised authority, which are currently more commonly associated with Mesopotamia (see Paulette 2013, 2016), would have also been 'conveyed' westwards and adopted by the communities of Anatolia, and then subsequently, by those of the Aegean and Greece.

Finally, when considering mobility and the potential for mobility, from the EBA I-II to EBA III periods in Anatolia, a reduction in the number of settlements is observed, and one of the key unanswered questions remains; what happened to the people from those abandoned settlements? Bachhuber (2015) suggests four possibilities; they were killed or starved to death, they were absorbed by larger settlements, they became more mobile pastoralists, they migrated (for example, to Cyprus where many Anatolian characteristics are witnessed in the Philia culture of the late 3rd millennium BCE). Apart from the scenario where they all die, the other three involve the movement of groups of people, either on a small spatial scale (to the nearest large settlement), across an area (mobile pastoralism), or larger distances (to another region). See also the emptying, and changing settlement dynamics, of areas of the surrounding rural hinterlands that accompanied the growths of Tell Brak, Tell Leilan, and Tell Beydar in the late 4th millennium BCE (McMahon 2020). It is logical to assume that these people would have taken their practices and traditions (including agricultural practices and dietary habits, amongst others) with them where they went, and this may have also played a role in the dissemination of particular agricultural practices resulting in a general homogenisation. One such example to think about at this juncture would be the movement of the Kura-Araxes people and their preference for free-threshing wheat. Another example to consider is the argument that cultural, architectural, technological, and agricultural production changes of the EBA Philia culture on Cyprus have been attributed to increased external contact (Kouka 2009; Lucas and Fuller 2020). Furthermore, the indications are that, following external contact and influences, the agricultural system of the 3rd millennium BCE on Cyprus more intensively integrated arable (cereal) agriculture, cash crops, and ante-mortem product exploitation of domestic animals (Lucas and Fuller 2020; Scirè-Calabrisotto et al. 2020). Ultimately, the 'EBA package' superseded the Cypriot agricultural system which had existed for millennia, demonstrating its pervasiveness. Whilst there are currently no stable isotope data from the Cyclades for the 4th to early 2nd millennium BCE, and very little from (late) 3rd millennium BCE Cyprus (see Goude et al. 2018; Lucas and Fuller 2020 – has a summary of stable isotope research on Cyprus; Scirè-Calabrisotto et al. 2020) it would be very surprising if their isotopic signals were not very similar to those of EBA Anatolia and EH and MH Greece. This hypothesis can only be confirmed with certainty once more stable isotope work to examine dietary habits has been conducted on further populations in the areas from the Balkans to Mesopotamia. Furthermore, more information should be gathered to test and further examine the diachronical extent of this hypothesis. Whilst this economic package was initially termed an 'EBA package', it likely also extended into the MBA, and possibly even parts of the LBA and Iron Age, only really being drastically altered (particularly with regards to human isotopic values) with the introduction of C_4 plants such as millet and sorghum into the intentionally cultivated and exploited botanical assemblage, entering into human dietary habits either through direct consumption, or indirectly as fodder for animals.

Conclusions

This study has demonstrated that there is a relatively distinct subsistence model of staple finance for the late 4th to early 2nd millennium BCE, visible in the adult human $\delta^{13}C$ and $\delta^{15}N$ values, as well as the archaeobotanical and archaeozoological records (see also Vermeersch et al. 2021a for the distinct nature of Levantine E-MBA botanical and faunal assemblages compared to the LBA and Iron Age). However, this model is not as homogeneous and ubiquitous as previously hypothesised, with evidence of variability on a pan-regional scale. In its simplest form (at least in terms of socio-economic driving forces) the EBA is a time of agriculture, metal, and wool. The Ebla texts reveal an economy based on agriculture, viticulture, animal husbandry, and textile, and metallurgical activities (Pettinato 1976, 1981, 1991; Bachhuber 2015). The stable isotope data, in conjunction with the data and information from other specialist researchers examined in this study would certainly appear to also support this being a time of agriculture and wool. Therefore, the idea of an E-MBA model of staple finance, encompassing extensive agricultural methods and intensive exploitation of ante-mortem animal products, is one that is both rational and appealing to researchers of the prehistoric GNE. Whilst it becomes most apparent from the late 4th millennium BCE onwards in northern Mesopotamia and Anatolia, it is doubtful that this phenomenon has a single point of origin (either spatially or temporally) but instead was something that developed progressively before being adopted and adapted by others. Furthermore, it likely developed both in conjunction with, and as a result and progeny of other societal and cultural developments such as the development of central control, urbanisation, long-distance trade and exchange networks, surplus production, wealth finance (particularly involving animal products), and intensified production from extensive agriculture with many of these factors in effect having a virtually reciprocal and indeed in some cases, a trajectorially linear relationship with each other. It follows on from, and develops, the idea of an intensification of the ante-mortem products revolution in the Chalcolithic of the Near East, and goes hand-in-hand with the increased control in the EBA of populations (organisation of labour, specialists, agricultural surplus and distribution) by emerging elites, intensified trade and exchange networks, urban planning and construction, and more intensive interactions with the environment, including arable and pastoral agriculture. In general, it can be said that the EBA is a time of increase, and also of development, towards what one might argue to be increased standardisation and regulation of architecture, funerary habits, genes, metallurgy, textile and ceramic production and craft specialisation, and in these respects the subsistence strategies and dietary habits of the populations are no different.

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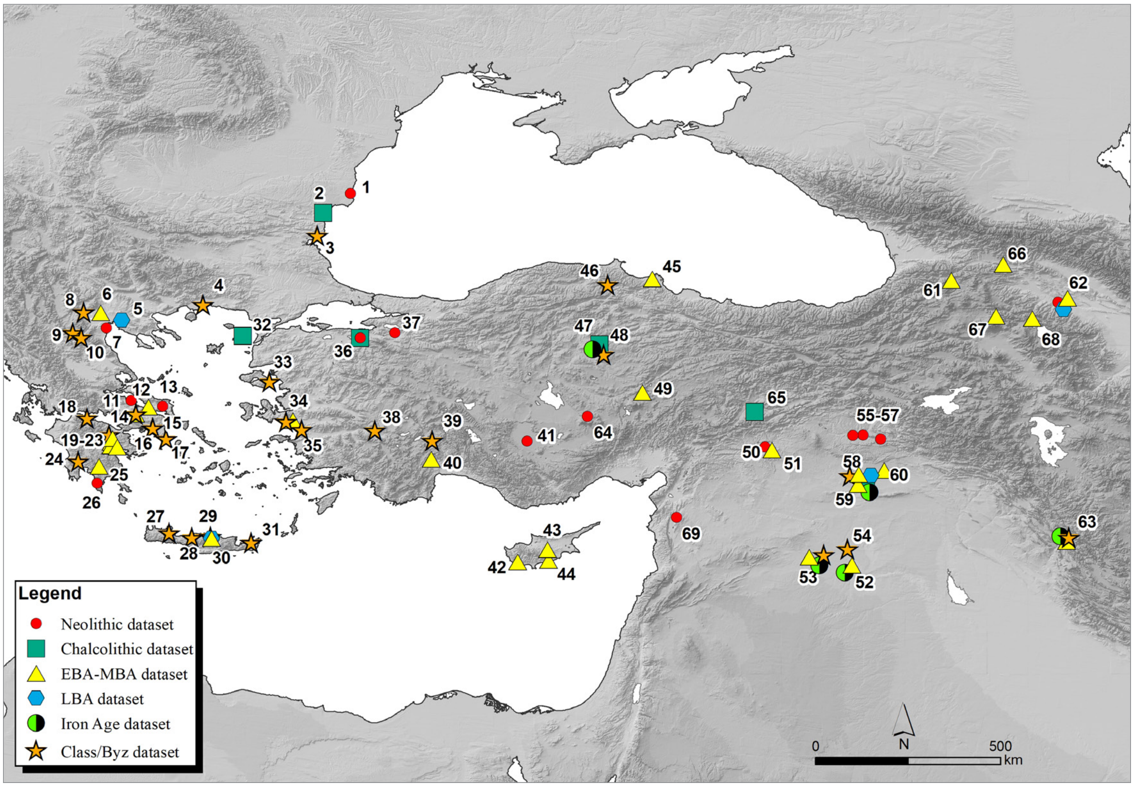


Figure 1. Map showing sites in the Greater Near East with stable isotope ($\delta^{13}C$ and $\delta^{15}N$) data used in this study. N.B. Sites that only have population means reported are marked with an *. 1. Durankulak*, 2. Varna*, 3. Mesebria, 4. Abdera, 5. Thessaloniki Toumba, 6. Archontiko, 7. Makriyalos, 8. Edessa, 9. Sourtara*, 10. Servia, 11. Halai, 12. Tharrounia, 13. Manika, 14. Thebes, 15. Kerameikos, Athens, 16. Plateia Kotzia, Athens, 17. Laurion, Athens, 18. Nemea, 19. Helike, 20. Mycenae*, 21. Aspis, 22. Lerna, 23. Asine, 24. Messene*, 25. Kouphovouno*, 26. Alepotrypa Cave, 27. Stylos*, 28. Eleutherna*, 29. Kastella, 30. Knossos, 31. Petras, 32. Uğurlu Höyük, 33. Mitilini*, 34. Bakla Tepe, 35. Ephesus, 36. Aktopraklık, 37. Barcın Höyük, 38. Hierapolis, 39. Sagalassos*, 40. Bademağacı, 41. Çatalhöyük, 42. Souskiou-Laona Settlement, 43. Marki-Alonia, 44. Psematismenos-Trelloukkas, 45. İkiztepe, 46. Kovuklukaya, 47. Çamlıbel Tarlası, 48. Boğazköy/Hattuşa, 49. Kültepe, 50. Nevalı Çori, 51. Titriş Höyük, 52. Tell Masaikh, 53. Tell Ashara, 54. Gebel Mashtale, 55. Hakemi Use, 56. Körtik Tepe*, 57. Hasankeyf Höyük, 58. Tell Brak, 59. Tell Barri, 60. Tell Leilan, 61. Chobareti, 62. Mentesh Tepe, 63. Tell Bakr Awa, 64. Aşıklı Höyük, 65. Arslantepe, 66. Kvatskhelebi, 67. Gegharot, 68. Kalavan-1, 69. Tell el-Kerkh.

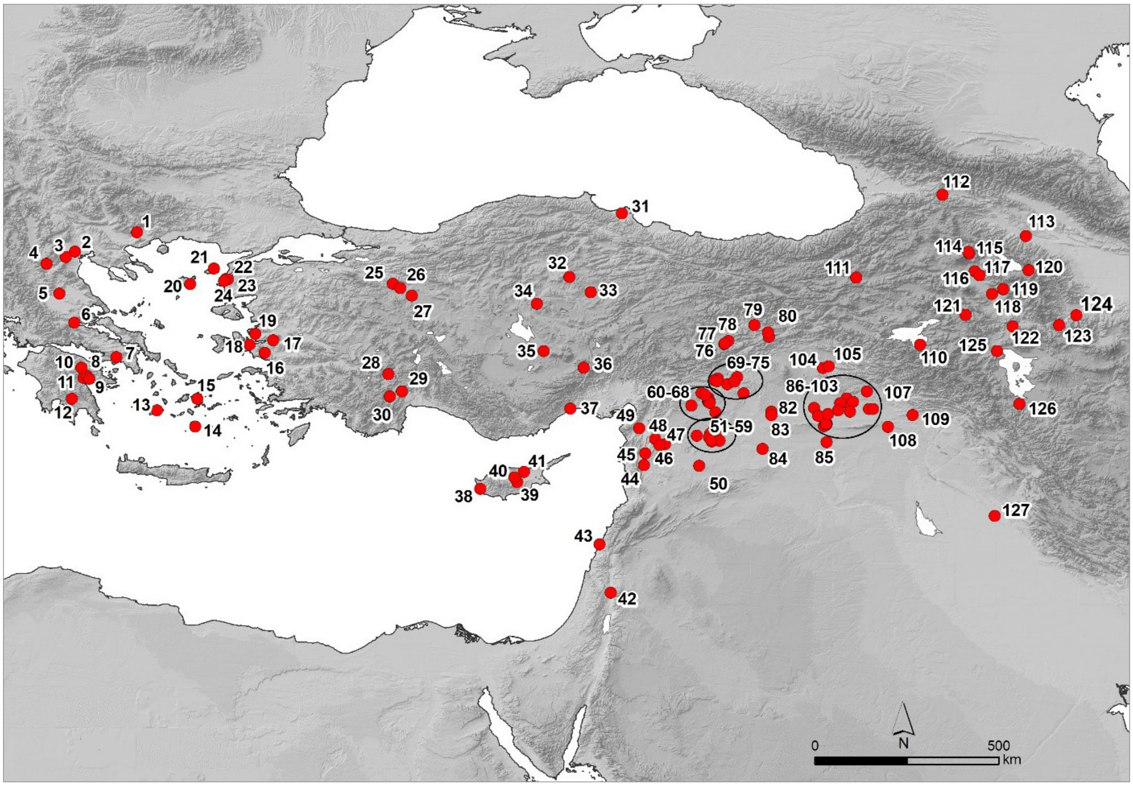


Figure 2. Map showing Greater Near East sites with archaeozoological and/or archaeobotanical data examined in this study. 1. Sitagroi, 2. Kastanas, 3. Pevkakia, 4. Megalo Nisi Galanis, 5. Zarko, 6. Agia Paraskevi, 7. Eleusis, 8. Tsoungiza, 9. Lerna, 10. Tiryns, 11. Asine, 12. Kouphovouno, 13. Phylakopi, 14. Emborio, 15. Zas, 16. Bakla Tepe, 17. Ulucak, 18. Liman Tepe, 19. Panaztepe, 20. Poliochni, 21. Yenibademli, 22. Beşiktepe, 23. Kumtepe, 24. Troy, 25. Demircihüyük, 26. Orman Fidanlığı, 27. Küllüoba, 28. Kuruçay Höyük, 29. Karataş-Semayük, 30. Bademağacı, 31. İkiztepe, 32. Çamlıbel Tarlası, 33. Çadır Höyük, 34. Kaman-Kalehöyük, 35. Acemhöyük, 36. Göltepe/Kestel, 37. Yumuktepe, 38. Lembas-Lakkous, 39. Politiko-Troullia, 40. Marki-Alonia, 41. Kythrea-Ayios Dhimitrianos, 42. Tall Al-Handaquq, 43. Tell el-Burak, 44. Tell Apamea, 45. Tell Qarqur, 46. Ebla, 47. Tell Tuqan, 48. Tell Afis, 49. Tell Tayinat, 50. Al-Rawda, 51. Umm el-Marra, 52. Tell Halawa, 53. Habuba Kabira, 54. Emar/Tell Meskene, 55. Selenkahiyeh, 56. Ali Al-Hajj, 57. Tell Hajji Ibrahim, 58. Tell es-Sweyhat, 59. Tell Hadidi, 60. Tell Shiukh Fawqani, 61. Tilbaşar Höyük, 62. Gre Virike, 63. Mezraa Höyük, 64. Yarım Höyük, 65. Zeytinli Bahçe, 66. Hacınebi, 67. Tilbeşar, 68. Horum Höyük, 69. Kurban Höyük, 70. Hayaz Höyük, 71. Gritille, 72. Titriş Höyük, 73. Hassek Höyük, 74. Lidar Höyük, 75. Kazane Höyük, 76. Arslantepe, 77. Gelinciktepe, 78. İmamoğlu Höyük, 79. Çayboyu, 80. Tepecik, 81. Korucutepe, 82. Tell Chuera, 83. Kharab Sayyar, 84. Ghanem al-Ali, 85. Tell Mashnaqa, 86. Tell Knedig, 87. Tell Bderi, 88. Tell Gudeda, 89. Tell Tuneinir, 90. Tell ‘Atij, 91. Tell Ziyadeh, 92. Tell Rad Shaqrah, 93. Tell al-Raqa’I, 94. Kashkashok IV, 95. Tell Beydar, 96. Tell Khazna, 97. Tell Barri, 98. Chagar Bazar, 99. Tell Mozan, 100. Tell Leilan, 101. Tell Arbid, 102. Tell Brak, 103. Tatıka, 104. Ziyaret Tepe, 105. Salat Tepe, 106. Hamoukar, 107. Tell el’Abd, 108. Tell Taya, 109. Tell Karrana 3, 110. Dilkaya, 111. Sos Höyük, 112. Natsargora, 113. Mentesh Tepe, 114. Gegharot, 115. Aparan III, 116. Shengavit, 117. Mokhra Blur, 118. Ovçular Tepesi, 119. Areni-1 Cave, 120. Sotk 2, 121. Köhneh Shahar, 122. Kul Tepe, 123. Kohneh Pasgah Tepesi, 124. Kohneh Tepesi, 125. Haftavan Tepe, 126. Tepe Hasanlu, 127. Tepe al-Atiqeh

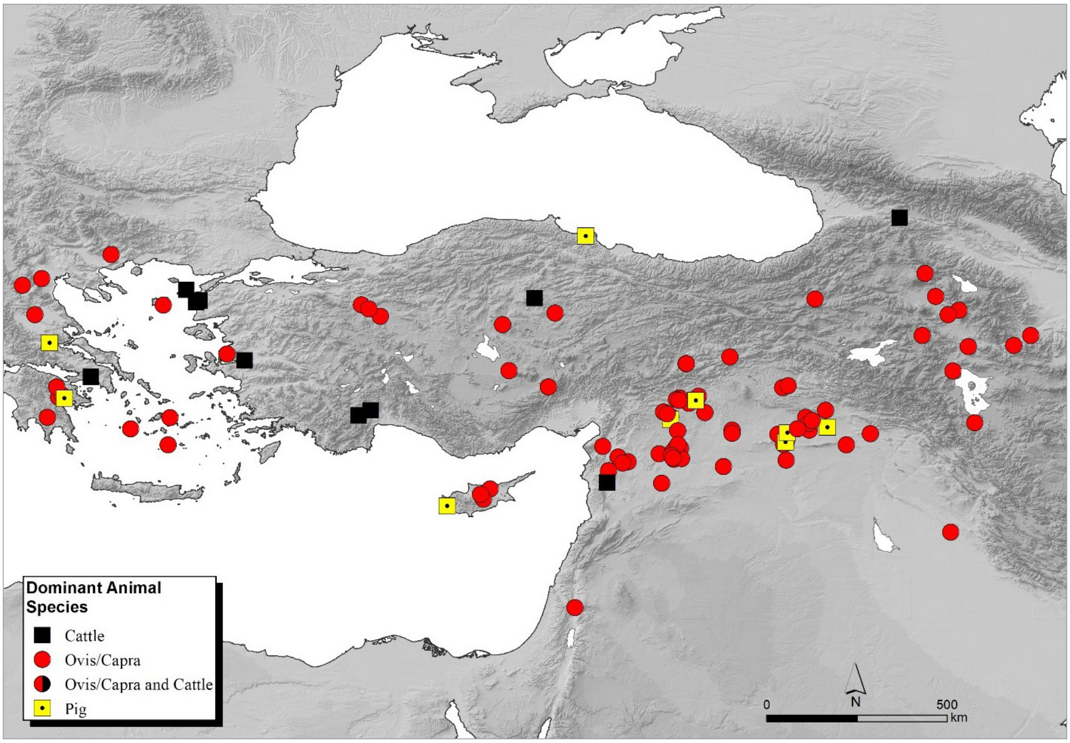


Figure 3. Map showing the dominant (by NISP) domestic faunal species at the 4th-2nd millennium BCE sites of the GNE examined in this study. Refer to Fig. 2 for site names.

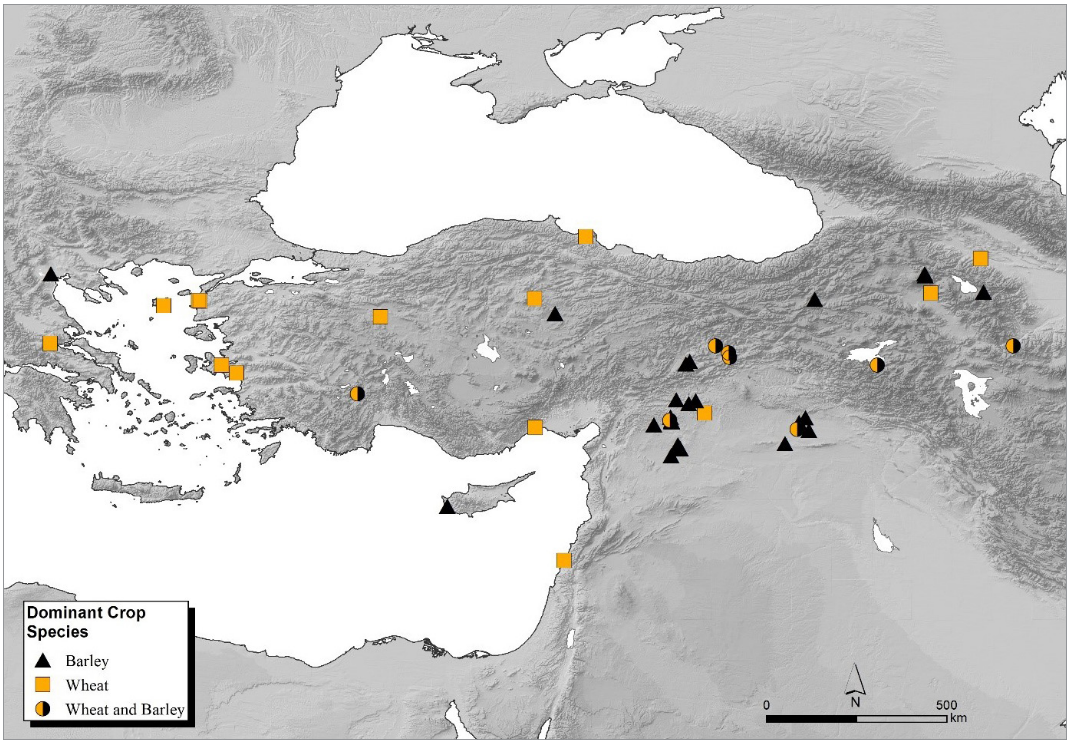


Figure 4. Map showing the dominant (by MNI) domestic crop species at the 4th-2nd millennium BCE sites of the GNE examined in this study. Refer to Fig. 2 for site names.

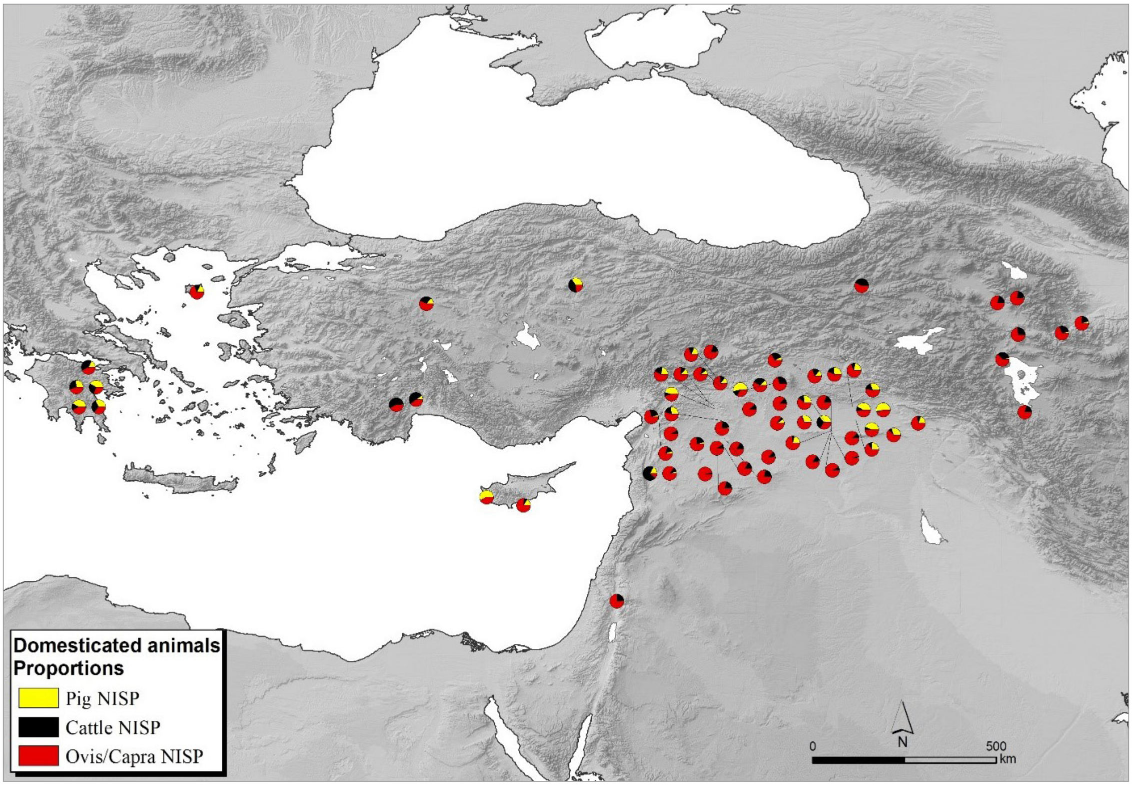


Figure 5. Map showing the proportional dominance (by NISP) of domestic faunal species at 4th-2nd millennium BCE sites of the GNE examined in this study. Refer to Fig. 2 for site names.

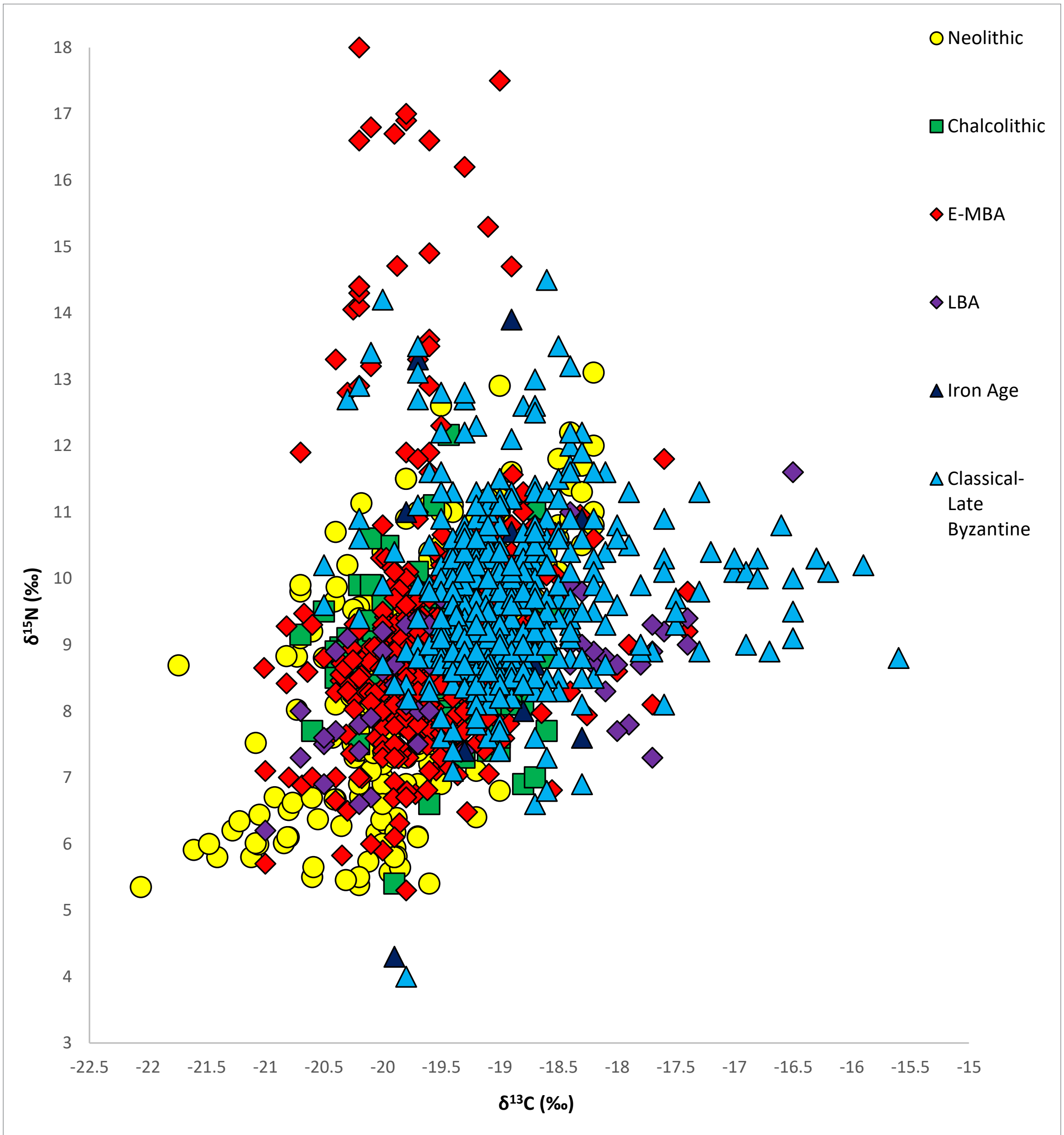


Figure 6. All human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values from the sites (Neolithic to Late Byzantine periods) examined in this study.

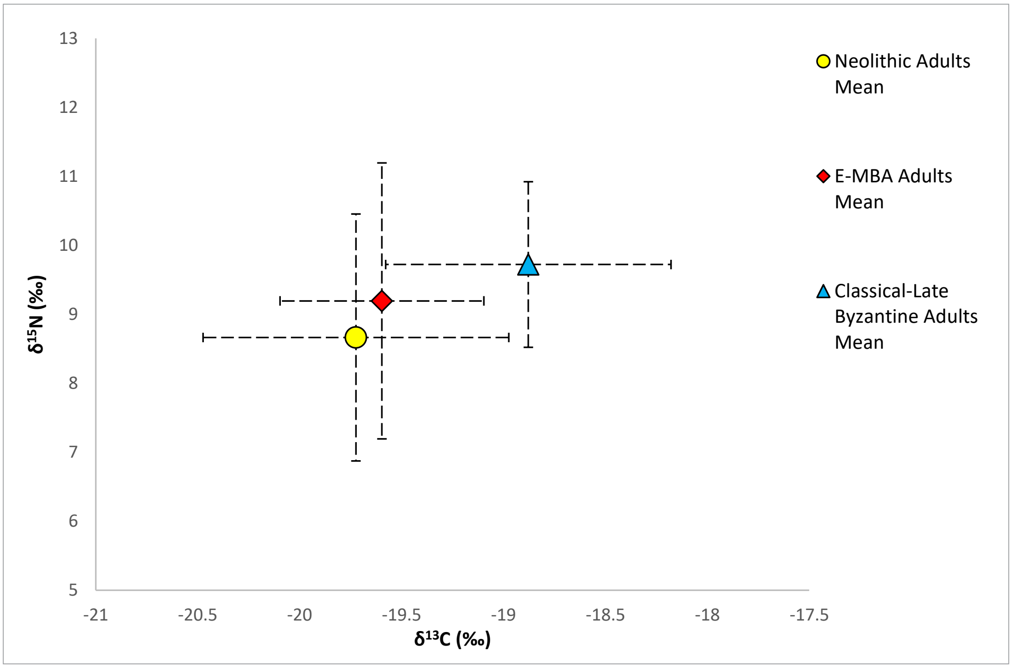


Figure 7. Mean adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values and standard deviations from the sites (Neolithic to Late Byzantine periods) examined in this study.

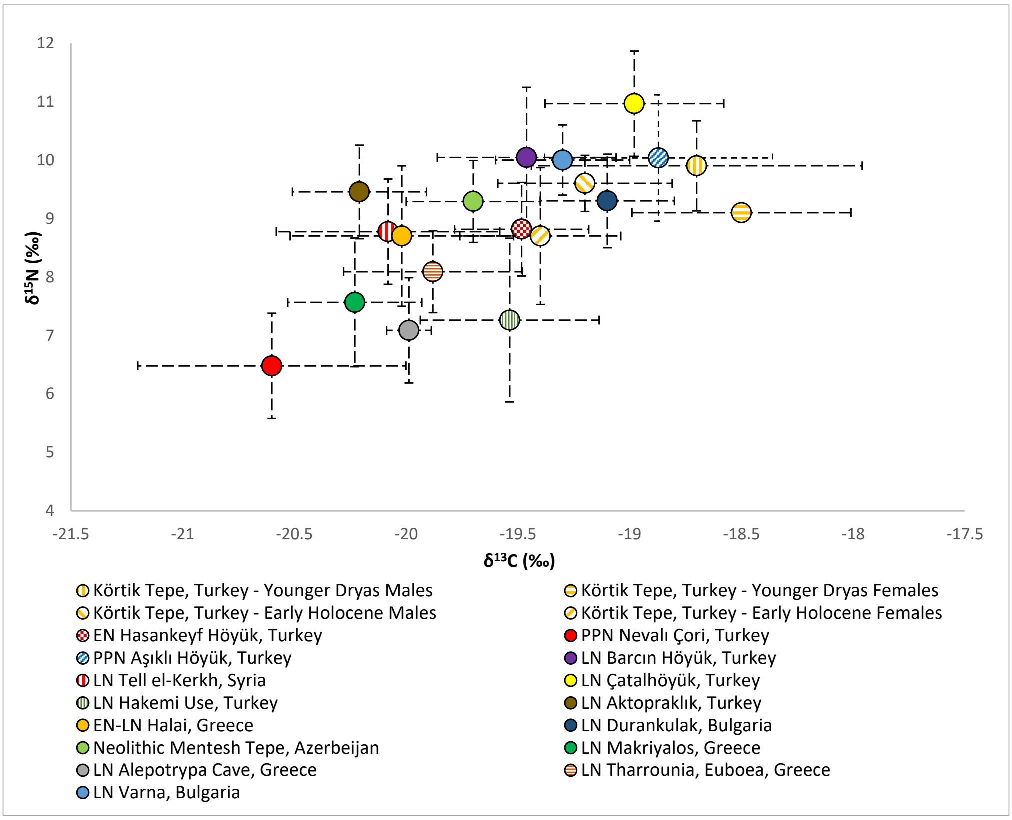


Figure 8. Mean adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values and standard deviations for the Neolithic sites examined in this study.

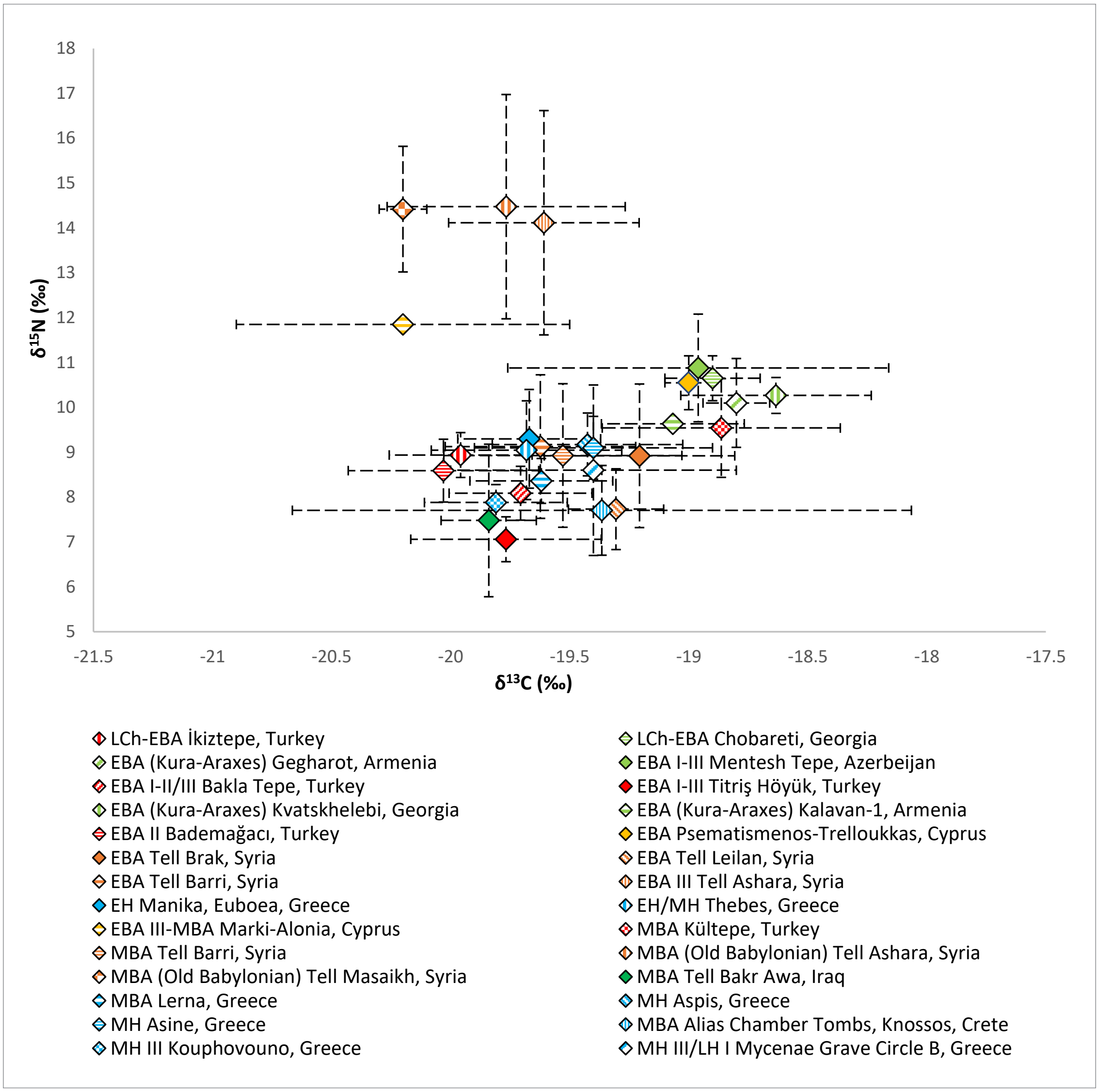


Figure 9. Mean adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values and standard deviations for the E-MBA sites examined in this study.

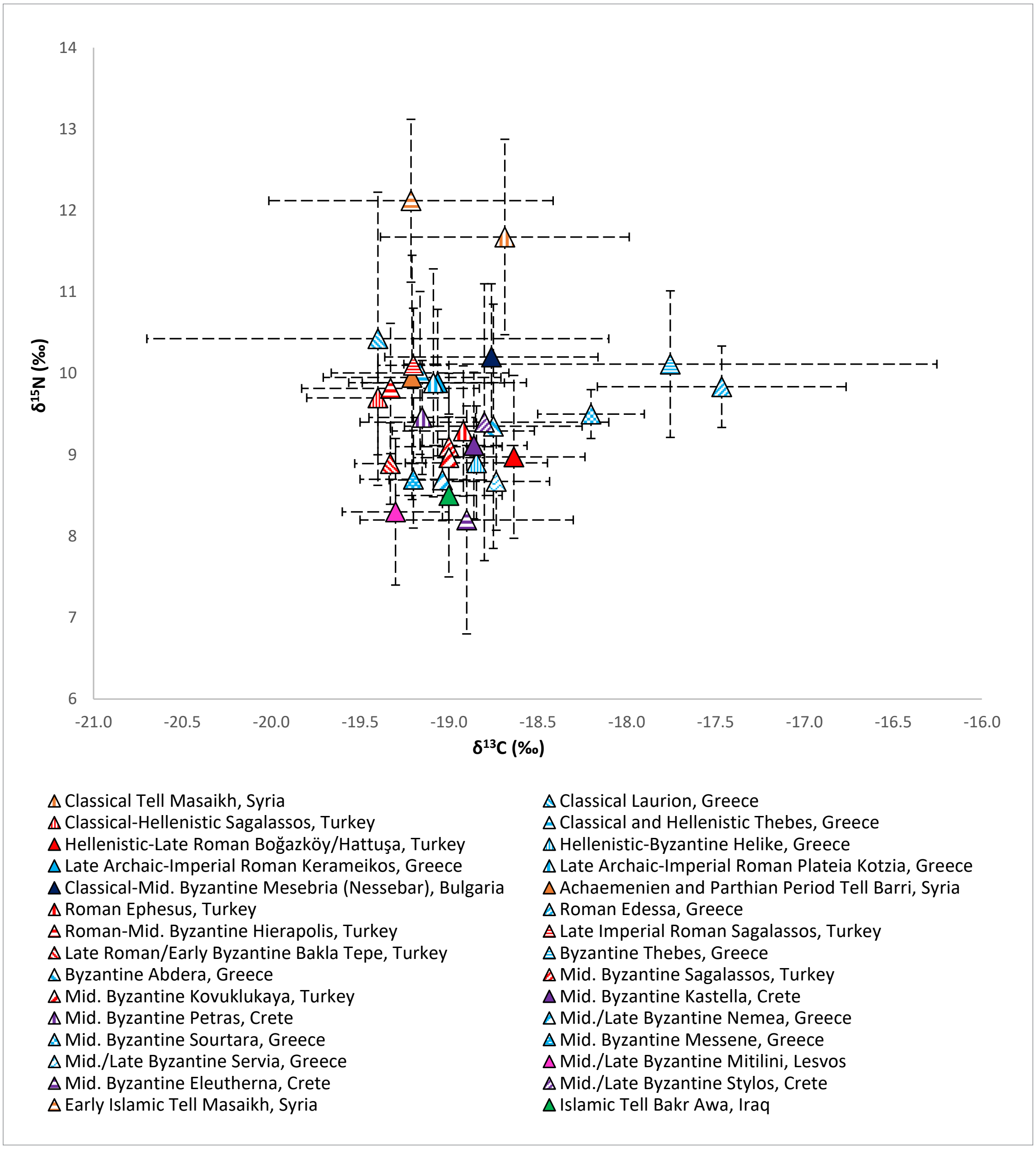


Figure 10. Mean adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values and standard deviations for the Classical to Late Byzantine period sites examined in this study.

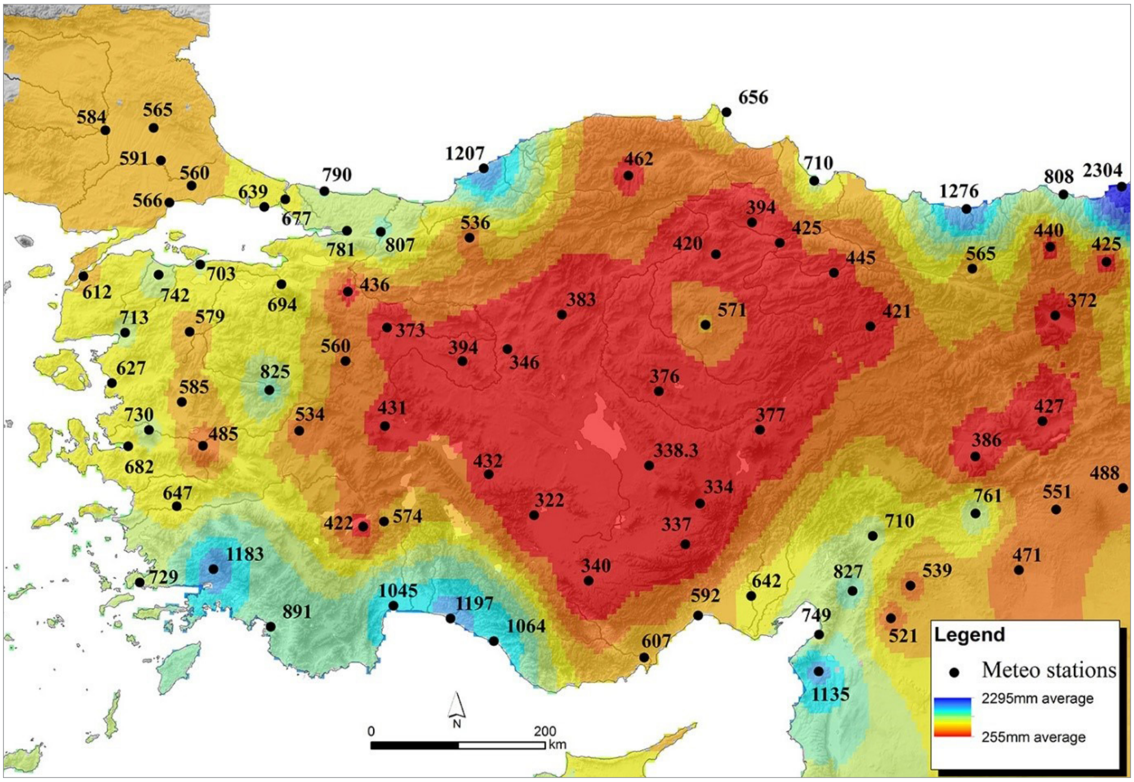
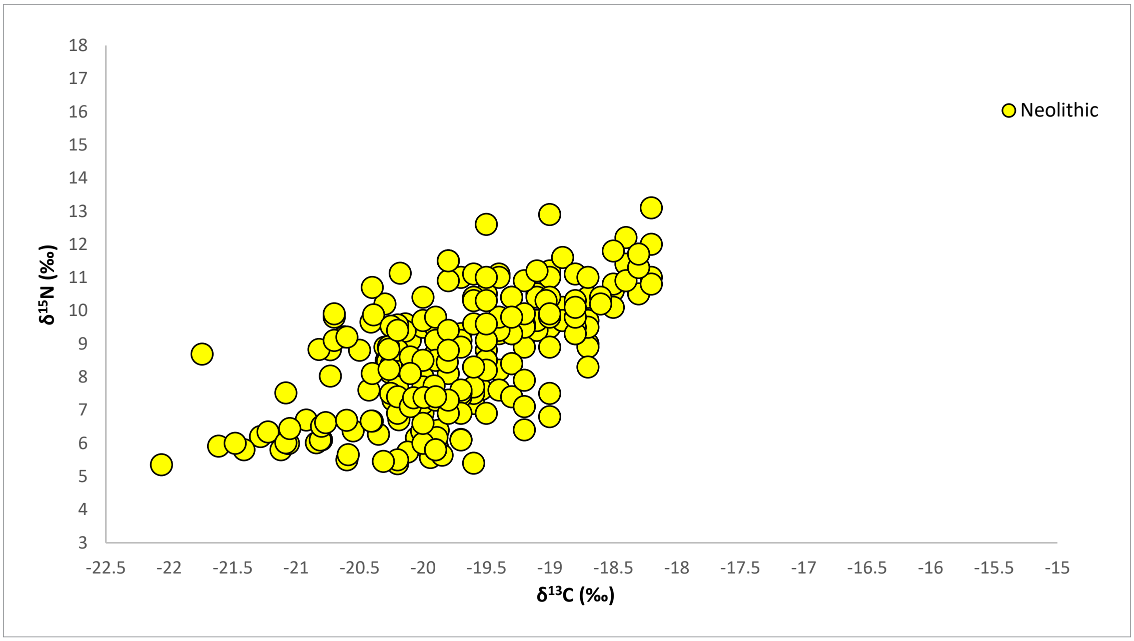
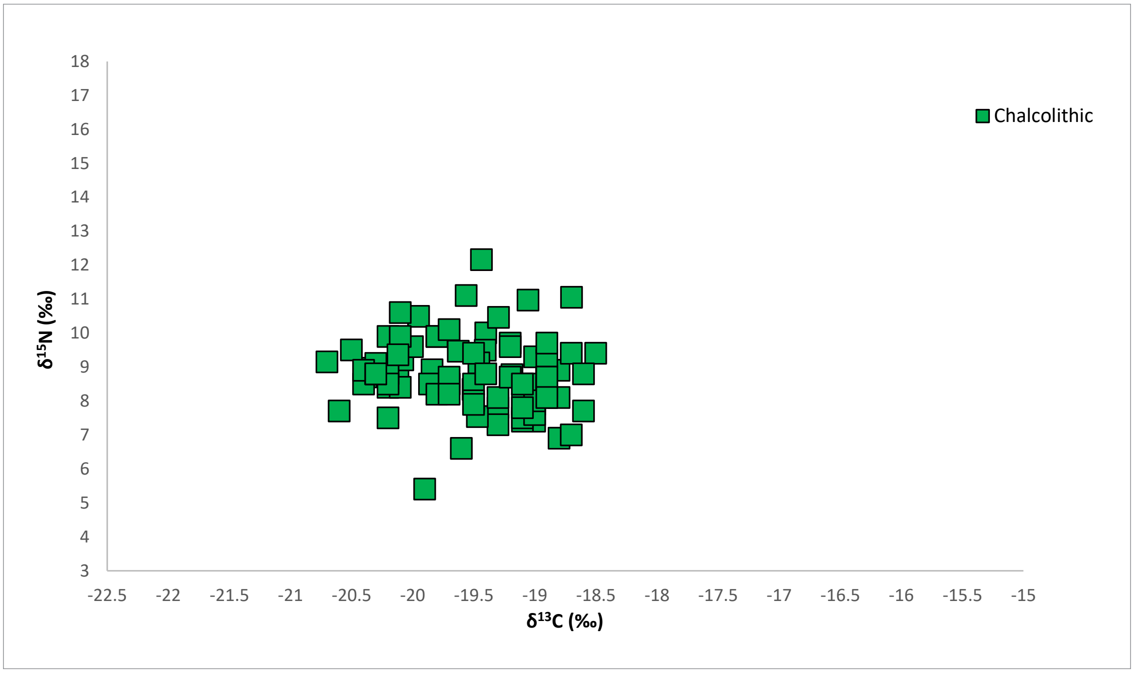


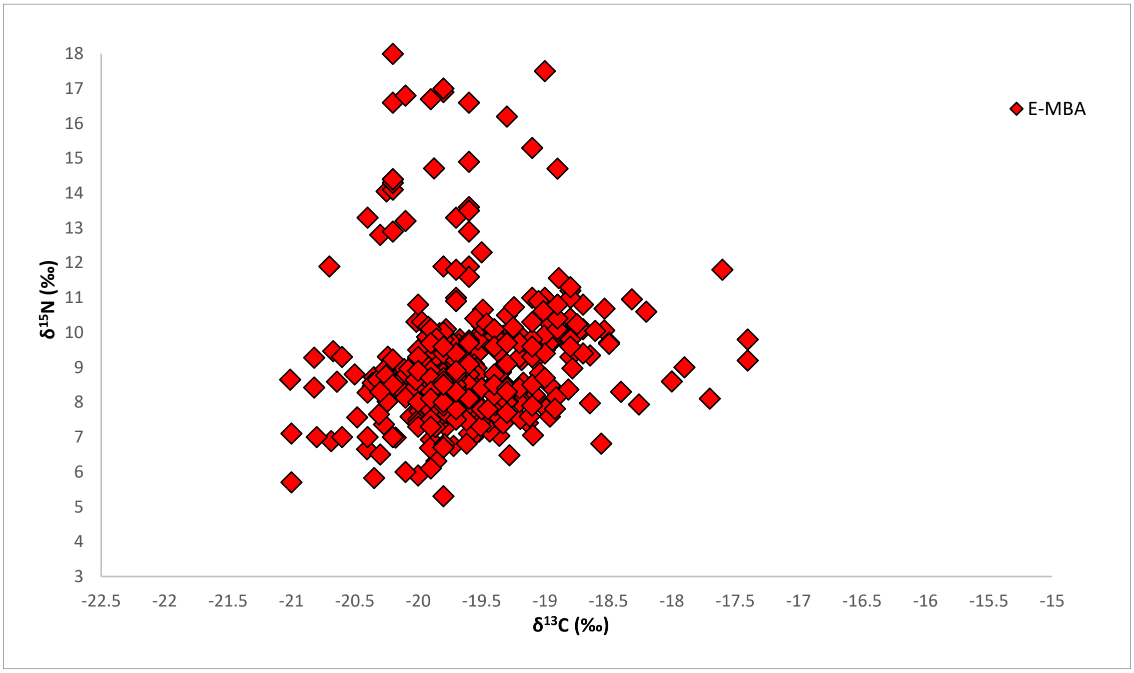
Figure 11. Map showing modern yearly average rainfall (in mm). Courtesy of the Konya Regional Archaeology Survey Project (KRASP) - http://www.krasp.net/en/results/modifying-landscapes/



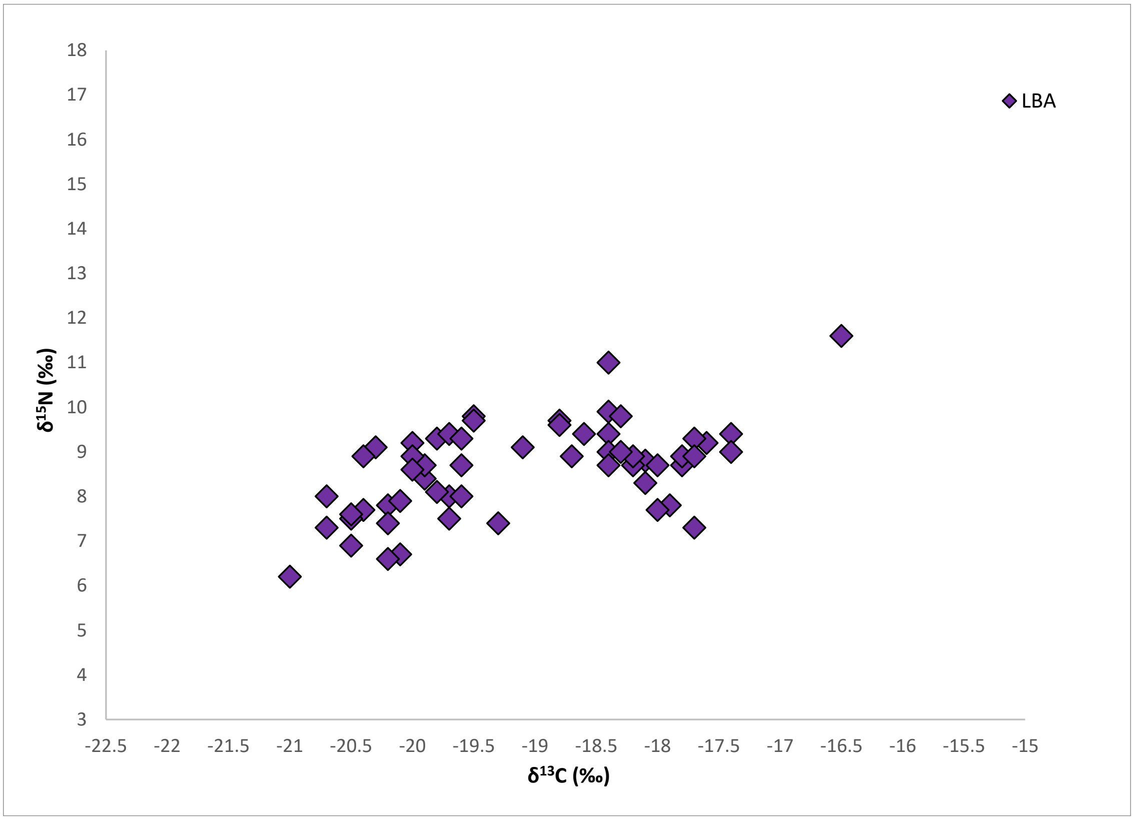
SI Figure 1. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Neolithic period.



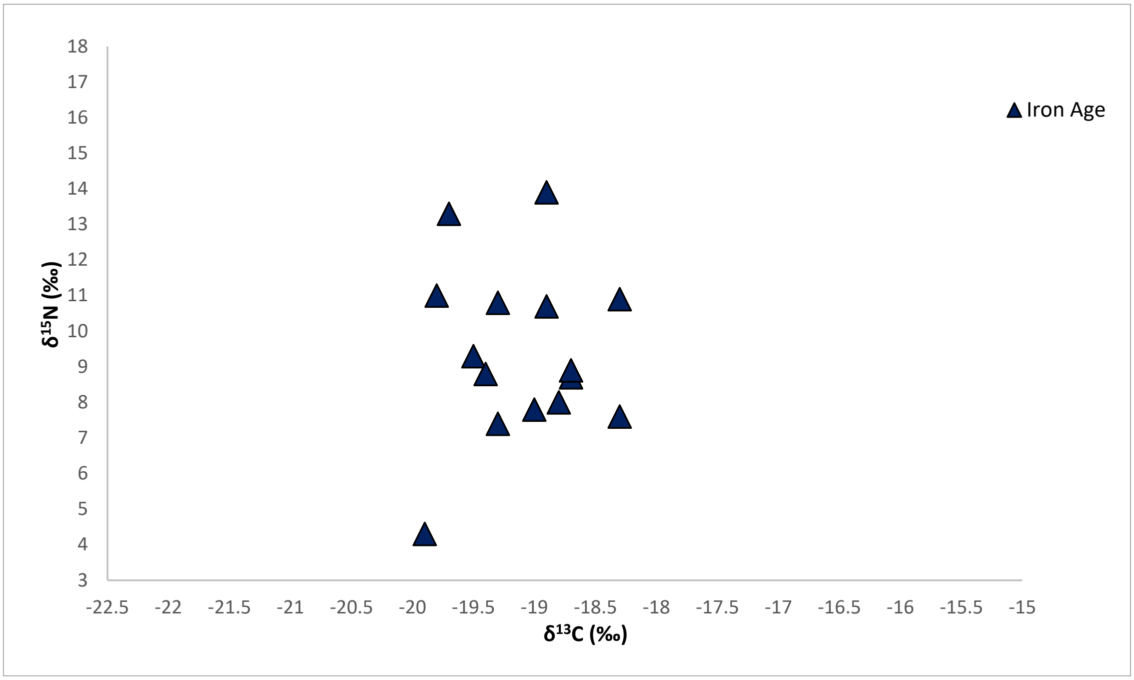
SI Figure 2. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Chalcolithic period.



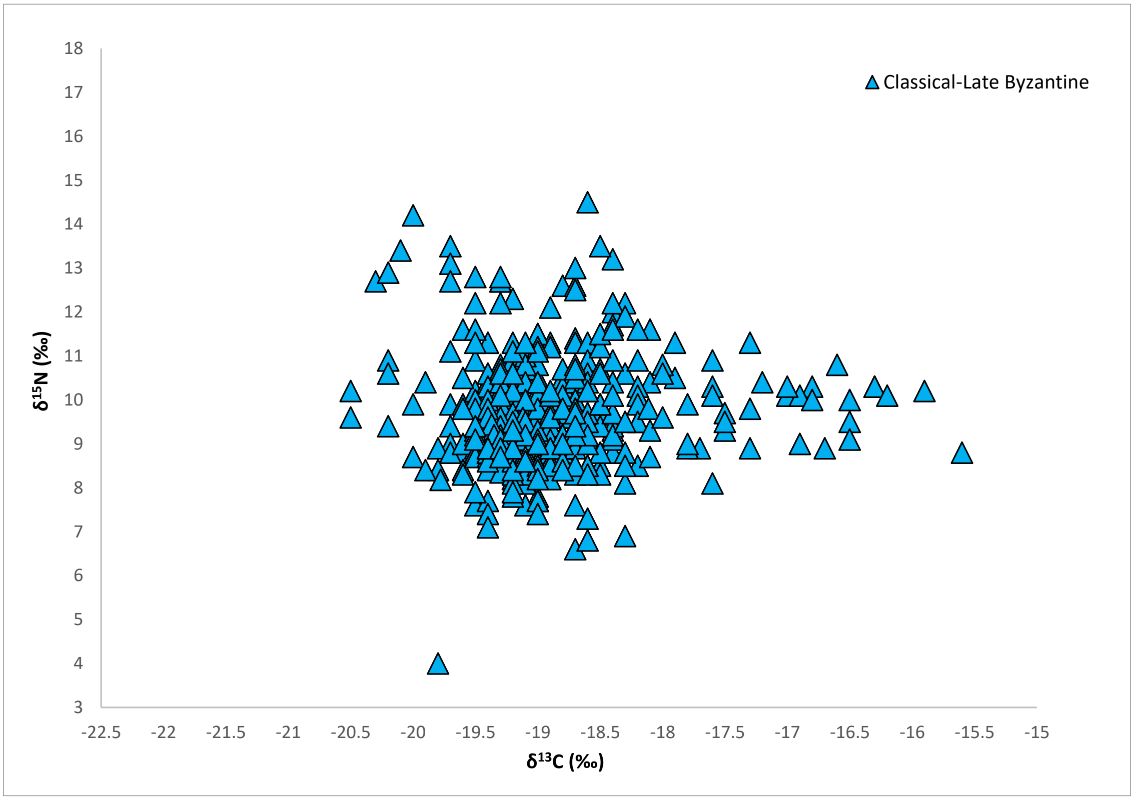
SI Figure 3. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Early-Middle Bronze Age period.



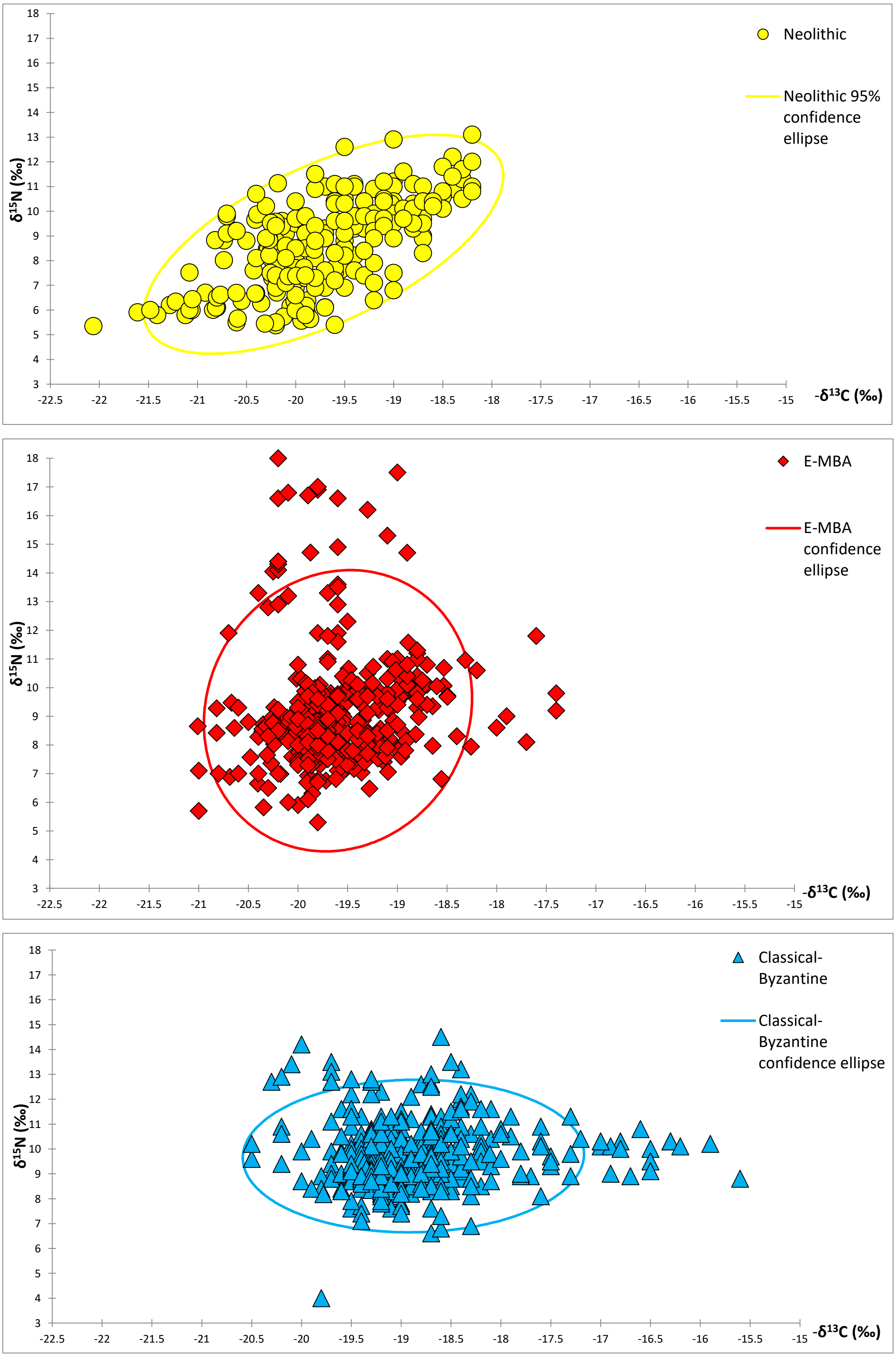
SI Figure 4. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Late Bronze Age period.



SI Figure 5. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Iron Age period.



SI Figure 6. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the Classical-Late Byzantine period.



SI Figure 7. Adult human bulk bone collagen $\delta^{13}C$ and $\delta^{15}N$ values for the grouped Neolithic, E-MBA, and Classical-Late Byzantine datasets with 95% confidence ellipses.

ARKEOLOJİ
BİLİMLERİ
DERGİSİ
TURKISH JOURNAL OF
ARCHAEOLOGICAL SCIENCES

Amaç ve Kapsam

Arkeoloji bir süredir geçmişin yorumlanmasında teknoloji ve doğa bilimleri, mühendislik ve bilgisayar teknolojileri ile yoğun iş birliği içinde yeni bir anlayışa evrilmektedir. Üniversiteler, ilgili kurum ya da enstitülerde yeni açılmakta olan "Arkeoloji Bilimleri" bölümleri ve programları, geleneksel anlayışı terk ederek değişen yeni bilim iklimine adapte olmaya çalışmaktadır. Bilimsel analizlerden elde edilen sonuçların arkeolojik bağlam ile birlikte ele alınması, arkeolojik materyallerin, yerleşmelerin ve çevrenin yorumlanmasında yeni bakış açıları doğurmaktadır.

Türkiye'de de doğa bilimleriyle iş birliği içindeki çalışmaların olduğu kazı ve araştırma projelerinin sayısı her geçen gün artmakta, yeni uzmanlar yetişmektedir. Bu nedenle Arkeoloji Bilimleri Dergisi, Türkiye'de arkeolojinin bu yeni ivmenin bir parçası olmasına ve arkeoloji içindeki arkeobotanik, arkeozooloji, alet teknolojileri, tarihlendirme, mikromorfoloji, biyoarkeoloji, jeokimyasal ve spektroskopik analizler, Coğrafi Bilgi Sistemleri, iklim ve çevre modellemeleri gibi uzmanlık alanlarının çeşitlenerek yaygınlaşmasına katkı sağlamayı amaçlamaktadır. Derginin ana çizgisi arkeolojik yorumlamaya katkı sağlayan yeni anlayışlara, disiplinlerarası yaklaşımlara, yeni metot ve kuram önerilerine, analiz sonuçlarına öncelik vermek olarak planlanmıştır.

Arkeoloji Bilimleri Dergisi uluslararası hakemli bir dergidir. Dergi, Ege Yayınları tarafından çevrimiçi olarak yayınlanmaktadır. Kazı raporlarına, tasnif ve tanıma dayalı çalışmalara, buluntu katalogları ve özgün olmayan derleme yazılarına öncelik verilmeyecektir.

www.arkeolojibilimleridergisi.org

ARKEOLOJİ BİLİMLERİ DERGİSİ
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Aims and Scope

Archaeology is being transformed by the integration of innovative methodologies and scientific analyses into archaeological research. With the establishment of new departments, institutes, and programs focusing on "Archaeological Sciences", archaeology has moved beyond the traditional approaches of the discipline. When placed within their archaeological context, studies can provide novel insights and new interpretive perspectives to the study of archaeological materials, settlements and landscapes.

In Turkey, the number of interdisciplinary excavation and research projects incorporating scientific techniques is on the rise. A growing number of researchers are being trained in a broad range of scientific fields including but not limited to archaeobotany, archaeozoology, tool technologies, dating methods, micromorphology, bioarchaeology, geochemical and spectroscopic analysis, Geographical Information Systems, and climate and environmental modeling. The Turkish Journal of Archaeological Sciences aims to situate Turkish archaeology within this new paradigm and to diversify and disseminate scientific research in archaeology. New methods, analytical techniques and interdisciplinary initiatives that contribute to archaeological interpretations and theoretical perspectives fall within the scope of the journal. The Turkish Journal of Archaeological Sciences is an international peer-reviewed journal. The journal is published online by Ege Yayınları in Turkey. Excavation reports and manuscripts focusing on the description, classification, and cataloging of finds do not fall within the scope of the journal.

www.arkeolojibilimleridergisi.org

ARKEOLOJİ BİLİMLERİ DERGİSİ
TURKISH JOURNAL OF ARCHAEOLOGICAL SCIENCES

Makale Gönderimi ve Yazım Kılavuzu

* *Please see below for English*

Makale Kabul Kriterleri

Makalelerin konu aldığı çalışmalar, Arkeoloji Bilimleri Dergisi'nin amaçları ve kapsamı ile uyumlu olmalıdır (bkz.: Amaç ve Kapsam).

Makaleler Türkçe veya İngilizce olarak yazılmalıdır. Makalelerin yayın diline çevirisi yazar(lar)ın sorumluluğundadır. Eğer yazar(lar) makale dilinde akıcı değilse, metin gönderilmeden önce anadili Türkçe ya da İngilizce olan kişilerce kontrol edilmelidir.

Her makaleye 200 kelimeyi aşmayacak uzunlukta Türkçe ve İngilizce yazılmış özet ve beş anahtar kelime eklenmelidir. Özete referans eklenmemelidir.

Yazarın Türkçesi veya İngilizcesi akıcı değilse, özet ve anahtar kelimelerin Türkçe veya İngilizce çevirisi editör kurulu tarafından üstlenilebilir.

Metin, figürler ve diğer dosyalar wetransfer veya e-posta yoluyla **archaeologicalsciences@gmail.com** adresine gönderilmelidir.

Makale Kontrol Listesi

Lütfen makalenizin aşağıdaki bilgileri içerdiğinden emin olun:

- Yazarlar (yazarların adı-soyadı ve iletişim bilgileri buradaki sırayla makale başlığının hemen altında paylaşılmalıdır)
- Çalışılan kurum (varsa)
- E.mail adresi
- ORCID ID

Makalenin içermesi gerekenler:

- Başlık
- Özet (Türkçe ve İngilizce)
- Anahtar kelimeler
- Metin
- Kaynakça
- Figürler
- Tablolar

Bilimsel Standartlar ve Etik

- Gönderilen yazılar başka bir yerde yayınlanmamış veya yayınlanmak üzere farklı bir yere gönderilmemiş olmalıdır.
- Makaleler özgün ve bilimsel standartlara uygun olmalıdır.

- Makalelerde cinsiyetçi, ırkçı veya kültürel ayrım yapmayan, kapsayıcı bir dil kullanmalıdır (“insanoğlu” yerine “insan”; “bilim adamı” yerine “bilim insanı” gibi).

Yazım Kuralları

Metin ve Başlıkların Yazımı

- Times New Roman karakterinde yazılan metin 12 punto büyüklüğünde, iki yana yaslı ve tek satır aralıklı yazılmalıdır. Makale word formatında gönderilmelidir.
- Yabancı ve eski dillerdeki kelimeler *italik* olmalıdır.
- Başlık ve alt başlıklar **bold** yazılmalıdır.
- Başlıklar numaralandırılmamalı, italik yapılmamalı, altları çizilmemelidir.
- Başlık ve alt başlıklarda yalnızca her kelimenin ilk harfi büyük olmalıdır.

Referans Yazımı

Ayrıca bkz.: Metin içi Atıflar ve Kaynakça Yazımı

- Referanslar metin içinde (Yazar yıl, sayfa numarası) şeklinde verilmelidir.
- Referanslar için dipnot ve son not kullanımından kaçınılmalıdır. Bir konuda not düşme amacıyla gerektiği taktirde dipnot tercih edilmelidir.
- Dipnotlar Times New Roman karakterinde, 10 punto büyüklüğünde, iki yana yaslı, tek satır aralıklı yazılmalı ve her sayfa sonuna süreklilik izleyecek şekilde eklenmelidir.

Şekiller ve Tablolar

- Makalenin altına şekiller ve tablolar için bir başlık listesi eklenmelidir. Görsellerde gerektiği takdirde kaynak belirtilmelidir. Her şekil ve tabloya metin içerisinde gönderme yapılmalıdır (Şekil 1 veya Tablo 1).
- Görseller Word dokümanının içerisine yerleştirilmemeli, jpg veya tiff formatında, ayrı olarak gönderilmelidir.
- Görüntü çözünürlüğü basılması istenen boyutta ve 300 dpi’nin üzerinde olmalıdır.
- Görseller Photoshop ve benzeri programlar ile müdahale edilmeden olabildiğince ham haliyle gönderilmelidir.
- Excel’de hazırlanmış tablolar ve grafikler var ise mutlaka bunların PDF ve Excel dokümanları gönderilmelidir.

Tarihlerin ve Sayıların Yazımı

- MÖ ve MS kısaltmalarını harflerin arasına nokta koymadan kullanınız (örn.: M.Ö. yerine MÖ).
- “Bin yıl” ya da “bin yıl” yerine “... binyıl” kullanınız (örn.: MÖ 9. binyıl).
- “Yüzyıl”, “yüz yıl” ya da “yy” yerine “yüzyıl” kullanınız (örn.: MÖ 7. yüzyıl).
- Beş veya daha fazla basamaklı tarihler için sondan sayarak üçlü gruplara ayırmak suretiyle sayı gruplarının arasına nokta koyunuz (örn.: MÖ 10.500)
- Dört veya daha az basamaklı tarihlerde nokta kullanmayınız (örn.: MÖ 8700).
- 0-10 arasındaki sayıları rakamla değil yazıyla yazınız (örn.: “8 kez yenilenmiş taban” yerine “sekiz kez yenilenmiş taban”).

Noktalama ve İşaret Kullanımı

- Ara cümleleri lütfen iki çizgi ile ayırınız (—). Çizgi öncesi ve sonrasında boşluk bırakmayınız.
- Sayfa numaraları, tarih ve yer aralıklarını lütfen tek çizgi (-) ile ayırınız: 1989-2006; İstanbul-Kütahya.

Kısaltmaların Yazımı

- Sık kullanılan bazı kısaltmalar için bkz.:

Yaklaşık:	yak.	Circa:	ca.
Bakınız:	bkz.	Kalibre:	kal.
Örneğin:	örn.	ve diğerleri:	vd.

Özel Fontlar

- Makalede özel bir font kullanıldıysa (Yunanca, Arapça, hiyeroglif vb.) bu font ve orijinal metnin PDF versiyonu da gönderilen dosyalar içerisine eklenmelidir.

Metin içi Atıflar ve Kaynakça Yazımı

- Her makale, metin içerisinde atıf yapılmış çalışmalardan oluşan ve "Kaynakça" olarak başlıklandırılan bir referans listesi içermelidir. Lütfen metin içerisinde bulunan her referansın kaynakçaya da eklendiğinden emin olun.
- Metin içerisindeki alıntılar doğrudan yapılabilir: '…Esin (1995)'in belirtmiş olduğu gibi' ya da parantez içerisinde verilebilir: 'analiz sonuçları gösteriyor ki … (Esin 1995).'
- Aynı parantez içerisindeki referanslar yayın yılına göre sıralanmalı ve ";" ile ayrılmalıdır: '… (Dinçol ve Kantman 1969; Esin 1995; Özbal vd. 2004).'
- Aynı yazarın farklı yıllara ait eserlerine yapılan atıflarda yazarın soyadı bir kere kullanılmalı ve eser yılları "," ile ayrılmalıdır: '... (Peterson 2002, 2010).'
- Aynı yazar(lar)ın aynı yıl içerisindeki birden fazla yayınına referans verileceği durumlarda yayın yılının yanına harfler 'a', 'b', 'c' gibi alfabetik olarak koyulmalıdır.
- Tek yazarlı kaynakları, aynı yazar adıyla başlayan çok yazarlı kaynaklardan önce yazınız.
- Aynı yazar adıyla başlayan fakat farklı eş yazarlara sahip kaynakları ikinci yazarın soyadına göre alfabetik sıralayınız.
- Aynı yazara ait birden fazla tek yazarlı kaynak olması durumunda kaynakları yıllara göre sıralayınız.
- Dergi makaleleri için doi bilgisi varsa kaynakçada mutlaka belirtiniz.

Aşağıda, farklı kaynakların metin içerisinde ve kaynakçada nasıl yazılacağına dair örnekler bulabilirsiniz.

Tek yazarlı dergi makaleleri, kitap içi bölümler ve kitaplar

Metin içerisinde:

Yazarın soyadı ve yayın yılı (Esin 1995).

Sayfa sayısı bilgisi verilecekse:

Yazarın soyadı ve yayın yılı, sayfa sayısı (Esin 1995, 140).

Dergi makalesi:

Bickle, P. 2020. Thinking Gender Differently: New Approaches to Identity Difference in the Central European Neolithic. *Cambridge Archaeological Journal* 30(2), 201-218. https://doi.org/10.1017/S0959774319000453

Kitap içi bölüm:

Esin, U. 1995. Aşıklı Höyük ve Radyo-Aktif Karbon Ölçümleri. A. Erkanal, H. Erkanal, H. Hüryılmaz, A. T. Ökse (Eds.), *İ. Metin Akyurt - Bahattin Devam Anı Kitabı. Eski Yakın Doğu Kültürleri Üzerine İncelemeler*, İstanbul: Arkeoloji ve Sanat Yayınları, 135-146.

Kitap:

Peterson, J. 2002. *Sexual Revolutions: Gender and Labor at the Dawn of Agriculture*. Walnut Creek, CA: AltaMira Press.

İki yazarlı dergi makaleleri, kitap içi bölümler ve kitaplar

Metin içerisinde:

Her iki yazarın soyadı ve yayın yılı (Dinçol ve Kantman 1969, 56).

Dergi makalesi:

Pearson, J., Meskell, L. 2015. Isotopes and Images: Fleshing out Bodies at Çatalhöyük. *Journal of Archaeological Method and Theory* 22, 461-482.
https://doi.org/10.1007/s10816-013-9184-5

Kitap içi bölüm:

Özkaya, V., San, O. 2007. Körtik Tepe: Bulgular Işığında Kültürel Doku Üzerine İlk Gözlemler. M. Özdoğan, N. Başgelen (Eds.), *Türkiye'de Neolitik Dönem. Yeni Kazılar, Yeni Bulgular*, İstanbul: Arkeoloji ve Sanat Yayınları, 21-36.

Kitap:

Dinçol, A. M., Kantman, S. 1969. *Analitik Arkeoloji, Denemeler*. Anadolu Araştırmaları III, Özel sayı, İstanbul: Edebiyat Fakültesi Basımevi.

Üç ve daha çok yazarlı dergi makaleleri ve kitap içi bölümler

Metin içerisinde:

İlk yazarın soyadı, "vd." ve yayın yılı (Özbal vd. 2004).

Dergi makalesi:

Özbal, R., Gerritsen, F., Diebold, B., Healey, E., Aydın, N., Loyet, M., Nardulli, F., Reese, D., Ekstrom, H., Sholts, S., Mekel-Bobrov, N., Lahn, B. 2004. Tell Kurdu Excavations 2001. *Anatolica* 30, 37-107.

Kitap içi bölüm:

Pearson, J., Meskell, L., Nakamura, C., Larsen, C. S. 2015. Reconciling the Body: Signifying Flesh, Maturity, and Age at Çatalhöyük. I. Hodder, A. Marciniak (Eds.), *Assembling Çatalhöyük*, Leeds: Maney Publishing, 75-86.

Editörlü kitaplar

Metin içerisinde:

Yazar(lar)ın soyadı ve yayın yılı (Akkermans ve Schwartz 2003).

Akkermans, P. M. M. G., Schwartz, G. M. 2003. (Eds.) *The Archaeology of Syria. From Complex Hunter-Gatherers to Early Urban Societies (c. 16.000-300 BC)*. Cambridge: Cambridge University Press.

Web kaynağı:

Soyad, Ad. Web Sayfasının Başlığı. Web Sitesinin Adı. Yayınlayan kurum (varsa), yayın tarihi. Erişim tarihi. URL.

ARKEOLOJİ BİLİMLERİ DERGİSİ
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Submission and Style Guideline

Submission Criteria for Articles

The content of the manuscripts should meet the aims and scope of the Turkish Journal of Archaeological Sciences (cf. Aims and Scope).

Manuscripts may be written in Turkish or English. The translation of articles into English is the responsibility of the author(s). If the author(s) are not fluent in the language in which the article is written, they must ensure that the text is reviewed, ideally by a native speaker, prior to submission.

Each manuscript should include a Turkish and an English abstract of up to 200 words and five keywords in both Turkish and English. Citations should not be included in the abstract.

If the author(s) are not fluent in the language of the manuscript, a translation of the abstract and the keywords may be provided by the editorial board.

Manuscripts, figures, and other files should be sent via wetransfer or e-mail to **archaeologicalsciences@gmail.com**

Submission Checklist

Each article must contain the following:

- Authors (please provide the name-last name and contact details of each author under the main title of the manuscript)
- Affiliation (where applicable)
- E-mail address
- ORCID ID

The manuscript should contain:

- Title
- Abstract (in English and Turkish)
- Keywords
- Text
- References
- Figures (when applicable)
- Tables (when applicable)

Scientific Standards and Ethics

- Submitted manuscripts should include original research that has not been previously published or submitted for publication elsewhere.
- The manuscripts should meet scientific standards.
- Manuscripts should use inclusive language that is free from bias based on sex, race or ethnicity, etc. (e.g., “he or she” or “his/her/their” instead of “he” or “his”) and avoid terms that imply stereotypes (e.g., “humankind” instead of “mankind”).

Style Guide

Manuscript Formatting

- Manuscripts should be written in Times New Roman 12-point font, justified and single-spaced. Please submit the manuscript as a word document.
- Words in foreign and ancient languages should be *italicized*.
- Titles and subtitles should appear in **bold**.
- Titles and subtitles should not be numbered, italicized, or underlined.
- Only the first letter of each word in titles and subtitles should be capitalized.

References

Cf.: In-Text Citations and References

- In-text citations should appear inside parenthesis (Author year, page number).
- Footnotes and endnotes should not be used for references. Comments should be included in footnotes rather than endnotes.
- The footnotes should be written in Times New Roman 10-point font, justified and single-spaced, and should be continuous at the bottom of each page.

Figures and Tables

- Please provide a caption list for figures and tables following the references. Provide credits where applicable. Each figure and table should be referenced in the text (Figure 1, or Table 1), but please do not include figures in the text document.
- Each figure should be submitted separately as a jpg or tiff file.
- Images should be submitted in the dimensions in which they should appear in the published text and their resolution must be over 300 dpi.
- Please avoid editing the figures in Photoshop or similar programs but send the raw version of the figures if possible.
- Tables and graphs prepared in Excel should be sent as both PDF and Excel documents.

Dates and Numbers

- Please use BCE/CE and please avoid using dots without dots (i.e., BCE instead of BC or B.C.).
- Please use a dot for numbers and dates with 5 or more digits (i.e., 10.500 BCE).
- Please avoid using dots for numbers and dates with 4 or less digits (i.e., 8700 BCE).
- Please spell out whole numbers from 0 to 10 (e.g., "the floor was renewed eight times" instead of "the floor was renewed 8 times").

Punctuation

- Please prefer em dashes (—) for parenthetical sentences: "Children were buried with various items, the adolescents—individuals between the ages of 12-19—had the most variety in terms of grave goods."
- Please prefer an en dash (-) between page numbers, years, and places: 1989-2006; İstanbul-Kütahya.

Abbreviations

- Commonly used abbreviations:

Approximately:	approx.	Figure:	Fig.
Confer:	cf.	*Id est:*	i.e.,
Circa:	ca.	*Exempli gratia:*	e.g.,
Calibrated:	cal.		

Special Fonts

- If a special font must be used in the text (e.g., Greek or Arabic alphabet or hieroglyphs), the text in the special font and the original manuscript should be sent in separate PDF files.

In-Text Citations and References

- Each article should contain a list of references in a section titled "References" at the end of the text. Please ensure that all papers cited in the text are listed in the bibliography.
- Citations in the text may be made directly, e.g., 'as shown by Esin (1995) ...' or in parenthesis, e.g., 'research suggests ... (Esin 1995)'.
- References within the same parenthesis should be arranged chronologically and separated with a ";", e.g., '... (Dinçol and Kantman 1969; Esin 1995; Özbal et al. 2004).'
- In references to the studies by the same author from different years, please use the last name of the author once, followed by the years of the cited studies, each separated by a ",", e.g., '... (Peterson 2002, 2010).
- More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c' placed after the year of publication.
- When dealing with multiple papers from the same author, single authored ones should be written before the studies with multiple authors.
- When dealing with papers where the first author is the same, followed by different second (or third, and so on) authors, the papers should be listed alphabetically based on the last name of the second author.
- When dealing with multiple single-authored papers of the same author, the papers should be listed chronologically.
- Please provide the doi numbers of journal articles.

Below, you may find examples for in-text citations and references.

Single-authored journal articles, book chapters, and books

In-text:

Last name and publication year (Esin 1995).

If the page number is indicated:

Last name and publication year, page number (Esin 1995, 140).

Journal article:

Bickle, P. 2020. Thinking Gender Differently: New Approaches to Identity Difference in the Central European Neolithic. *Cambridge Archaeological Journal* 30(2), 201-218. https://doi.org/10.1017/S0959774319000453

Book chapter:

Esin, U. 1995. Aşıklı Höyük ve Radyo-Aktif Karbon Ölçümleri. A. Erkanal, H. Erkanal, H. Hüryılmaz, A. T. Ökse (Eds.), *İ. Metin Akyurt - Bahattin Devam Anı Kitabı. Eski Yakın Doğu Kültürleri Üzerine İncelemeler*, İstanbul: Arkeoloji ve Sanat Yayınları, 135-146.

Book:

Peterson, J. 2002. Sexual Revolutions: *Gender and Labor at the Dawn of Agriculture*. Walnut Creek, CA: AltaMira Press.

Journal articles, book chapters, and books with two authors

In-text:

Last names of both authors and publication year (Dinçol and Kantman 1969, 56).

Journal article:

Pearson, J., Meskell, L. 2015. Isotopes and Images: Fleshing out Bodies at Çatalhöyük. *Journal of Archaeological Method and Theory* 22, 461-482.
https://doi.org/10.1007/s10816-013-9184-5

Book chapter:

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