THE IMPACT OF THE 4.2 KA BP EVENT IN WESTERN ANATOLIA: AN EVALUATION THROUGH PALAEOENVIRONMENTAL AND ARCHAEOLOGICAL DATA

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ÇAĞLAYAN BAL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF SETTLEMENT ARCHAEOLOGY

JULY 2019

Approval of the Graduate School of Social Sciences

Prof. Dr. Tülin Gençöz
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Prof. Dr. D. Burcu Erciyas
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Assoc. Prof. Dr. Evangelia Pişkin
Supervisor

Examining Committee Members

Prof. Dr. D. Burcu Erciyas (METU, SA) ____________________

Assoc. Prof. Dr. Evangelia Pişkin (METU, SA) ____________________

Asst. Prof. Dr. H. Levent Keskin (Ankara Üni., PRT) ____________________

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Çağlayan Bal

Signature :

ABSTRACT

THE IMPACT OF THE 4.2 KA BP EVENT IN WESTERN ANATOLIA: AN EVALUATION THROUGH PALAEOENVIRONMENTAL AND ARCHAEOLOGICAL DATA

Bal, Çağlayan
M.Sc., Department of Settlement Archaeology
Supervisor: Assoc. Prof. Dr. Evangelia Pişkin

July 2019, 208 pages

Palaeoenvironmental and archaeological research in the eastern Mediterranean and adjacent regions asserts a correlation between the 4.2 ka BP event, an abrupt climatic change (ca. 2200-1900 BC), and societal changes at the end of the 3rd millennium BC. It has been hypothesized that the drought as a result of the event led to social disturbance, conflicts, migrations and in some cases, societal collapses following a breakdown in agriculture and animal husbandry. Similarly, palaeoenvironmental studies provide evidence for the 4.2 ka BP event and its impacts in Anatolia including western Anatolia. From ca. 2500 BC onwards, the Anatolian peninsula witnessed the appearance of regional centres with monumental buildings and strong fortifications, the rise of elites and increasing social complexity, the development of a long-distance exchange network and an advanced metallurgical industry. Towards the end of the 3rd millennium BC, however, the societies lost their sophisticated characteristics and experienced a crisis period that is testified by the large number of settlements that were destroyed by fire events and were abandoned, in particular in western Anatolia. This thesis aims at understanding if there is acausal relationship between the 4.2 ka BP event and major changes in social, economic and political structure of western Anatolian societies at the end of the 3rd millennium BC through a synthetic analysis of palaeoenvironmental, bioarchaeological and archaeological data. It provides a multifaceted perspective on the suggested relationship by focusing on changes in agricultural and animal husbandry practices and changes in regional settlement patterns.

Keywords: The 4.2 ka BP Event, Palaeoenvironment, Bioarchaeology, Western Anatolia, Early Bronze Age

ÖZ

4,2 KA İKLİM OLAYININ BATI ANADOLU'DAKİ ETKİSİ:
PALEOÇEVRESEL VE ARKEOLOJİK BİR DEĞERLENDİRME

Bal, Çağlayan
Yüksek Lisans, Yerleşim Arkeolojisi Bölümü
Tez Yöneticisi: Doç. Dr. Evangelia Pişkin

Temmuz 2019, 208 sayfa

Doğu Akdeniz ve komşu bölgelerde yapılan paleoçevresel ve arkeolojik çalışmalar, 4,2 ka ani iklim değişikliği (yaklaşık MÖ 2200-1900) ve MÖ 3. binyılın sonunda gerçekleşen toplumsal değişimler arasında bir ilişki olduğunu öne sürmektedir. Bu iklim olayının bir sonucu olan kuraklığın, tarım ve hayvancılık faaliyetlerini olumsuz yönde etkileyerek toplumsal huzursuzluk, çatışmalar, göçler ve bazı durumlarda toplumsal çöküşlere neden olduğu ileri sürülmektedir. Benzer şekilde, paleoçevresel çalışmalar, Batı Anadolu da dahil olmak üzere Anadolu'da 4,2 ka iklim olayı ve etkileri için kanıt sunmaktadır. Batı ve Orta Anadolu, yaklaşık MÖ 2500'den itibaren anıtsal yapılara ve savunma duvarına sahip olan bölgesel merkezlerin ve artan sosyal karmaşıklık ile birlikte seçkinlerin ortaya çıkışına ve bir uzun mesafe ticaret ağının ve ileri düzey bir metalürji endüstrisinin gelişimine tanıklık etmiştir. Fakat, MÖ 3. binyılın sonlarına doğru, bölgede yaşayan toplumlar özellikle Batı Anadolu'da bu gelişmiş özelliklerini kaybetmiş ve yangınlarla tahrip olmuş ve terk edilmiş çok sayıda yerleşimin işaret ettiği bir kriz dönemi yaşamışlardır. Bu tez, paleoçevresel, biyoarkeolojik ve arkeolojik verilerin bütüncül bir değerlendirmesiyle 4,2 ka iklim olayı ve MÖ 3. binyılın sonunda Batı Anadolu toplumlarının yaşadığı sosyal, ekonomik ve siyasal değişimlerin arasında bir neden-sonuç ilişkisi olup olmadığını anlamayı amaçlamaktadır. Bu çalışma, tarım ve hayvancılık faaliyetlerindeki ve bölgesel yerleşim düzenlerindeki değişimlere odaklanarak konuya ilişkin çok yönlü bir bakış açısı sağlamaktadır.

Anahtar Kelimeler: 4,2 ka İklim Olayı, Paleoçevre, Biyoarkeoloji, Batı Anadolu, Erken Tunç Çağı

To My Parents

ACKNOWLEDGEMENTS

I would like to primarily thank my thesis supervisor Assoc. Prof. Dr. Evangelia Pişkin for her endless support and encouragement throughout my thesis study. Her intelligence, knowledge and patience were invaluable for me to develop ideas and to evaluate my study from other perspectives and as well as, to overcome challenges and to never give up. I owe her much. She is more than a supervisor to me.

I am grateful to the members of the thesis jury, Prof. Dr. Burcu Erciyas and Asst. Prof. Dr. Levent Keskin for their valuable comments and contributions to my study.

I would also like to express my special thanks to Dr. Michele Massa not only for his suggestions and comments on my work but also for his friendship, endless support and encouragement.

Special thanks to my friends Iraz Alpay, Dilşad Kolenoğlu, Merve Görgüner, Tülin Kaya and many others for their friendship, precious support and sharing this long journey together. All you have done means much more to me than you could ever think.

Finally, but most importantly, I would like to express my heartfelt gratitude to my parents, Suzan Bal and Mehmet Ali Bal, and my sister, Melike Bal. Thank you for letting me pursue my dream and having always being there for me. Without your love, support and patience, this thesis would have never been accomplished.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The relationship between human societies and the climate has played a crucial role in the human history. In particular, several major climatic changes throughout the Holocene (ca. 11500 BP-today) affected human societies and their developments significantly. Under changing climatic conditions, societies have sought to adapt to their surrounding environment to sustain their lives.

The 4.2 ka BP event is one of those climatic changes that has been suggested as the reason behind the major transformations in past societies at the end of the 3rd millennium BC in the eastern Mediterranean and adjacent regions. Synthesized palaeoenvironmental and archaeological studies have suggested a causal relationship between the 4.2 ka BP event, ca. 2200-1900 BC, and major societal changes at the end of the 3rd millennium BC. Moreover, it has been hypothesized that aridity as a consequence of the particular climatic change affected first the economic structure of the societies and then, led to social and political conflicts, migration of populations and finally, a societal collapse in the eastern Mediterranean (Weiss, 1993; deMenocal, 2001).

This thesis aims at investigating if there is a causal relationship between the 4.2 ka BP climatic change and changes in social, economic and political structure of Early Bronze Age societies at the end of the 3rd millennium BC in western Anatolia. It will focus on the impacts of the 4.2 ka BP event and major societal changes as a response to the event. The subject will be examined by synthesizing different strands of analysis on palaeoenvironmental data, bioarchaeological data from several sites and archaeological excavations and surveys in western Anatolia. Through the integrated examination of the already published data, this study will contribute to a multifaceted understanding of different human responses to the aridity in western Anatolia.

CHAPTER 2

PALAEOENVIRONMENTAL AND ARCHAEOLOGICAL EVIDENCE FOR THE 4.2 KA BP EVENT IN THE EASTERN MEDITERRANEAN AND ADJACENT REGIONS

2.1. The Climate in the Eastern Mediterranean and Adjacent Regions throughout the Holocene and the 4.2 ka BP Event

The Holocene (11,500 calBP to present, Mayewski et al., 2004) characterized by overall warmer climatic conditions than the preceding Upper Palaeolithic (Robinson et al., 2006) has supported and sustained the development of human societies. The period itself witnessed the first Neolithic settlements, the emergence of complex societies and, finally, modern society that we all are a part of.

Holocene climate in the eastern Mediterranean has been relatively well studied, and the analysis of a diverse range of palaeoclimatic proxies shows that its instability and dynamicity has had considerable effects on humans and environment. The first half of the Holocene (~9.7-7 ka calBP) is characterized by wet climatic conditions with elevated rainfall and high lake levels (Robinson et al., 2006) and in the second half, the climate shifted to drier conditions, reduced rainfall and lower lake levels around 6500 BP (Roberts et al., 2008), becoming gradually drier since then (Finné et al., 2011).

Besides the general drying trend of the climate, several rapid climatic changes (hereafter RCCs) occurred at 9000-8000, 6000-5000, 4200-3800, 3500-2500, 1200-1000 and 600 calBP throughout the Holocene (Mayewski et al., 2004). RCCs affected not only the climatic conditions but also human societies significantly.

Development of human societies has considerably depended on environmental and climatic conditions. Thus, these RCCs seem to be closely related to some significant turning points in the history of humanity: the 8.2 ka BP event (9000-8000 calBP) with the spread of Neolithic to the Aegean and southeast Europe (Weninger et al., 2014), the 5.2 ka BP event (6000-5000 calBP) with the abrupt collapse of Late Uruk colonies in Mesopotamia (Staubwasser & Weiss, 2006), the 3.2 ka BP event (3500-2500 calBP) with the Late Bronze Age Collapse in the Near East (Kaniewski et al., 2013) and similarly, the 4.2 ka BP event (4200-3800 calBP) with the collapse of the Akkadian Empire in Mesopotamia (Weiss et al., 1993; deMenocal, 2001).

The 4.2 ka BP event, occurred at 4200-3800 calBP, is an abrupt climatic change that led to a widespread drought across the northern hemisphere, particularly in mid- and low latitudes (e.g., China (Huang et al., 2011), India (Berkelhammer et al., 2012), Mesopotamia (Weiss et al., 1993), northern Italy (Drysdale et al., 2006) and Tanzania (Thompson et al., 2002)). Although it was a less spread RCC in comparison to others, it had relatively dramatic effects on human societies at the end of the 3rd millennium BC and therefore, it makes it more interesting to study.

The abrupt climatic change is characterized by drought conditions and reduced rainfall in the eastern Mediterranean and adjacent regions (Roberts et al., 2011) where the climate is mainly determined by the North Atlantic Oscillation (NAO), bringing precipitation in winter and the Indian Monsoon in summer (Lionello et al., 2016). Factors behind the 4.2 ka BP RCC are still not known but it disturbed apparently the NAO and possibly the Indian Monsoon, therefore causing a decrease in the seasonal precipitations that deeply affected rainfed agricultural practices in the Eastern Mediterranean (Staubwasser & Weiss, 2006).

The impact and the timing of the event varied from region to region depending on their resilience to changing environmental conditions. Therefore, semi-arid and continental regions such as Upper Mesopotamia, inland Levant and central Anatolia, quite sensitive to reduced precipitation and with a modern mean yearly rainfall of 200-350 mm, were affected first at 2250-2000 BC (~4.2 ka calBP). Then, more humid areas such as coastal Levant and the Taurus Mountains experienced impacts of the drought at 2050-1900 BC (4.0-3.9 ka calBP). Effects of the event were not easily reversed in dry regions that made them, therefore, marginal for plant growth (Roberts et al., 2011).

2.2. Palaeoenvironmental Evidence for the 4.2 ka BP Event in the Eastern Mediterranean and Adjacent Regions

The 4.2 ka BP event has been evidenced through various palaeoclimatic records in Northern Mesopotamia, the Levant and the Red Sea, the Persian Gulf, the Black Sea, the Caspian Sea, the Iranian Plateau, Greece and the Balkans. The sites with evidence, mentioned in the text, are presented in Figure 1 and a summary of important information regarding the event on the sites is presented in Table 17 in Appendix A.

2.2.1. Northern Mesopotamia, the Levant and the Red Sea

The settlement of Tell Leilan (northern Syria) presents evidence for a considerable increase in aridity around 2200 BC. According to the results of micromorphological and physicochemical analysis of soil-stratigraphic units, the environmental degradation started around 2600 BC. Aridity, with reduced rainfall and increase of dust veil frequency, peaked at around 2200 BC and lasted until ca. 1900 BC. In addition, soil-stratigraphic data from Abu Hgeira 2 and Abu Hafur, located in the close vicinity of Tell Leilan, provides similar supporting evidence (Weiss et al., 1993).

A core extracted from the alluvial deposits of the Rumailiah River (Jeblah, Syria) was analysed in order to reconstruct palaeovegetation from ca. 2150 to 550 BC in coastal Syria. The results show that the area had arid vegetation possibly due to lower winter precipitations within the time period between 4.2-3.9 calBP (Kaniewski et al., 2008).

Figure 1. Map showing sites with palaeoenvironmental evidence for the 4.2 ka BP event in the eastern Mediterranean and adjacent regions that are discussed in the text. 1. Tell Leilan, 2. Ebla, 3. Rumailiah River, 4. Qatna, 5. Jeita Cave, 6. Soreq Cave, 7. Dead Sea, 8. Sedom Cave, 9. Shaban Deep, 10. Awafi, 11. Gulf of Oman, 12. Southwestern Crimea, 13. Caspian Sea, 14. Lake Zeribar, 15. Lake Mirabad, 16. Qazvin Plain, 17. Levantine Basin, 18. Southern Aegean, 19. Northwestern Aegean, 20. Lake Dojran, 21. Lake Ohrid, 22. Lake Shkodra, 23. Lake Vrana.

On the other hand, a stalagmite from the Jeita Cave (Lebanon), presents a record of 11.9-1.1 ka BP. Analysis of the stalagmite shows that after 5.8 ka high $\delta^{18}O$ and $\delta^{13}C$ values are indicative of drier conditions, though this sample does not demonstrate any record of the 4.2 ka BP event. It shows instead a wetter period between 4.0 and 3.0 ka with a small decrease in $\delta^{18}O$ and $\delta^{13}C$ values, and does not seem in agreement with other proxies from the region. This might be a result of the low chronological resolution of the stalagmite, that prevents a clear observation of the 4.2 ka BP event. In addition, today average yearly rainfall at the site is ca. 1000 mm (Verheyden et al., 2008). Therefore, impacts of the drought, depend also on the local environmental conditions, may have been masked and the event was not recorded.

The speleothem samples from the Soreq Cave (Israel) present a climate reconstruction of the mid-Holocene (7000-4000 BP) for the eastern Mediterranean. The results of oxygen and carbon stable isotope analyses on the samples prove a drying event that peaked at 4200-4050 BP (Bar-Matthews et al., 2011).

Marine sediments from the Dead Sea (Israel), a significant reservoir to record climate variability sensitively in the Near East, give a record for the last 10,000 years based on lake level reconstruction. According to the reconstruction, the time period between ca. 5.3 ka calBP and 3.5 ka calBP was characterized by high lake levels, i.e., wetter climatic conditions, however, this period was interrupted by several abrupt climatic changes that shifted to drier conditions. One of these climatic changes occurred at ca. 4.2 ka calBP that is characterized by an abrupt decrease in lake level and lasted for ca. 300 years (Migowski et al., 2006).

A subfossil *Tamarix* tree trunk found inside the Sedom Cave (Israel) provides a climatic reconstruction of the period between ca. 4840 BC-130 AD. Stable oxygen and nitrogen isotope analyses of the subfossil show that after the highest precipitation peak at ca. 3000 BC, the climate became gradually drier during the 3rd millennium BC. Between 2200 and 1900 BC (ca. 4200 BP), the lake level of Dead Sea dropped more than 45 m (Frumkin, 2009).

Similarly, the marine records from the Shaban Deep (northern Red Sea) cover the period between 5900 and 3900 calBP. Analysis of the marine cores provides a reconstruction of changes in sediment composition and shows a major textural transition around 4200 calBP that suggests a major drought event (Arz et al., 2006).

Archaeological studies in the ancient city of Ebla, Syria revealed many charred plant remains. Stable carbon isotope analysis of these plant remains present a reconstruction of ancient environment between the mid-3rd millennium BC and mid-2nd millennium BC with. According to the results, $\delta^{13}C$ value shows a peak, i.e., a rapid increase, between 2200 and 1750 calBC and this time span coincides with the abrupt arid event, i.e. 4.2 ka BP event, which is observed through various proxies from the sites in the adjacent regions (Fiorentino et al., 2008).

Stable carbon isotope analysis of ancient charred plant remains from Ebla and Qatna, Syria, provides information on the palaeoclimate for 150 years, from 3rd millennium BC to the end of the 2nd millennium BC. According to the results, drier conditions prevailed, i.e., low water availability testified by high $\delta^{13}C$ values, at 2300-2050 BC following a humid period at 2650-2350 BC (Fiorentino et al., 2012).

Stable carbon isotope analysis of barley grains from 33 archaeological sites from coastal region, Euphrates regions, Khabur region and other inland regions provides information on water stress from 10,000 calBC to 500 calBC. Within the period of the dry event of the 4.2 ka BP event, these four regions that exhibit differences in water availability show different $\Delta^{13}C$ values. In coastal sites with relatively stable and high annual precipitation results show mostly favourable conditions for barley cultivation with a mean value of $\Delta^{13}C$ mostly above 17‰, and therefore, drought did not have major impacts on these sites, i.e., there was a moderate drought stress. However, in the Euphrates and Khabur regions, drier inland with a permanent major river, had minima of $\Delta^{13}C$ was rarely above 17‰ and even reaching 13‰. In other inland regions, far from coast and large rivers, values are mostly below 17‰ and shows strong to moderate stress. In the Middle Bronze Age (ca. 1900-1600 calBC), results show a continuation of this process (Riehl et al., 2014).

2.2.2. The Persian Gulf

Geochemical analysis of a lacustrine sediment core from the inter-dune dry lake of Awafi (United Arab Emirates) provides a climatic reconstruction between 18,000 calBP and present. Results show that a wet period between 5200 and 4200 calBP was interrupted by an intense aridity, minima in precipitations, desiccation and the deposition of aeolian sand between 4200 and 4000 calBP (Parker et al., 2006).

A marine core from the Gulf of Oman, an area that receives aeolian dust from Mesopotamia, presents a climatic reconstruction for the last ca. 6000 years. Analysis of the core shows an abrupt aridity beginning at 4025±150 BP that lasted for 400 years (Cullen et al., 2000).

2.2.3. The Black Sea, Caspian Sea and Iranian Plateau

Soil stratigraphy and pollen records from the Heraklean Peninsula and the Chyornaya Valley (southwestern Crimea, Ukraine) cover the last ca. 12,000 years. Analysis of the samples shows that a wet period between 5.4 ka and 4.6 ka was followed by a dry phase with decrease in arboreal pollen and the development of calcic horizons in cinnamomic soils between 4.2 ka and 3.5 ka (Cordova & Lehman, 2005).

Sediment cores from the middle and southern Caspian Sea, the world's largest inland water body, provide information on climate between 14.47 and 2.43 ka calBP. The analysis shows that between 10.55 and 4.11 ka calBP water levels were high (Leroy et al., 2007), as water from the Amu Darya reached the lake through channels of the Uzboy (Leroy et al., 2013). However, the main change in dinocyst assemblages around 4.11 ka calBP and 3.9 ka calBP (Leroy et al., 2007) suggests low lake levels. In addition, a hiatus and a gypsum crystal layer that occurred around 3.9 ka calBP confirm the decrease in lake levels, probably as a result of the Amu Darya river's decreased flow to the lake or its return to the Aral Sea (Leroy et al., 2013). This sharp transition might be an effect of the 4.2 ka BP event and the small delay in the timing of the lake level drop, i.e. reaction to aridity, might be due to the time needed by large water bodies to be affected by the changing climatic conditions (Leroy et al., 2014).

Calcareous sediments from Lake Zeribar (Iran), located in a valley, provide a geological record covering the last 13 ka. According to core analysis, after ca. 4.5 ka BP the lake levels were high and spring precipitation fell until ca. 4 ka BP.

However, between ca. 4 ka BP and 3.5 ka BP, low lake levels, increased *Salix* pollen and detrital minerals indicate drought conditions due to decreased spring rainfall (Stevens et al., 2001). In addition, another analysis spanning the last 25,000 years shows that the lake was considerably shallow with decreased oak pollen and increased *Salix* pollen around 4500-3800 ka calBP (Wasylikowa et al., 2006).

Analysis of a sediment core from Lake Mirabad (Zagros Mountains, Iran) shows that δ^{18}O values were relatively high between 5800 and 4300 calBP, indicating a dry period, but decreased in the period between 4200 to 3300 calBP denoting wetter conditions. Therefore, the results do not present evidence for the 4.2 ka BP event. However, this might be due to coarse stratigraphic resolution (Stevens et al., 2006).

Analysis of alluvial sequences from the Qazvin Plain (northwestern Iran) shows that climatic conditions were drier, even arid, during the period between 4550 and 3250 calBP, the so-called “Central Iranian Drought”, and that this drought seems closely related to a settlement hiatus in the region. This event was clearly different than the 4.2 ka BP event but it must have been linked to it (Schmidt et al., 2011).

2.2.4. Greece and the Balkans

A core from the northwestern Aegean provides a 22,000-year-long climatic record. Analysis of the core shows that smectite/illite ratios decreased starting from 4.9 ka and being centred at 4.4 ka. It was resulted due to the dry climate and less water influx from the Black Sea (Ehrmann et al., 2007) that is supported by a positive shift in the δ^{18}O value of benthic foraminifera species (Kuhnt et al., 2008). Moreover, positive shifts in the δ^{13}C value of benthic foraminifera species the record show a dry period centred at c. 4.0 ka BP (Kuhnt et al., 2008).

A core from the southern Aegean and one from Levantine Basin, covering the last 12,000 years, do not present any record for the event. Small fluctuations in δ^{13}C values indicate that there were only minor changes in climatic conditions for the last 5000 years in the region. Therefore, contrary to the northern Aegean, the southern

Aegean and the Levantine Basin seem more stable to regional climatic changes (Kuhnt et al., 2008).

Lake Dojran is located at the border between Greece and Macedonia. A core from the lake presents a climatic record of the last ca. 12,500 calBP. Results suggest high lake levels and humid conditions from 7900 to 4300 calBP. However, 4300 -2800 calBP was a period of distinct change in proxies and a greater instability. Low inflow and dry conditions started at around 4.3 calBP and peaked at around 4000 calBP with minima in grain size and a peak in $\delta^{18}O$ that is probably linked to the cooling event at 4.2 calBP (Francke et al., 2013).

Analysis of a core from Lake Ohrid, located in a carstic depression at the Albania/Macedonia border, provides climatic information for the last ca. 39,500 years. Carbonate concentration decreased between ca. 4100 and 3600 calBP, along with diatom abundance around 4200 calBP. This could be an impact of a combination of both cooling and a drought, since it is difficult to distinguish if there is a signal for temperature or precipitation (Wagner et al., 2009).

Lake Shkodra, the largest natural freshwater lake in the Balkan region, presents a climatic record of the last 4500 years. Multifaceted analysis of sediment cores from the lake shows that a major humid period centred at ca. 4300 calBP (Zanchetta et al., 2012) was followed by an arid phase around 4000-4100 calBP with a minimum in pollen flux and concentration, and a peak of deciduous oaks (Sadori et al., 2015).

A sediment core from Lake Vrana, a large and deep carstic lake on the island of Cres (Croatia), provides climatic information spanning the last ca. 16,000 years. The analysis shows the sudden spread of *Quercus ilex*, a drought-tolerant species, at ca. 4.2 ka BP which is possibly linked to a period with drier summers but also may suggest events of forest clearance (Schmidt et al., 2000).

2.3. Archaeological Evidence for the 4.2 ka BP Event in the Eastern Mediterranean and Adjacent Regions

The 4.2 ka BP event, dateable approximately between 2250-1900 calBC (slightly different dates for different areas) is a series of drought spells that coincides with substantial changes in the settlement structure, the socio-economic and political organization of societies in the eastern Mediterranean and adjacent regions. These include the Harappan civilization in the Indus Valley, the first states in Mesopotamia (Akkad and Ur III), the Levant, Anatolia, the Aegean and the Old Kingdom in Egypt. There is an ongoing debate among scholars whether these changes be correlated to and caused by, the effects of the 4.2 ka BP event (the Indus Valley: Staubwasser and Weiss, 2006; Mesopotamia: Weiss, 2017; the Levant: Höflmayer, 2015; Anatolia: Massa & Şahoğlu, 2015; the Aegean: Wiener, 2014; Egypt: Carlos & Moreno, 2015).

In the Eastern Mediterranean, the 4.2 ka BP event corresponds to the transition from the Early Bronze Age (hereafter EBA) to the Middle Bronze Age (hereafter MBA) and with the collapse of complex societies (Weiss et al., 1993; Wiener, 2014), in particular, the collapse of the Akkadian Empire in Mesopotamia (Weiss et al., 1993; Weiss, 2017).

The relationship between the 4.2 ka BP event and the collapse of the complex societies and the major changes ca. 2200 BC has been built on the disturbance in agricultural production, the major subsistence strategy of the Early Bronze societies in the eastern Mediterranean. As it was discussed in depth, within the period of the 4.2 ka BP event, annual mean precipitation in the region considerably reduced that led to arid conditions. Therefore, the sedentary dry agriculturalists, majority of the Early Bronze societies, suffered from interrupted agricultural production, in particular, in the semi-arid and arid marginal areas (Weiss, 2015). However, one should not forget that favourable or unfavourable climatic conditions do not necessarily ensure the development or collapse of societies (Anderson et al., 2007; Rosen, 2007).

Besides the nature of a climate change, the severity and extent, and its effects on carrying capacity of the environment/food supplies (Wiener, 2014), Rosen (2007) argues that, impacts of a climate change on societies depend on several internal factors such as technological development, degree of the social organization and perception of the climatic change (the environment in general) and its causes. Perception of the environment, in fact, determines the measures against the climatic change. For example, if the environment is perceived culturally, then, measures against the climatic change will be much linked to internal social factors rather than technological change. In addition, a society is not a solid entity rather consists of different groups and individuals and their responses to environmental change would be, of course, different. Therefore, responses to environmental change may vary even in a given society as well. For example, Schwartz (2007) states that deurbanization, political decentralization and economic fluctuations at the transition at ca. 2200 BC must have affected elites and elite institution more heavily in comparison to non-elite individuals.

Adaptation ability of societies to impacts of a climate change depends on several factors and some of them make complex societies less flexible in adopting changing climatic conditions (Rosen, 2007):

- Subsistence strategy mainly depending on agricultural production;
- Sedentary societies being attached to the land;
- Large populations;
- High specialisation in technology;
- Coercive political controls and;
- Blurred aspects such as cultural conservatism and cosmologies.

Considering the discussion above, EBA societies of the eastern Mediterranean (northern Mesopotamia, western Syria, Levant and Aegean (Figure 2)) underwent major changes throughout the period of the climatic stress and were impacted differently and tried to adapt the new environmental conditions, i.e., impacts of the drying event through their varying measures.

2.3.1. Northern Mesopotamia

Sites from northern Mesopotamia, in particular, in the Khabur Plains, the Euphrates River and the Balikh Valley regions, provide archaeological evidence for the 4.2 ka BP event (Figure 3).

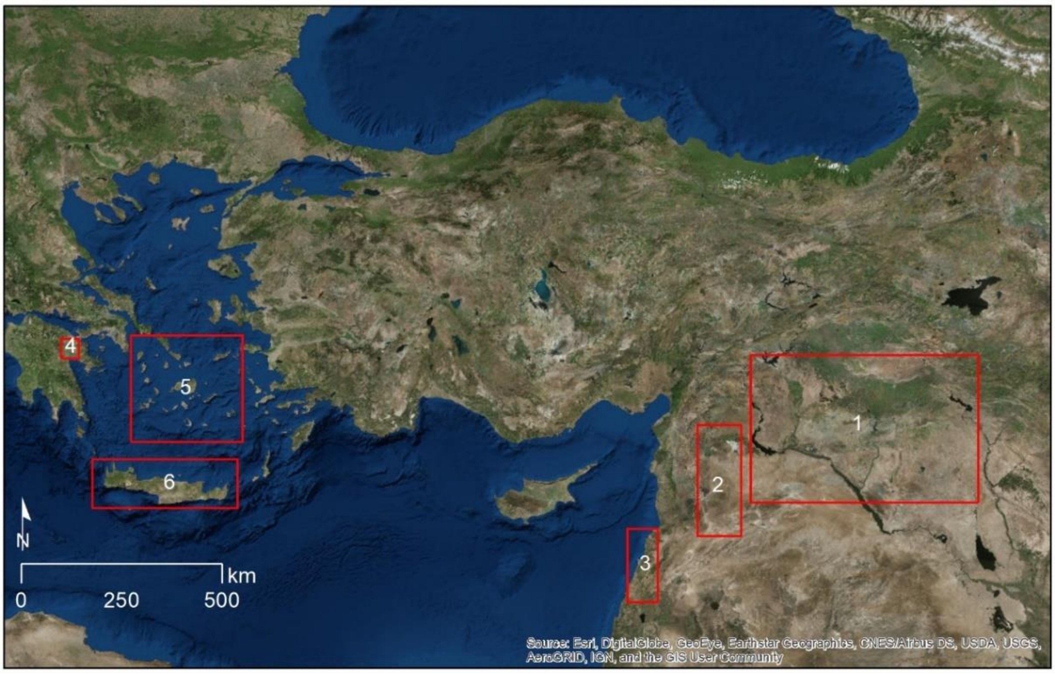

Figure 2. Map showing regions that provide archaeological evidence for the 4.2 ka BP event in the eastern Mediterranean. 1. Northern Mesopotamia, 2. Western Syria, 3. Coastal Levant, 4. Northeastern Peloponnese, 5. Cyclades, 6. Crete.

The collapse of the Akkadian Empire, the first known empire in the world, is interpreted as an impact of the 4.2 ka BP event. Expansion of the Akkadian Empire started at ca. 2350 BC and expeditions were organized that reached the Euphrates, Mari, Tuttul and Ebla and later, Tell Brak, Tell Leilan in the Khabur Plains and Nineveh, nearby the river Tigris in northern Mesopotamia. In the second half of the 3rd millennium BC, Akkadians further conquered the settlements in southwestern Iran, northeastern Iraq and northeastern Syria. After then, Tell Leilan, Tell Mozan and Tell Brak became significant fortresses of the empire (Weiss, 2015). Weiss et al. (1993) suggested that the Akkadian Empire of the southern Mesopotamia had already imperialized northern Mesopotamia ca. 2300 BC and started to collect agro-revenues from the settlements there (Figure 4). With the abrupt climate change at ca. 4.2 ka BP, dry-farming areas in northern Mesopotamia suffered from reduced rainfall and aridification. Then, sedentary agriculturalists deserted the settlements there. Therefore, reduced crops from northern Mesopotamia led the empire collapse and abandon its fortresses in northern Mesopotamia at ca. 2200 BC (Weiss, 2012; Weiss, 2017).

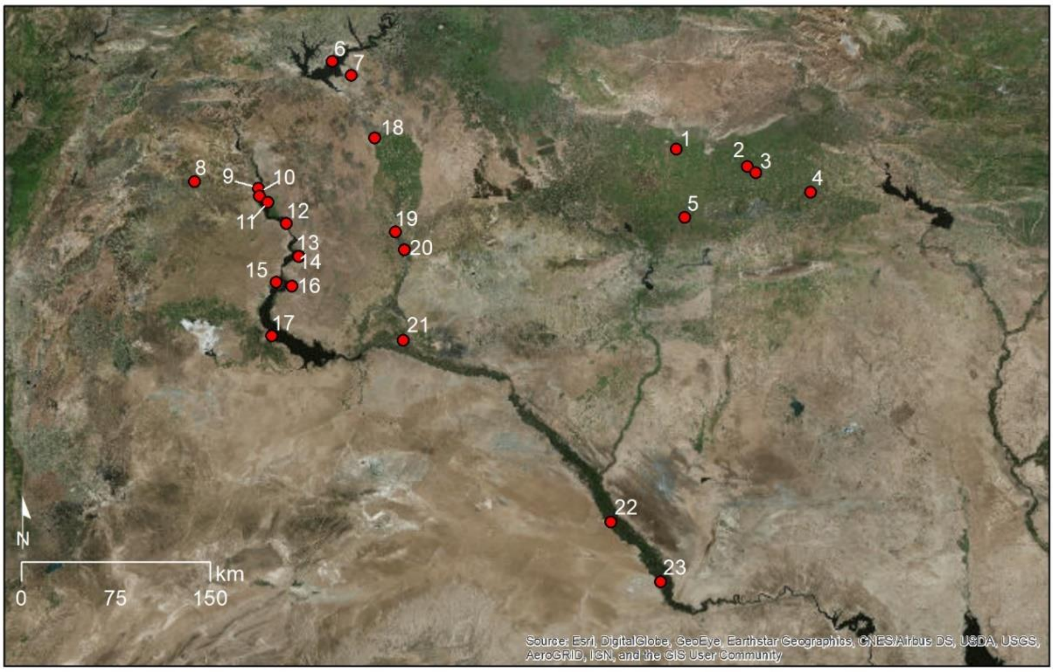

Figure 3. Map showing sites with archaeological evidence for the period of the 4.2 ka BP event in northern Mesopotamia. The Khabur Plains: 1. Tell Mozan, 2. Tell Leilan, 3. Tell Mohammed Diyab, 4. Tell Hamoukar, 5. Tell Brak; the Atatürk Dam region: 6. Samsat, 7. Titriş Höyük; the Euphrates River region: 8. Tilbeşar Höyük, 9. Carchemish; the Tishrin Dam region: 10. Jerablus Tahtani, 11. Shiukh Tahtani, 12. Qara Quzaq, 13 and 14. Tell Kabir and Tell Banat; the Tabqa Dam region: 15. Selenkahiye, 16. Tell es-Sweyhat, 17. Emar; Balikh Valley region: 18. Kazane Höyük, 19. Tell Sahlan, 20. Tell Hammam et-Turkman, 21. Tuttul; the middle Euphrates region: 22. Terqa, 23. Mari.

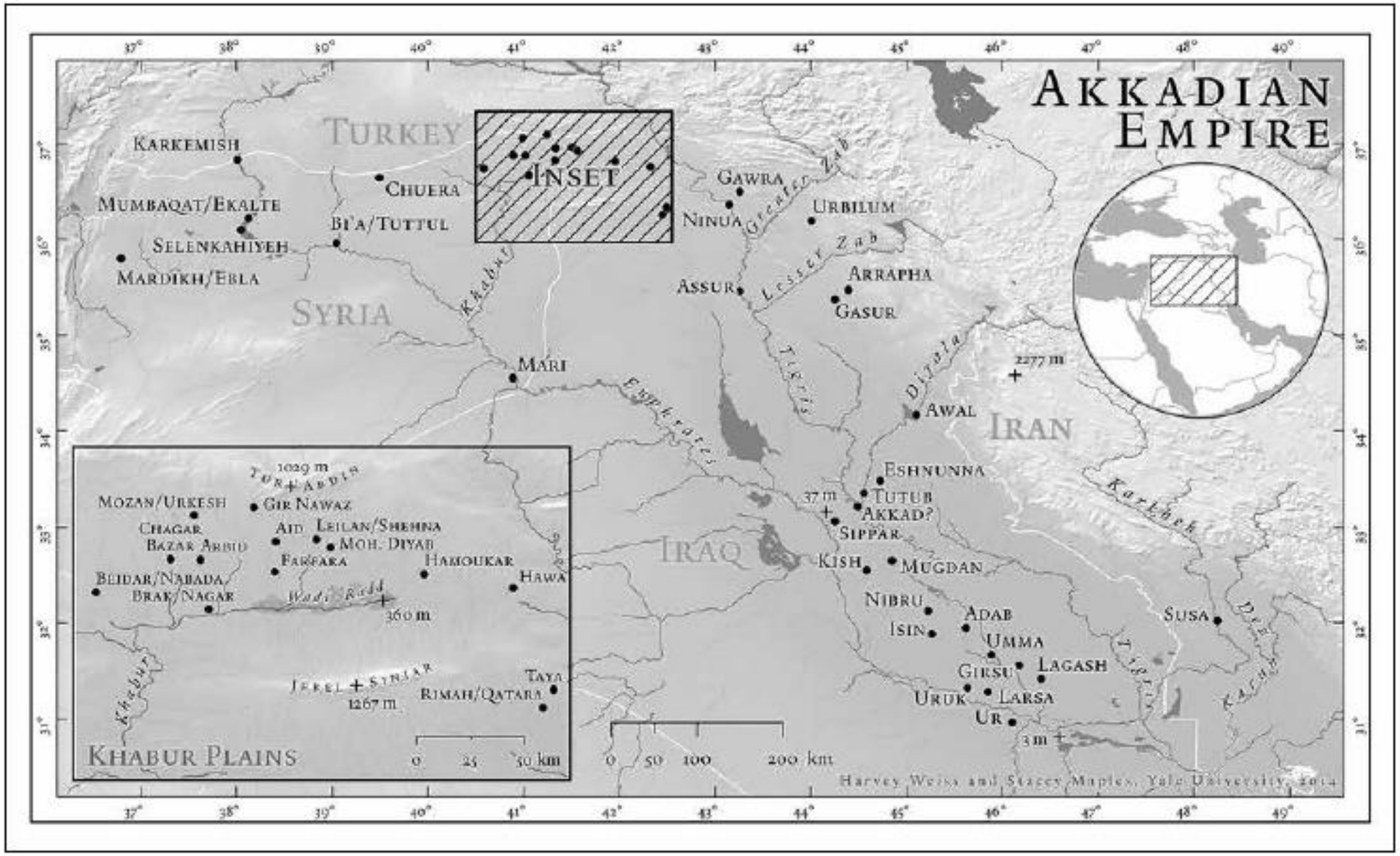

Figure 4. The Akkadian Empire and settlements in the Khabur Plains ca. 2250 BC (Weiss, 2015, Fig. 3).

2.3.2. The Khabur Plains

Reduced annual rainfall made majority of areas in the Khabur Plains, already a marginal production region, unfavourable for further dry agricultural practices (Staubwasser & Weiss, 2006). Thus, the Akkadians and local populations abandoned settlements in the region. According to results of the Tell Leilan survey, settled area in the region decreased by 87% after the collapse (Figure 5; Arrivabeni, 2012).

Site	Akkadian Period (ca. 2350–2250 B.C.)	post-Akkadian/EJZ 4c (ca. 2250–2200 B.C.)		post-pA/EJZ 5 (ca. 2200–1950 B.C.)	Khabur (ca. 1950–1700 B.C.)
Leilan	90	0.002	(-99%)	0	90
Mozan	120	20	(-83%)	<20	<20
Brak	70	<35	(-50%)	0	10
Moh Diyab	50	14	(-72%)	0	35
Chagar Bazar	10	1	(-90%)	0	9
Hamoukar	100	0*	(-100%)	0	0
Arbid	4	3.2	(-20%)	0	1.75
Barri	<6	0	(-100%)	0**	6
Leilan Region Survey	397	69	(-87%)	0	767

* Chronology uncertain; unlikely but possible partial occupation this period.
** Isolated stratum 35 kiln within this period.

Figure 5. Reduction in site size (ha) in the Khabur Plains in the late 3rd millennium-early 2nd millennium BC (Weiss, 2017, Table 6.1).

Tell Brak (ancient Nagar) was among major settlements under Akkadian administration with a 40-ha acropolis and a 30-ha worker settlement on its south. With the collapse of the empire, the site where a grain storeroom and the Naram-Sin Palace were incomplete was abandoned. In the post-Akkadian period, the site size was reduced 50% (Arrivabeni, 2012). Within the period, some houses were erected on the acropolis. However, all these buildings were abandoned at ca. 2200 BC and only at ca. 1950/1900 BC, the site was reoccupied (Weiss, 2015).

Tell Leilan, 90 ha, was a significant site where large-scale grain storage, processing and distribution activities were carried out by the Akkadians in the late 23rd century

BC. The site with a multi-roomed Akkadian Administrative Building and an unfinished building were abandoned suddenly ca. 2254-2220 calBC. In the post-Akkadian period, a four-roomed house was built on the remnants of the Akkadian Administrative Building and was abandoned at 2233-2196 calBC. After a ca. 250-year gap, the site was reoccupied (Weiss, 2015).

At Tell Mozan (ancient Urkesh), ca. 100 ha., an Akkadian palace and its 100 ha lower town were abandoned at the same time with Tell Brak and Tell Leilan. After the abandonment, the site size decreased by 84% (Arrivabeni, 2012) and several buildings were constructed on the acropolis. The site continued to be occupied until the 18th century BC (Weiss, 2015).

Similarly, two Akkadian buildings that were still under construction at Tell Mohammed Diyab and at Tell Hamoukar, 100 ha, were abandoned at the end of the Akkadian period, ca. 2200 BC (Weiss, 2015).

The sedentary dry agriculturalists in the Khabur Plains moved to refugia in adjacent regions including the southern Mesopotamia, the central Euphrates region, the Orontes River and the southern Levant regions with water sources and coastal Syria and Lebanon with sites near rivers (Figure 6) (Weiss, 2014).

Besides habitat tracking to refugia, dry agriculturalists from depopulated sites in northern Mesopotamia adopted a pastoralist economy. Nomad activities of Hanaean/Amorite pastoralists were documented epigraphically at two periods: ca. 2100-2000 BC and ca. 2000-1800 BC. They were documented in the southern Mesopotamia between 2100 and 2000 BC, after the Akkadian collapse. To prevent Amorite pastoralists to move in the southern Mesopotamia and to refugia in the Orontes river region, walls such as “The Repeller-of-the-Amorites” and Trés Long Mur (Figure 6) were constructed. In the period between ca. 2000 BC and 1800 BC, Amorite pastoralists became dynasts in the southern Mesopotamian cities and adopted a sedentary life in northern Mesopotamia, when the pre-4.2 ka BP event climatic conditions returned (Weiss, 2015). In this period, Amorites established a

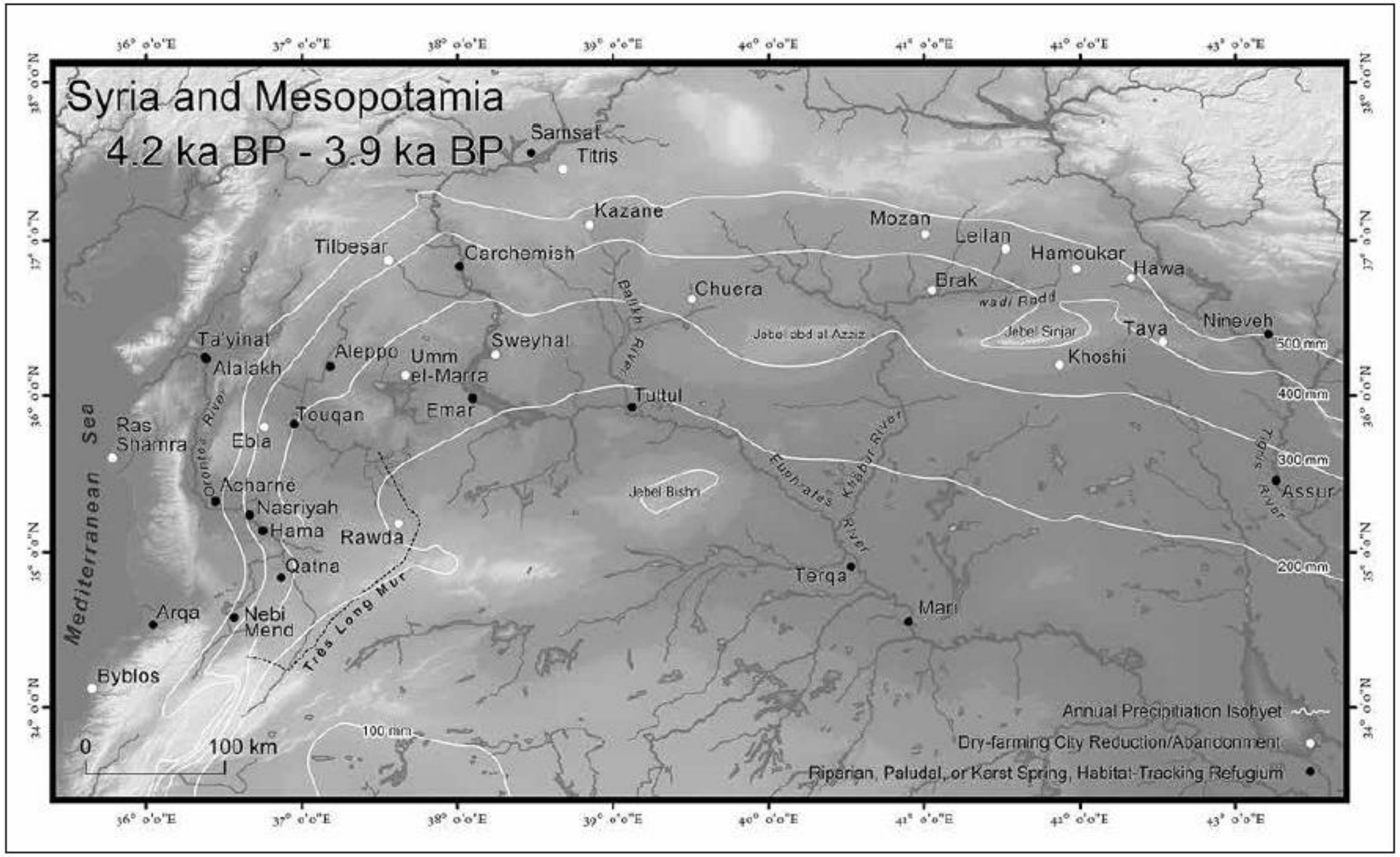

Figure 6. Map showing reduction or abandonment of dry farming sites and refugia in Syria and Mesopotamia during 4.2-3.9 ka BP (Weiss, 2015, Fig. 10).

social network across a large area, from the southern to northern Mesopotamia in the early 2nd millennium BC. This social network, in fact, were connecting human groups depending on different subsistence strategies, i.e., pastoralists and sedentary agriculturalists. Therefore, it was a survival strategy based on an exchange mechanism and was a response to the climatic stress due to the 4.2 ka BP event (Wossink, 2009).

2.3.3. The Euphrates River

In the middle Euphrates region that was a refugia for dry farming agriculturalists and Hanaean/Amorite pastoralists (Weiss, 2015) sites were abandoned in the late EBA and early MBA, however, some sites show evidence for continuity. Weiss (2015) stated that urban settlements such as Mari, Terqa, Tuttul, Emar, Carchemish and Samsat grew during the climatic stress. In the Tishrin Dam region, Jerablus Tahtani and Tell Banat, apart from its clifftop citadel, were abandoned in the EBA IVB. Shiukh Tahtani and Qara Quzaq show an occupational hiatus between the EBA IV and MBA I. On the other hand, Tell Kabir continued into the 2nd millennium BC. In the Tabqa Dam region, Selenkahiye was abandoned in the EBA IVB. Tell es-Sweyhat and dry farming cities near Urfa and Harran, at Tilbeşar, Titriş and Kazane (Weiss, 2015) were deserted in the early MBA.

2.3.4. The Balikh Valley

Wossink (2010) examined the presence of a collapse at the end of the EBA through comparing site size and population development through the EBA and the MBA in the Balikh Survey (BS) region, the Birecik-Euphrates Dam Survey (B-EDS) region and the North Jazira Survey (NJS) region (Figure 7 and Figure 8). From the graphs, average settlement size increases in all three regions between 2250 BC and 2000 BC. On the other hand, each region exhibits different demographic developments.

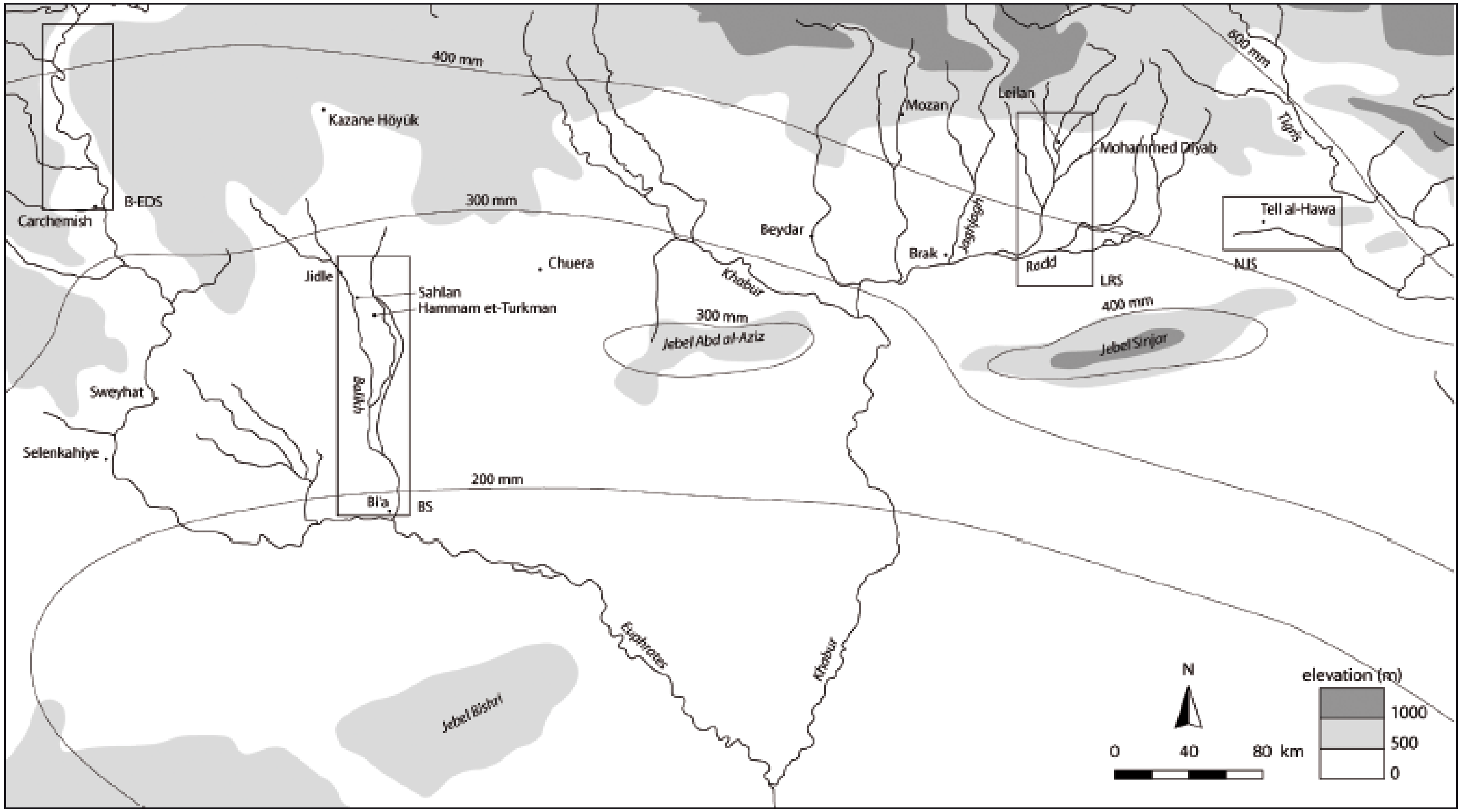

Figure 7. Map showing the Jezirah with B-EDS, BS and NJS regions and some sites (Wossink, 2010, Fig. 1).

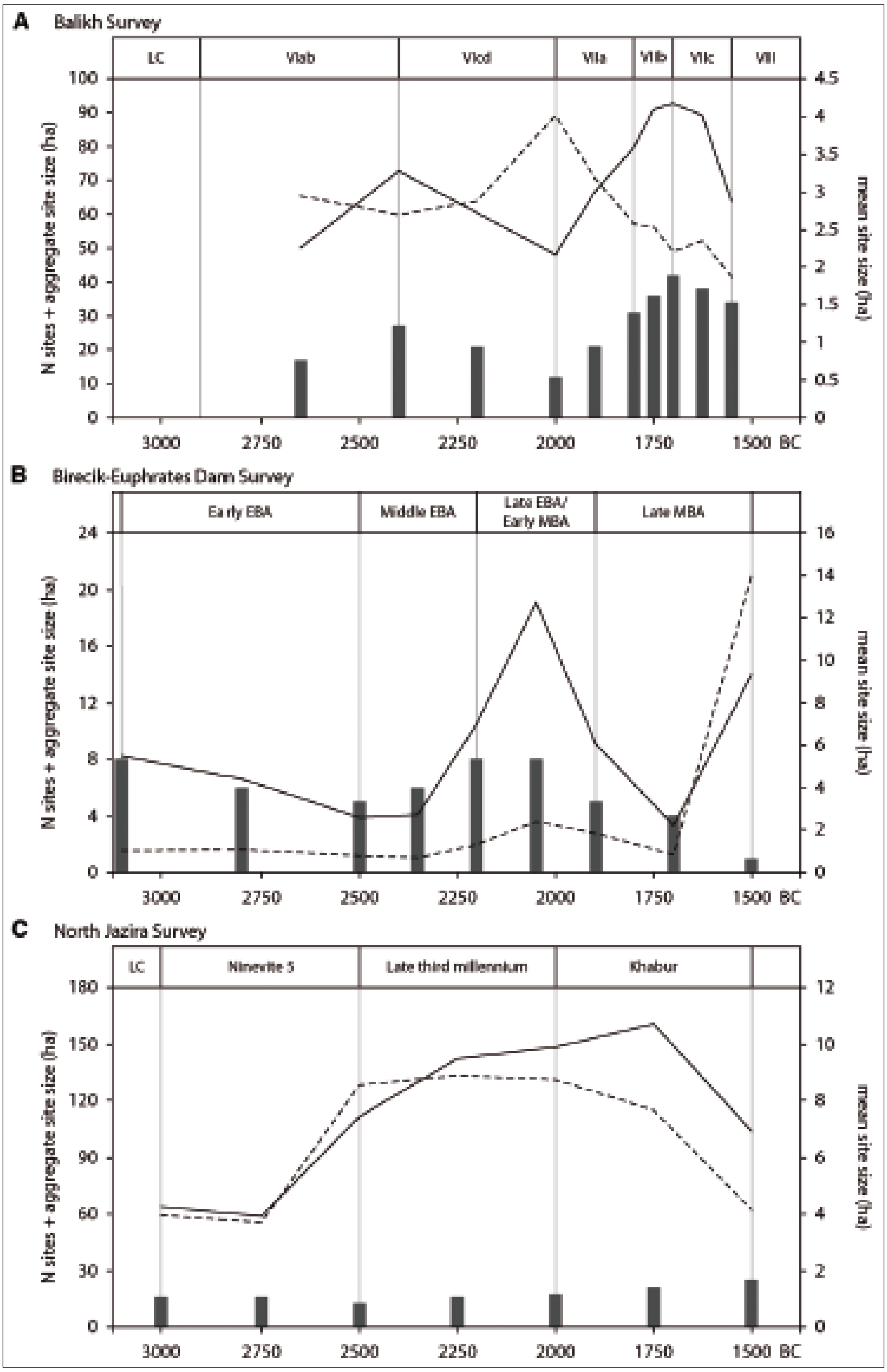

Figure 8. Graphs showing demographic development in northern Mesopotamia. A: The Balikh Survey region; B: The Birecik-Euphrates Dam Survey region; C: The North Jazira Survey region. Bars on the bottom, solid line and dashed line represent number of simultaneously occupied sites, aggregate site sizes and mean site sizes respectively (Wossink, 2010, Fig. 2).

In the BS region, total population reduced considerably after 2500 BC (Figure 8A). The B-EDS region experienced a population maximum within the final quarter of the 3rd millennium BC (Figure 8B). In the NJS region, population increased during the 3rd millennium BC and decreased around 1500 BC (Figure 8C). According to the results, apparently there was not a whole collapse during the transition in northern Mesopotamia.

In the Balikh Valley, as the number of sites increased, the mean site size reached a maximum at 2000 BC and then decreased (Figure 8A). This suggests that population nucleated in larger settlements toward 2000 BC and then, dispersed into small settlements. In addition, the demographic reconstruction in Figure 9 shows that the total population was mostly higher than the carrying capacity of the region, ca. 7000, during all periods. The population reduction and the settlement nucleation might be linked to the 4.2 ka BP event. However, one should not ignore the fact that the region with a population above the carrying capacity was already more vulnerable to collapse independently of climate change. On the other hand, nucleation in larger settlements that provide better protection and higher chance to reach limited resources is a survival strategy under climatic stress. Moreover, construction of fortification walls ca. 2350 BC at Hammam et-Turkman, Jidle, possibly Sahlan and Kazane Höyük and the reconstruction of fortification wall at Tell Bi'a (ancient Tuttul) point to conflicts and a serious need for protection. In all, results of the survey suggest that the region continued to the MBA with no major break (Wossink, 2010).

2.3.5. Western Syria

In western Syria (Figure 10), the EBA IVA (2500-2300 BC) is characterized by social complexity and urban cities at Ebla, Qatna, Umm el-Marra and circular urban settlements at al-Rawda, es-Sur and Sha'irat. In this period, Ebla with other urban cities in the wetter agricultural regions, expanded to the drier regions for long-distance trade, maximization of agricultural production and pastoralism, i.e., sheep/goat herding. In the EBA IVB (2300-2100 BC) urban centres continued. However, towards the end of the period, many settlements including round settlements were destroyed and abandoned. Ebla was destructed by the end of the EBA IVA and its size and public buildings reduced. In the following period, EBA IVB, new buildings including temples and a palace with water cisterns (Weiss, 2015) were constructed. However, at the end of the EBA IVB, Ebla, while its palace was still under construction (Weiss, 2015), underwent another destruction (Schwartz, 2017).

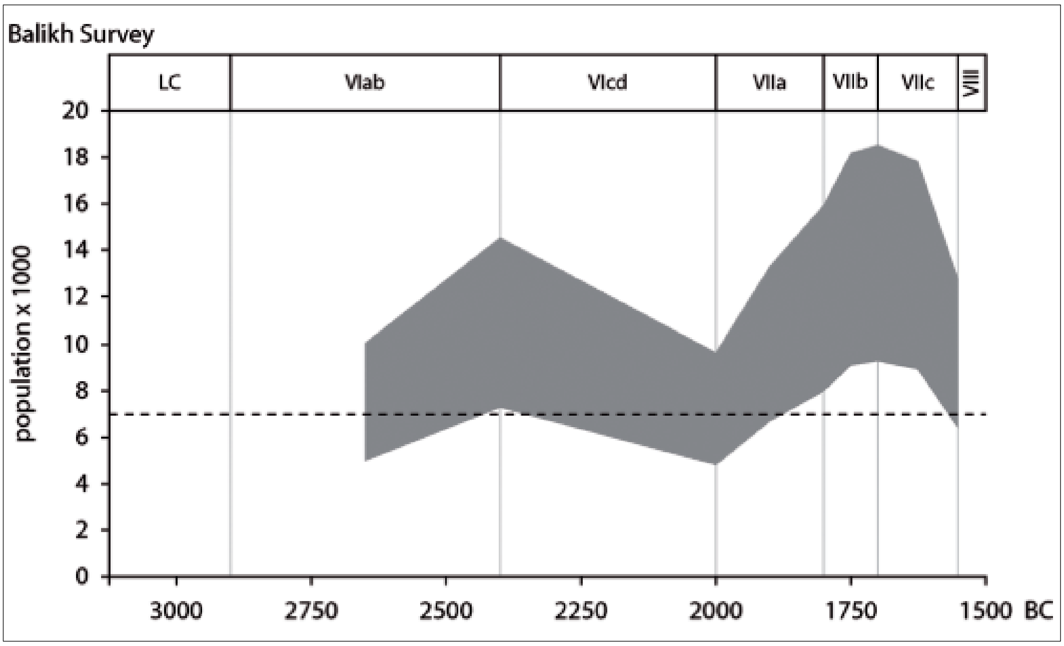

Figure 9. Reconstruction of population development in the Balikh Survey region. Dashed line represents the carrying capacity of the region (Wossink, 2010, Fig. 4).

The MBA, started ca. 2000 BC, is characterized by a marked change in material culture styles, settlement organization and political entities and political units that included mainly Amorite administrators (Schwartz, 2017). These changes, therefore, point to a substantial transformation at transition from the EBA to the MBA. During this transition, Qatna, near the Orontes River, was an attractive environment with its 70-ha artificial lake for the sedentary agriculturalists under climatic stress and then, expanded to a 100-ha square settlement (Weiss, 2015).

Besides Qatna, Tell Afis and Tell Tuqan show occupational continuity as well. On the other hand, sedentary settlements that inhabited drier regions in the east of Ebla and Qatna were abandoned and majorly depopulated in the MBA I (2000-1800 BC). In addition, Ebla and Hama possibly had an occupational hiatus at the transition (Schwartz, 2017).

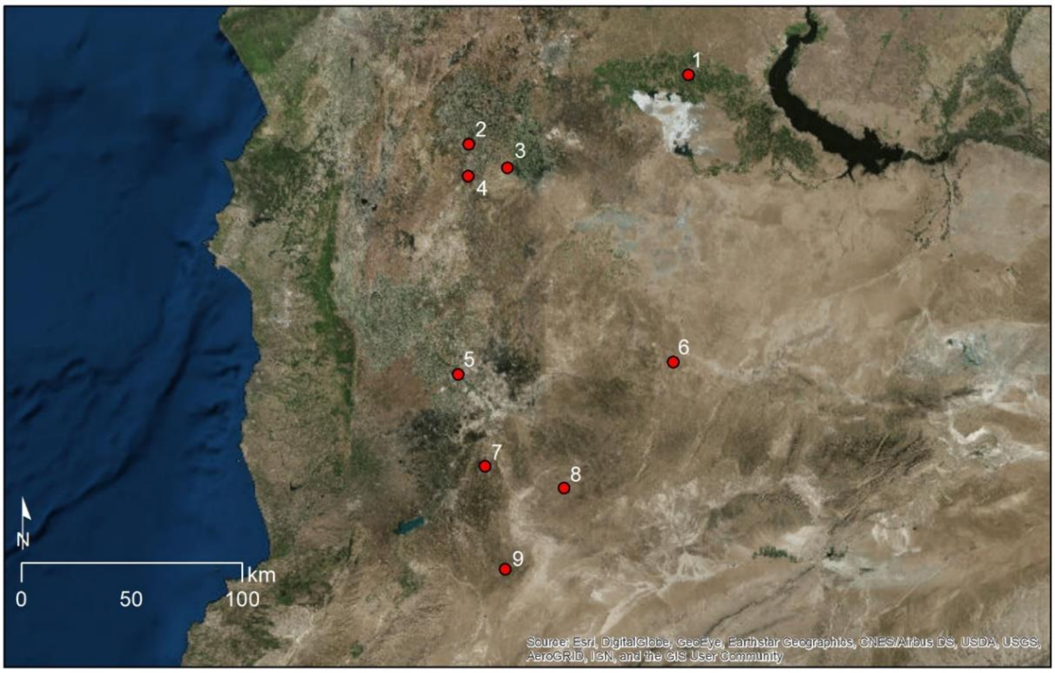

Figure 10. Map showing sites that provide archaeological evidence for the period of the 4.2 ka BP event in western Syria. 1. Umm el-Marra, 2. Tell Afis, 3. Tell Tuqan, 4. Ebla, 5. Hama, 6. Al-Rawda, 7. Qatna, 8. Tell es-Sur, 9. Tell Sha'irat.

In the north, in the semi-arid Jabbul Plain, ca. 70% of the settlements disappeared at the transition to the MBA. Umm el-Marra, the largest Bronze Age site in the region, shows evidence for an occupational gap between the end of the EBA IVB and later MBA (Schwartz, 2017).

2.3.6. The Coastal Levant

The transition from the EBA III to the EBA IV witnessed major cultural changes in the coastal Levant (Figure 11). This transition was traditionally dated to ca. 2300/2000 BC and interpreted as an impact of the 4.2 ka BP abrupt climate change (Rosen, 2007). However, radiocarbon analyses from several sites in the Levant have recently proved that the end of the EBA III and the transition to the EBA IV in the Levant occurred around 2500 BC, ca. 300 years earlier than thought and the event (Höflmayer, 2015; Höflmayer et al., 2014; Regev et al., 2012a; Regev et al., 2012b). According to radiocarbon dates, the EBA III and EBA IV are dated to ca. 2900-2500 BC and ca. 2500-2000 BC respectively (Höflmayer et al., 2014).

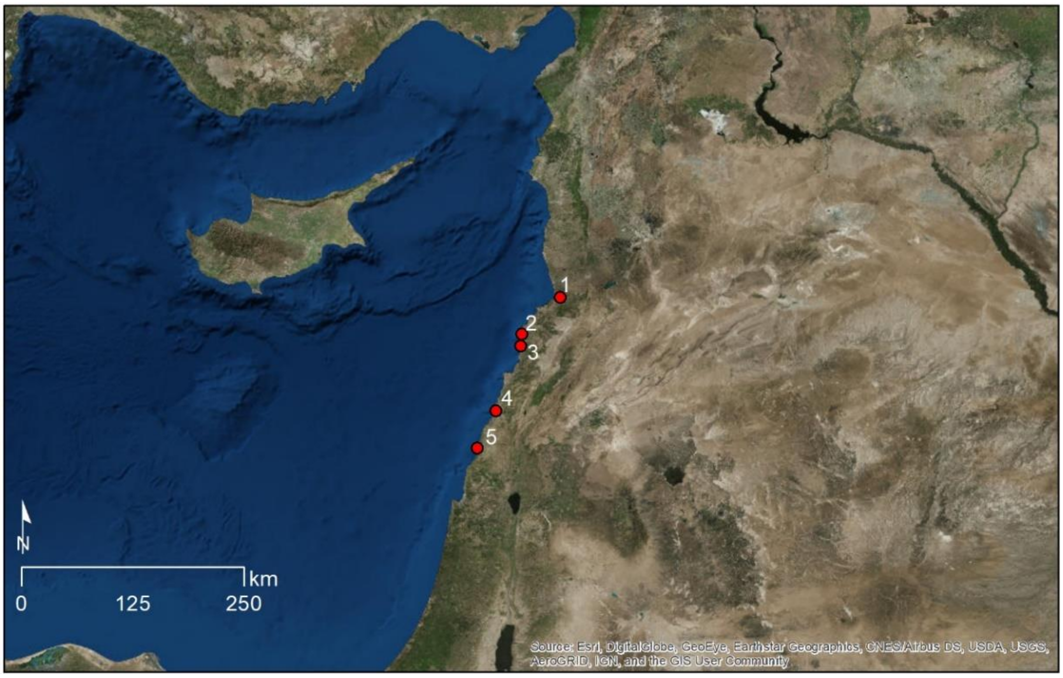

Figure 11. Map showing sites that provide archaeological evidence for the period of the 4.2 ka BP event in the coastal Levant. 1. Tell Arqa, 2. Tell Fadous- Kfarabida, 3. Byblos, 4. Sidon, 5. Tyre.

In the EBA III (ca. 2900-2500 BC), urban settlements were abundant in the coastal region (Genz, 2015). This period was characterized by heavy fortification systems, monumental structures with administrative purposes and inter-regional trade networks with ancient Syria and Egypt (Höflmayer, 2015). In particular, urban centres at Tell Arqa, Byblos, Sidon and Tell Fadous-Kfarabida that had multi-roomed and non-domestic buildings were densely occupied (Genz, 2015). However, at the end of the period, all urban settlements were deserted accompanied by a considerable demographic decline and sedentary agriculturalists shifted to pastoral economy (Höflmayer, 2015).

In the EBA IV (ca. 2500-2000 BC), the size of the settlements was considerably reduced and monumental buildings and fortification systems disappeared. Small unfortified villages and pastoral encampments were the characteristics of the period (Höflmayer, 2015). Moreover, the northern and southern regions followed different trajectories. In the northern coastal region, urban settlements such as Tell Arqa and Byblos maintained their urban characteristics with dense occupation, multi-story houses and continued religious practices and relations with Ebla in western Syria, Ur III and Egypt. The settlement at Tell Fadous-Kfarabida declined considerably. The period was represented only by pits with high number of fine wares and drinking vessels that point to possible feasting activities at the site. On the other hand, in the southern coastal region, Tyre, a short-lived campsite, is the only known settlement within this period so far. It suggests that the number of settlements in the southern coast reduced and even settlements were almost totally disappeared in the EBA IV. The southern region was reoccupied only in the MBA II (Genz, 2015).

2.3.7. The Northeastern Peloponnese

The northeastern Peloponnese (Figure 12), on the Greek mainland, witnessed significant changes at ca. 2200 BC that corresponds to the transition from the Early Helladic Period II (hereafter EH II) to the Early Helladic Period III (hereafter EH III) (Weiberg and Finné, 2013).

Figure 12. Map showing survey areas and some sites that provide archaeological evidence for the period of the 4.2 ka BP event in the northeastern Peloponnese on the Greek mainland. 1. Tsoungiza, 2. Zygouires, 3. Mastos, 4. Tiryns, 5. Lerna, 6. Talioti Valley.

The EH II (ca. 2700-2200 BC) is characterized by urban features, increased monumentality and social complexity. In the late EH II, construction of possible administrative buildings, namely corridor houses, sealing practices and communal feastings were common. However, at the end of the period, ca. 2200 BC, use of many materials such as seals and some practices including sealing practices and construction of corridor houses were gave up and complex societies altered (Weiberg and Finné, 2013).

Surveys in the northeastern Peloponnese (Figure 13) provide information on settlement patterns in the late EH II and EH III. Results suggest a possible nucleation period prior to 2200 BC (Figure 14) and major abandonment of minor sites in the Corinthia and in the Argive Plain (Weiberg and Finné, 2013). In the Berbati-Limnes Valley, the number of sites decreased dramatically (Figure 15). Only one site, Mastos, provides clear evidence for a late EH II occupation. On the other hand, in Talioti Valley, all settlements were abandoned. In all, in the late EH II, the settlements in the marginal regions and at less significant locations were deserted and settlements were probably more concentrated in the Corinthia and the Argive Plain (Weiberg and Finné, 2013).

Figure 13. Surveyed areas in the northeastern Peloponnese. A. Phlius Basin, B. Nemea Valley Archaeological Project, C. Berbati-Limnes Archaeological Survey, D. Argolid Exploration Project, E. Methana Survey Project, F. Eastern Korinthia Archaeological Survey/Saronic Harbors Archaeological Research Project (Weiberg and Finné, 2013, Fig. 2).

Two major settlements at Tiryns and Lerna in the Argive Plain were important centres and continued to develop during the late EH II period. House of the Tiles, possibly administrative building, and refinement in the seal motifs at Lerna and the Rundbau, possibly administrative building, and development in architecture at Tyrins testify the flourish. However, at ca. 2200 BC, growth of the both sites terminated. House of the Tiles and the Rundbau were destroyed (Weiberg and Finné, 2013).

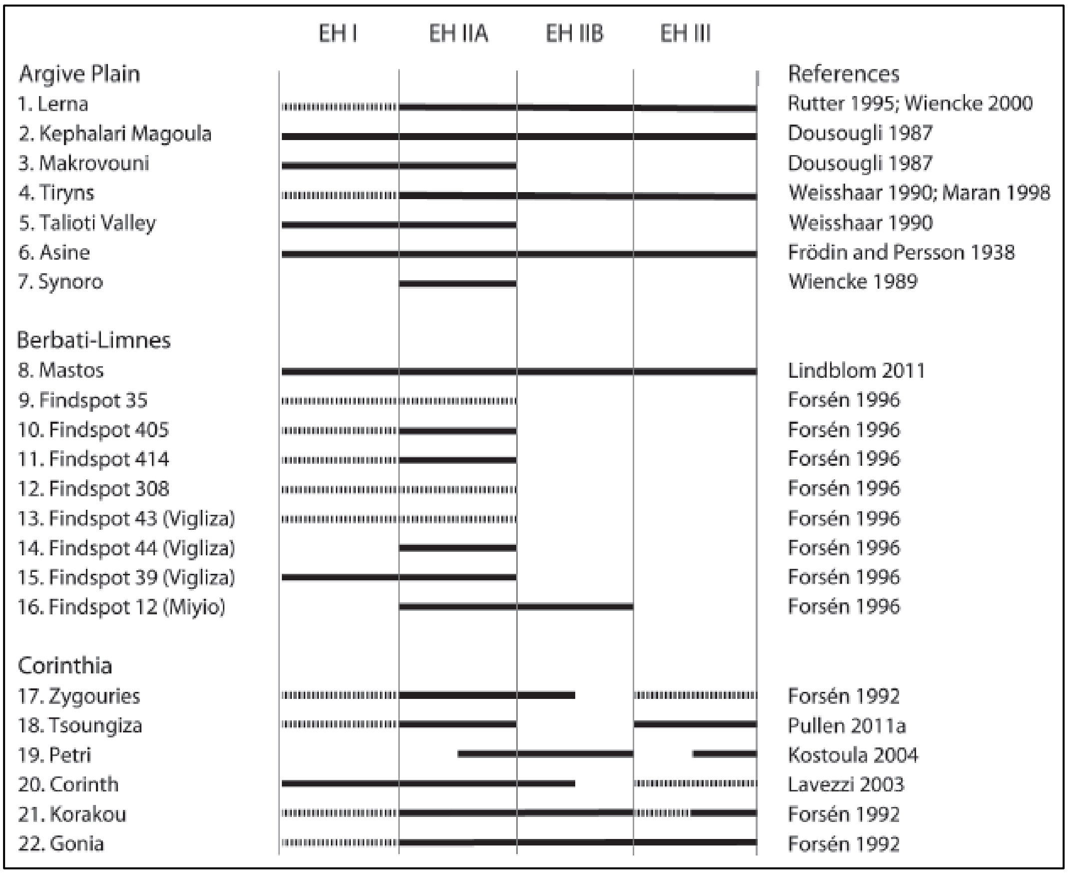

Figure 14. Changes in occupation patterns through time in the Argive Plain, Berbati-Limnes and Corinthia. Solid lines: definite occupation periods. Broken lines: Uncertain occupation periods (Weiberg and Finné, 2013, Fig. 5).

In the following period, EH III, site numbers reduced substantially and only several sites continued (Figure 14). On the other hand, some interior sites, Tsoungiza and Zygouires were reoccupied. After EH III, at Lerna and Tiryns and as well as, Tsoungiza, free-standing apsidal houses were constructed. These free-standing buildings may have represented a more family-oriented settlement structure and possibly changed social hierarchies. At Lerna, on the remnants of the House of the Tiles a tumulus was built that might have been in remembrance of the monumental building of the preceding period (Weiberg and Finné, 2013).

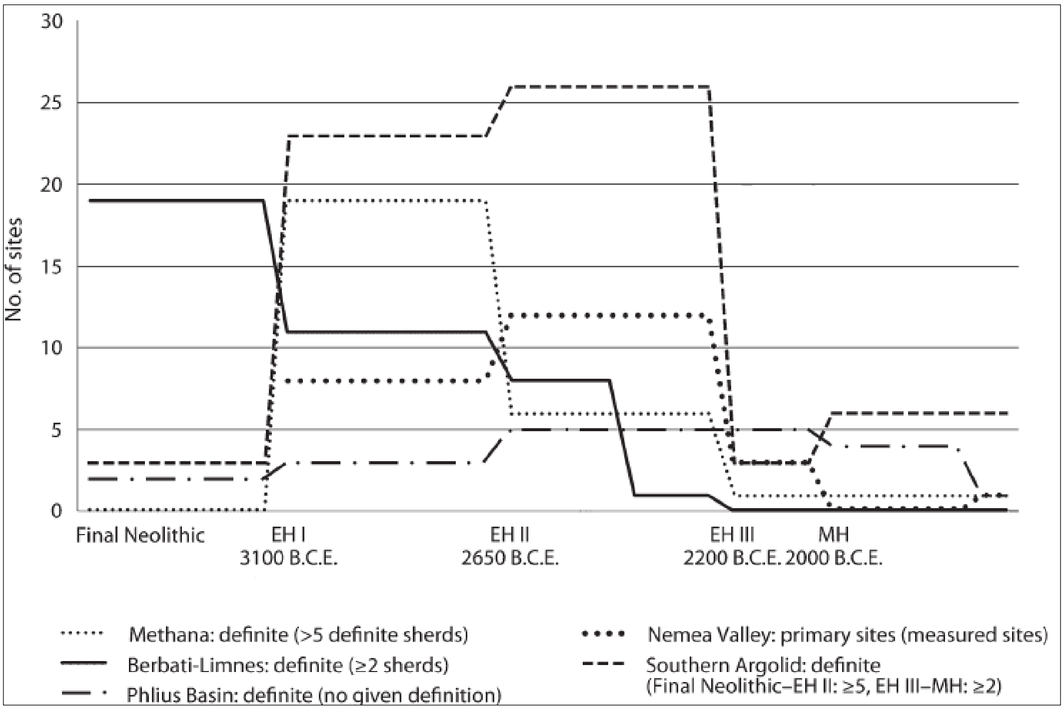

Figure 15. Change in number of sites in the survey areas through time in the northeastern Peloponnese (Weiberg and Finné, 2013, Fig. 1).

Weiberg and Finné (2013) argue that suggested factors for the transition that are environment, climate and migration were not satisfyingly evident in both archaeological and palaeoenvironmental records. They suggest that a perspective from "regional identity" that depends on common shared values and ideas in a given society in a given region could shed light on the changes at the transition at 2200 BC. Substantial changes in settlement structure, for example, free-standing buildings instead of agglomerated houses and monumental architecture including destruction of possible administrative buildings and construction of a tumulus on the remnants of the House of the Tiles at Lerna were intentional choices of the society lived in the northeastern Peloponnese and were related to change in understanding of social hierarchies and personal decisions and so on. The authors argue as well that the transition at 2200 BC and its impacts should not be seen as a collapse but a release or restructuring (Weiberg and Finné, 2013).

Wiener (2014), however, sees major cultural change and destruction and abandonment of sites at the transition ca. 2200 BC as a result of the climate change and interpret these as the collapse of the complex societies. He also adds that the first evidence for horses in Greece comes from the EH III and that (semi-)nomadic communities might have arrived in Greece during this period as well.

2.3.8. The Cyclades

In the Cyclades (Figure 16), the transition from the late EBA II (Anatolianising/Kastri Group phase) to the Middle Cycladic (MC) period is defined as a gap. The end of the late EBA II/beginning of the EBA III is dated to ca. 2200 BC conventionally. However, results of recent radiocarbon analysis on samples from Dhaskalio that is one of the rare sites evidencing the transition of EBA II-EBA III, pulled this transition back to ca. 2300 BC (Renfrew et al., 2012). Then, the suggested gap is situated in the 23rd century BC (Manning, 2017).

According to Wiener (2014), societies in the Cyclades were affected by the impacts of the drying event as well. After the EBA III, many sites were abandoned and seals and seal impressions previously present at several sites such as Markiani on Amorgos and Aplomata on Naxos disappeared. Fortification on hilltops at survived sites such as Kastri on Syros and Panormos on Naxos seem to be for people and food protection. In addition, sling stones and a spearhead found at Panormos might point to violent conflicts over limited resources. On the other hand, some sites on Kos were already deserted by the end of the EBA II and not inhabited in the EBA III as well, apart from Koukos. In addition, armed hunter-warrior male figurines appeared for the first time at the end of the Early Cycladic II, ca. 2300-2200 BC, and might support the destructions and conflicts after the climate change (Wiener, 2014).

On the other hand, Kouka (2013) argues that there was no break at the transition from the EBA to the MBA in the Cyclades. The settlement at Heraion on Samos, the largest island site in the eastern Aegean in the EBA, is located in one of the largest plains with high water availability on the island. In the late EBA II, the residential Cyclopean Building, pottery including fine drinking cups and imported wares and small finds prove high socio-political characteristics of the site that was surrounded by fortification walls since the beginning of the EBA. The EBA III was testified with evidence as well. In the MBA, the site moved a few meters away from the centre of the EBA settlement and continued with fortifications. In this period, pottery assemblage shows interactions with mainland Greece, western Anatolia and Crete that suggests the importance of the settlement in the MBA (Kouka, 2013). Kouka (2013) argues that there was no gap at the transition from the EBA to the MBA and defines this transition as an introversion. Moreover, she adds that absence of the MBA culture at several sites, for example, Skala Sotiros on Thasos and Asomatos on Rhodes or the limited MBA occupation at Poliochni on Limnos resulted from shifting to adjacent sites (Kouka, 2013).

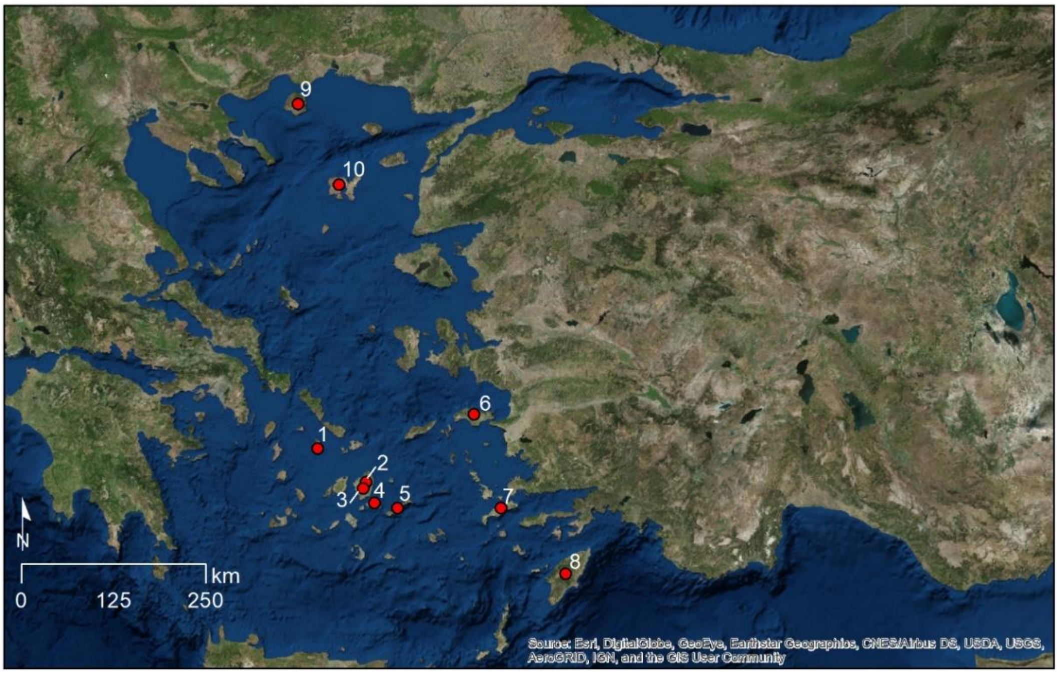

Figure 16. Map showing sites from the Cyclades and several other islands that provide archaeological evidence for the period of the 4.2 ka BP event in the Aegean. 1. Kastri on Syros, 2 and 3. Aplomata and Panormos on Naxos, 4. Dhaskalio, 5. Markiani on Amorgos, 6. Heraion on Samos, 7. Koukos on Kos, 8. Asomatos on Rhodes, 9. Skala Sotiros on Thasos, 10. Poliochni on Limnos.

2.3.9. Crete

The major developments on Crete (Figure 17) started after 2200 BC (Early Minoan III-Middle Minoan IA; hereafter EM and MM respectively), in contrast to the Cyclades and the Greek mainland that suffered from the marked decline until ca. 2000 BC (Manning, 2017; Wiener 2014).

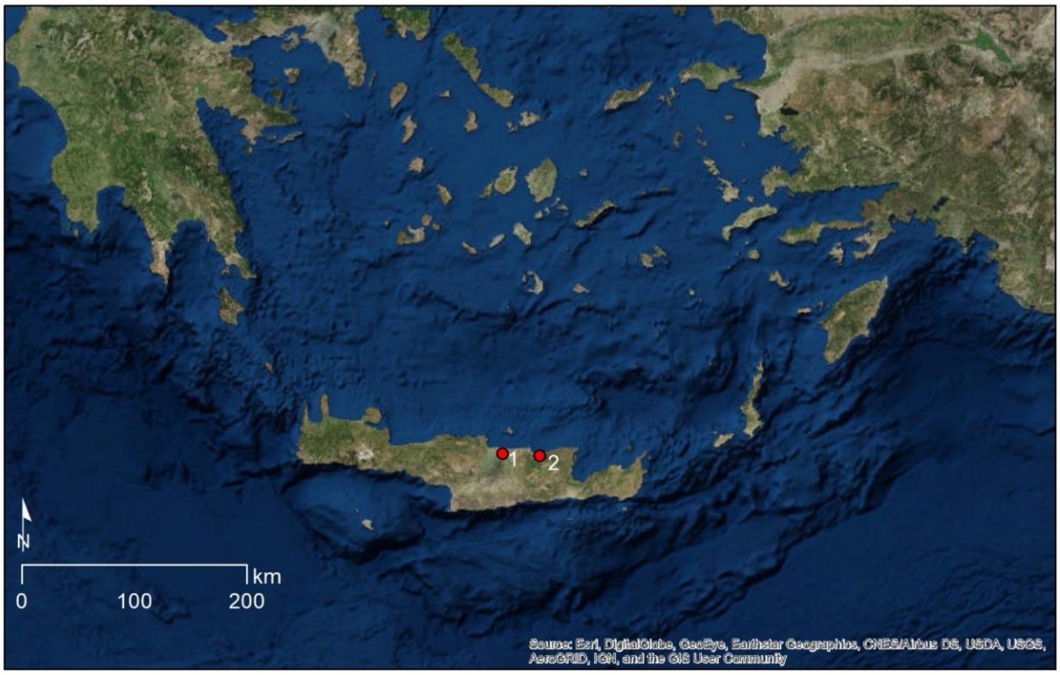

Figure 17. Map showing sites that provide archaeological evidence for the period of the 4.2 ka BP event on Crete. 1. Knossos, 2. Malia.

In the EM II, settlements at important agricultural areas such as Knossos and Malia expanded and urban characteristics including monumental buildings and representative or administrative systems practicing sealing developed. However, in comparison to the Aegean, hierarchical development and social complexity were limited in the late EBA II. Due to the fact that, during this period, Crete, on the edges of both the Near Eastern and Aegean Bronze Age systems, was not a part of long-distance trade and was largely isolated. At the end of the EM II, several sites were destroyed and abandoned in the northeast that involved in external trade networks and in the in the marginal regions in the east and south that today suffer from water scarcity. All these site destructions and abandonments seem to be linked to the 4.2 ka BP drying event and its impacts. Populations from deserted areas moved to areas with high water availability, sustainable agricultural practices and developed socio-political networks that resulted site size expansion and nucleation in settlements during the EM III-MM IA. In this period, at Knossos, for example, the site size expanded to three to six times of its size in the EM I-II and became a-20-37 ha town. Therefore, the 4.2 ka BP event, ca. 2200 BC, plausibly contributed to the high social complexity and hierarchical developments on Crete in the EM III-MM IA. In the MM, increased social complexity, developments in sailing technology and perhaps need for more raw material led the Cretan society became a significant power in the eastern Mediterranean. (Manning, 2017).

2.4. Cultural Change at the End of the 3rd Millennium BC and Its Relationship to the 4.2 ka BP Climatic Change

Major changes in the eastern Mediterranean are clearly evident at transition from the EBA to the MBA towards the end of the 3rd millennium BC. This transitional period is characterized in many places by changes in settlement patterns, site destructions and abandonments, changes in material culture (Wossink, 2009), deurbanization, political decentralization and economic decline (Schwartz, 2017).

Societal collapse, major site abandonments and destruction are clearly evident in the Khabur Plains as a whole, partially in the Balikh Valley, the east of Ebla, Hama and Qatna in western Syria, in southern Levant, northeastern Peloponnese, Cyclades and on Crete. The common point of abandoned and/or destroyed sites mentioned throughout the text is that they were all situated in marginal areas, arid or semi-arid areas that were already threatened by interannual precipitation variability and with emerging drought conditions societies could no longer practiced dry agriculture and deserted the sites to move to refugia or to shift to pastoralist economy. Major settlements, settlements close to any permanent rivers, springs or water sources, for example, Qatna with a 70-ha artificial lake (Weiss, 2015) continued to the following period, the MBA, without a major break. In particular on Crete, besides abandonments of smaller sites, major settlements further flourished at this transition.

Responses of the eastern Mediterranean societies in the period of abrupt climate change are (Weiss, 2015; Wossink, 2009):

1. Political collapse and regional abandonments in arid and semi-arid regions, for example, in the Khabur Plains and the east of Ebla, Hama and Qatna;
2. Ensuing habitat-tracking to refugia with permanent water resources, rivers springs and so on, for example, movement of Amorite pastoralists to southern Mesopotamia and the Orontes River region and nucleation into larger settlements in the Balikh Valley;
3. Nomadisation of sedentary dry agriculturalists in marginal areas, for example, shifting to pastoralism;
4. Establishments of social network to cooperate with populations practicing different subsistence strategies, for example, Amorites in the early 2nd millennium BC.

Coincidence of the 4.2 ka BP event abrupt climate change and the transition from the EBA to the MBA in the eastern Mediterranean and beyond do not necessarily mean that they were directly related and the cultural change was a consequence of the climate change. However, more or less synchronously and one moment in time (Schwarz, 2007), widespread changes were directly linked to the decline in agricultural production and water availability. This clearly points to a common factor. Therefore, the 4.2 ka BP event, clearly evident by palaeoenvironmental records, and its drought impacts seem reasonable factors that could lead to such major changes. However, of course, it is not possible to say that the changes were the direct results of the event. Instead, it must have accentuated or exaggerated internal weaknesses (Rosen, 2007). Spatial and temporal variety of responses suggest and further support that the impacts of the climate change mainly depended on political, economic and social structures of the societies.

In order to understand how climatic change impacted societies and what shaped the responses of them, there are some important points to consider. First of all, the chronological synchronization of the climate change and cultural change are of primary importance. The 4.2 ka BP event is a period of ca. 300 years. Coincidence of any cultural change with the event period is most likely. Because, human communities may experience major changes and feel the impacts even in decades. Moreover, relative dating is quite common in the discipline of archaeology which can be sometimes misleading as in the case of the coastal Levant (Höflmayer, 2015). Therefore, comparing high resolution palaeoenvironmental analyses with radiocarbon or OSL (optically stimulated luminescence) dated archaeological remains can promise the most reliable information on temporal synchronization. In addition, especially, stable isotope analysis of plant remains has a great potential to reconstruct water availability and environmental conditions as in the case of Ebla and Qatna (Fiorentino et al., 2012). Although it is scarce, analysis of human and animal bones is also capable of to present palaeoenvironmental conditions, palaeodiet and migration including from lowlands to highlands or vice versa (Mashkour, 2003). Approaching the subject through studying changes in settlement patterns and demographic reconstructions seems reliable and promising as shown in the Balikh Valley (Wossink, 2009; 2010) and northeastern Peloponnese (Weiberg and Finné, 2013). On the other hand, each settlement is unique and act possibly independently in a given region (Kouka, 2013). Generalizations can be sometimes misleading. On the other hand, each independent site should be interpreted considering local and then, larger area where it is located and its relations to neighbouring regions through time (Anderson et al., 2007).

CHAPTER 3

PALAEOENVIRONMENTAL EVIDENCE FOR THE 4.2 KA BP EVENT IN ANATOLIA

3.1. The Climate in Anatolia throughout the Holocene and the 4.2 ka BP Event

Palaeoenvironmental and palaeoclimatic research focusing on the Holocene is relatively limited in Turkey. However, synthetic analyses of diverse proxies from Turkey and the wider eastern Mediterranean region clearly suggest that climatic evolution in Turkey has experienced similar climatic sequences with the eastern Mediterranean region in macro scale (Roberts et al., 2008; Finné et al., 2011) – as it is today. Therefore, a number of research on climatic data sources such as lacustrine, terrestrial and marine sediments, pollen and speleothems from different sites in Turkey shows that humid conditions, i.e., high water levels prevailed in the early Holocene (before ca. 6500 BP) and climate has become drier, i.e., low water level and open vegetation throughout the mid- and late Holocene (Roberts et al., 2001; Roberts et al., 2011; Kuzucuoğlu et al., 2011; Göktürk, 2011). Similar to the eastern Mediterranean proxies, rapid climate changes (RCCs), including the 4.2 ka BP event, were recorded by several proxies across Anatolia as well.

As discussed in the previous chapter, the 4.2 ka BP event is an RCC occurred at 4200-3800 BP (Mayewski et al., 2004). The RCC is characterized by a series of unpredictable short dry spells across a ca. 400 years period (Wossink, 2009). Fluctuations in rainfall patterns, in particular, decrease in amount of yearly average rainfall in the eastern Mediterranean and adjacent regions (Roberts et al., 2011) are mainly determined by the North Atlantic Oscillation (NAO) that brings winter precipitation to the region (Lionello et al., 2006). Factors behind the 4.2 ka BP RCC are still not known but it disturbed apparently the NAO. Therefore, it caused a decrease in the seasonal precipitations and deeply affected rainfed agricultural practices in the eastern Mediterranean (Staubwasser & Weiss, 2006).

Turkey's modern climate has been well studied compared to its palaeoclimate. Considering that no dramatic changes occurred in topography and landforms, therefore, modern climatic conditions of Turkey can form a reasonable basis for a better understanding of palaeoclimatic evolution throughout the Holocene and in particular, the impacts of the 4.2 ka BP event.

3.1.1. Modern Climate in Anatolia

The climate in Anatolia shows Mediterranean characteristics in macro scale but exhibits local variations due to the diverse landscape and the irregular topography. The Black Sea and Mediterranean basins, the Pontic Mountains and the Taurus Mountains running parallel to the coast and the central Anatolian plateau with a mean elevation of 1130 m are the main physiographic factors affecting Turkey's climate (Figure 18; Türkeş, 1996; Sariş et al., 2010). The mountain ranges in the south and the north act as natural barriers to humid air masses and they, therefore, cause milder conditions with high precipitations in coastal regions and continental climate with less precipitations on the Anatolian plateau (Sensoy et al., 2008).

The Earth's climate systems are affected by the ocean-current system majorly (Bozyurt & Özdemir, 2014). It affects the movement of humid air masses and therefore, can cause considerable changes in rainfall patterns and variations in climate. For Turkey, clouds bringing winter rainfall are primarily originated from the Atlantic Ocean and the Mediterranean Sea (Türkeş, 1996). In particular, fluctuations in the Atlantic Ocean are overwhelmingly influential on the precipitation and temperature variability in Turkey, since they control winter precipitations that constitute the major amount of the annual rainfall.

Figure 18. Map showing main physiographic factors that affect the climate in Anatolia.

Fluctuations in the NAO can make the climate drier or wetter than normal values in the region. Impacts of the NAO fluctuations are more explicit in western and mid-Turkey (Türkeş & Erlat, 2003). On the other hand, its impacts weaken in lower longitudes in the Mediterranean and southeastern Anatolian regions (Bozyurt & Özdemir, 2014). Moreover, the Black Sea and eastern Anatolian regions (Türkeş & Erlat, 2003) response to the NAO weakly or insignificantly. On the other hand, Cullen and deMenocal (2002) revealed strong relations between the NAO and changes in streamflow of the Tigris and the Euphrates Rivers. In short, it seems that extreme NAO phases affect western and mid-Turkey more and can cause considerable disturbances in precipitation and its uniformity.

Turkey has a highly variable precipitation pattern (Türkeş, 1996; Türkeş & Tatlı, 2009; Sariş et al., 2010). Türkeş (1996) defined seven different climate zones based on the seasonality of precipitation (Figure 19, Table 1). The Marmara (MRT) and Black Sea (BLS) regions have a uniform rainfall. Marmara has warm and light rainy summers and the Black Sea, having temperate conditions, receives maximum rainfall in autumn. The Coastal Aegean and Mediterranean (MED) regions receive seasonal rainfall and both have rainy winters and springs and hot and dry summers.

The Inner Aegean (MEDT) region, where mountains extend perpendicular to the coast and let humid air masses pass through the interior, has a moderate rainfall in winter and spring. In semi-arid regions of central Anatolia (CCAN) and eastern Anatolia (CEAN), major rainfall occurs in spring and winter in the mid- and early summer in eastern Anatolia. Southeastern Anatolian (CMED) region receives seasonal rainfall in winter and spring and has hot and dry summers.

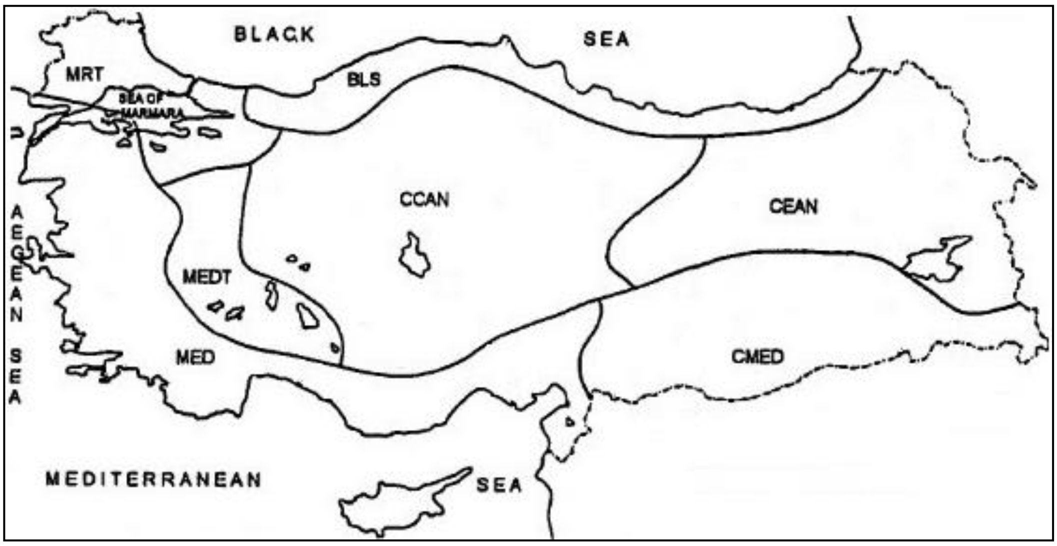

Figure 19. Map showing climatic zones in Turkey based on the seasonality of precipitation (Türkeş, 1996, fig. 2). MRT: Marmara Transition, MED: Mediterranean, MEDT: Mediterranean Transition, BLS: Black Sea, CCAN: Continental Central Anatolia, CEAN: Continental Eastern Anatolia, CMED: Continental Mediterranean.

The vulnerability and the adaptive ability of the regions to a changing climate including toward drier conditions depend on the reliability of mean annual rainfall. A region having a more stable and uniform rainfall regimes throughout the year is, therefore, more resistant to unpredictable changes. Each region, with respect to the seasonality of rainfall, responds differently to climatic change, in particular to arid conditions (Türkeş, 1996). Türkeş (1996) provides information on rainfall variability by calculating coefficients of variation across the country ranging between ca. 14% and ca. 36% (Figure 20, Table 1). The coefficient of 20% is the threshold value for uniformity of the rainfall such that regions with coefficients above 20% have a more variable rainfall regime and tend to experience more severe and frequent droughts. On the other hand, regions with coefficients below 20% receive more uniform rainfall and are more resistant to a potential drought event. According to Figure 20 and Table 1, rainfall regimes are more stable in the north than in the south. In the arid and semi-arid southeastern Anatolia (CMED) and Mediterranean (MED) regions the yearly average rainfall is highly variable with almost all coefficients above 25%. On the other hand, the Black Sea (BLS) region with coefficients lower than 20% is the only region in Turkey that receives highly reliable rainfall. The rest of the regions (80% of the country) have coefficients of more than 25% (Türkeş, 1996).

Table 1. Regions in Turkey with mean annual rainfall and reliability of rainfall based on their climate zones.

Region	Climate Zone	Mean Annual Rainfall (Türkeş, 1996)	Reliability of Rainfall (based on coefficients of variation) (Türkeş, 1996)
Marmara	MRT	600-800 mm	Variable (> 20 %)
Black Sea	BLS	> 1000 mm	Uniform (< 20%)
Coastal Aegean	MED	> 800 mm	Variable (> 20 %)
Mediterranean	MED	> 800 mm and up to 1500 mm on the slopes of Taurus Mountains	Variable (> 20 %)
Inner Aegean	MEDT	600-800 mm	Variable (> 20 %)
Central Anatolia	CCAN	350-500 mm	Variable (> 20 %)
Eastern Anatolia	CEAN	> 500 mm	Variable (> 20 %)
Southeastern Anatolia	CMED	400-800 mm (increases from south to north)	Variable (> 20 %)

Türkeş and Tatlı (2009) show that standardized precipitation index (SPI) probabilities, a probability index to characterize drought events, decrease from south to north. It means that deviations from normal precipitation values are much less in northern Turkey in compliance with the precipitation uniformity of the Black Sea region. Among SPI probabilities under extremely dry conditions, the Mediterranean coast and southeastern Anatolia have the highest ones, that have an unstable precipitation regime, and the Black Sea region with its highly reliable and uniform precipitation pattern has the lowest probabilities.

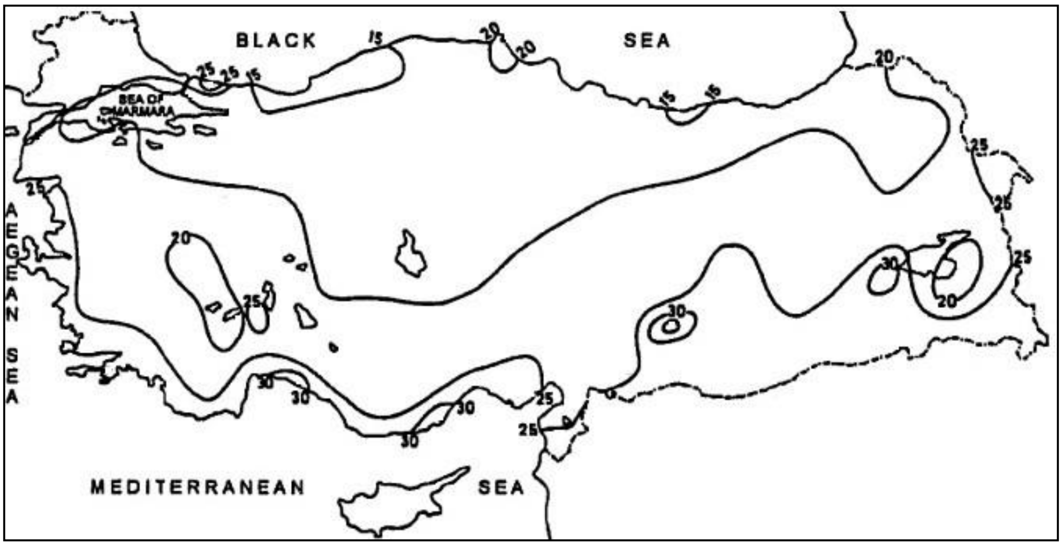

Figure 20. Map of coefficients of variation of Turkey (in percent) (Türkeş, 1996, Fig. 3).

A study aiming to characterize precipitation patterns across Turkey through classification of seasonality and magnitude of precipitation by Sariş et al. (2010) substantially supports the results by Türkeş (1996) and Türkeş and Tatlı (2009). Seasonality of precipitation differs greatly in coastal regions and inland (Figure 21).

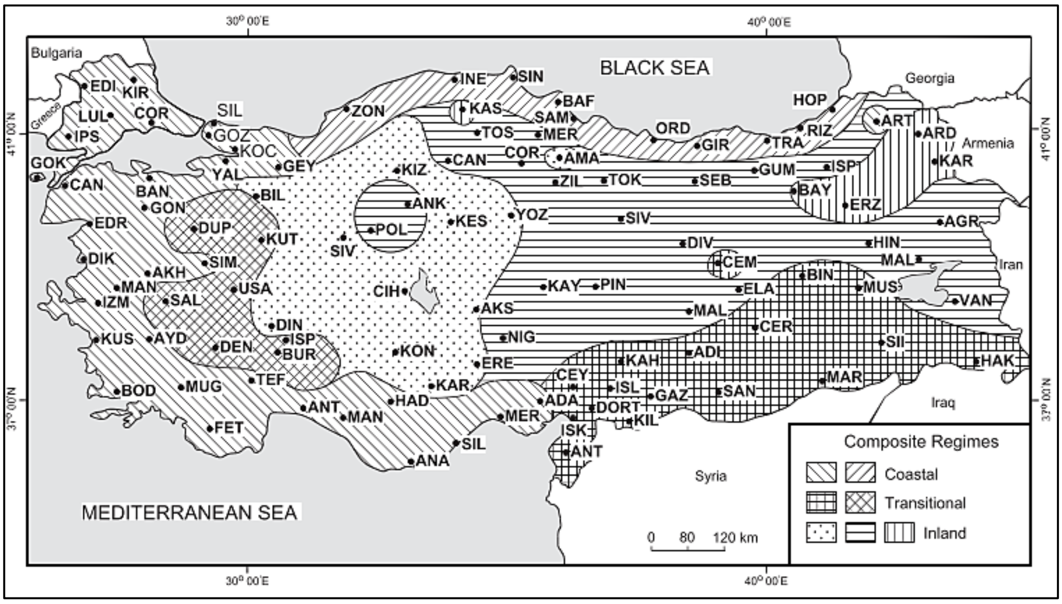

Figure 21. Map showing simplified precipitation regime across Turkey with abbreviated station names (Sariş et al., 2010, fig. 8).

According to the information above, Turkey seems to be quite sensitive to climatic changes and quite vulnerable to changes in rainfall patterns and drought conditions, with the exclusion of the Black Sea region. The most vulnerable regions seem to be the Mediterranean and southeastern Anatolian regions with coefficients of variation above 25% and the highest SPI probabilities under extremely dry conditions, although they have a mean annual rainfall of more than 800 mm (up to 1500 mm) and 400-800 mm that increases from south to north respectively. These regions are followed by central and eastern Anatolian regions with coefficients of variation above 20% and a mean annual rainfall of 350-500 mm and more than 500 mm respectively. Aegean and Marmara regions with a mean annual precipitation of 600-800 mm and coefficients of variation above 20% seem overall relatively more resistant to drought.

Palaeoclimatic data shows that the 4.2 ka BP event was recorded by Turkish proxies as well. Since the event disturbed the NAO, it caused fluctuations in the precipitation pattern across Anatolia. According to explanations above, regarding the climate and precipitation variability across Turkey, all regions, except the Black Sea region, must have experienced the impact of the event in varying degrees of severity. However, when interpreting the event and its impacts, besides general climatic trends, the possible contribution of local landscape and topography to climatic conditions should be kept in mind.

3.2.Palaeoenvironmental Evidence for the 4.2 ka BP Event in Anatolia

Several palaeoclimatic analyses have recorded the 4.2 ka BP event across Anatolia. The sites with evidence, mentioned in the text, are presented in Figure 22 and a summary of essential information regarding the event in the sites are in Table 18 in Appendix B.

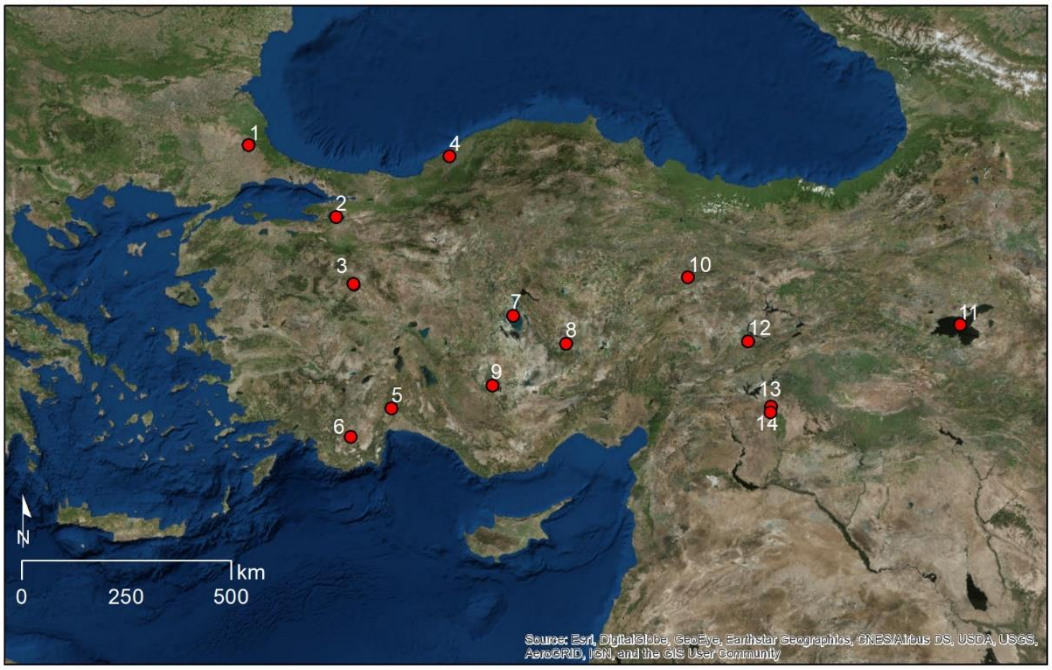

Figure 22. Map showing sites with palaeoenvironmental evidence for the 4.2 ka BP event in Anatolia that are discussed in the text. 1. Uzuntarla Cave, 2. Lake İznik, 3. Kureyşler Valley, 4. Sofular Cave, 5. Kocain Cave, 6. Karagöl, 7. Lake Tuz, 8. Nar Lake, 9. Çarşamba Alluvial Fan, 10. Tecer Lake, 11. Lake Van, 12. Arslantepe Höyüğü, 13. Göbekli Tepe, 14. Kazane Höyük.

3.2.1. The Marmara Region (Northwestern Anatolia)

Uzuntarla Cave, Kırklareli, presents a climatic record for the last ca. 4100 years. The analysis shows less rainfall and increased temperature by a decrease in $\delta^{13}C$ and an increase in $\delta^{18}O$ values between ca. 2050 calBC and 1950 BC (Figure 23; Göktürk, 2011).

Sediment cores from Lake İznik, a freshwater lake near Bursa, present a climatic reconstruction for the last 4700 years. Analysis of the samples shows that Lake İznik had become increasingly arid with fluctuations of wet/dry periods throughout the sequence. One of the arid periods between two humid periods occurred between 4.4 and 4.2 ka calBP with low lake levels and very low or lack of deposition and/or erosion (Figure 24, Zone 2; Ülgen et al., 2012). In addition, analysis of pollen assemblages from the lake spanning the last ca. 31,000 years shows that forest retreatment and a decrease in pollen concentration and influx occurred at ca. 4.1 ka calBP (Figure 25). These changes might be linked to the 4.2 ka BP event (Miebach et al., 2016).

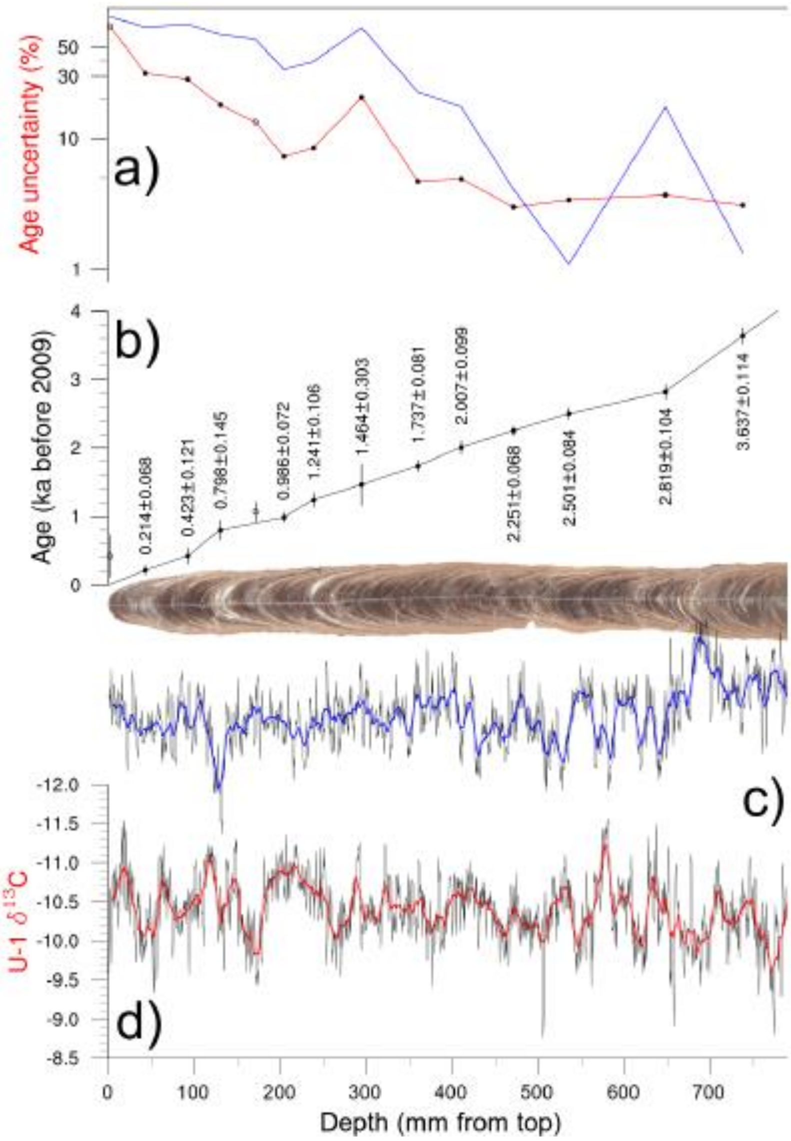

Figure 23. Results of Th dating (a and b) and stable $\delta^{18}O$ (c) and $\delta^{13}C$ (d) isotope analyses on stalagmites from Uzuntarla Cave (Göktürk, 2011, Fig. 4.2).

Analysis on land sediments from the Kureyşler Valley, Kütahya, provides a climatic record of ca. 14,000 years. Analysis results show a negative shift in $\delta^{18}O$, a decrease in total organic carbon and a significant shift in magnetic susceptibility curve that point to a severe drought ca. 4200 calBP (Figure 26). Moreover, pollen analysis with a decrease in Pinus pollen and a considerable increase in Poaceae pollen supports the severe drought event (Figure 27; Ocakoğlu et al., 2019).

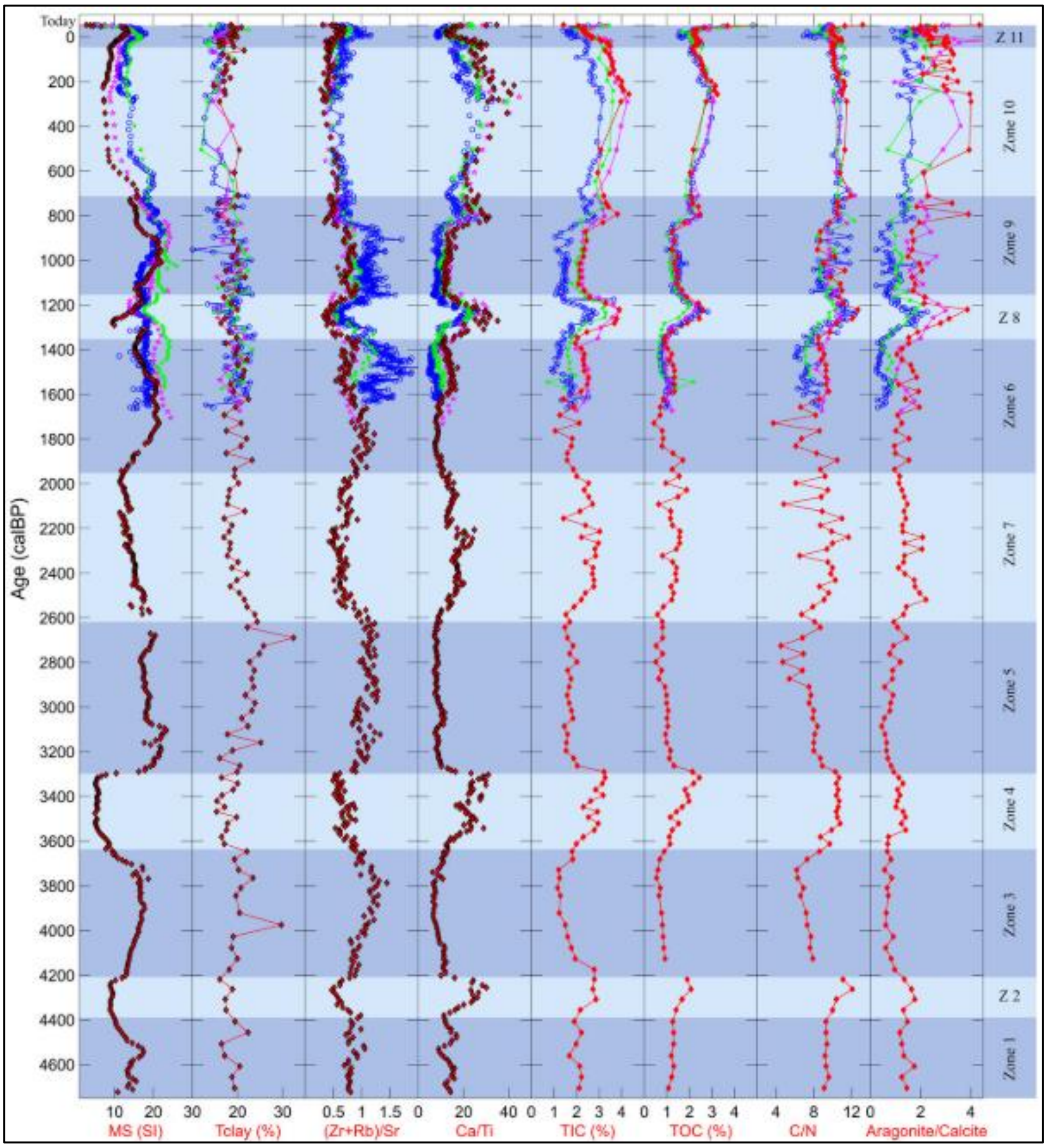

Figure 24. Changes in sediment parameters for the last ca. 4700 calBP, Lake İznik (Ülgen et al., 2012, Fig. 7). Impacts of the 4.2 ka BP event is presented in Zone 2. Diamonds, circles, stars, and asterisks represent different cores. MS: Magnetic Susceptibility, Tclay: Total clay, TIC: Total inorganic carbon, TOC: Total organic carbon, C/N: Carbon/Nitrogen.

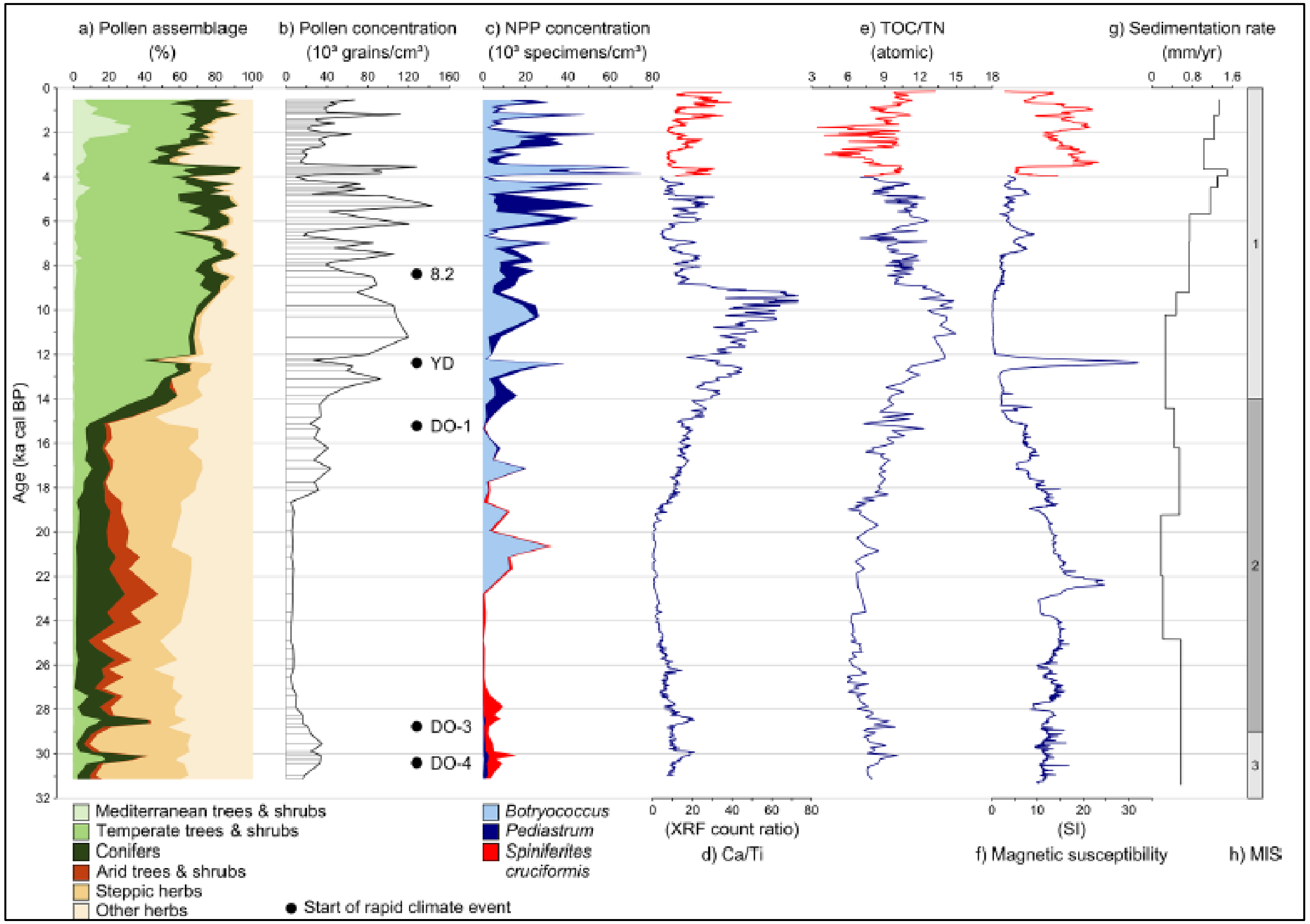

Figure 25. Changes in different proxies through time in sediment from Lake İznik (Miebach, et al. 2016, Fig. 5). NPP: Non-pollen palynomorph, TOC/TN: Total organic carbon/Total nitrogen, MIS: Marine isotope stages, YD: Younger Dryas, DO: Dansgaard-Oeschger, 8.2: The 8.2 ka BP event.

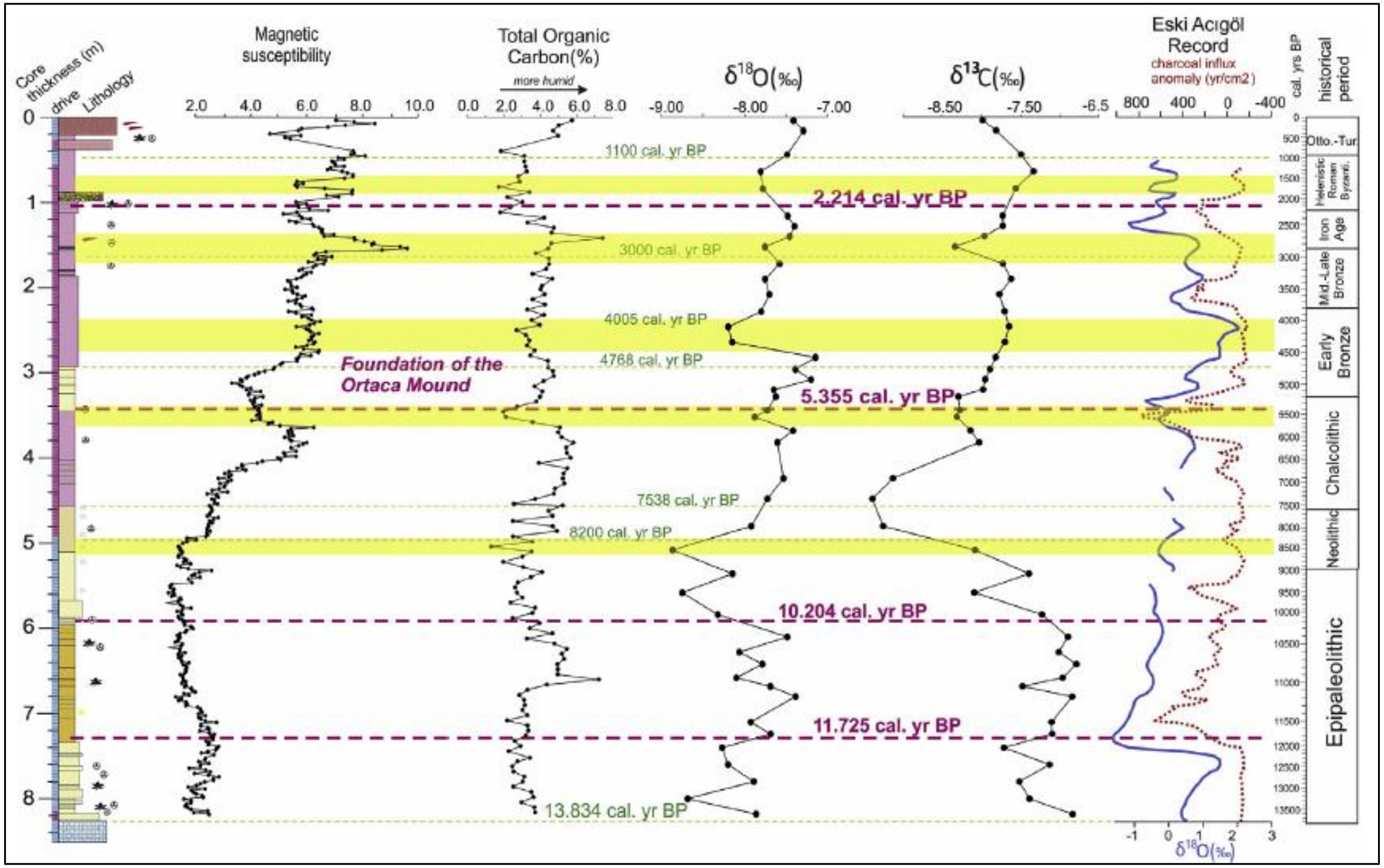

Figure 26. Changes in non-pollen proxies in sediment samples from the Kureyşler Valley through time in comparison with the record of Eski Acıgöl (Ocakoğlu et al., 2019, Fig. 7). Yellow bands: cold and wet events.

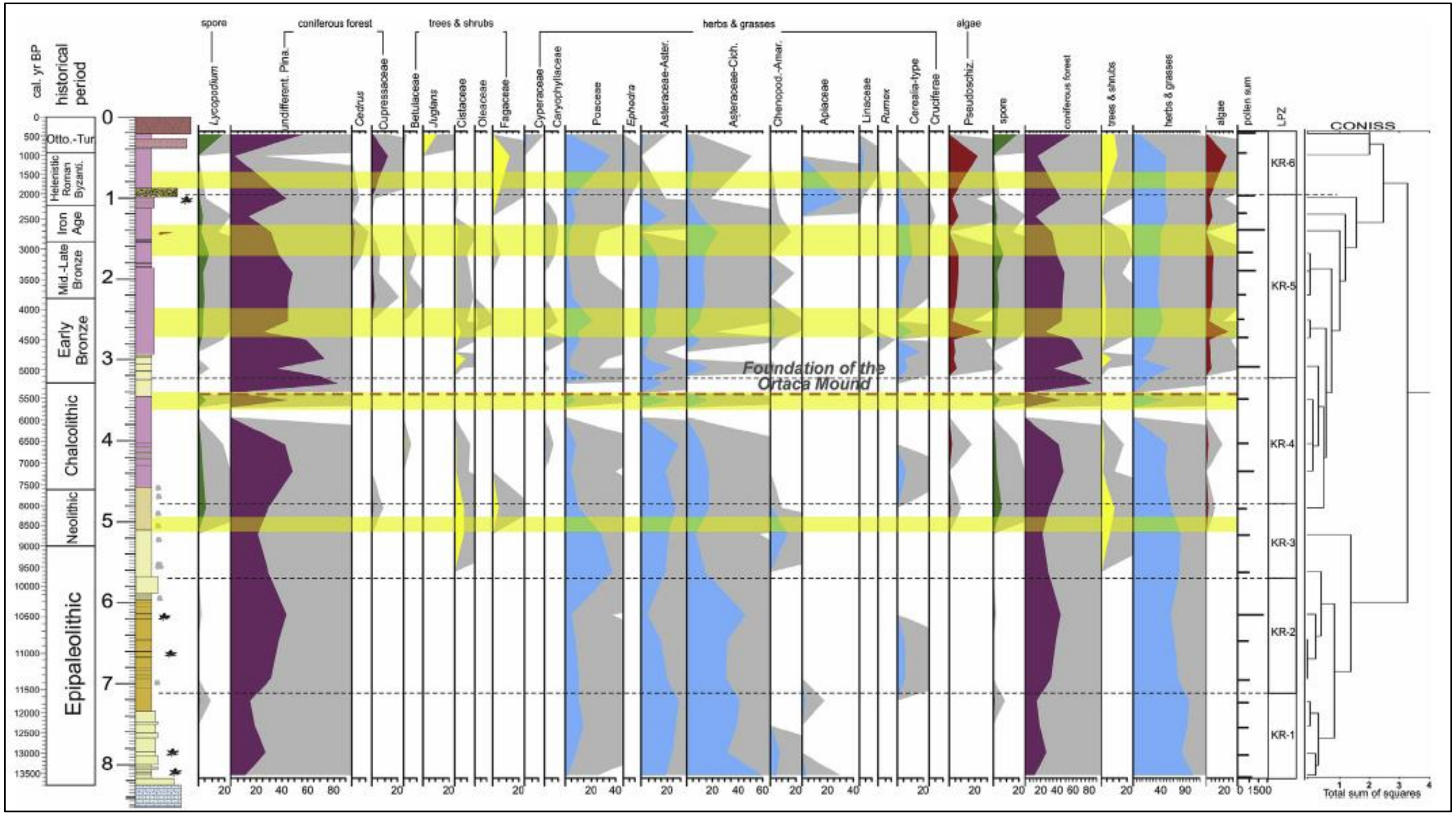

Figure 27. Results of pollen analysis on sediments from the Kureyşler Valley (Ocakoğlu et al., 2019, Fig. 8). Yellow bands: cold and wet events.

3.2.2. The Black Sea Region (Northern Anatolia)

Sofular Cave, in Zonguldak, on the foothills of Akçakoca Mountains and quite close to the Black Sea, provides a climatic record for the last 50,000 years. Analysis on stalagmites shows that the 4.2 ka BP event and as well as, other events such as the 5.2 ka BP and 3.2 ka BP were clearly not recorded (Göktürk et al., 2011).

3.2.3. The Mediterranean Region (Southern Anatolia)

Analysis of a stalagmite from Kocain Cave, Antalya, provides a reconstruction of winter temperatures in the eastern Mediterranean for the last ca. 5700 years. The results show that a prolonged period of warm winters between ca. 2600 and 900 BC was interrupted by two short term coolings. The first one that occurred at ca. 2260 BC following a warm period between ca. 2580 BC and 2260 BC and lasted for ca. 80 years took place within the period of the 4.2 ka BP. However, records from the cave are interpreted as a cold event with a drop in $\delta^{13}C$ values (Figure 28) and an increase in $\delta^{18}O$ value (Göktürk, 2011).

Palaeoenvironmental investigation of sediments from Karagöl (drained) and Avlan Gölü, intra-montane lakes that are located in a valley in the Elmalı Basin, Antalya, suggests that between 3510 BC and 1000 BC lakes were larger with high lake levels due to moist climate and the peak that occurred at ca. 2000 BC (Figure 29). This peak most likely made the region unfavourable for human habitation that is supported by archaeological studies showing that after this period the region had been abandoned for a long period of time between ca. 2000 BC and 1150 BC (Foss, 2006). This peak in lake level in the basin surrounded by mountain massifs of Akdağlar (3016 m) and Beydağları (3086 m) where permanent snow lines are 3500 m and 3600 m respectively (Çiner, 2003), might be resulted from higher snowmelt from the mountain massifs, due to high temperatures, i.e., the 4.2 ka BP dry event (Massa & Şahoğlu, 2015).

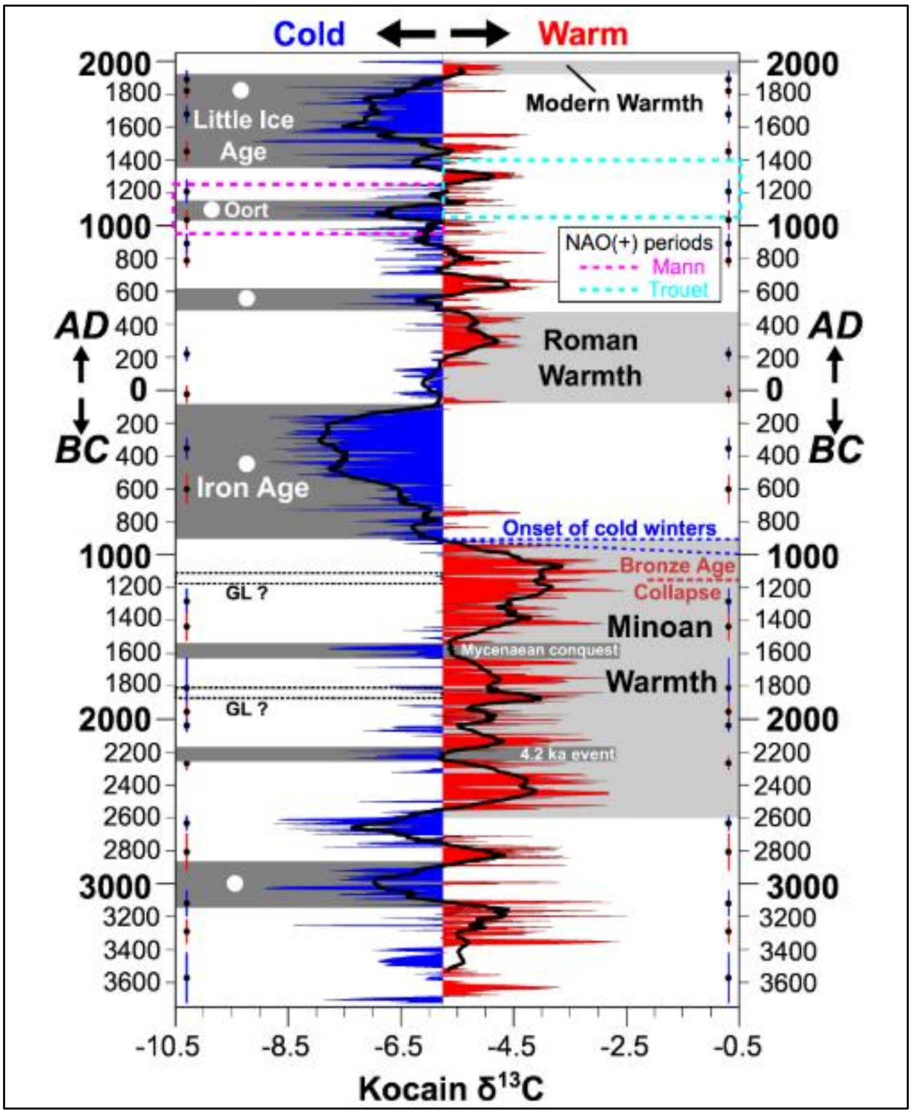

Figure 28. Changes in $\delta^{13}C$ values through time, Kocain Cave (Göktürk, 2011, Fig. 3.7). Some important events including the 4.2 ka BP event are marked with grey bars.

Phase	*Period*	*Summary*
A	8600 - 3510 B.C.	Thermal maximum; marshy rather than lacustrine environment.
B	3510 - 1000 B.C.	Moist climate; larger and deeper lakes.
C	1000 B.C. - A.D. 335	Drop in lake levels, and a shift from lake area to marshland.
D	A.D. 335 - 900	Warmer climate, additional evaporation and still lower and saltier lake levels.
E	A.D. 900 - present	Modern conditions; moderately higher lake levels (until their drainage in the 1960s and 1970s).

Figure 29. Phases of the lakes in the Elmalı Basin through the Holocene (Foss, 2006, Table 1).

3.2.4. Central Anatolia

Lake Tuz, Aksaray, provides a climatic record for the last ca. 20,000 years. The lake experienced two major formation states of alluvial fans at 7000-5500 BP and 2500-2000 BP. In between, several minor states took place and one of them occurred, probably, at 4300 BP (Kashima, 2002). In my opinion, this minor formation state might be originated from the low inflow of water bodies due to increased aridity.

Nar Lake, a maar lake, Aksaray, provides a ca. 13,000-year-long climatic record. Analysis of samples from the lake shows that dry conditions prevailed with high, dolomite content that is above 20%, between ca. 4300 and 4150 BP (Figure 30; Dean et al., 2015).

Geological analysis of sediment cores that were taken through, and adjacent to 17 mounds including Çatalhöyük, in the Çarşamba Alluvial Fan, Konya, provides information on alluvial deposits throughout the Holocene. Alluvial deposits consist of Lower Alluvium, ca. 9500-4500 calBP, and Upper Alluvium that started at ca. 4200 BP and it means that there is no deposition between the layers (Figure 31). The composition of the Upper Alluvium shows that climate shifted to drier conditions (Boyer et al., 2006). Therefore, the hiatus between the layers where alluvial deposition was interrupted could be related to drought caused by the 4.2 ka BP event. Settlement distribution and pattern through time show that the number of settlements considerably decreased from the EBA II, ca. 2800-2400 BC, to the EBA III, 2400-1950 BC (Massa & Şahoğlu, 2015).

A core from Tecer Lake, Sivas, provides a climatic reconstruction for the last 6000 years. Mineralogic analysis of cores from the lake shows that the lake was increasingly drying between ca. 4950 BP and 4300 BP. A humid period with high lake levels at ca. 4480-4300 ends with a 450-year long hiatus from ca. 4300 BP to 3850 BP (ca. 2350-1950 BC) when dry conditions prevailed and lake level dropped suddenly (Figure 32). This hiatus, therefore, resulted from lack of sediment deposition due to dry conditions (Kuzucuoğlu et al., 2011).

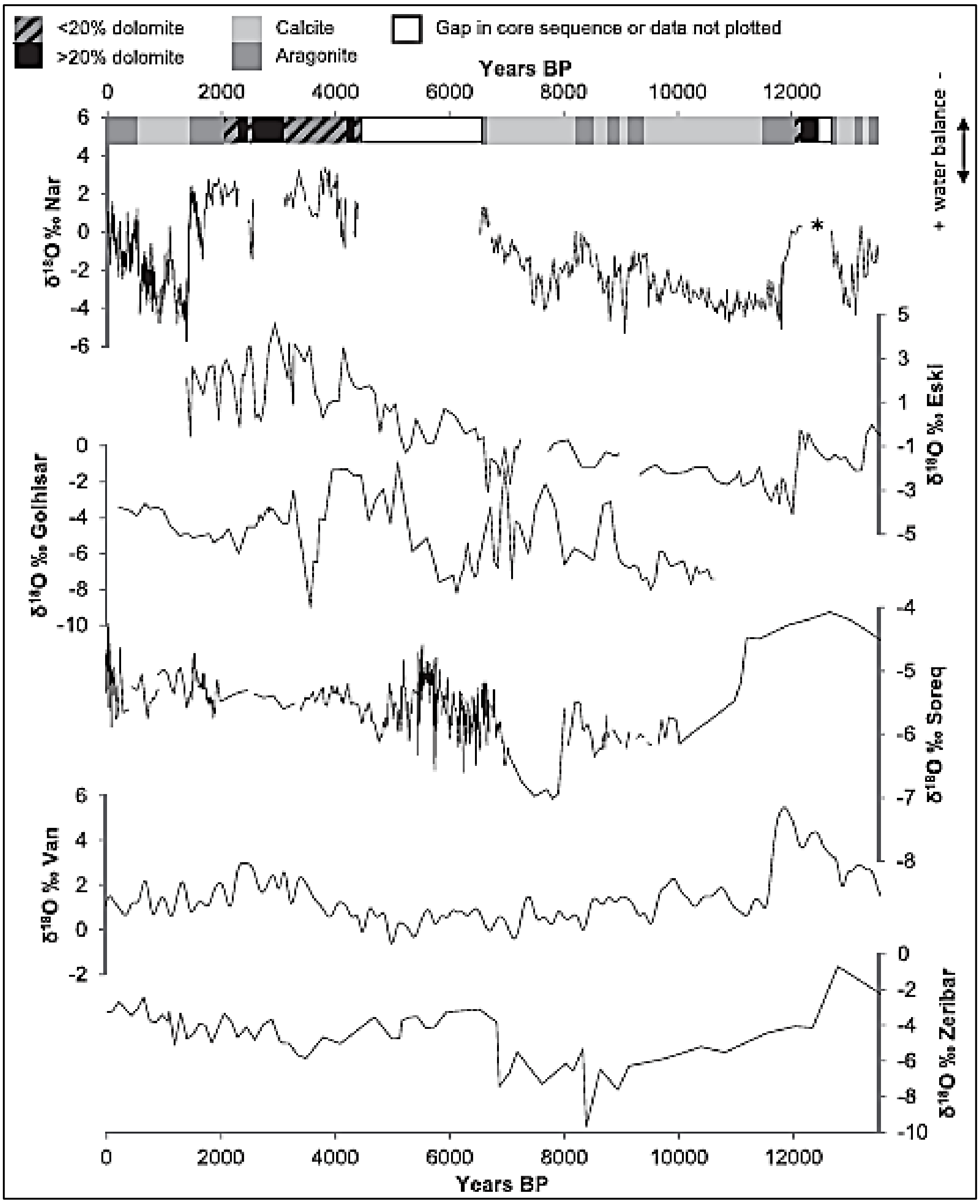

Figure 30. Comparison of $\delta^{18}O$ records of Nar Lake and other sites in the region, Eski Acıgöl, Lake Gölhisar, Soreq Cave, Lake Van and Lake Zeribar (Dean et al., 2015, Fig. 5).

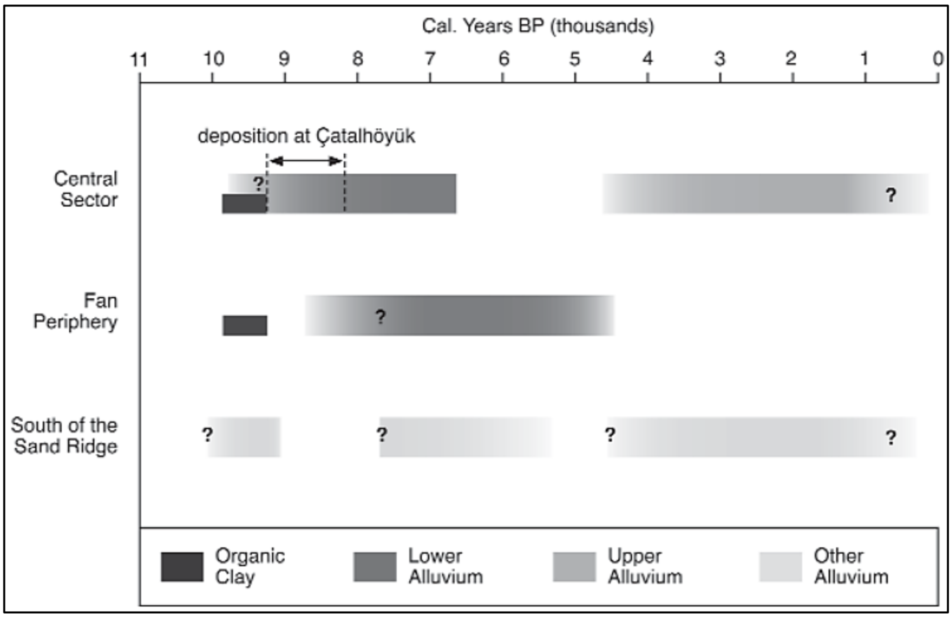

Figure 31. Changes in alluvium deposition throughout the Holocene in Çarşamba Alluvial Fan (Boyer et al., 2006, fig. 6).

3.2.5. Eastern Anatolia

Sediments from Lake Van, the largest lake in Turkey, Van/Bitlis, presents a climatic record for the last ca. 13,700 years. Analysis of sediments shows that climate shifted to drier conditions that is testified by reduced humidity, low lake level, a decrease in pollen percentage, concentration and influx values of *Quercus* at ca. 4200-3500 BP. In addition, an increase in $\delta^{18}O$ value and higher charcoal values suggest the degradation of woodlands due to increasing aridity (Figure 33, V-8; Wick et al., 2003). The analyses conducted by Lemcke and Sturm (1997) confirms the previous results and shows a reduction in lake level and humidity due to a climate shift to continental climate with reduced precipitation (Lemcke & Sturm, 1997).

Arslantepe, Malatya, is an ancient settlement that was occupied at least from the 5th millennium BC to the end of the Neo-Hittite period (8th century BC). Analysis of plant macro-remains provides information on climatic conditions from 3350 BC to 2000 BC. At ca. 2300-2200 BC a drought period, following a humid period between ca. 2850 BC and 2500 BC, with less precipitation occurred and it is testified by a minimum in the juniper record (Figure 34, Masi et al., 2013).

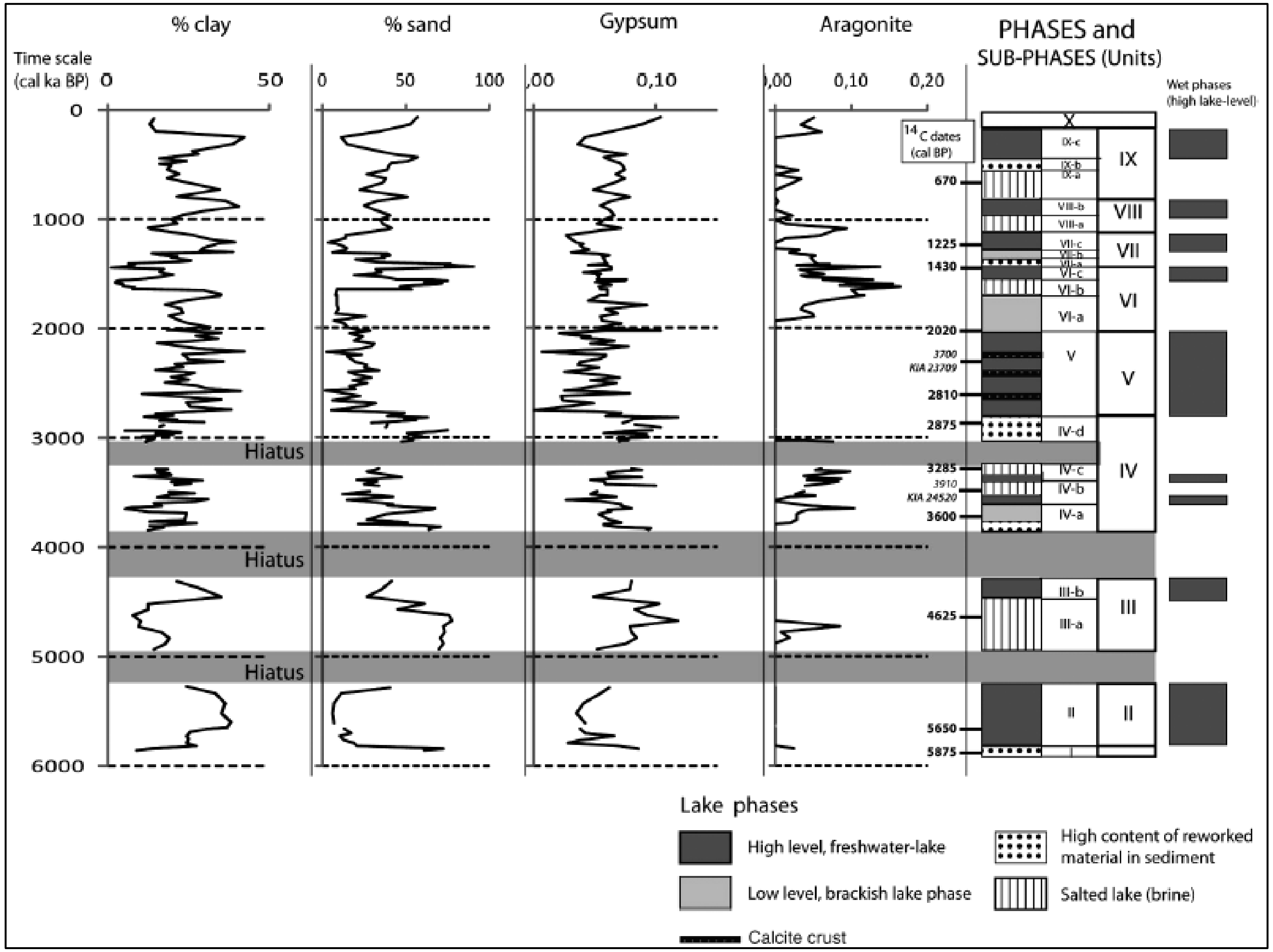

Figure 32**.** Lake phases throughout the last ca. 6000 years, Tecer Lake (Kuzucuoğlu et al., 2011, Fig. 6).

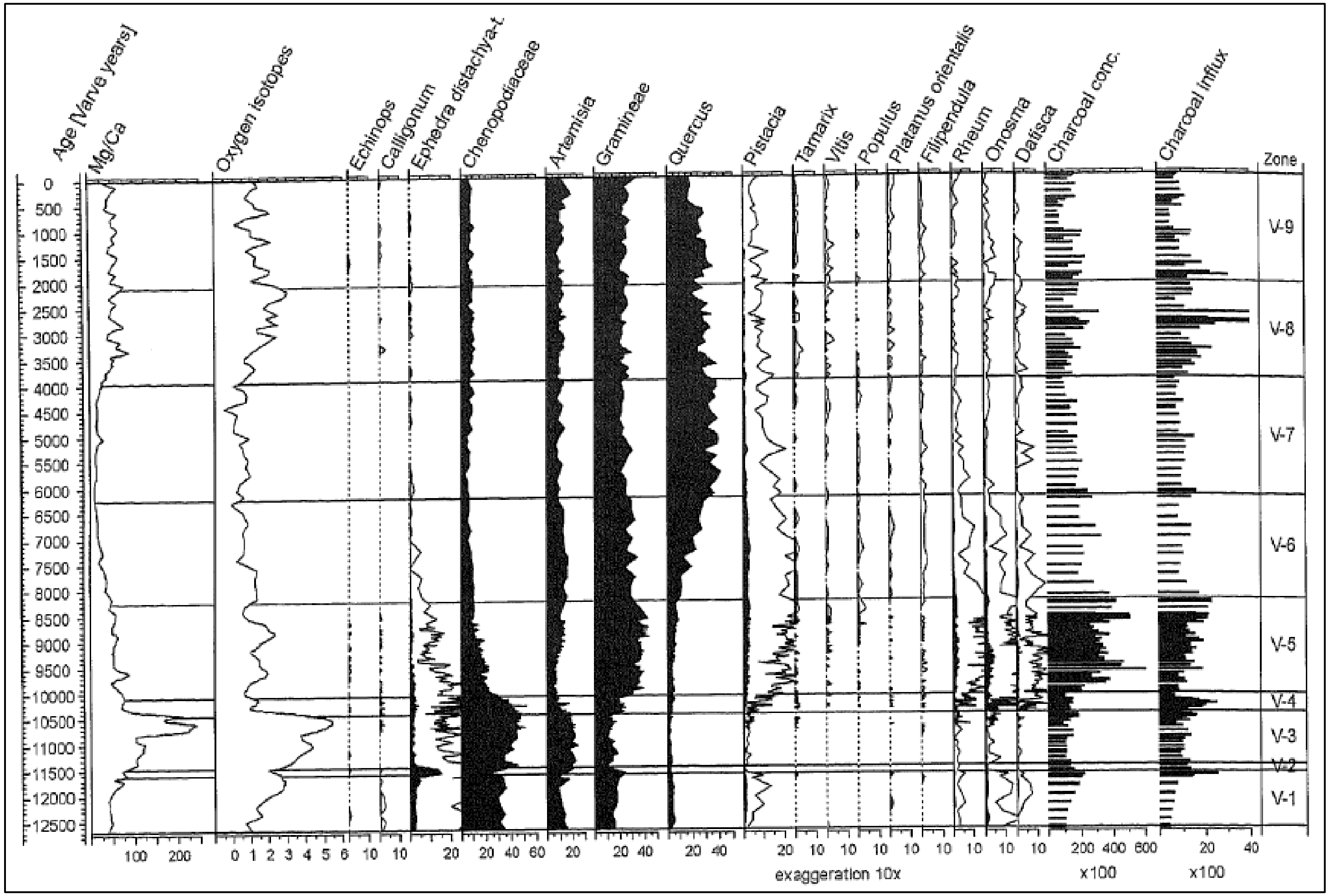

Figure 33. Changes in several parameters through time, Lake Van (Wick et al., 2003, Fig. 4).

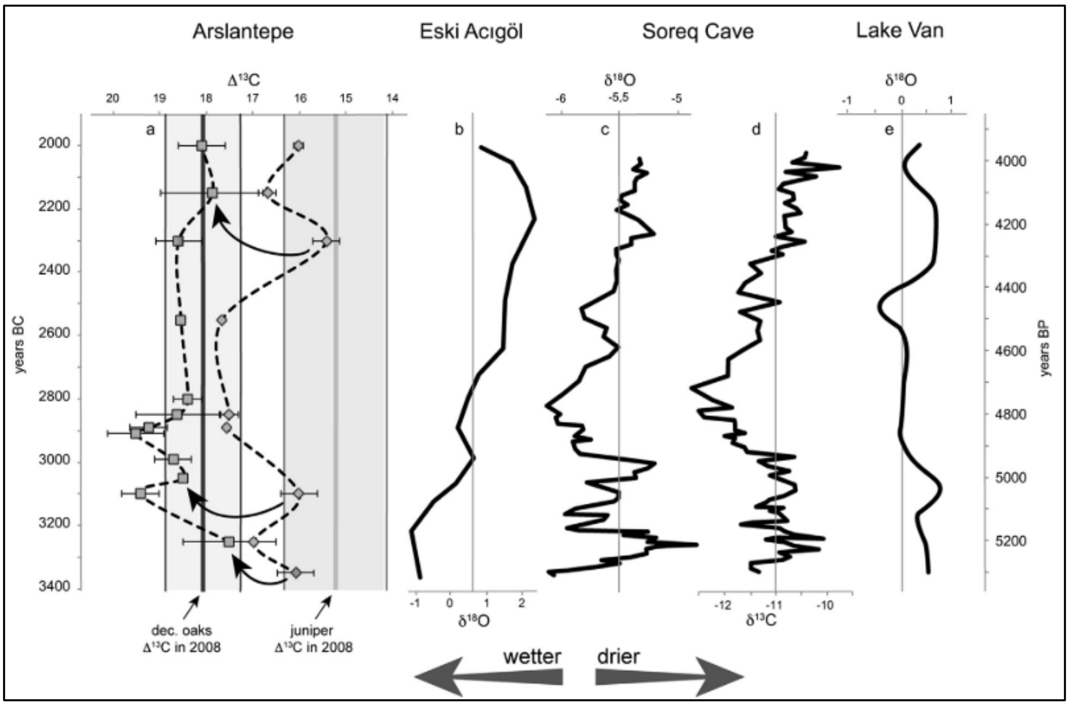

Figure 34. Comparison of proxies from Arslantepe, Eski Acıgöl, Soreq Cave and Lake Van (Masi et al., 2013, fig. 4).

3.2.6. Southeastern Anatolia

Göbekli Tepe, a prehistoric site, Şanlıurfa, presents a climatic record derived from pedogenic carbon coatings on stones for ca. 10,000-4000 calBP. Following a humid period that started at ca. 6000 calBP, at ca. 4000 calBP the climate shifted irreversibly to more arid conditions that is manifested by the termination of accumulation of carbonate (Figure 35; Pustovoytov et al., 2007). These results are confirmed by geoarchaeological investigation on sediments mainly from seasonal streams and modern irrigation channels in the vicinity of Kazane Höyük, an ancient settlement close to Göbekli Tepe, Şanlıurfa. The analysis shows that shortly after the 3rd millennium BC, alluvial deposition stopped and it is interpreted as a climatic shift to drier conditions when rainfall decreased and became unstable (Rosen, 1997).

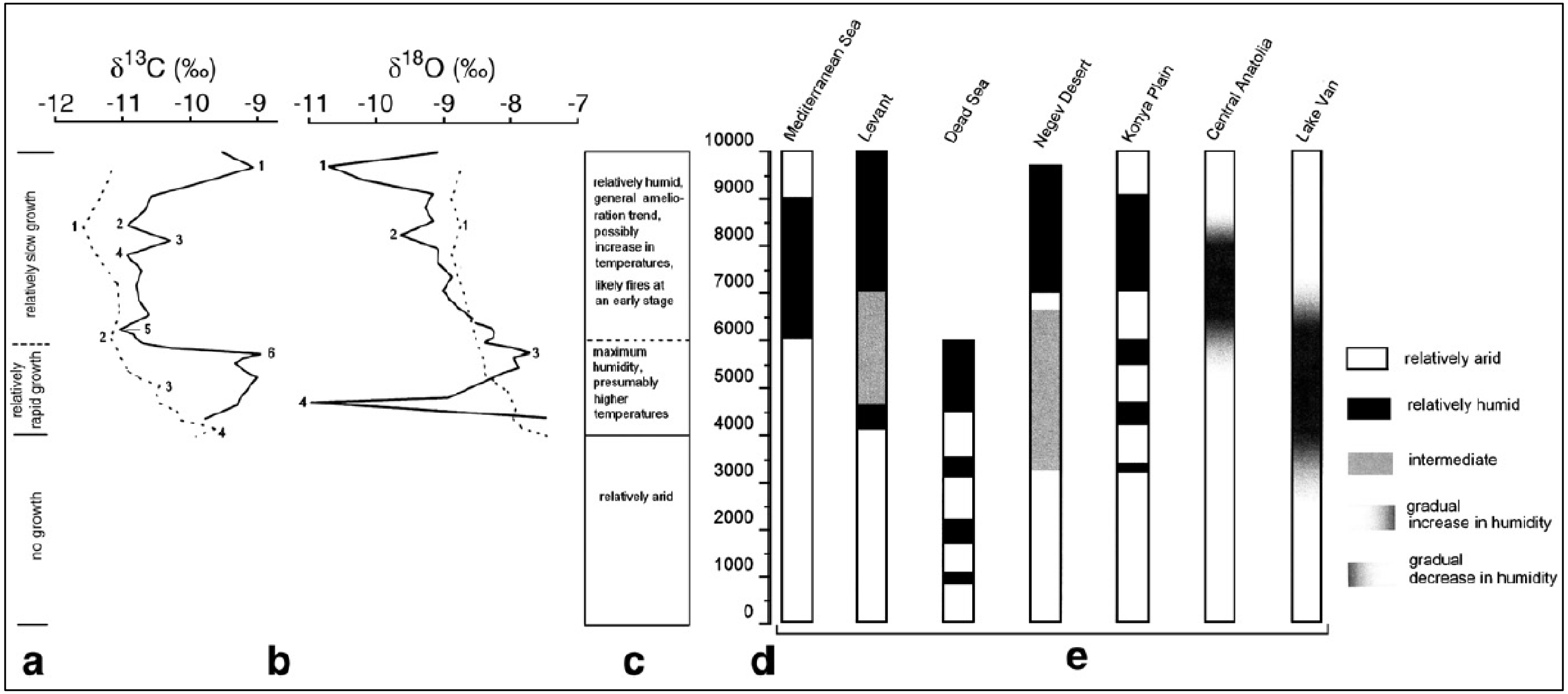

Figure 35. Comparison of $\delta^{13}C$ and $\delta^{18}O$ results from Göbekli Tepe with other proxies from the Near East (Pustovoytov et al., 2007, fig. 8).

3.3.Understanding of the 4.2 ka BP Event and Its Impacts on Anatolia

Modern climatological analyses show that the climate in Anatolia has Mediterranean characteristics in macro scale, however, varies locally due to the diverse landscape and the irregular topography. Moreover, it is affected by several climate systems, in particular, the NAO. Fluctuations of the NAO directly affect the precipitation amount and uniformity in Anatolia.

As discussed above and shown in Figure 19, Figure 20, Figure 21 and Table 1, the Black Sea region is the only region that receive uniform rainfall and is resistant to drought. The rest of the regions, 80% of the country, have a variable rainfall pattern and are more vulnerable to drought. Consequently, Turkey is quite vulnerable to decreased rainfall and drought conditions.

The 4.2 ka BP event disturbed the NAO that brings winter precipitation, majority of annual rainfall, and caused a decrease in seasonal precipitations in the eastern Mediterranean, including Anatolia. Considering Anatolia's climate and its vulnerability to drought, the region must have suffered from the event and its impacts. In particular, all regions, except the Black Sea region, that have a variable rainfall pattern and are more prone to drought are expected to be affected severely.

Palaeoenvironmental records for the 4.2 ka BP event come from several sites in Anatolia (Figure 22): Uzuntarla Cave and Lake İznik in the Marmara region; Sofular Cave in the Black Sea region; Kocain Cave, Karagöl and Avlan Gölü in the Mediterranean region; Lake Tuz, Nar Lake, Çarşamba Alluvial Fan and Tecer Lake in central Anatolian region; Lake Van and Arslantepe in the eastern Anatolian region; and Göbekli Tepe and Kazane Höyük in the southeastern Anatolian region.

All sites, except Sofular Cave and Kocain Cave, clearly shows less rainfall, low lake level and drought conditions within the period of the climate change (Table 18 in Appendix B). Sofular Cave in Zonguldak, the Black Sea region, despite of its chronology with high resolution (5.4 years), shows no evidence for the event. However, the cave is located in the Black Sea region, where rainfall is highly reliable and above 1000 mm/yr and as stated in the beginning, besides general characteristics of the regional climate, local landscape and physiography is also significant for climatic conditions. It seems that the event, i.e., decreased rainfall was not recorded, since its impacts were masked through local climatic conditions that could successfully tolerate drought conditions. On the other hand, in Kocain Cave, located in Antalya, the Mediterranean region, the event was recorded. However, this event was interpreted as a cool event and was not linked to the 4.2 ka BP event.

Other sites from various regions clearly provide evidence for the event and its impacts. However, the beginning and the time span of the event vary by region and site as summarized in Table 18 in Appendix B. The variation in the timing and duration of the event seem to depend on the local climatological characteristics and as well as, the chronological resolution of the analysis and dating technique. For example, the records from Nar Lake and Çarşamba Alluvial Fan show that the event is dated to ca. 4300-4150 BP based on varve counting and U-Th dates with a resolution of ca. 25 years and ca. 4500-4200 calBP based on ^{14}C, OSL dates and archaeological chronology with a resolution of 300-400 years respectively. Apparently, it is not possible to provide a precise date for the event across Anatolia. However, investigation of the climate change and its impacts at a regional scale can provide valuable insights on the subject.

In conclusion, as evidenced by the limited number of palaeoenvironmental data, several sites in Anatolia were affected by the 4.2 ka BP event and its environmental impacts. Due to variable rainfall pattern across Anatolia and its vulnerability to drought, Anatolia witnessed reduced rainfall, low lake level and increased open vegetation during the period of the climate change. Although it is limited, available palaeoenvironmental data can shed light on the nature of this climatic change and its impacts on different habitats in Anatolia. Moreover, I think that Anatolia with its diverse climatic features has a great potential for further palaeoenvironmental research on the event and believe that new research projects focusing on palaeoclimatic and palaeoenvironmental histories in the region will significantly contribute to a better understanding of the 4.2 ka BP event and its impacts, and the Holocene climate in Anatolia and the eastern Mediterranean.

CHAPTER 4

THE EARLY BRONZE AGE IN WESTERN ANATOLIA

In the literature, the beginning of the EBA in the Anatolian peninsula is dated to ca. 3000 BC and the EBA chronology is divided into three sub-periods (Steadman & McMahon, 2011, p. 230, Table 10.3):

- Early Bronze Age I (EBA I) 3000 – 2700/2600 BC
- Early Bronze Age II (EBA II) 2700/2600 – 2300 BC
- Early Bronze Age III (EBA III) 2300 – 2000 BC

Although the characteristics of the EBA III can be differentiated from that of the EBA II, there is no notable difference between the EBA I and EBA II (Bachhuber, 2014). Moreover, from ca. 2500 BC onwards, EBA societies experienced major changes in their economic, social and political structures (Şahoğlu, 2005). Therefore, all these make this three-partite division artificial and for the purpose of this study, considering developments in material culture and substantial changes in social structure of societies, it is more appropriate to divide the EBA as in the following (Bachhuber, 2014):

- EBA I/II ca. 3000 – 2500 BC
- EBA II/III ca. 2500 – 2200 BC
- Transitional period ca. 2200 – 2000 BC

4.1.The Early Bronze Age I/II (ca. 3000 – 2500 BC)

Information on characteristics of western Anatolian societies and their material culture comes from Troy and Liman Tepe in the coastal region, Demircihöyük and

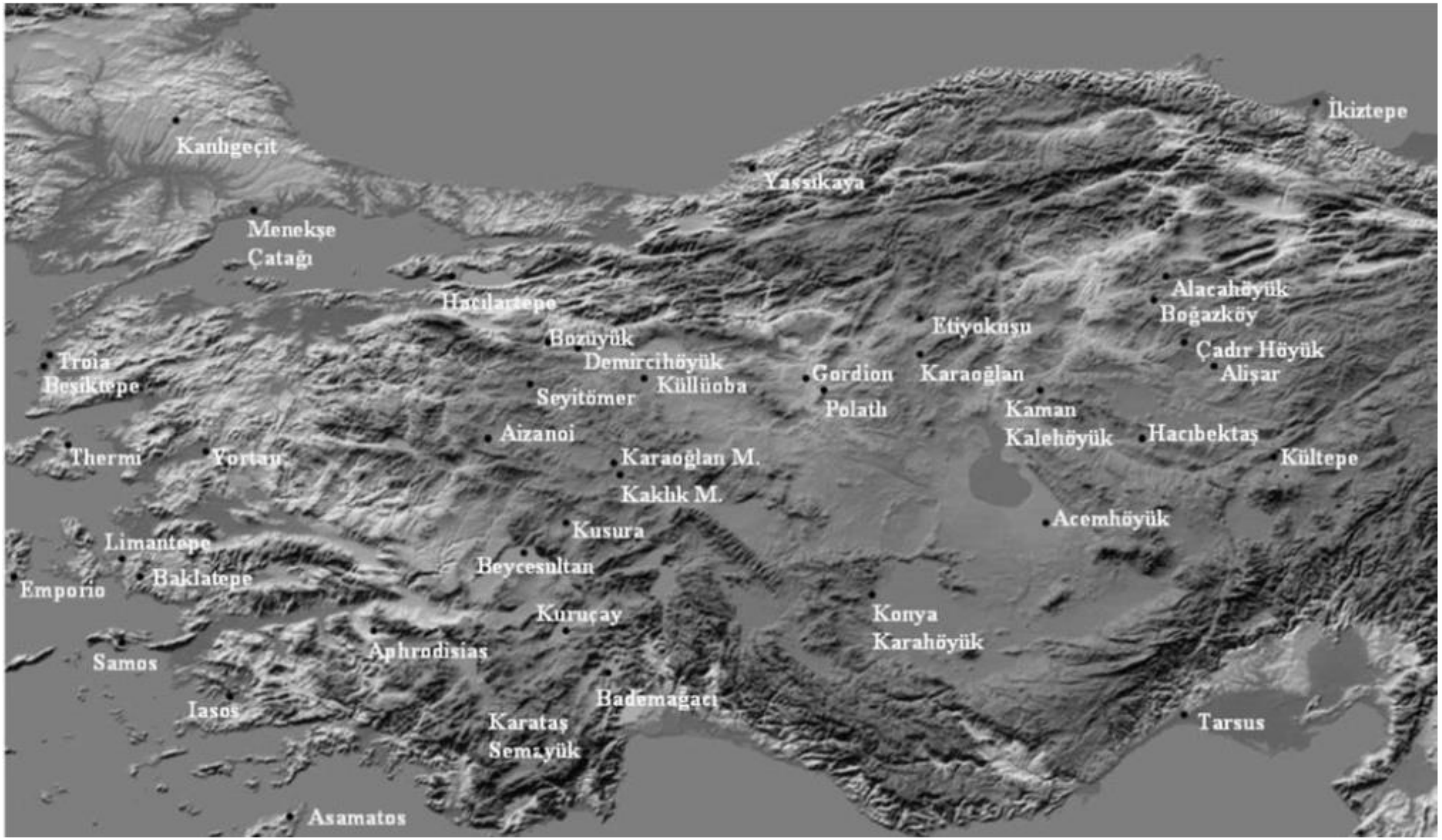

Figure 36. Major EBA sites in the Anatolian peninsula and on the Aegean islands (Efe, 2007, Fig. 1).

Küllüoba in northwestern Anatolia and, Beycesultan, Bademağacı and Karataş-Semayük in southwestern Anatolia (Figure 36).

In the EBA I, Troy was a village surrounded by a defensive stone wall with bastions (Figure 37). Two free-standing apsidal houses were revealed from the early EBA I. However, later in the period, adjacently built long houses were the characteristics of the site. In particular, House 102 represents an early example of megaron, a building in rectangular form including a porch and a main room with a hearth in the centre (Ünlüsoy, 2006).

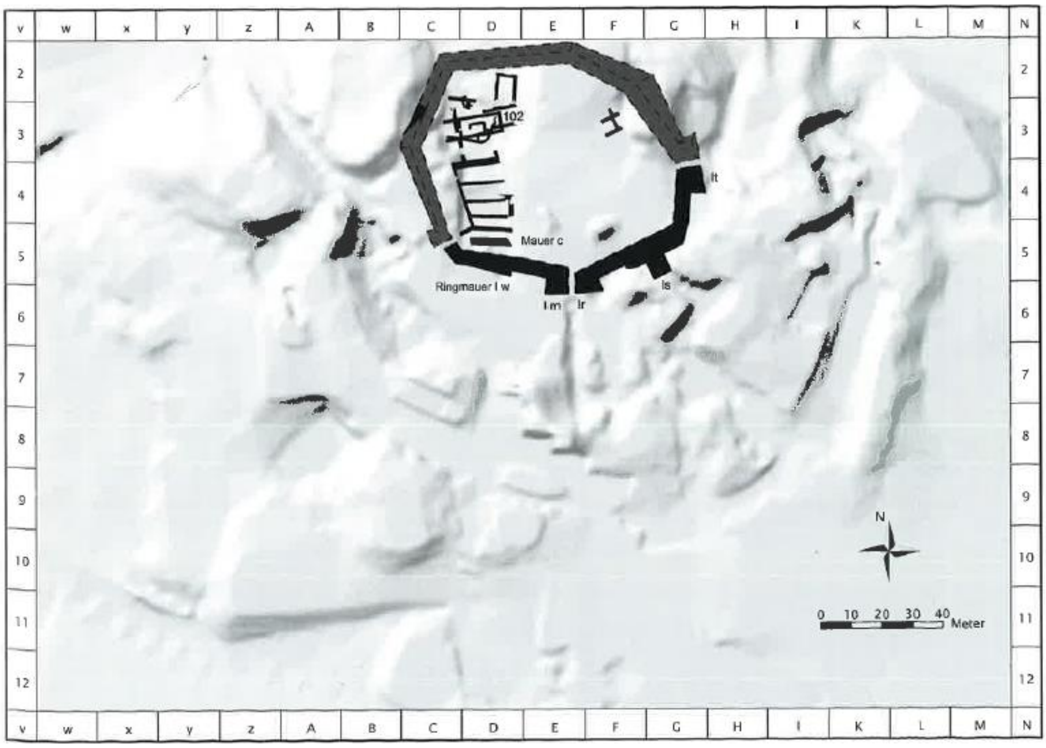

Figure 37. Settlement plan of Troy in the EBA I (Ünlüsoy, 2006, p. 137, Abb. 4).

In the EBA I, the prehistoric settlement at Liman Tepe was surrounded by a fortification wall with a rampart all around the site (Figure 38). Access to the settlement was through a gate on the fortification wall that was guarded by towers on the both sides. There were long houses that had stone foundations and mudbrick superstructure and were built adjacent to each other and to the fortification wall.

These houses having a hearth in the centre of the main building were domestic in function. On the other hand, some scarce evidence shows that these houses might have been partly used as workshop as well (Erkanal & Şahoğlu, 2016).

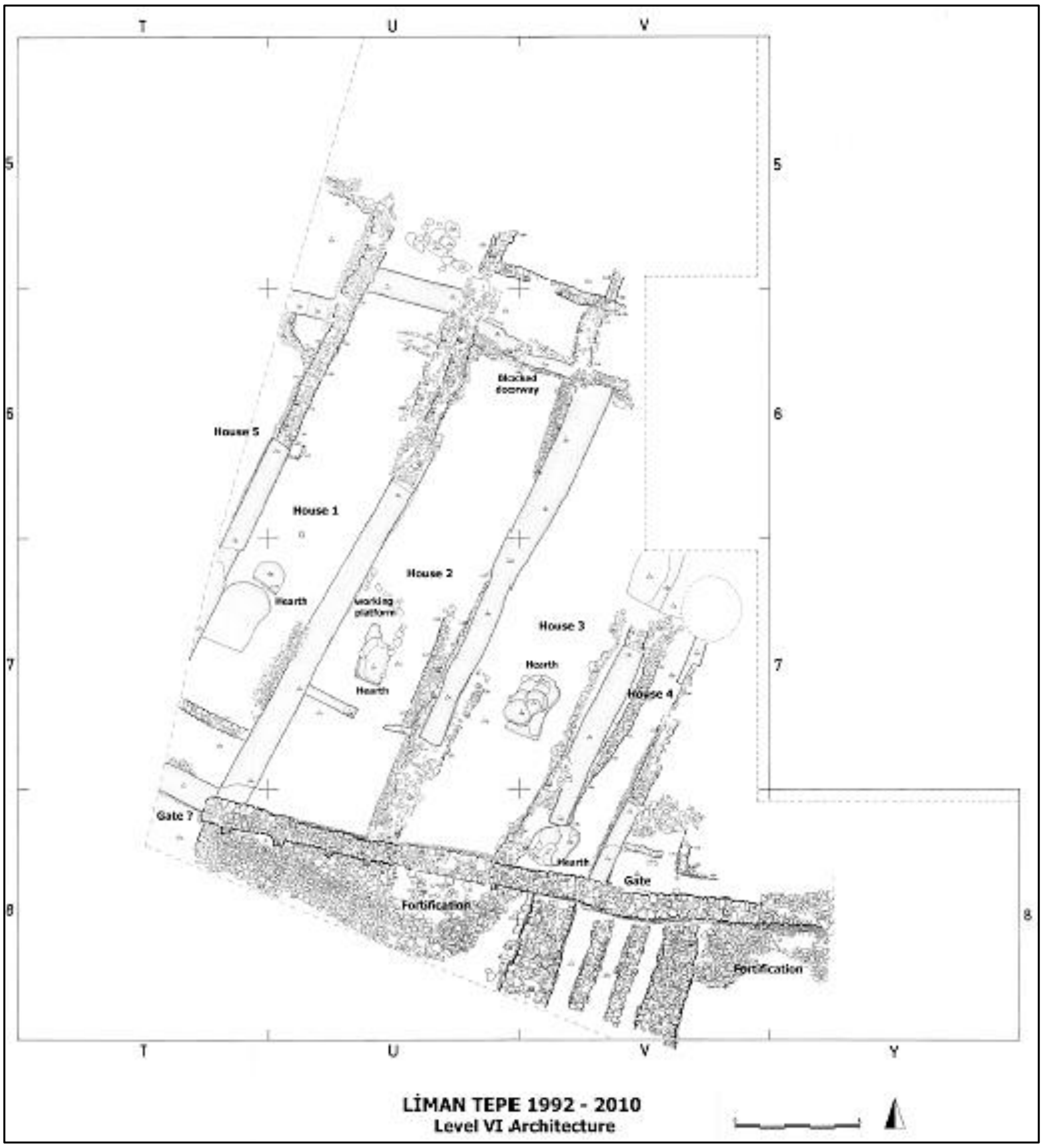

Figure 38. Long houses at Liman Tepe in the EBA I (Erkanal & Şahoğlu, 2016, Fig. 3).

The settlement at Demircihöyük had a circular plan and was surrounded by a fortification wall made from stone and mudbrick (Figure 39). The fortification was strengthened by rectangular bastions and saw-tooth projections and had two gates in the north and southwest. Inside the fortification, houses with stone foundation and

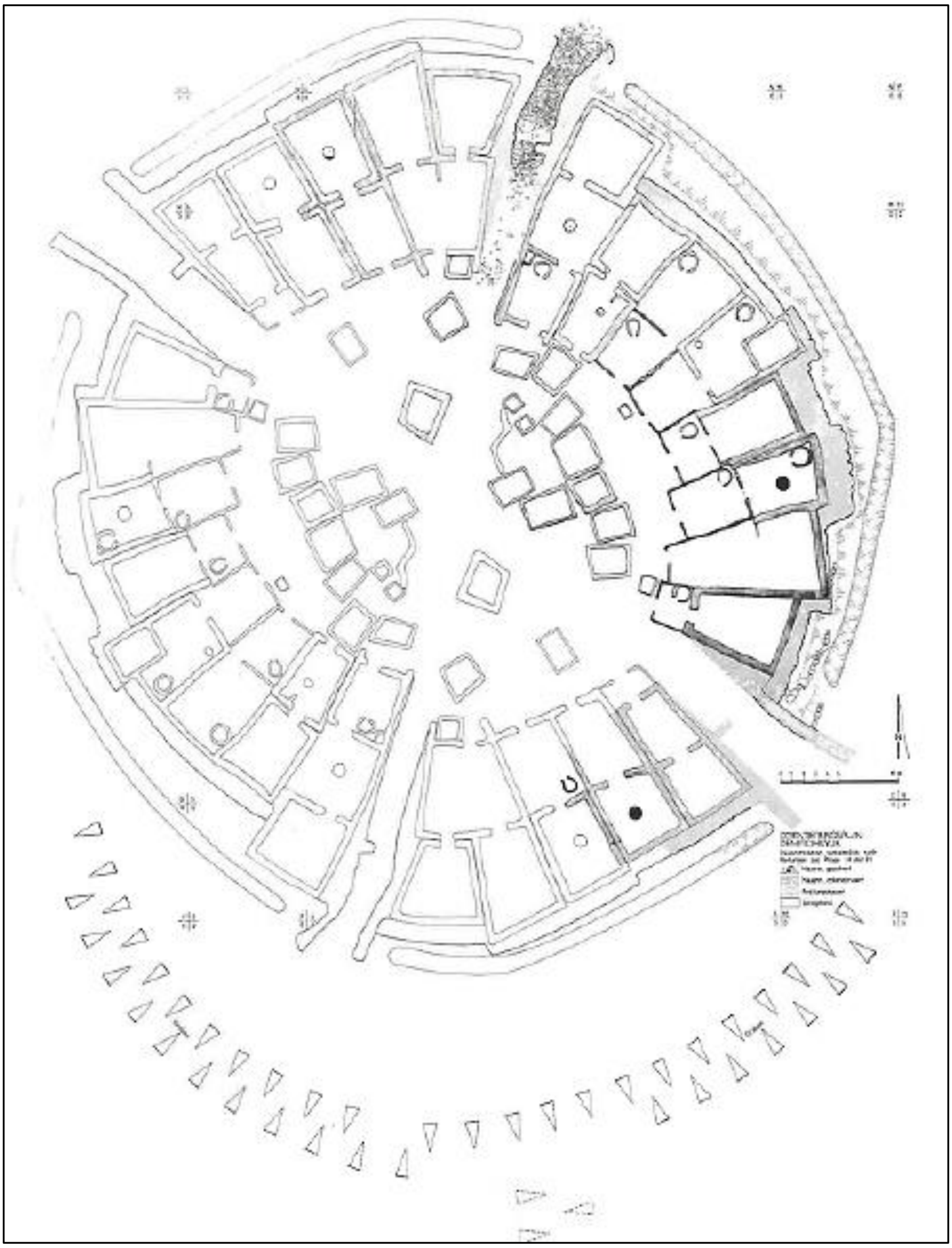

Figure 39. Settlement plan of Demircihöyük in the EBA II (Korfmann, 1983, Abb 343)

mudbrick walls were built adjacent to each other and arranged around a courtyard. Houses usually consisted of two rooms and had a hearth and a dome oven. In the courtyard, there were storage bins in front of the houses. The houses located close to the gates, in particular, the two houses on the right-hand side of the north gate, seem special in function. In particular, the house closer to the north gate had three rooms with solid foundations and was the largest buildings of all the occupation phases. This could point to a social differentiation and special position of the resident(s) of this building. The site experienced several fire disasters through the period and came to a sudden end at the end of EBA II without an evidence for a conflagration. After the abandonment, the site was resettled in the MBA (Korfmann, 1983).

Küllüoba provides scarce information on the EBA I (ca. 3000-2700 BC). On the mound, long houses that were mostly built adjacent to each other were revealed (Figure 40). In the EBA II (ca. 2700-2400 BC), already in the beginning of the period, the settlement was divided into an upper town and a lower town. In the upper town, surrounded by a fortification wall, there were both free-standing houses in a central courtyard and houses built adjacent to the fortification wall around the courtyard (Figure 41).

At Küllüoba, in the lower town, similarly, buildings consisted of both free-standing houses and houses that were built adjacent to each other and to the fortification wall (Figure 42). In the upper town, Complex I and Complex II (Figure 41), seem to point to a social stratification, were most likely used for administrative purposes. Complex I consisted of a rectangular court and a main building with several rooms of residence, storage rooms and kitchen. Moreover, silos were dug under some rooms. On the other hand, Complex II was a free-standing complex in the centre of the courtyard. It consisted of houses, kitchen and as well as, storage rooms. The most monumental building of the complex was the one that had a porch and three rooms with a hearth in the centre of the main room. It was accessed through a stone paved ramp attesting a possible administrative purpose (Fidan, 2012).

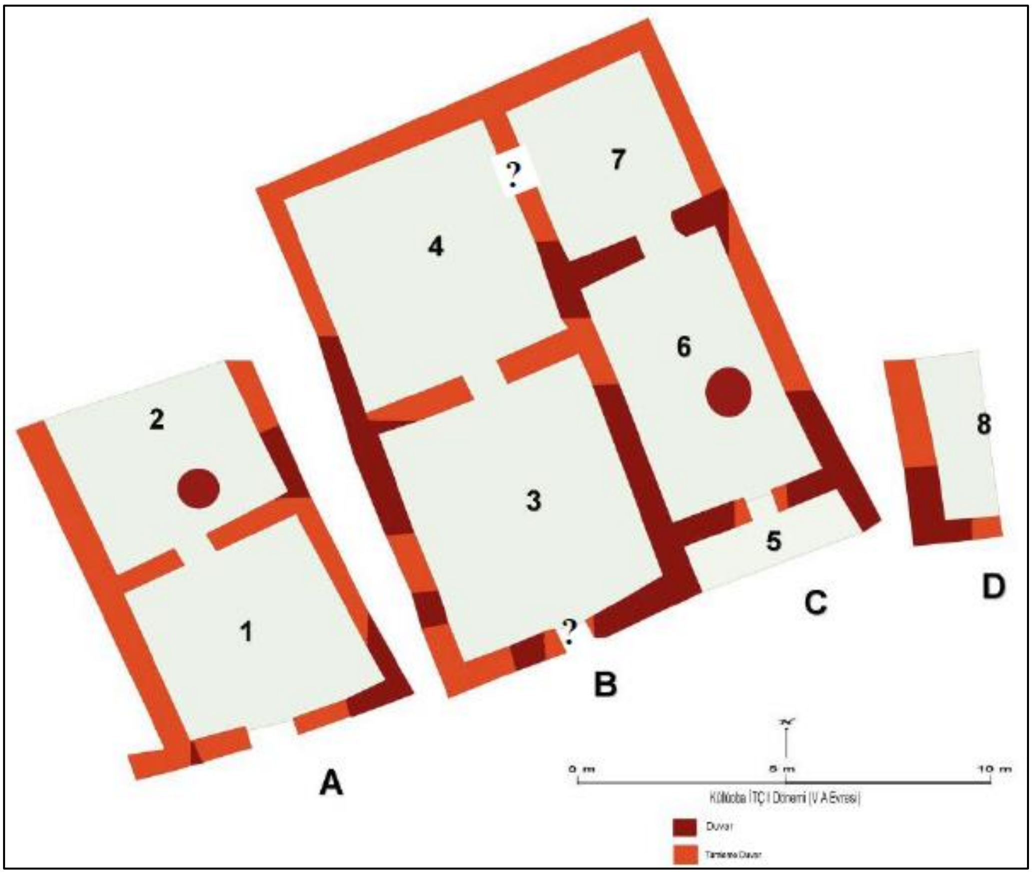

Figure 40. Long houses at Küllüoba in the EBA I (Fidan, 2012, Resim 9). Dark red: Wall; Light red: Completed wall.

Restricted information on the period at Beycesultan shows that the site expanded in the beginning of the period. On the site, fragmentary mudbrick walls and a stone enclosure wall were unearthed. Later in the period, the first so-called religious building, that will be discussed later, appeared (Figure 43). It was a single roomed building made from mudbrick with a simple porch (Lloyd & Mellaart, 1962).

The settlement at Bademağacı was majorly occupied in the EBA II, ca. 2700 BC onwards until the MBA (ca. 1800 BC). The settlement was surrounded by a stone defensive wall with several gates and had a stone paved belt around for protection from floods (Figure 44). Inside the wall, houses, mostly megara, were arranged around a courtyard and built adjacent to each other. All houses had stone foundations and were abundantly rectangular in form. A complex consisted of at least 17 rooms (Duru & Umurtak, 2009) was unearthed in the centre of the mound and was most

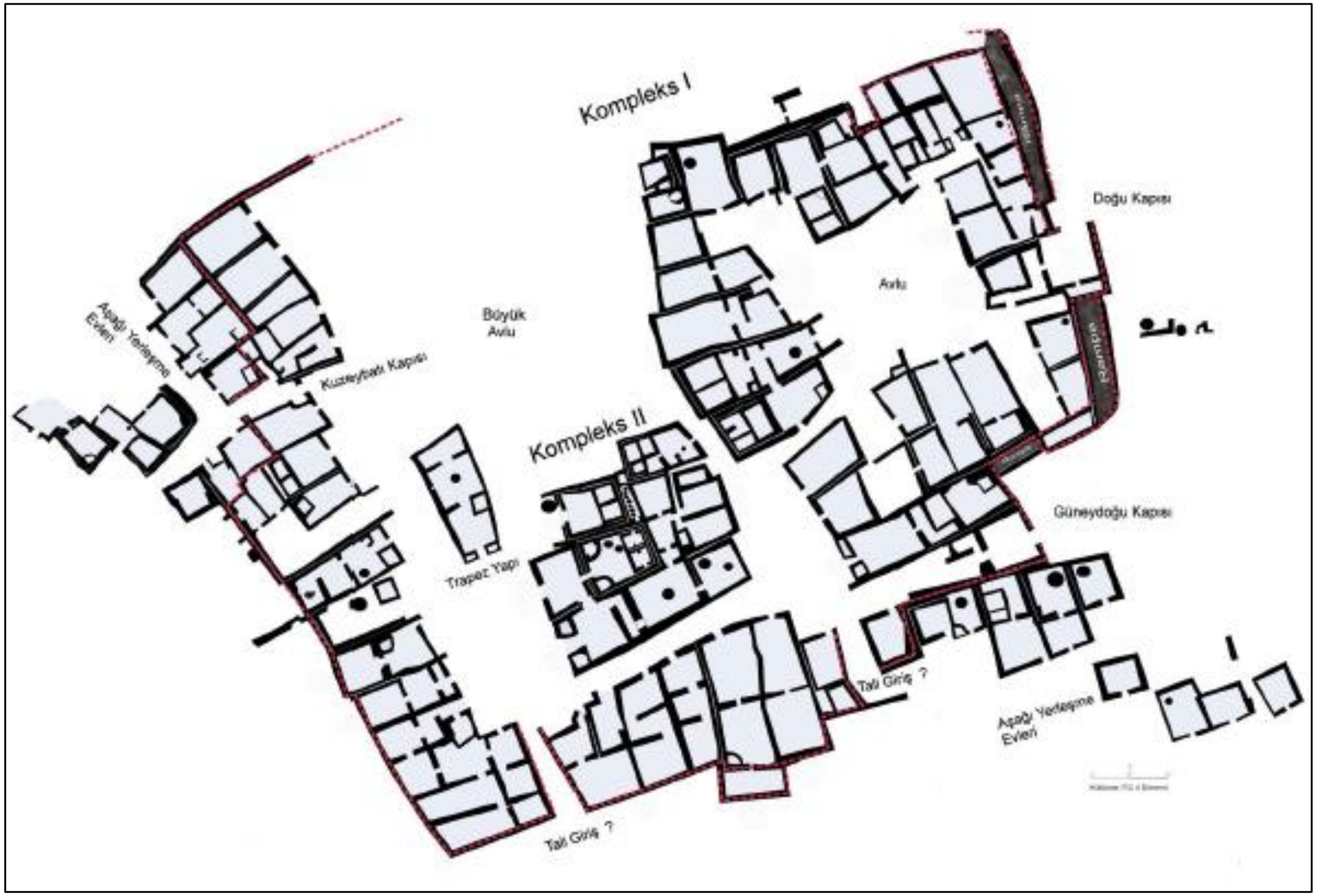

Figure 41. Settlement plan of Küllüoba in the early and middle EBA II with Complex I and Complex II (Fidan, 2012, Resim 21).

Figure 42. Houses in the lower town in the early EBA II, Küllüoba (Fidan, 2012, Resim13).

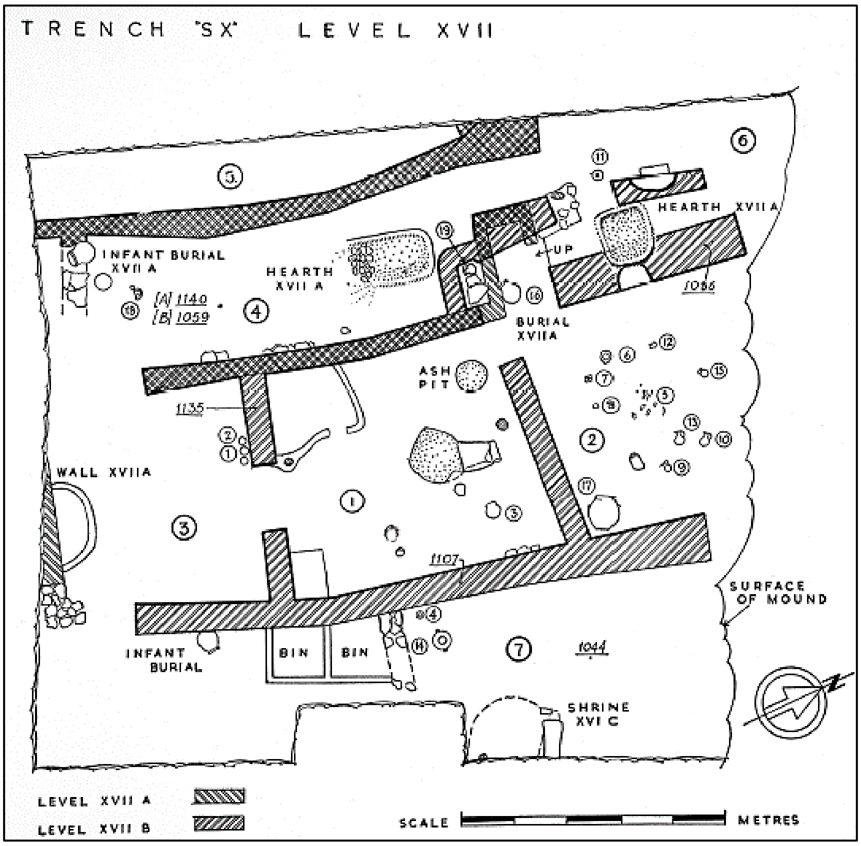

Figure 43. The first religious building at Beycesultan in the EBA I (Lloyd & Mellaart, 1962, Fig. 9).

likely both the residence of the ruler(s) and the administrative, i.e., palace in purpose (Duru, 2008). The south of the site with buildings and finds seems the most significant part of the settlement. A building complex consisting of two rows of rectangular rooms, whose function could not be determined, was unearthed in the southeast of the settlement (Duru & Umurtak, 2011). In the southwest of the settlement, there were the facilities that gave access to the settlement. A part of the facilities was the megaron with windows and a door directly accessing the outside of the settlement (Duru & Umurtak, 2010). After a few decades, windows and the door of the megaron were blocked through construction of a wall. Later in the period, on top of these buildings, parallel thick walls were built and in one of the rooms associated with these walls, in situ large number of pots and a vast number of bronze objects, silver pins, a silver bowl and a golden ear plug were revealed. Considering the precious finds and the location of the storage room on the edge of the settlement makes it difficult to interpret the function and purpose of these rooms (Duru & Umurtak, 2011).

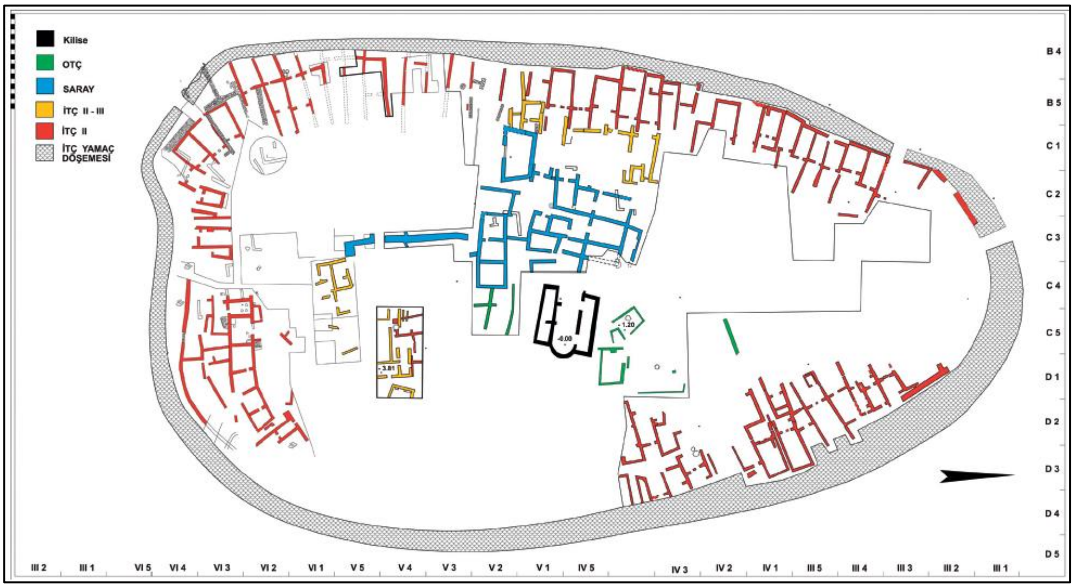

Figure 44. The settlement plan of Bademağacı in the EBA II (Duru & Umurtak, 2011, Res. 1). Black: The church; Green: MBA; Blue: The palace; Yellow: EBA II-III; Red: EBA II; Grey: EBA stone paved belt.

In the early phases of the period at Karataş-Semayük, occupied only in the EBA, there was a large rectangular house built in the centre of the settlement and was enclosed by a courtyard with a buttressed oval wall strengthened by several ramparts (Figure 45; Warner, 1994; Mellink, 1974). This complex was surrounded by a palisade. Besides, some circular pit houses were unearthed in the vicinity of the central complex. In the last phase of the period, all buildings and palisade were pulled down and new structures were built on top of them that there is no information on (Warner, 1994).

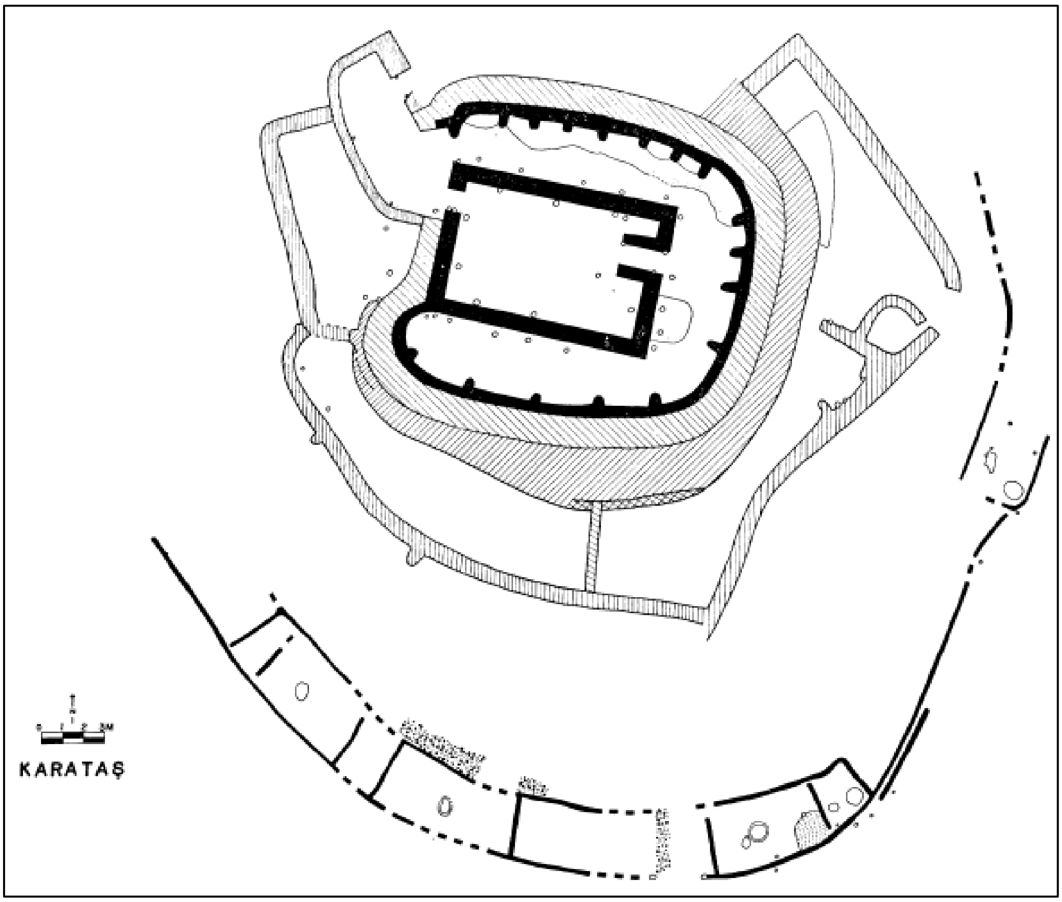

Figure 45. Karataş-Semayük in the EBA I (Mellink, 1974, ILL. I).

4.2. The Early Bronze Age II/III (ca. 2500 – 2200 BC)

Towards the end of the EBA II and in the beginning of the EBA III or, i.e., in the second half of the third millennium BC, the western Anatolian sites, more broadly the sites in the Anatolian peninsula, underwent significant changes (Şahoğlu, 2005):

- Appearance of large organized settlements with lower and upper towns that were surrounded by strong fortification walls;
- Appearance of monumental buildings, administrative in purpose, in the upper towns;
- Emergence of ruling elites and social stratification supported by the growth of certain settlements' size accompanied with a significant decrease in the number of settlements that led to appearance of regional centres and point to centralization (Çevik, 2007; Özdoğan, 2011);
- Shift of pottery production technology, i.e., potter's wheel, to western Anatolia;
- Changes in human diet being attested by first appearance and wide distribution of some pottery forms such as wheel-made plates, depata, tankards, cutaway-spouted jugs and Syrian bottles that were majorly drinking cups over the Anatolian peninsula including the key sites mentioned in the text;
- Developments in metallurgy in terms of production and adornment techniques and first use of tin bronze.

One of the most important characteristics of this certain period is the active engagement of the Anatolian peninsula and as well as, western Anatolia in an interregional exchange network extending from the Syro-Mesopotamia through the southeastern Anatolia and then, central and western Anatolia to the Thrace, Cyclades and mainland Greece through overland and maritime routes (Figure 46 and Figure 47; the Anatolian Trade Network, Şahoğlu, 2005; the Great Caravan Route, Efe, 2007; possible overland and maritime routes, Massa & Palmisano, 2018). On the basis of this exchange network were the metallurgy and the exchange of metals,

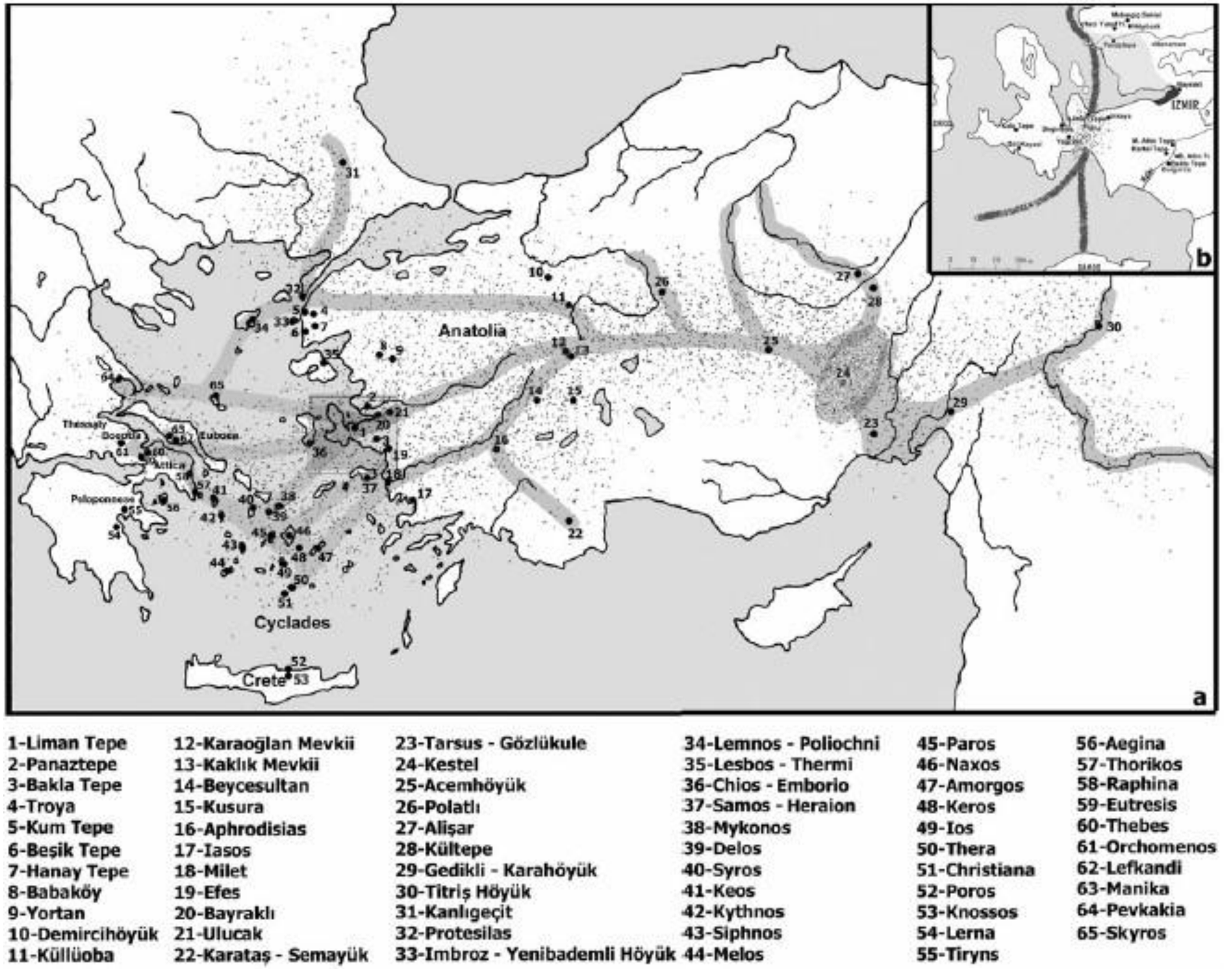

Figure 46. The Anatolian Trade Network in the late EBA II and the early EBA III (Modified from Şahoğlu, 2005, Figure 1).

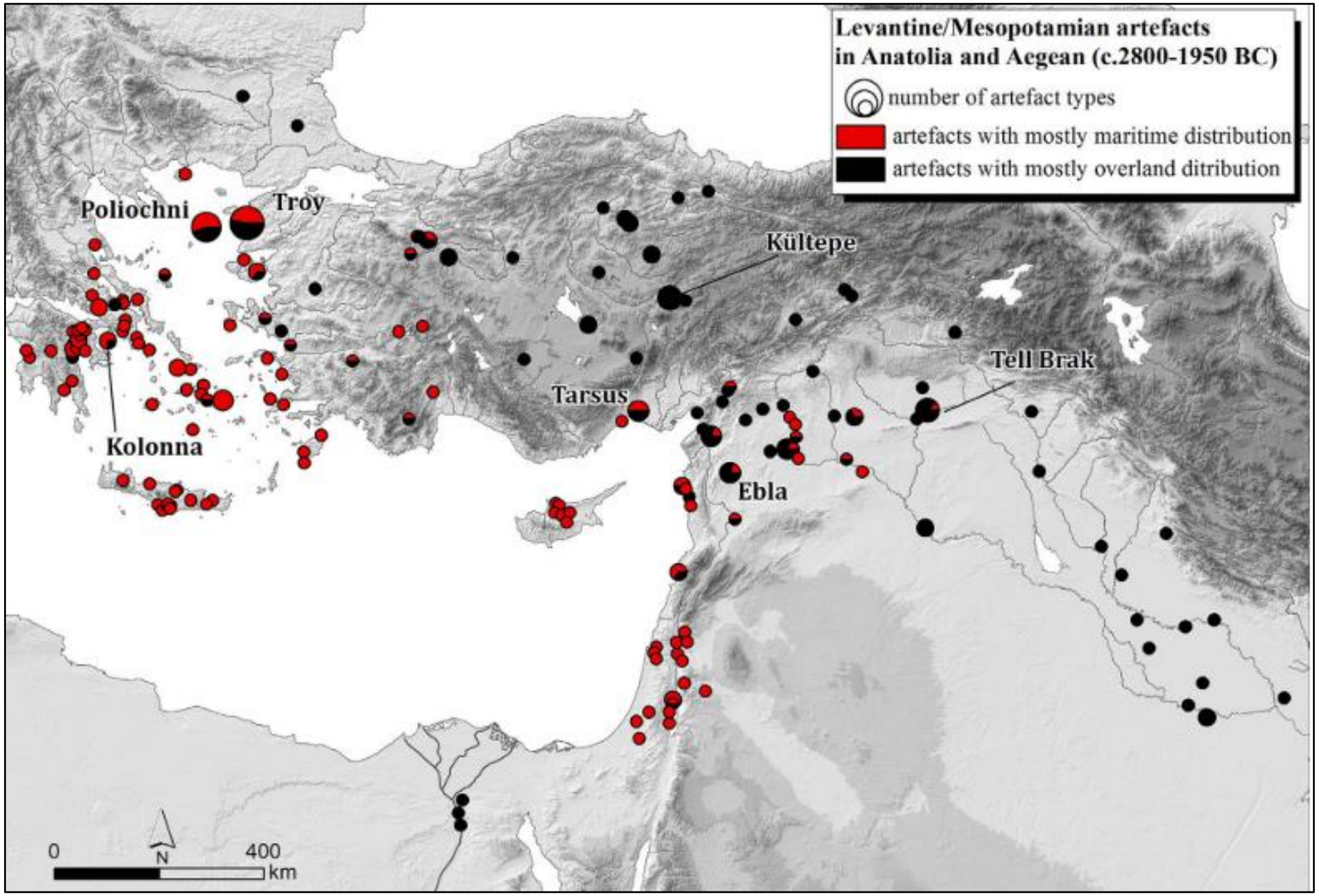

Figure 47. Maritime and overland exchange routes in Mesopotamia, Anatolia and the Aegean (Massa & Palmisano, 2018, Fig. 14).

in particular tin (Şahoğlu, 2005; Schoop, 2011), and this network characterizes a new economic system of controlling procurement and distribution of raw materials and products through seals by the rulers of the regional centres (Şahoğlu, 2005). Possibly the metal ores in Anatolia (cf. archaeological evidence for prehistoric mining in Kestel-Göltepe (Yener, 2000), near Kayseri (Yener et al., 2015)) were the target of this exchange network and the metals from Anatolia were exported to other regions and exchanged with perfumes, oils, textiles, wine and lapis lazuli (Şahoğlu, 2005; Schoop, 2011). The relationship between the exchange network and changes in social, economic and political structure of the societies of the period was an interplay. Appearance of regional centres and emergence of elites must have created need for raw materials and technologies (Şahoğlu, 2005) and the intensified relations with the Syro-Mesopotamia and the control of the procurement and distribution of raw materials contributed to consolidation of those changes (Efe, 2007).

Information on this period of significant developments comes from Troy and Liman Tepe in the coastal region, Küllüoba and Seyitömer in the northwestern Anatolia and Beycesultan and Karataş-Semayük in the southwestern Anatolia (Figure 36).

The settlement at Troy became larger in the late EBA II and the architecture and the fortification with gate systems reached monumental size (Ünlüsoy, 2006). In this period, the settlement consisted of an upper town and a large lower town. Both the upper town and the lower town were surrounded by a fortification wall made from rock and mudbrick and a wood respectively (Korfmann, 2006). In the upper town, free-standing larger buildings were the norm and the Palace IIa, a building in megaron form with solid walls, was the most striking one (Figure 48**)**. Detachment of the upper town from the lower town and the presence of monumental buildings point to a stratified society and a ruling or elite class (Korfmann, 2006; Ünlüsoy, 2006). Moreover, large number of valuable metal objects from Troy prove the sophisticated metallurgical techniques and high degree of specialization. Among the finds are jewellery, vessels, tools, weapons and metal bars (Figure 49 and Figure 50; Sazcı & Treister, 2006).

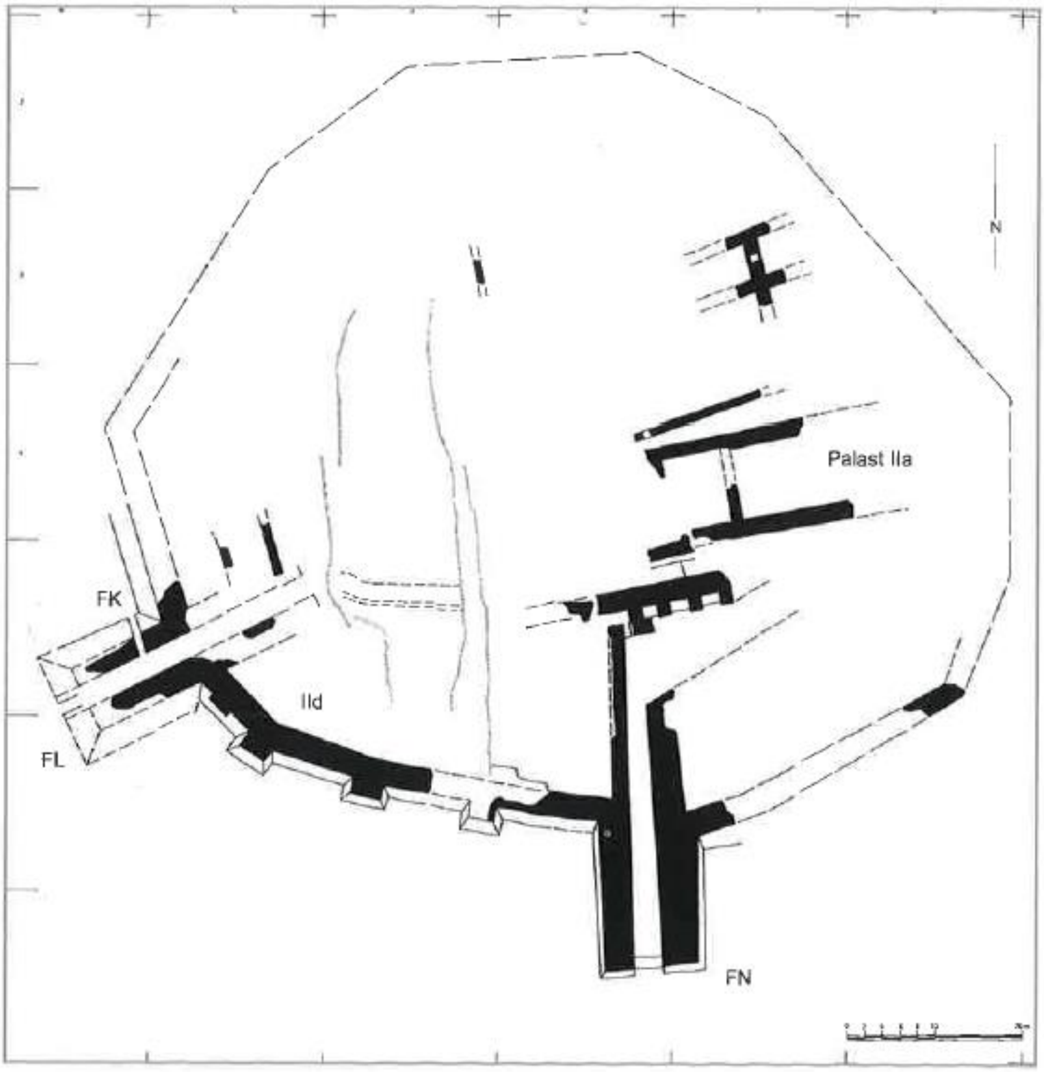

Figure 48. Settlement plan of Troy's upper town in the late EBA II (Ünlüsoy, 2006, Abb. 5).

In the beginning of the EBA III, the architecture of Troy reached monumental size. The group of buildings including megara, in particular the Megaron IIA, must have been cultic and administrative in function (Figure 51; Korfmann, 2006). There were larger buildings consisting of several rooms that were used for storage and commercial purposes (Ünlüsoy, 2006). The site became a significant component of the interregional trade network. Moreover, wares produced through the use of the potter's wheel appeared for the first time on the site (Korfmann, 2006). Later in the period, after a fire destruction, buildings except the Megaron IIA, were replaced with building complexes consisting of several smaller rooms. This change seems to

Figure 49. Some ornaments made from gold from Treasures C and D, Troy (Sazcı & Treister, 2006, Abb. 1).

Figure 50. Some ornaments and bars made from gold from the treasure F, Troy (Sazcı & Treister, 2006, Abb. 5).

point to a transformation in social structure. This phase was ended by a large fire as well (Ünlüsoy, 2006). In the late EBA III (ca. 2250-2200 BC), monumental megara were completely disappeared and narrower and smaller buildings were built instead (Figure 52; Korfmann, 2006). Given that the lack of monumental buildings and an organized settlement architecture, Troy in the EBA III is argued to be a poor village. On the other hand, some later fieldwork revealed three megara in the characteristics of earlier phases and regarding this, some researchers refute the idea of a poor village (Ünlüsoy, 2006; Sazcı, 2001). However, the precise dating of these megara could not be determined (Sazcı, 2001).

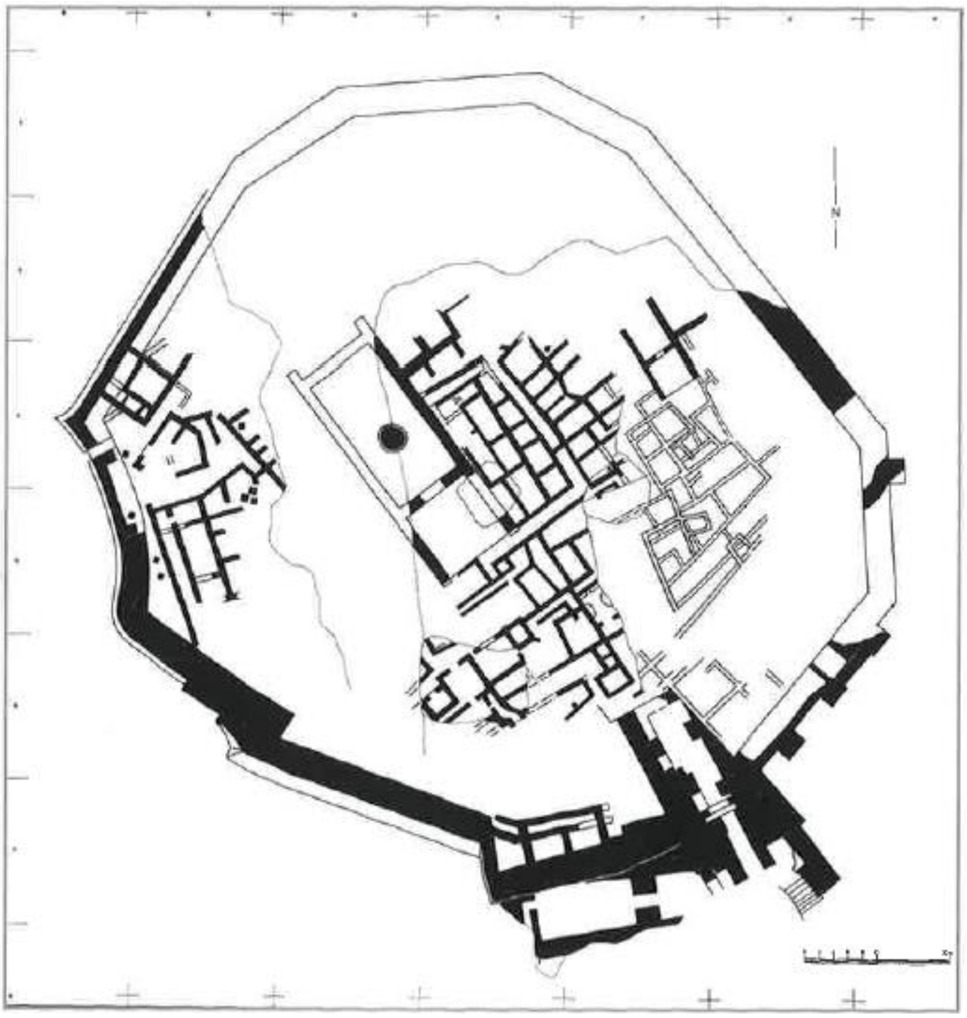

Figure 51. Settlement plan of Troy in the early EBA III (Ünlüsoy, 2006, Abb. 9).

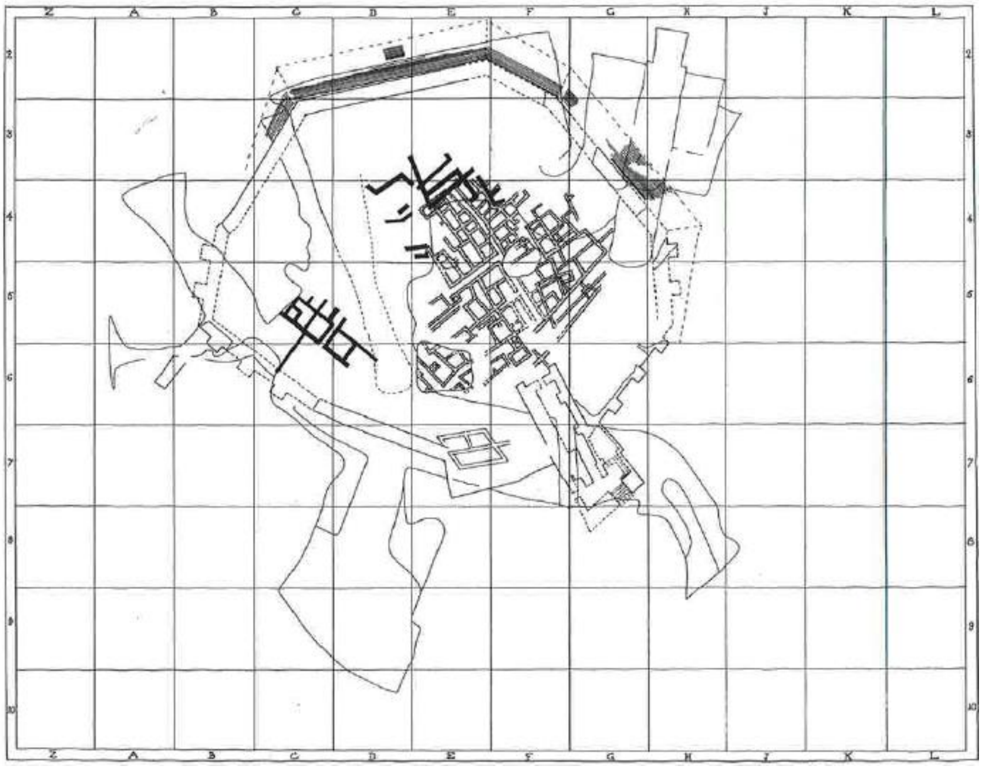

Figure 52. Settlement plan of Troy in the late EBA III (Ünlüsoy, 2006, Abb. 10).

In the beginning of the period, the settlement at Liman Tepe reached a monumental size. The settlement was surrounded by a massive fortification with massive bastions in horseshoe shape (Figure 53; Erkanal & Şahoğlu, 2016; Ersoy et al., 2011). The settlement was divided into an upper and a lower town. In the upper town, there were large building complexes consisting of several buildings (Figure 54). A central complex with many rooms, a courtyard and a multiroomed building was located in the centre of the settlement. Finds from the complex, large storage jars, several idols and a stamp seal point to the religious and administrative characteristics of the complex (Şahoğlu, 2008). At the end of the period, this central complex and buildings around it came to an end due to a large fire. Liman Tepe, due to eroded layers, provides very scarce information on the EBA III. Earlier in the period, a new upper town surrounded by a perimeter wall was established and outside the wall, the period is represented by pits only. Considering several depata, tankards and wheel-made plates, plenty of tortoise shells and a piece of gold that majority of pits yielded, these pits were most likely used for ritual purposes (Erkanal & Şahoğlu, 2016).

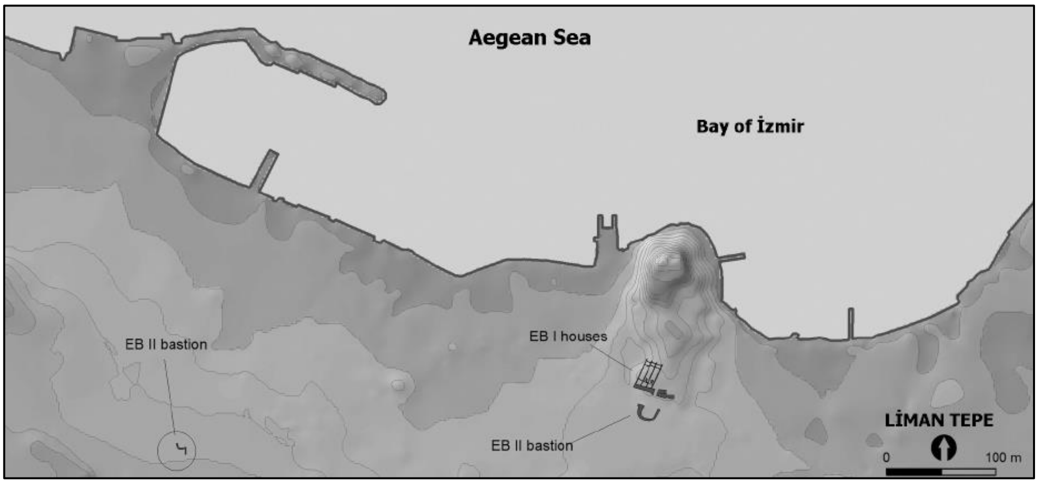

Figure 53. Bastions and the extent of the settlement at Liman Tepe in the EBA II (Erkanal & Şahoğlu, 2016, Fig. 10).

Figure 54. Liman Tepe in the EBA II. 1: EB I Fortification, 2: "Stratigraphic Trench" in House 2, 3: Central Complex, 4: EBA II Structures (Şahoğlu, 2008, Fig. 6).

In the late EBA II, at Küllüoba, inhabitants of the settlement, consisting of an upper town and a lower town, followed the same settlement plan (Fidan, 2012). However, later in the period, considering changes in architectural plans of the both complexes, it seems that these buildings were not complexes any more. This significant change points to a new organization. In the lower town, there were houses built adjacent to each other on the side of a street. Towards the beginning of the EBA III, significant changes occurred on the site. Free-standing buildings having stone foundations and two rooms at most were built and between the buildings, square silos were dug into the ground (Figure 55). Appearance of a few hand-made Troy plates and single handled tankards. The information on the EBA III (ca. 2400-2200 BC) is, however, limited and only fragmented stone foundations and a large number of offering and trash pits were revealed (Fidan, 2012).

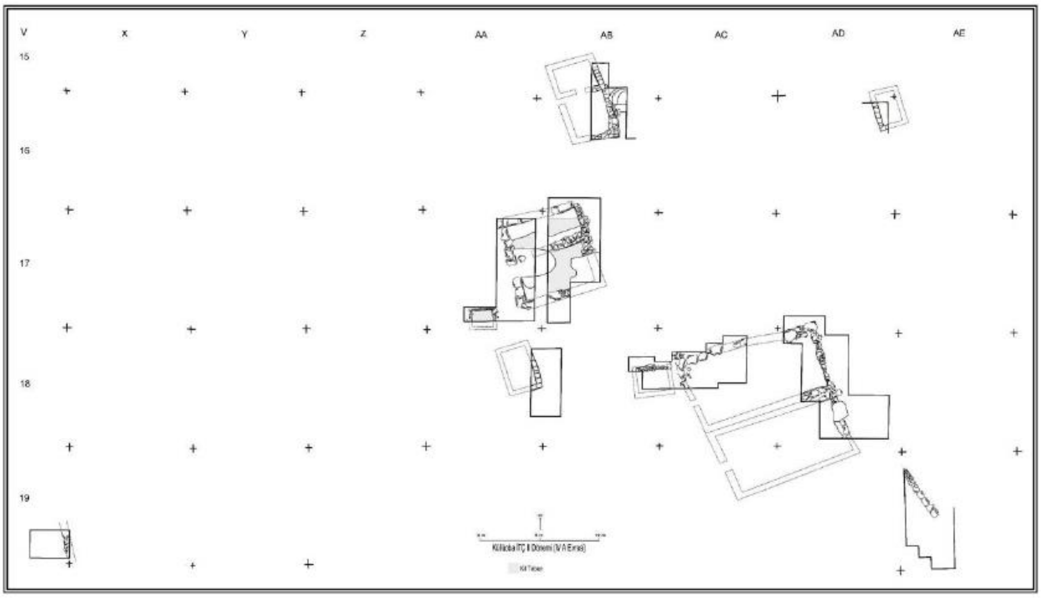

Figure 55. Houses in the latest phase of the EBA II/transition to the EBA III, Küllüoba (Fidan, 2012, Resim 20).

The middle EBA III is well known from the settlement at Seyitömer (Bilgen & Bilgen, 2015). In the mid-EBA III, the site had a systematized settlement plan (Figure 56). There were houses, storage rooms and workshops made from stone and mudbrick and built adjacent to each other. Moreover, a sanctuary, a free-standing megaron with several libation cups in the centre, and a palace complex were unearthed in the southwest of the mound. The palace complex consisted of a large main room, a front room and several storage rooms having the largest vessels of the occupation phase and the main yielded many finds including golden, silver and bronze objects, beads and 10 Akkadian cylinder seals. This occupation phase came to an end by a large fire ca. 2000 BC (Bilgen et al., 2015).

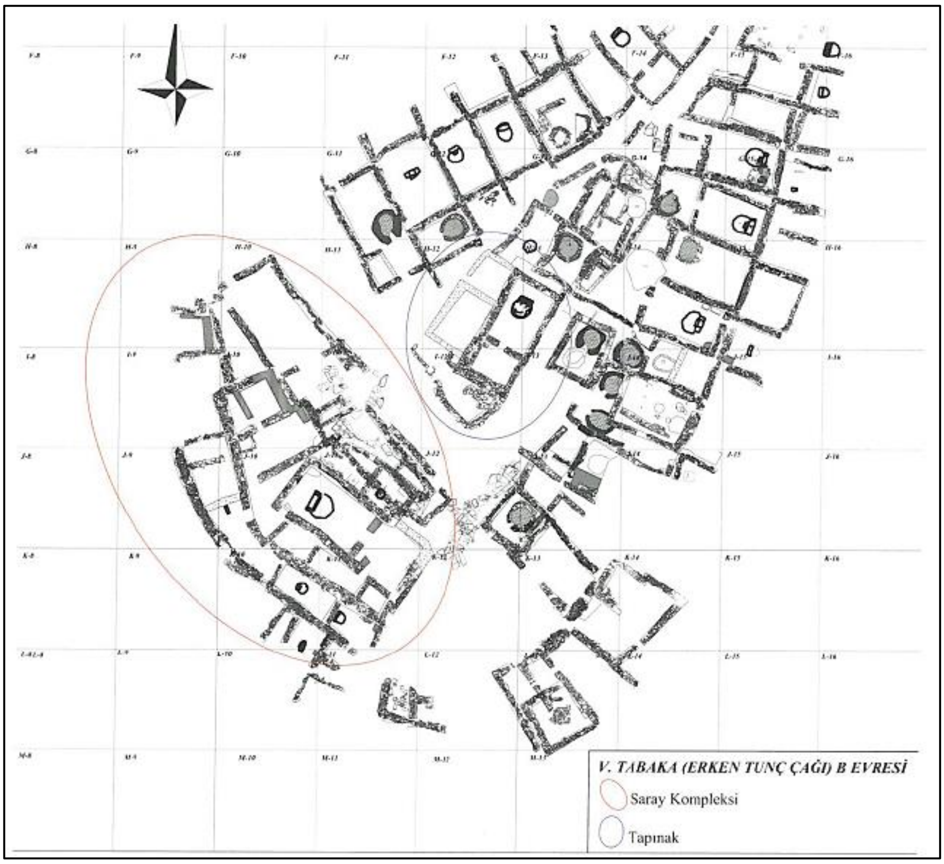

Figure 56. Settlement plan of Seyitömer in the mid-EBA III (Bilgen et al., 2015, Fig. 140). The circled are in the southwest: Palace complex; The circled are in the centre: Temple.

In the beginning of the period at Beycesultan, for the first time, twin sanctuaries, Shrine A and Shrine B, were constructed adjacent to each other. Both shrines had a sanctuary in rectangular form that was accessed through a simple portico and a small sacristy or “priest’s room”. There was an altar, composed of twin stelae and horns on the ground in the centre of the sanctuary, and vessels and receptacles for liquid and other offerings were placed around the stelae. Moreover, the shrines had blood altars, clay grain bins, open hearths and baking ovens. Later in the period, shrines reached their mature architectural plan (Figure 57). Towards the end of the period, shrines were clearly separated by large chambers and then, in the latest phase of the period, building complex forming the two sanctuaries was rebuilt (Figure 58). However, regarding evidence from the buildings, they seem not to be used as religious buildings anymore and the period ended by a destruction. In the early EBA III, after the destruction, the size of the settlement decreased. Only wall remains with a substantial stone foundation and mudbrick superstructure were revealed. In the following phases, megara, namely Megaron A, B and C were the norm on the site (Figure 59; Lloyd & Mellaart, 1962).

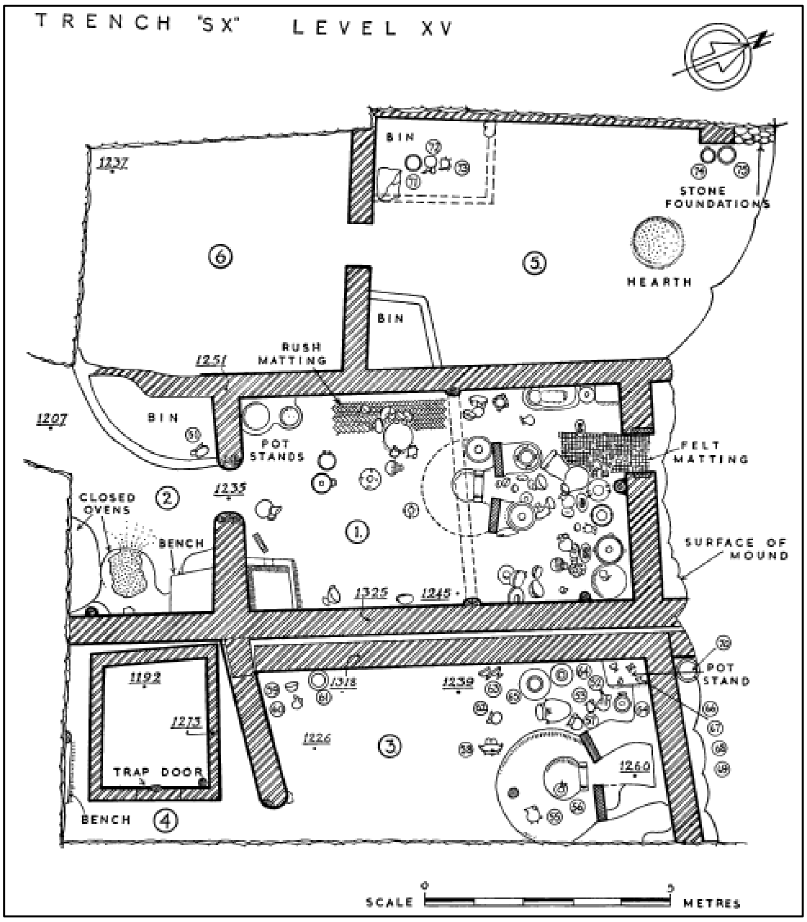

Figure 57. Shrines in the early EBA III, Beycesultan (Lloyd & Mellaart, 1962, Fig. 13).

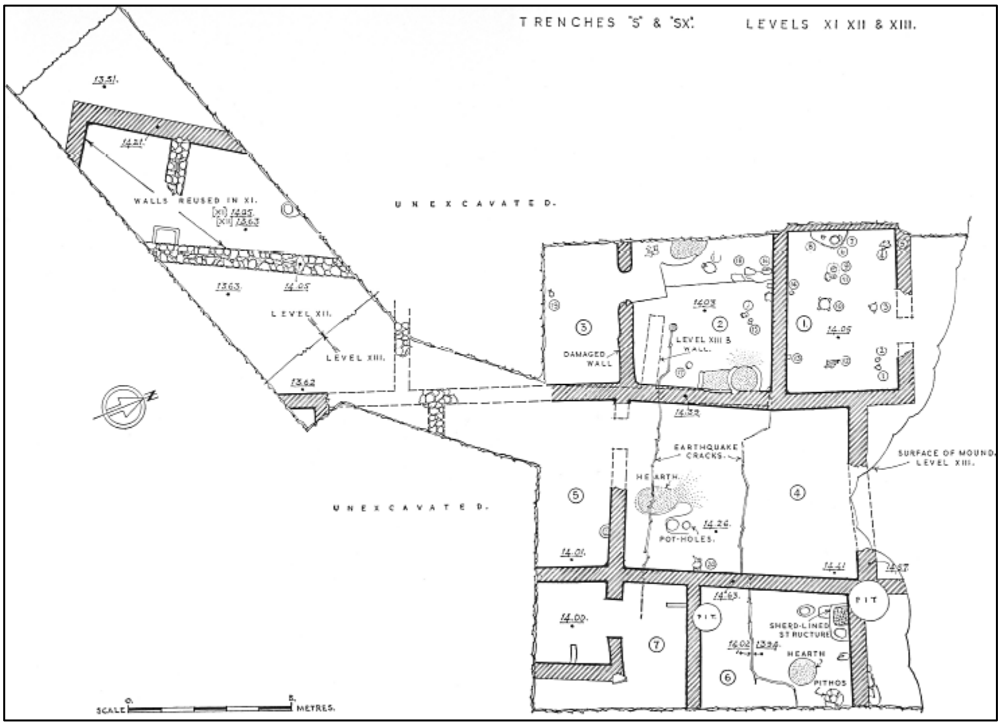

Figure 58. Shrines towards the end of the EBA II, Beycesultan (Lloyd & Seton, 1962, Fig. 21).

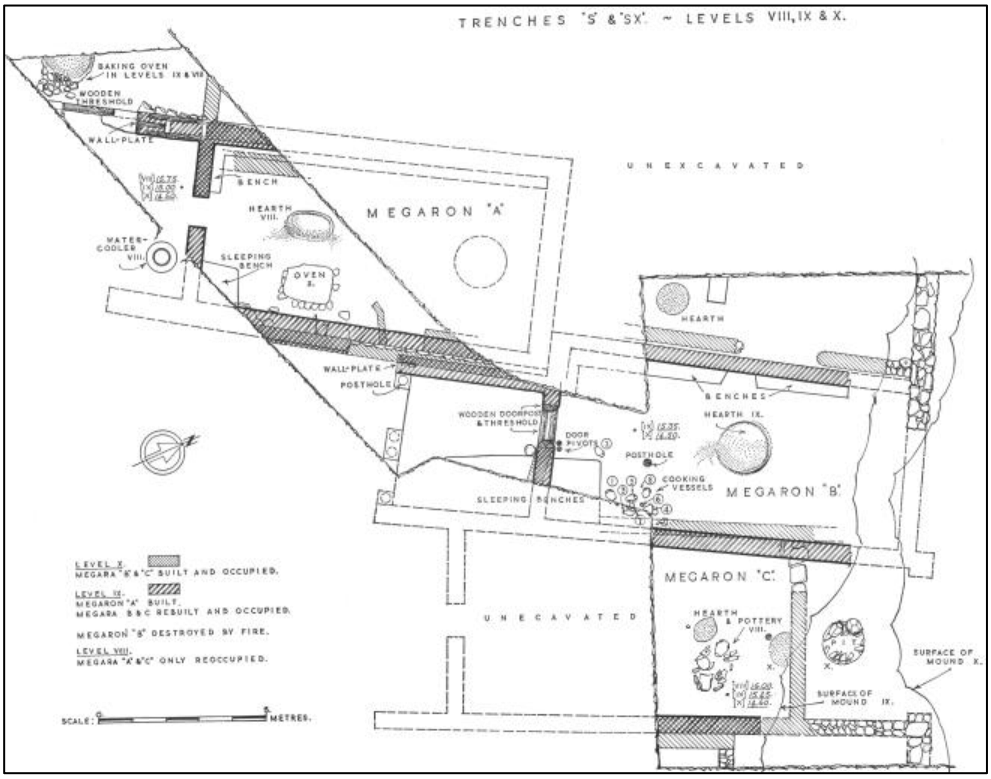

Figure 59. Megara A, B and C in the EBA III, Beycesultan (Lloyd & Seton, 1962, Fig. 22).

The settlement at Karataş-Semayük reached it largest dimension in the EBA II (Warner, 1994). The settlement was surrounded by an enclosure wall and throughout the period, megara were the norm on the site (Figure 60). Besides, there were rectangular single roomed buildings used for storage purposes. In the latest phase of the EBA II, wheel-made tankards were yielded. In the early EBA III, limited evidence from shows that the centre of the site was still inhibited. Well-built megara represented the architecture of the period (Figure 61) and the number of houses that had storage facilities increased. In this period, there were wheel-made vessels, tankards and depata (Warner, 1994).

Figure 60. Megara at Karataş-Semayük in the EBA II (Warner, 1992, Plate 13).

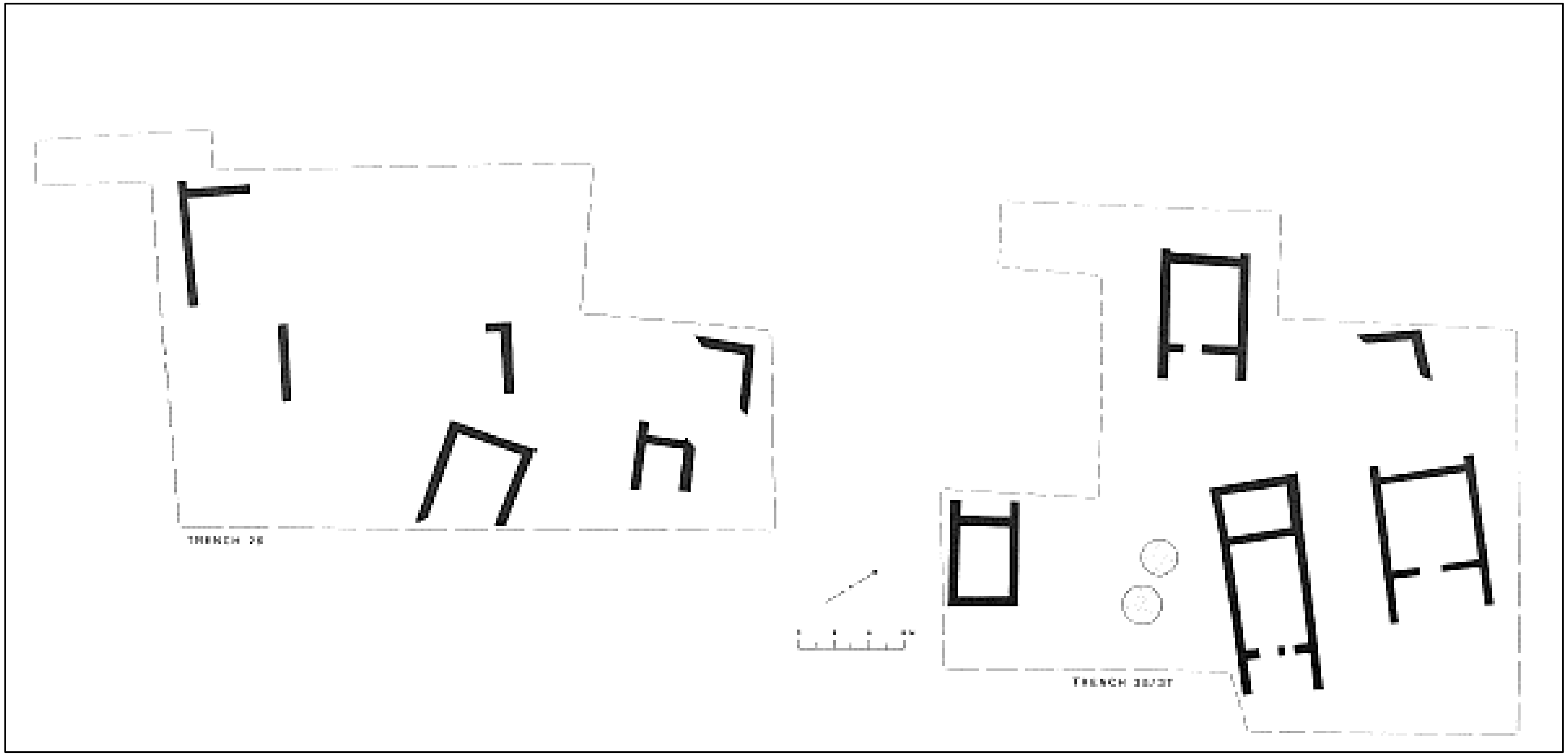

Figure 61. Megara in the early EBA III at Karataş-Semayük (Warner, 1992, Plate 12).

4.3. The End of the Early Bronze Age and Transition to the Middle Bronze Age (ca. 2200 – 2000 BC)

In the late EBA III (ca. 2200-2000 BC), most of the settlements in western Anatolia and as well as, the Anatolian peninsula, experienced dramatic changes. Monumental building complexes in upper towns representing the central authority disappeared and adjacent smaller buildings took their place. This shift seems to point to a substantial change in social structure. Moreover, the interregional exchange network collapsed and settlements that were previously regional centres lost their importance. After this collapse, a trade network was re-established at the beginning of the second millennium BC, in particular, between the central Anatolia and Mesopotamia. Despite the continued relations between the central and western Anatolia in this period, the latter seems to be isolated from this new trade network (Şahoğlu, 2005).

The occupation phases of the western Anatolian sites dated to the late EBA III were generally eroded and therefore, majority of the settlements provide very scarce information on the period. Troy and Liman Tepe in the coastal region, Küllüoba and Seyitömer in the northwestern Anatolia and Beycesultan, Bademağacı and Karataş-Semayük in the southwestern Anatolia provide some information on the changes in the late EBA III (Figure 36).

At Troy, during the transition to the MBA (ca. 2200-1750 BC (Korfmann, 2006)), economic conditions of the town significantly changed (Korfmann, 2006) and besides findings associated to the previous phases of the EBA in Aegean characteristics, new elements with the inner Anatolian origin started to appear on the site. In the early phase of the transition period, the upper town expanded gradually and there were various building complexes that were separated by streets. The most explicit architectural change in the period is the appearance of the dome ovens. Use of dome ovens instead of simple open hearths accompanied with changes in vessels forms and abundance of wild animal bones among faunal remains clearly points to a change in the cooking and eating habits of the society. In the later phase, i.e., early 2nd millennium BC, the site underwent extensive construction activities and a significant reorganization. Trapezoid houses made from limestone quarry stones were the characteristics in architectural form. In this period, almost all buildings had dome ovens. The number of wild animal bones were, however, significantly lower than that of cattle and pig bones (Blum, 2006).

At Liman Tepe, in the late EBA III, the settlement lost its significance and monumentality (Erkanal & Şahoğlu, 2016). In the beginning of the 2nd millennium BC, the architectural form was represented by oval buildings built in wattle and daub technique arranged around a stone paved courtyard (Erkanal & Şahoğlu, 2016).

At Küllüoba, during the transition, a significant change occurred. Throughout the EBA, northwestern Anatolian societies were in close contact with the Aegean societies. However, with the transition to the MBA, they shifted to the inner Anatolian culture. In the early phases of the period, there were free-standing single-roomed rectangular buildings and then, in the succeeding phase, megara. In the later phases, there were multi-roomed buildings with stone foundation and mudbrick superstructure scattered over a wider area that points to an influence from the inner Anatolia and silos and hearths were in open area and almost every single room. Moreover, pre-Hittite ware and spouted jugs, characteristic wares of the period, started to replace with the EBA III wares and almost 60% of the pottery were produced through potter's wheel (Şahin, 2014).

In the late EBA III, the settlement plan of Seyitömer was more or less continued from the previous period (Figure 62). The sanctuary with its decreased size was destroyed and rebuilt several times. This occupation phase ended by a large fire as well. Finds from the both phases are bowls, depata and drinking cups and other jar and vessels, metal objects, mainly ornament, axes, pins, perforation tools and arrow heads (Bilgen et al., 2015). The early and middle MBA at Seyitömer is OSL dated to ca. 20th-19th century BC and 1790-1750 BC respectively (Bilgen, 2011). All MBA phases represent very similar architectural characteristics and throughout the period, the settlement was not organized as in the EBA III that point to a dramatic change in society. In the early MBA, the mound was surrounded by a fortification wall and access to the town was through the gates in the west and southwest. Buildings on the mound were either free-standing or built adjacently to form a complex. Majority of the buildings were used as residence and had generally hearths and storage facilities inside. There were workshops and storage rooms as well. Outside the fortification, there were buildings that, however, provided no architectural features but only hearths. Regarding finds such as beads, bronze arrow head and stamps from the houses, they are argued to be a residence for the non-local merchants. Both the early and middle phases of the MBA ended by a large fire that seems to be a consequence of a massive earthquake (Bilgen & Bilgen, 2015).

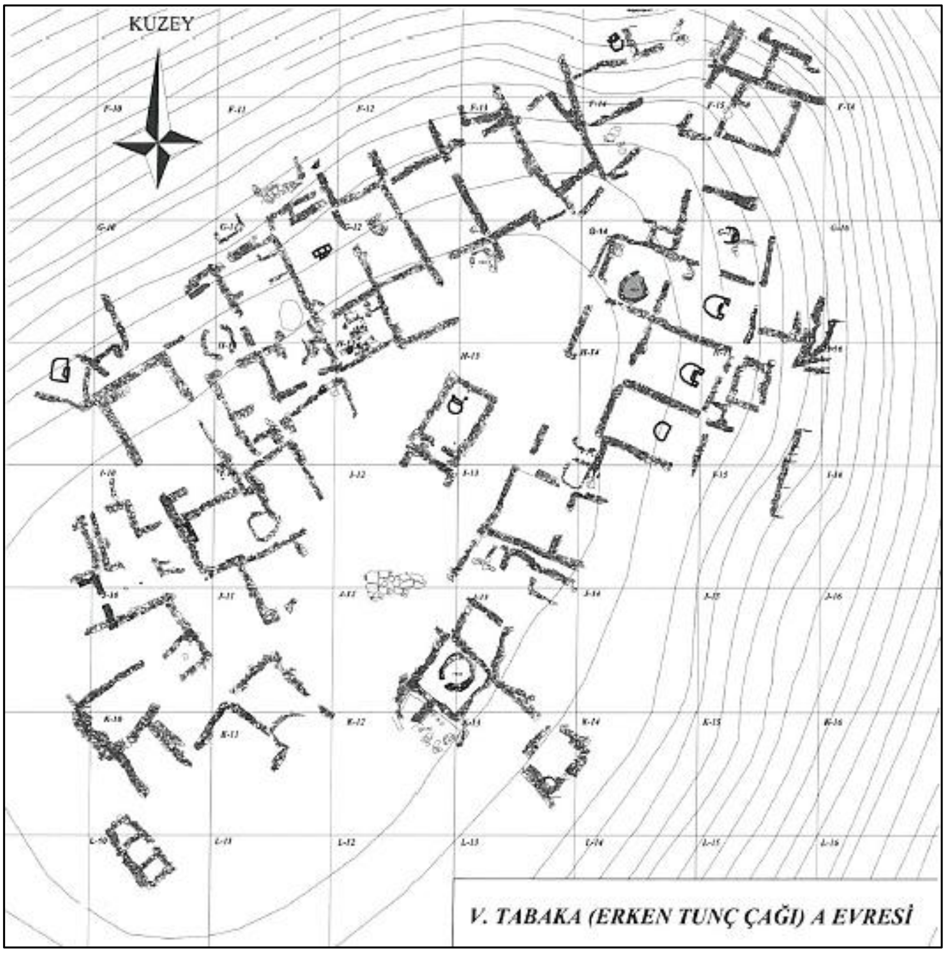

Figure 62. Settlement plan of Seyitömer in the late EBA III (Bilgen et al., 2015, Fig. 139).

At Beycesultan, in the final phase of the EBA III or the first century of the 2nd millennium BC, megara of the previous period were replaced with a complex of small buildings whose function is unknown (Figure 63; Lloyd & Mellaart, 1962).

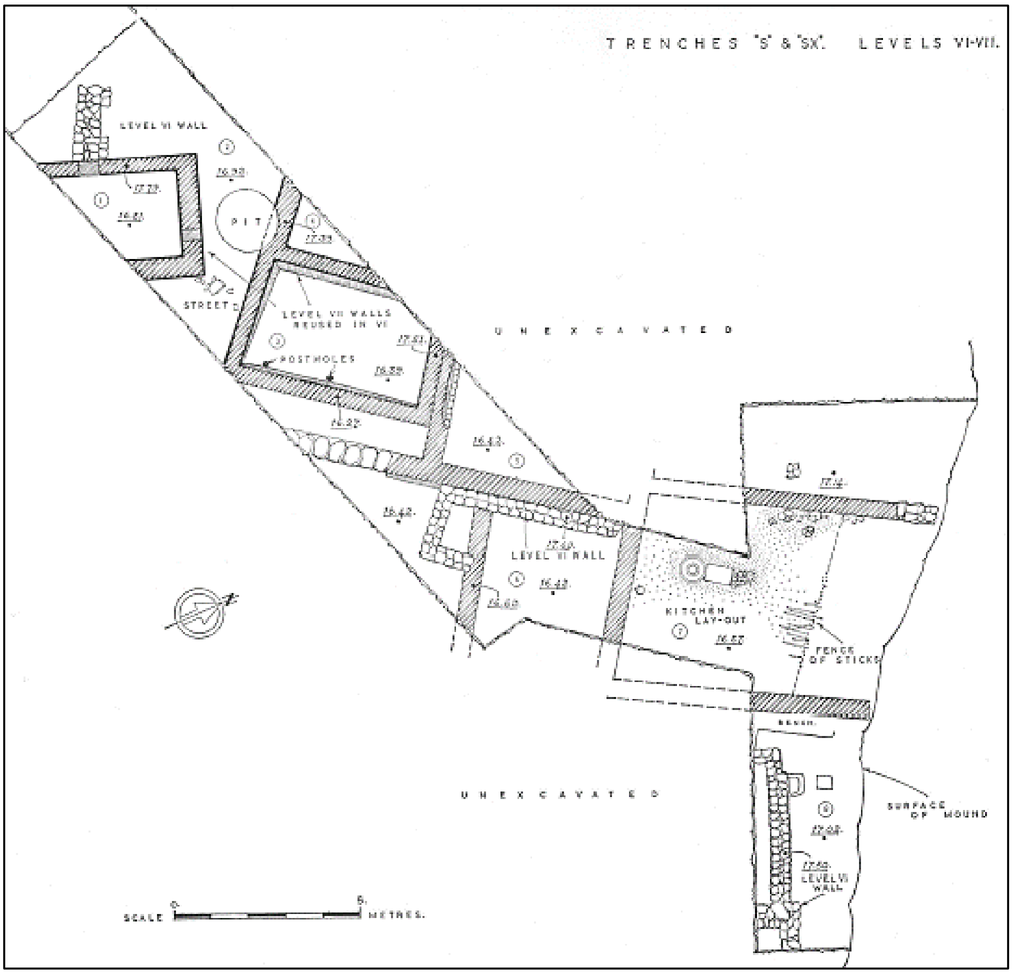

Figure 63. Complex of small buildings at the end of the EBA III at Beycesultan (Lloyd & Mellaart, 1962, Fig. 25).

At Bademağacı, after the severe destruction at the end of the EBA II, there was no major occupation until the MBA (ca. 2000-1800 BC). However, there is very scarce information on the period. There was a gate between two massive stone towers that is dated to a period between the EBA III and MBA. Remains dated to the MBA are some fragmented and disturbed stone foundations that must have belonged to single-roomed rectangular houses. A fragmented thick stone foundation might be remains of a fortification system (Duru, 2008).

After the early EBA III, the site of Karataş-Semayük, the site was continued to inhabited with interruptions and regarding no evidence for a disaster or a sudden abandonment, the reason why the site was not occupied continuously is not known (Warner, 1994).

As evidenced, all settlements mentioned in the text experienced substantial changes during the transition period of ca. 2200-2000 BC. Monumental buildings representing the existence of elites or rulers in upper towns disappeared and instead, smaller and narrower buildings were built. Moreover, almost all settlements underwent large fire disasters through the period and some of them were even abandoned. Until the MBA, none of the sites presented complex social characteristics. All these changes point to a significant transformation during the transition and reorganization after it.

CHAPTER 5

METHODS FOR UNDERSTANDING THE 4.2 KA BP EVENT AND HUMAN RESPONSES IN WESTERN ANATOLIA THROUGH PALAEOENVIRONMENTAL AND ARCHAEOLOGICAL DATA

The 4.2 ka BP climatic event has been relatively well studied in western Anatolia (Göktürk, 2011; Ülgen et al., 2012; Miebach et al., 2016; Ocakoğlu et al., 2019; Galicki & Doerner, 2010; Foss, 2006). However, its impacts on EBA societies in the region are not well understood. This thesis aims to assess whether there is a causal relationship between the 4.2 ka climatic event and social, political and economic changes in western Anatolian societies at the transition from the EBA to the MBA (ca. 2200-1900 BC) through a synthetic review of palaeoenvironmental, bioarchaeological and archaeological data. In more detail, the methodology of this study is based on integrated interpretation of changes in agricultural and animal husbandry practices through investigation of archaeobotanical and zooarchaeological analysis and changes in regional settlement patterns through examination of archaeological excavation and survey studies.

The causal relationship between the particular climatic event and significant changes in EBA societies in western Anatolia will be explored through focusing on two major issues:

1. Palaeoenvironmental data to determine the timing and intensity of the event in western Anatolia and its contemporaneity with any major societal collapse;
2. Human responses as a consequence of the drought to understand, as being suggested by a vast number of studies, if societies in western Anatolia experienced social unrest, conflicts and migration accentuated by a

breakdown in agricultural and animal production and then, exhibited diverse responses to the climatic stress including successful adaptations and total collapse.

Afterwards, challenges in linking the 4.2 ka BP event and social, economic and political changes in the western Anatolian societies will be discussed to see if a reliable causal relationship can be established. To do this, the nature, handicaps and strengths of archaeological, bioarchaeological and palaeoenvironmental data will be presented and how they should be interpreted will be addressed. The palaeoenvironmental, archaeological and bioarchaeological data and the results of studies on the subject in western Anatolia will be re-evaluated. Then, the reliability of suggested relationship between the 4.2 ka BP event and changes in western Anatolian societies at ca. 2200-1900 BC will be discussed. Finally, suggestions will be made on how to overcome challenges in such an interdisciplinary study that integrates palaeoenvironmental and archaeological data focusing on western Anatolia.

5.1.The Study Region

Western Anatolia is the focus of the study and for this thesis, it is defined not only by the topography and climate but also similar cultural developments during the EBA. Therefore, western Anatolia is the region limited by the Marmara Sea in the north and the Mediterranean Sea in the south and the Aegean Sea in the west and Türkmen Mountain, Emirdağ in the east (Darkot & Tuncel, 1978) and Sultan Mountains in the southeast (Figure 64). The mountain ranges extending in east-west direction and rivers such as the Gediz and Büyük Menderes cutting those ranges westward constitute the geography of the region (Steadman, 2012), and the region having such features is a home to diverse habitats. Western Anatolia with its temperate climate, fertile plains in the coast, its close relationship with the Thrace, Cyclades and the mainland Greece through the Aegean Sea and the central Anatolia through natural passes formed by river valleys between the mountain ranges and as well as, significant metal ores was a significant region throughout the EBA (Erkanal, 2011).

Figure 64. Map showing western Anatolia, the study region.

With increasing interest in the region, western Anatolia has been the subject of a wide range of archaeological surveys and excavations. More than 90 sites that have been excavated to investigate the EBA in the region make western Anatolia one of the regions that is relatively well-studied. Moreover, several of these sites including Troy, Demircihöyük, Küllüoba, Karataş-Semayük and Beycesultan have contributed to a well-established regional chronology that has been further enhanced by radiocarbon and OSL dates from more than 10 sites (Massa, 2016, pp. 36-37). Furthermore, besides archaeological research, several specialist studies focusing on analysis of plant and animal remains from the sites and palaeoenvironmental research have provided detailed information on the past environmental and climatic conditions including the 4.2 ka BP event period.

Western Anatolia is selected for this study for two reasons. First, it is a fragile environment lacking the abundant water sources such as big rivers and lakes of other areas in Anatolia and receiving a variable and unstable rainfall throughout a year (Türkeş, 1996; Sariş et al., 2010). All these features make the region vulnerable to aridity to a certain extent (Türkeş, 1996; Sariş et al., 2010; Massa & Şahoğlu, 2015) and increase the risk of failing to resist a drought event. Secondly, a large spectrum of palaeoenvironmental, bioarchaeological and archaeological research in the region has provided a good set of data to pursue a research on human-climate change interaction. Therefore, western Anatolia has a good potential to contribute to an understanding of the relationship between a climatic change with a specific reference to the 4.2 ka BP event and human activity in terms of social, economic and political changes as a response to the event.

5.2.Reconstruction of the 4.2 ka BP Event in Western Anatolia

The 4.2 ka BP event and its impacts have been investigated through several palaeoenvironmental studies in western Anatolia. Published palaeoenvironmental data in western Anatolia from Lake İznik, Kureyşler Valley, Kocain Cave and Elmalı Basin and as well as, Uzuntarla Cave that is a non-western Anatolian site will be reassessed to understand the timing and intensity of the event and its impact on the water availability in the study region. In fact, Uzuntarla Cave is not located in western Anatolia. However, its proximity to the study region and high-resolution analysis results make the site quite significant for a better understanding of the 4.2 ka BP in western Anatolia.

5.2.1. Stalagmites

Stable $\delta^{13}C$ and $\delta^{18}O$ isotope analysis and Th dating on two stalagmites from Uzuntarla Cave, Kırklareli, and Kocain Cave, Antalya (Göktürk, 2011), provides information on the 4.2 ka BP event. Several parameters will be checked to understand the 4.2 ka BP event and its impacts:

1. Changes in $\delta^{13}C$ and $\delta^{18}O$ values to observe changes in rainfall and temperature during the 4.2 ka BP event;
2. Event period recorded by the sample to determine when the event started and ended;
3. Temporal resolution to understand how precise the dating of the event is and it exactly coincides with the significant changes in western Anatolian societies and the end of the EBA to propose a causal relationship.

5.2.2. Lacustrine Sediments

Six cores from Lake İznik were investigated through geochemical and mineralogic analysis and were dated through Pb-Cs and ^{14}C AMS dating (Ülgen et al., 2012) and three cores were subjected to palynological analyses (Miebach et al., 2016). Several parameters will be checked to understand the 4.2 ka BP event and its impacts:

1. Changes in physical, geochemical and mineralogical proxies such as magnetic susceptibility (MS), total organic carbon (TOC), carbon/nitrogen and aragonite/calcite ratios to observe changes in rainfall during the 4.2 ka BP event;
2. Changes in pollen assemblage through palynological analysis to understand changes in pollen concentration and influx that show expansion or retreatment of forest;
3. Event period recorded by the sample to determine when the event started and ended;
4. Temporal resolution to understand how precise the dating of the event is and if it exactly coincides with the significant changes in the western Anatolian societies at the end of the EBA to propose a causal relationship.

Analysis of two cores from Karagöl based on litho-stratigraphy, mineralogy and faunal content with ^{14}C AMS dates (Galicki & Doerner, 2010) provides information on the 4.2 ka BP event in the region. Several parameters will be checked to understand the 4.2 ka BP event and its impacts:

1. Shifting between peat, marl/lime mud and gyttja that shows changes in lake level;
2. Event period recorded by the sample to determine when the event started and ended;
3. Temporal resolution to understand how precise the dating of the event is and if it exactly coincides with the significant changes in the western Anatolian societies at the end of the EBA to propose a causal relationship.

5.2.3. Land Sediments

Geochemical and stable $\delta^{13}C$ and $\delta^{18}O$ isotope analysis of six sediment cores with ^{14}C dates, from Kureyşler Valley, Kütahya (Ocakoğlu et al., 2019) provides information on the climatological conditions during the 4.2 ka BP event in the region. Several parameters will be checked to understand the 4.2 ka BP event and its impacts:

1. Changes in geochemical proxies such as magnetic susceptibility (MS), total organic carbon (TOC) to observe changes in rainfall during the 4.2 ka BP event;
2. Changes in $\delta^{13}C$ and $\delta^{18}O$ values to observe changes in rainfall and temperature during the 4.2 ka BP event;
3. Changes in pollen assemblage through palynological analysis to understand changes in *Pinus* and Poaceae pollen;
4. Event period recorded by the sample to determine when the event started and ended;

5. Temporal resolution to understand how precise the dating of the event is and if it exactly coincides with the significant changes in the western Anatolian societies at the end of the EBA to propose a causal relationship.

5.3. Impacts of a Drought Event on Ancient Societies

5.3.1. Changes in Agricultural and Animal Husbandry Practices

First and foremost, agricultural and animal husbandry practices must have been affected by the drought event and altered environment. Therefore, investigation of changes in plant and animal husbandry that can be related to climate change contributes to a better understanding of responses to the particular event. According to archaeobotanical and zooarchaeological analyses in Anatolia and the wider Eastern Mediterranean, drought conditions can be testified through:

1. An increase in the amount of drought resistant crops such as barley and bitter vetch (cf. Çizer, 2015; Blum & Riehl, 2015);
2. Isotopic analysis of plants that clearly shows growing conditions of crops in terms of water availability, i.e., if crops grew under drought conditions (cf. Riehl et al., 2014; Fiorentino et al., 2008; Fiorentino et al., 2012);
3. Cultivation of a broad spectrum of different crops to reduce the risk of crop failure (cf. Blum & Riehl, 2015; Riehl & Marinova, 2016; Riehl, 2017);
4. Isotopic analyses of animal bones to understand changes in animal diet and if societies shifted to pastoralism and moved animals from lowlands to highlands or vice versa (Mashkour, 2003);
5. An increase in the ratio of sheep/goat to cattle, i.e., favouring domestic animals with less food and water requirement, that points to a shift to pastoralism (Wossink, 2009);
6. An increase in amount of wild hunted animals (cf. Gündem, 2010) to diversify meat resources (Riehl, 2017);

7. An increase or decrease in amount of pigs depending on some factors.
    a. A decrease in amount of pigs that requires water and forested environment and that are not suitable for a pastoralist economy (Gündem, 2010);
    b. An increase in amount of pigs and wild boars as an easier and cheaper meat source (cf. Gündem, 2010).

As the already investigated changes clearly suggest, the EBA societies in Anatolia and the wider eastern Mediterranean region exhibit signs of responses and adaptation to the adverse impacts of the 4.2 ka BP event. By modifying and shifting between their agricultural and animal husbandry practices, they clearly sought to adapt to changing environmental conditions. Similarly, western Anatolian societies must have reacted to drought event and tried to overcome its impacts in various ways. Therefore, evidences for such adaptations and their nature will be searched for in archaeobotanical and zooarchaeological data from western Anatolia.

More specifically, archaeobotanical data from Yenibademli Höyük, Troy, Küllüoba, Liman Tepe and Çukuriçi Höyük provides information throughout the EBA and transition to the MBA. Through the investigation of such data, changes in agricultural practices as a response to the drought event will be determined. To do this, following parameters will be tested:

1. Increasing number of drought-tolerant crops;
    a. A decrease in wheat to barley ratio;
    b. An increase in glumed wheat to free threshing wheat ratio;
    c. An increase in drought tolerant pulses and famine foods such as bitter vetch (*Vicia ervilia*) and grass pea (*Lathyrus sativus*).
2. Diversification of crop species that presents a measure taken against the total crop failure;
3. Presence of crops that grew under aridity that is testified through stable $\Delta^{13}C$ isotope analysis on crop remains;
4. An increase in pulses used as fodder for animals due to altered pastures and natural fodder.

Zooarchaeological data from Kanlıgeçit, Yenibademli Höyük, Maydos-Kilisetepe, Troy, Demircihöyük, Küllüoba, Ulucak Höyük, Çukuriçi Höyük, Aphrodisias-Pekmez and Karataş-Semayük sheds light on development and changes in animal husbandry throughout the EBA including the transition to the MBA. Similarly, western Anatolian societies could have either continued to pursue a sedentary agriculturalism or shifted to nomadism accompanied by a pastoralist economy. Therefore, their responses through changes in animal husbandry to the climatic change depend on their choice. Human responses to climatic stress and aridity that can be traced to changes in animal husbandry practices are diverse:

1. Favouring domestic animals with less food and water requirements to avoid adverse impacts and limitations of less water availability and altered natural pastures;
    a. A decrease in sheep to goat ratio;
    b. An increase in sheep/goat to cattle ratio.
2. An increase in number of hunted wild animals, in particular, fallow deer and wild boar, to remedy the lack in food and diversify meat source;
3. Favouring or disfavouring pigs and wild boars depending on some factors.
    a. An increase in amount of pigs and wild boars, since they are carnivore and prolific as a cheap alternative for meat procurement;
    b. A decrease in amount of pigs and wild boars, since they live in forested environment with water and are not suitable for a pastoralist economy.

5.3.2. Changes in Socio-Political Structure

Previous extensive research on the subject suggests that following the disturbance of agricultural and animal husbandry practices, societies faced some social problems including conflicts, migrations and collapse. Social and political responses to the 4.2 ka climatic event can be summarized as:

1. A collapse in political formation and contemporaneous abandonment of a large number of settlements in arid and semi-arid regions and therefore, a notable change in regional settlement patterns (Weiss, 2015);
2. Movement of populations to refugia with permanent water resources, rivers, springs and so on and aggregation of populations into larger settlements (Weiss, 2015);
3. Rivalry among sedentary agriculturalists for limited arable land and water resources (Wossink, 2009);
4. Shift of sedentary agriculturalists in marginal areas to pastoralism (Weiss, 2015; Wossink, 2009);
5. Enhanced relationships with communities following different subsistence strategies (Weiss, 2015).

It should be noted that abovementioned responses are derived from the studies focusing on northern Mesopotamia that is the only very well-studied region in the eastern Mediterranean and adjacent regions regarding the subject. In fact, it is risky to propose that the same responses seen in northern Mesopotamia will be valid for western Anatolia too, since the social and political structure of societies in those two regions were surely not the same. Additionally, the natural environment in the two regions is not the same. However, it can be hypothesised that western Anatolian societies might have similarly responded to the drought event at least in some aspects. Moreover, these responses are taken rather as a “model” explaining possible adaptation of societies drought stress conditions that is going to be tested for its validity in western Anatolia.

To verify presence of such responses in western Anatolia, changes in regional settlement patterns will be investigated through published archaeological data from surveys in Gelibolu Peninsula, Marmara Sea, Balıkesir-Manisa, Büyük Menderes, Beycesultan hinterland, Yenişehir-İznik and Eskişehir regions and excavations at Troy, Demircihöyük, Seyitömer Höyük, Küllüoba, Liman Tepe, Beycesultan, Bademağacı and Karataş-Semayük. All the data provides information on the social, economic and political development and transformation of the western Anatolian societies throughout the EBA and the transition to the MBA. Any possible changes related to the drought event will be search for through:

1. Contemporaneous abandonment of a large number of settlements in marginal areas.
    a. Adopting nomadism with a pastoralist economy that can be confirmed through a decrease in sedentary settlement number and an increase in archaeology less visible site number that were temporarily inhabited by nomads;
    b. Migration to refugia and aggregation into larger settlements being already powerful and having a better access to limited resources that can be testified through an increase in site number and extent and population of such settlements.

5.4.Limitations

Although there are good datasets to research the subject in western Anatolia, the nature of palaeoenvironmental, bioarchaeological and archaeological data and the strengths and weaknesses of the synthetic method based on combining such data create some limitations.

Limited number of palaeoenvironmental research in western Anatolia come from the southwestern and northwestern Anatolia that means the coastal region lacks such research and a reliable climatic reconstruction. Moreover, the temporal resolution of palaeoenvironmental studies in the region is majorly low that may lead problems of determining the timing and duration.

There are several archaeobotanical and zooarchaeological studies in western Anatolia. However, they are concentrated in the coastal region where palaeoenvironmental data is significantly lacking. In addition, studies are majorly cover the EBA II period and only a few studies provide information on the EBA III and the transition to the MBA that is the focus of this thesis. Moreover, the quality of these studies considerably varies by site and creates some difficulties when comparing results from different sites. Furthermore, both archaeobotanical and zooarchaeological remains were dated according to the archaeological stratigraphy and therefore, limited number of results are based on ^{14}C dates. This may prevent precise dating of changes in plant and animal species through time across the region.

Similar to bioarchaeological studies, archaeological surveys and majority of excavations lack an absolute dating. Although such research, in particular surveys, provides a comprehensive and *longue durée* perspective on societal changes, their own methodological limitations and dating problems may lead to biased conclusions on changes related to the climatic event.

The temporal and spatial scales and chronological resolution of palaeoenvironmental, bioarchaeological and archaeological data significantly differ and this creates some problems when combining and interpreting such data together. Archaeological studies aim at observing changes in centuries and even decades. On the other hand, palaeoenvironmental studies majorly deal with changes of thousands of years, therefore, with a relatively low temporal resolution in comparison to archaeological studies. Integrating data with significantly differing scales may prevent to exactly overlap the climatic event and changes in societies that are related to it.

CHAPTER 6

RESPONSES TO THE 4.2 KA BP EVENT IN WESTERN ANATOLIA

6.1.Changes in Agricultural and Animal Husbandry Practices in Western Anatolia under Aridity

Human responses to a drought event should be clearly observable through changes in agricultural and animal husbandry practices, since both activities highly depend on water availability. Therefore, archaeobotanical and zooarchaeological analysis from western Anatolian sites can considerably contribute to the understanding of how societies responded to the changing conditions through their agricultural and animal husbandry adaptations.

6.1.1. Changes in Agricultural Practices in Western Anatolia under Aridity

Analysis of plant remains from Yenibademli Höyük, Troy, Küllüoba, Liman Tepe and Çukuriçi Höyük provides a reconstruction of agricultural practices and crop preferences throughout the EBA and at the transition to the MBA in western Anatolia (Figure 65).

The plant assemblage from Yenibademli Höyük, Gökçeada, consists of more than 2,000 million specimens and is dated to the EBA II, ca. 2900-2600 BC (^{14}C dated). Plant remains include cereals, legumes, fruits and wild weeds that were derived from various contexts such as floors, hearths, burnt layers and pithoi. Moreover, the site yielded large storage finds from more than eight contexts, including einkorn and emmer wheat, barley, bitter vetch, broad bean, Spanish vetchling, garden pea and clover, that are very unique contexts and are not comparable with other remains. Therefore, they are not considered within this study to avoid biased interpretations. At the site, legumes are the major crops. With this feature, Yenibademli Höyük differs greatly from other Anatolian sites where cereals are the dominating crops and represents similarities to Aegean sites such as Lerna and Kastanas (Oybak-Dönmez, 2005).

Figure 65. Map showing the western Anatolian sites with archaeobotanical analysis mentioned in the text.

Plant remains from Troy, Çanakkale, were gathered from all occupation phases, namely Troy I-IV, ca. 2950-1950 BC (Troy I: ca. 2950-2500 BC (roughly EBA I), Troy II: 2500-2350 BC (EBA II), Troy III: 2350-2200/2150 BC (EBA III) and the transition period: 2200/2150-1950 BC) (Blum & Riehl, 2015). Archaeobotanical analysis on remains is based on the investigation of ca. 12,800 carbonized seeds including cereals and legumes, fruits, chaff remains and charcoal fragments from various contexts such as pits, hearths, floors and so on (Riehl, 1999). The assemblage is mainly derived from Troy II and Troy IV and Troy IV assemblage has large storage finds of garden pea linseed that are not considered quantitatively within this study. In all occupation phases, cereals are the major crops (Blum & Riehl, 2015).

Küllüoba, Eskişehir, provides a plant assemblage that consists of more than 500,000 seeds and is dated to the EBA period, 3000-1900 BC (EBA I: 3000-2700 BC, EBA II: 2700-2400 BC, EBA III: 2400-2200 BC and the transition period: 2200-1900 BC). Plant remains were yielded from various contexts such as hearths, floors, pits from both from outside and inside contexts and includes cereals, legumes, fruits and wild weeds. Cereals are the dominating crops throughout the EBA except the EBA I when the freshwater taxon (*Phalaris arundineacea*-type) is the major crop. The freshwater taxon was most probably a field weed but on the other hand, it was majorly originated from grazing or fodder collecting (Çizer, 2015).

The plant assemblage from Liman Tepe, İzmir, consists of ca. 3,000 specimens that are dated to the EBA I (ca. 3000-2700/2600 BC) and EBA II early (2700/2650-2500 BC). The majority of the assemblage belongs to the EBA I and thus, samples from the EBA II are very limited. According to analysis results, cereals are the major crops in both periods (Oybak-Dönmez, 2006).

Çukuriçi Höyük, İzmir, provides a crop assemblage of 424 specimens that are dated to the EBA I, 2900-2750 BC (^{14}C dated). Plant remains include cereals, legumes, fruits and wild plants and were collected from the centre and the northern edge of the mound. Results show that cereals are the major crops (Horejs et al., 2011).

As already discussed in chapter 5, responses of societies that can be traced to changes in agricultural practices are examined through the following changes:

1. An increase in drought-tolerant crops;
    a. A decrease in wheat to barley ratio;
    b. An increase in glumed wheat to free threshing wheat;
    c. An increase in drought tolerant pulses and famine food such as bitter vetch, grass pea/chickling vetch and chickpea.

2. Presence of crops that grew under aridity that is testified through stable $\Delta^{13}C$ isotope analysis on crop remains;
3. An increase in pulses used as fodder for animals due to altered pastures and natural fodder;
4. Diversification of crop species to buffer the risk of total crop failure.

Favouring drought-tolerant crops was one of the measures taken by sedentary agriculturalists under drought conditions. To understand the changes in crop preferences, einkorn and emmer wheat (*Triticum monococcum* and *Triticum dicoccum*), bread/durum wheat (*Triticum aestivum/durum*) and barley (*Hordeum vulgare*) and the ratios of total wheat (einkorn, emmer and bread/durum wheat) to barley and glumed wheat (einkorn and emmer wheat) to free threshing wheat (bread/durum wheat) will be investigated. Since barley and glumed wheat are more drought-resistant in comparison to wheat and free threshing wheat respectively, a decrease in wheat to barley ratio and an increase in glumed wheat to free threshing wheat are expected during a drought event.

Table 2 shows the number and distribution of mentioned crops species from western Anatolian sites throughout the EBA and at the transition to the MBA. However, there are some problems and points to discuss before the analysis.

Botanical remains from Troy were majorly studied by Riehl (1999). According to her publication, analysed samples were collected from Troy I and II together, representing EBA assemblage, and Troy IV, as MBA assemblage and there were no samples from Troy III. Analysis of mixed material of Troy I and II conflicts with the scope of this thesis, since it aims to observe changes in each period. Therefore, the analysis result of Troy I/II material is not useful for this study. Moreover, the remains were investigated regarding their find contexts and only, a general evaluation and a total number of finds from a context is provided. That means that there is no information on each crop specie, their find context and individual or total find number in specie basis. Although it is well-studied, these problems make Troy's plant assemblage almost totally useless for this study. On the other hand, a later publication provides brief information on einkorn and emmer wheat, barley and some other pulses that were collected from Troy I, Troy II, Troy III and Troy IV separately in terms of relative abundance through occupation phases (Blum & Riehl, 2015). Thus, the information from the latter publication is considered as much as possible in a meaningful way within this study.

The plant assemblages from Çukuriçi Höyük and EBA II Liman Tepe are very restricted and cannot represent the whole site. Therefore, these two assemblages are excluded from this study.

As it can be seen in Table 2, sizes of each site's assemblage are highly varied and this makes it difficult to understand and interpret number of crops and their meaning. Therefore, to make each assemblage comparable with another, relative abundance of crops in each assemblage was calculated (Table 3).

According to Table 3 and Figure 66, in the EBA I and II, wheat is the dominant cereal and emmer and einkorn wheat in particular are the major species in all settlements. Besides, the amount of barley increases slightly at Liman Tepe and Troy in respect to previous period. At Küllüoba, consumption of bread/durum wheat and barley seem to decrease in the EBA II. Moreover, at Küllüoba towards the end of the EBA II, there is an increase in amount of bread/durum wheat and in particular, barley. In the EBA III, the trend of the previous period continues at Küllüoba that means barley and bread/durum wheat constitutes 10-13% and 9-12% of the cereal assemblage respectively. Moreover, there is a significant increase in barley at Troy. In the late EBA III/ the MBA, at Troy, barley loses its importance in respect to previous period but still constitutes ca. 12% of the cereal assemblage.

As seen in Table 3 and Figure 66, it is not possible to determine a general regional trend in crop preference under climatic stress. Apparently, settlements seem to react differently to changing climatic and environmental conditions through time. Two settlements at Küllüoba and Troy, on the other hand, seem to behave in a similar way through time. In addition, both settlements were occupied throughout the EBA without a major break, a detailed investigation on Troy and Küllüoba can provide insights on changes in crop preference from one period to another over a long-term period.

Table 2. The number and distribution of *Triticum dicoccum/monococcum*, *Triticum aestivum/durum* and *Hordeum vulgare* in the EBA and at the transition to the MBA in western Anatolia. EBA III L.: Late EBA III, TRY: Troy (Riehl, 1999; Blum & Riehl, 2015) KO: Küllüoba (Çizer, 2015), LT: Liman Tepe (Oybak-Dönmez, 2006), ÇH: Çukuriçi Höyük (Horejs et al., 2011), YB: Yenibademli Höyük (Oybak-Dönmez, 2005). ?: Number of these crops are not provided in the publications.

Period	EBA I				EBA II					EBA III		EBA III L./MBA	
Site	TRY	KO	LT	ÇH	YB	TRY	KO		LT	TRY	KO	TRY	KO
							Early	Late					
Triticum dicocc./monoc.	?	4464	305	3	3604	?	149393	29170	10	?	3917	?	1372
Triticum aestivum/durum (grain)	?	2527	31	0	0	?	4745	4619	0	?	537	?	220
Triticum (grain)	?	0	98	0	0	?	0	0	5	?	0	?	0
Total *Triticum* (grain)	?	6991	434	3	3604	?	154138	33789	15	?	4454	?	1592
Hordeum vulgare (grain)	?	1383	106	9	32	?	907	4546	4	?	656	?	182

Table 3. Relative abundance and distribution of *Triticum dicoccum/monococcum*, *Triticum aestivum/durum* and *Hordeum vulgare* and ratios of *Triticum dicocc./monoc.* to *Hordeum vulgare* and *Triticum dicocc./monoc.* to *Triticum aestivum/durum* in the EBA and at the transition to the MBA in western Anatolia. Abbreviations refer to Table 2.

Period	EBA I			EBA II				EBA III		EBA III L./MBA	
Site*	TRY	KO	LT	YB	TRY	KO		TRY	KO	TRY	KO
						Early	Late				
Triticum dicocc./monoc.	97.87%	53.31%	56.48%	99.12%	93.6%	96.35%	76.09%	73.24%	76.65%	87.08%	77.34%
Triticum aestivum/durum	0%	30.18%	5.74%	0%	0%	3.06%	12.05%	0%	10.51%	0%	12.4%
Triticum	0%	0%	18.15%	0%	0%	0%	0%	0%	0%	0%	0%
Total *Triticum*	97.87%	83.48%	80.37%	99.12%	93.6%	99.42%	88.14%	73.24%	87.16%	87.08%	89.74%
Hordeum vulgare	2.13%	16.52%	19.63%	0.88%	6.4%	0.58%	11.86%	26.76%	12.84%	12.92%	10.26%
(Total Triticum) : (Hordeum vulgare)	**46:1**	**5.1:1**	**4.1:1**	**113:1**	**14.6:1**	**170:1**	**7.4:1**	**2.7:1**	**6.8:1**	**6.7:1**	**8.8:1**
(Triticum dicocc./monoc.) : (Triticum aestivum/durum)	**-**	**1.8:1**	**9.8:1**	**-**	**-**	**31:1**	**6.3:1**	**-**	**7.3:1**	**-**	**6.2:1**

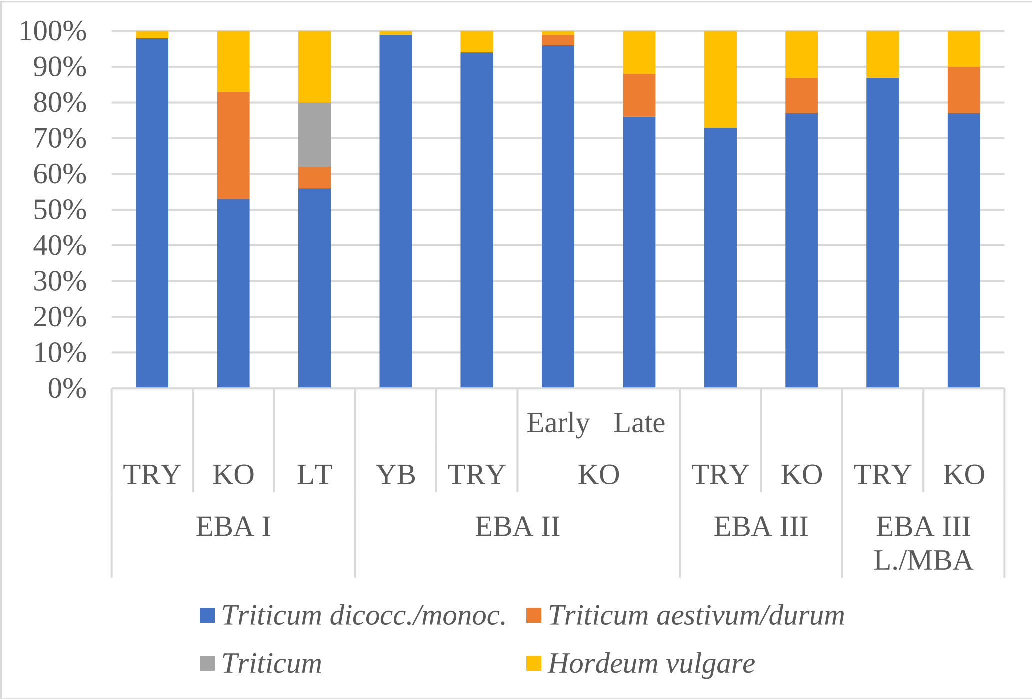

Figure 66. Bar chart showing relative abundance of *Triticum dicoccum/monococcum*, *Triticum aestivum/durum*, *Triticum* and *Hordeum vulgare* in each site through time. Abbreviations refer to Table 2.

In Table 4, relative abundance of crops and related ratios at Troy and Küllüoba are demonstrated. In Table 5, changes in percentage with respect to previous period are shown. Under aridity, a decrease in ratio of wheat to barley and an increase in einkorn and emmer wheat to bread/durum wheat is expected. According to Table 4 and Table 5, at Küllüoba, the ratio of wheat to barley decreases by 96% and 8% at the transitions from EBA II early to EBA II late and EBA II late to EBA III respectively. The ratio of emmer and einkorn wheat to bread/durum wheat increases by 1622% and 16% at the transition from EBA I to EBA II and EBA II late to EBA III respectively. Overlapping changes in both ratios at the transition from EBA II late to EBA III suggest a disturbance due to a possible drought event. At Troy, the ratio of wheat to barley decreases by 68% and 83% at the transitions from the EBA I to EBA II and from the EBA II to EBA III. At the transition to the EBA II late/MBA, both sites do not present expected changes that attests no climatic stress or aridity during the period. In summary, changes in crops suggest an aridity that starts in the late EBA II and continued into the EBA III.

Table 4. Relative abundance of *Triticum dicocc./monoc.*, *Triticum aestivum/durum*, *Hordeum vulgare* and ratios of Total *Triticum* to *Hordeum vulgare* and *Triticum dicocc./monoc.* to *Triticum aestivum/durum* throughout the EBA at Küllüoba and Troy. Abbreviations refers to Table 2.

Site	Küllüoba					Troy			
Period	EBA I	EBA II		EBA III	EBA III L./MBA	EBA I	EBA II	EBA III	EBA III L./MBA
		Early	Late						
Triticum dicocc./monoc.	53.31%	96.35%	76.09%	76.65%	77.34%	97.87%	93.6%	73.24%	87.08%
Triticum aestivum/durum	30.18%	3.06%	12.05%	10.51%	12.4%	0%	0%	0%	0%
Total *Triticum*	83.48%	99.42%	88.14%	87.16%	89.74%	97.87%	93.6%	73.24%	87.08%
Hordeum vulgare	16.52%	0.58%	11.86%	12.84%	10.26%	2.13%	6.4%	26.76%	12.92%
(Total Triticum) : (Hordeum vulgare)	**5.1:1**	**170:1**	**7.4:1**	**6.8:1**	**8.8:1**	**46:1**	**14.6:1**	**2.7:1**	**6.7:1**
(Triticum dicocc./monoc.) : (Triticum aestivum/durum)	**1.8:1**	**31:1**	**6.3:1**	**7.3:1**	**6.2:1**	**-**	**-**	**-**	**-**

Table 5. Changes in relative abundance of crops and ratios in respect to previous period throughout the EBA at Küllüoba and Troy. Abbreviations refer to Table 2.

Site	Küllüoba				Troy		
Period	EBA I → EBA II E.	EBA II E. → EBA II L.	EBA II L. → EBA III E.	EBA III → EBA III L./MBA	EBA I → EBA II	EBA II → EBA III	EBA III → EBA III L./MBA
Triticum dicocc./monoc.	81%	-21%	1%	0%	-4%	-22%	19%
Triticum aestivum/durum	-90%	300%	-17%	30%	-	-	-
Total *Triticum*	14%	-11%	-1%	3%	-4%	-22%	19%
Hordeum vulgare	-94%	1100%	8%	-23%	200%	350%	-52%
(Total *Triticum*) : (*Hordeum vulgare*)	**3233%**	**-96%**	**-8%**	**29%**	**-68%**	**-83%**	**148%**
(*Triticum dicocc./ monoc.*) : (*Triticum aestivum/durum*)	**1622%**	**-80%**	**16%**	**-15%**	**-**	**-**	**-**

Under aridity, similar to cereals, drought-tolerant pulses and famine food are expected to increase. To verify this signal in western Anatolian sites, changes in bitter vetch (*Vicia ervilia*), grass pea/chickling vetch (*Lathyrus sativus/cicera*) and chickpea (*Cicer arietinum*) that can grow under dry conditions will be examined.

Table 6 shows the distribution of mentioned pulses throughout the EBA in western Anatolian sites. According to Table 6, *Vicia ervilia* is present in almost all settlements throughout the EBA. Similarly, *Lathyrus sativus/cicera* is majorly present in the settlements throughout the EBA. On the other hand, *Cicer arietinum* seems to appear from the EBA II onwards only at Küllüoba. In general, drought-tolerant crops are present in western Anatolian sites from the EBA II onwards that may point to aridity that already started in the EBA II. In fact, to understand changes in drought-tolerant pulses, amount of those pulses through the EBA should be compared. However, none of the sites but Küllüoba provides such a large pulse assemblage to make such a comparison.

In Table 7, distribution of drought-tolerant pulses and changes in their amount at Küllüoba can be observed. Regarding Figure 67, all pulses reaches their maximum in the EBA II that suggests an increase in need for pulses being able to grow under dry conditions. Their presence continues into the EBA III and the EBA L./MBA as well. However, one should consider that the absolute counts of *Lathyrus sativus/cicera* and *Cicer arietinum* are limited. Therefore, interpretations based on these pulses is not likely reliable. Moreover, a storage find of more than 180,000 purely processed seeds of *Vicia ervilia* from the late EBA II proves its major contribution to human diet (Çizer, 2015).

Stable carbon isotope analysis of crops clearly shows if a crop grew under favourable conditions or aridity. The analysis of barley seeds from Troy II (EBA II) and Troy IV (the late EBA III/MBA) shows insights on growing conditions of barley (Blum & Riehl, 2015). Figure 68 shows analysis results. $\Delta^{14}C$ values above 17‰ points to favourable conditions under which the crops grew. On the other hand, 16‰ is the threshold value and any values below the threshold value means definite

Table 6. Distribution of drought-tolerant pulses throughout the EBA in western Anatolian sites. Abbreviations refer to Table 2.

Period	EBA I				EBA II					EBA III		EBA III L./MBA	
Site	TRY	KO	LT	ÇH	YB	TRY	KO		LT	TRY	KO	TRY	KO
							Early	Late					
Vicia ervilia		X	X	X	X	X	X	X	X	X	X	X	X
Lathyrus sativus/cicera		X	X	X	X		X	X			X		X
Cicer arietinum							X	X			X		X

Table 7. Frequencies and distribution of drought-tolerant crops at Küllüoba, throughout the EBA. Abbreviations refer to Table 2.

Period	EBA I	EBA II		EBA III	EBA III L./MBA
		Early	Late		
Vicia ervilia	ca. 300	3648	ca. 300	ca. 300	179
Lathyrus sativus/cicera	38	55	32	18	8
Cicer arietinum	0	9	72	13	2

drought conditions. Analysis results of barley from Troy II and Troy IV show considerably different growing conditions. As shown in Figure 68, barleys from Troy II grew under favourable conditions with a $\Delta^{14}C$ value above 17‰. On the other hand, $\Delta^{14}C$ value of barleys from Troy IV is located somewhere between 17‰ and 16‰ and it means that those barleys definitely grew under aridity. However, it cannot be determined as severe drought conditions (Blum & Riehl, 2015).

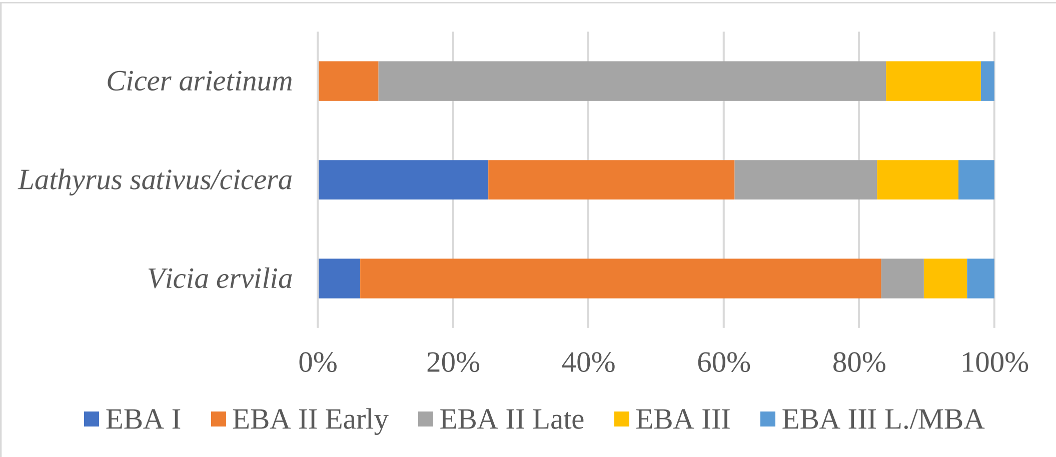

Figure 67. Relative abundance of each drought-resistant pulse throughout the EBA at Küllüoba. Abbreviations refer to Table 2.

Diversification of crops is another measure taken against drought conditions to reduce the risk of total crop failure. Analysed pulses are *Vicia ervilia* (bitter vetch), *Lathyrus sativus/cicera* (grass pea), *Cicer arietinum* (chickpea), *Lens culinaris* (lentil), *Pisum sativum* (garden pea), *Vicia faba* (broad bean), *Lathyrus clymenum* (Spanish vetchling). Table 8 demonstrates distribution of different pulses throughout the EBA. Almost all pulses are present in the settlements throughout the EBA. *Lathyrus clymenum* is observed at Yenibademli Höyük only and *Cicer arietinum* is present from the EBA II onwards at Küllüoba. The results show that from the EBA II onwards, diversity of crops highly increases. These results can be due to an increasing need of drought-tolerant pulses and/or an increase in domestic animal number to feed, since pulses are used as fodder for animals as well.

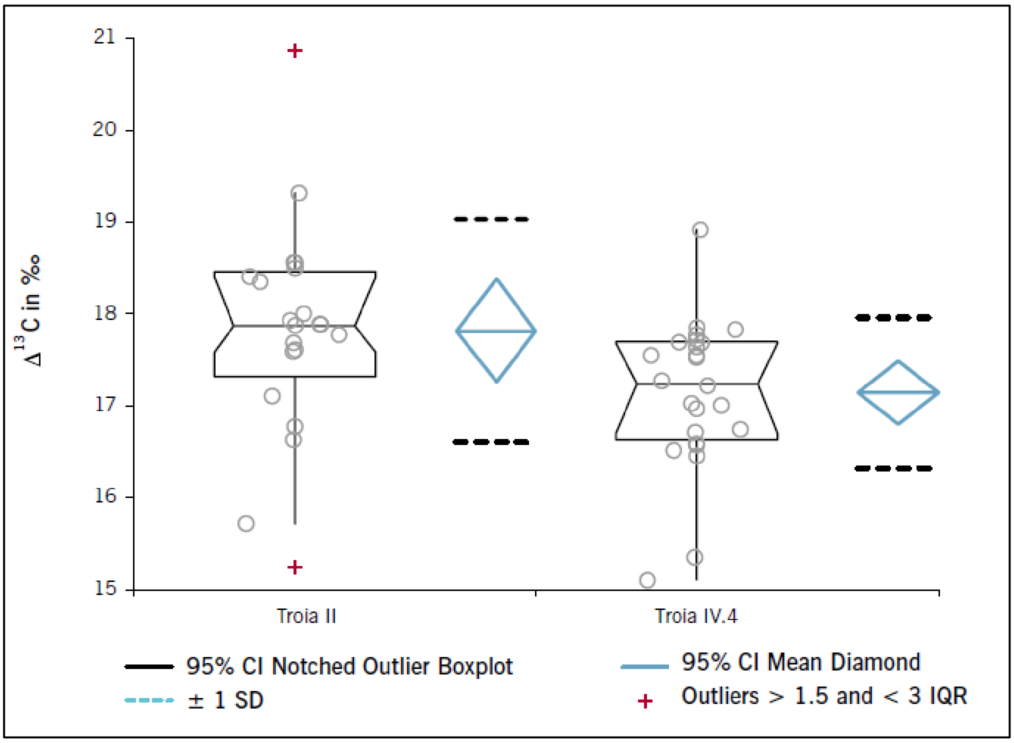

Figure 68. Results of stable ^{14}C isotope analysis of barleys from Troy II and Troy IV (Blum & Riehl, 2015, Fig. 22).

Küllüoba provides a detailed information on pulses and changes in their distribution and number through time. According to Figure 69, total amount of pulses increases from the late EBA II onwards. In particular increase in bitter vetch, with a large find of purely processed *Vicia ervilia*, suggests its major consumption by humans (Çizer, 2015). Similarly, other pulses must have been consumed by humans majorly. Therefore, the society at Küllüoba, grows a broad spectrum of crops from the late EBA II onwards mainly for human consumption.

Table 8. Distribution of pulses in western Anatolian sites throughout the EBA. Abbreviations refer to Table 2.

Period	EBA I				EBA II					EBA III		EBA III L./MBA	
Site	TRY	KO	LT	ÇH	LT	YB	KO Early	KO Late	TRY	KO	TRY	KO	TRY
Vicia ervilia		X	X	X	X	X	X	X	X	X	X	X	X
Lathyrus sativus/cicera		X	X	X		X	X	X		X		X	X
Cicer arietinum							X	X		X		X	
Lens culinaris		X	X	X		X	X	X	X	X	X	X	X
Pisum sativum			X			X	X	X				X	X
Vicia faba		X				X	X	X		X		X	
Lathyrus clymenum						X							

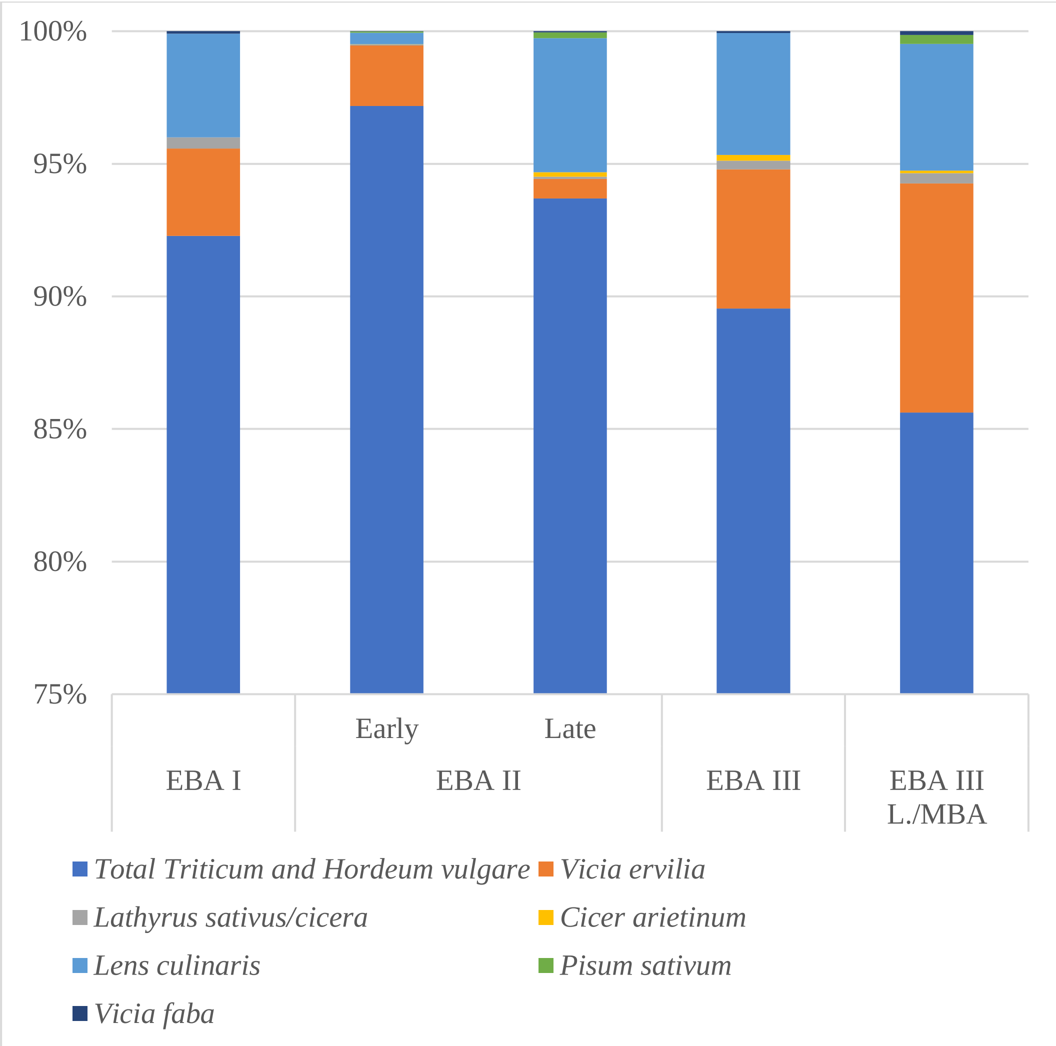

Figure 69. Distribution and relative abundance of pulses throughout the EBA at Küllüoba. Abbreviations refer to Table 2.

Due to aridity and altered pastures and natural fodder, pulses that can be used as animal fodder are expected to increase. As already discussed, Küllüoba presents a wide range of pulses that can be used as fodder for animals as well from the late EBA II onwards. In Table 9, pulses that are mainly eaten by human already specified in Table 8 and Figure 69 and crops and cereals that are definite fodders including *Trifolium* (clover), *Trifoliea*, *Trigonella capitala/lunata*-t. and *Bromus spp*. (grass) are listed. As shown in Table 9, number of all pulses highly increases in the EBA II that may point to an increase in human population and/or number of domestic animals. In the EBA III and the late EBA III/MBA, number of all pulses, except bitter vetch, significantly decreases.

Table 9. Distribution and number of pulses and cereals mainly consumed by humans and by animals as fodder throughout the EBA in western Anatolian sites. Abbreviations refer to Table 2. *Large storage finds, M means million. ?: Number of these crops are not provided in the publications.

Period	EBA I				EBA II					EBA III		EBA III L. /MBA	
Site	TRY	KO	LT	ÇH	YB	KO		TRY	LT	TRY	KO	KO	TRY
						Early	Late						
Vicia ervilia		ca. 300	33	8	10661	3648	ca. 300	?	1	?	ca. 300	179	?
Lathyrus sativus/cicera		38	12	1	57	55	32				18	8	?
Cicer arietinum						9	72				13	2	
Lens culinaris		355	70	9	15	693	2066	?		?	262	99	?
Pisum sativum			2		1500 M*	82	92					7	?
Vicia faba		8			95 M*	12	16				4	3	
Lathyrus clymenum					116								
Trifolium				4	53M*	?							?
Trifoliea			6										
Trigonella capitala/lunata-t.		2181				1070	433				70	72	
Bromus spp.					3	1033	271				?		

6.1.2. Changes in Animal Husbandry Practices in Western Anatolia under Aridity

Analysis of animal remains from Kanlıgeçit, Yenibademli Höyük, Maydos-Kilisetepe, Troy, Demircihöyük, Küllüoba, Ulucak Höyük, Çukuriçi Höyük, Aphrodisias-Pekmez and Karataş-Semayük contributes the knowledge on animal husbandry practices throughout the EBA and at the transition to the MBA across the region (Figure 70).

Figure 70. Map showing the western Anatolian sites with zooarchaeological analysis mentioned in the text.

Kanlıgeçit, Kırklareli, provides a faunal assemblage that consists of more than 9,700 identified specimens including domesticated and wild mammals is dated to the EBA, ca. 3000-2000 BC (EBA I: 3000-2700/2600 BC, EBA II: 2700/2600-2300 BC, EBA III: 2400-2200 BC and the late EBA III/MBA: the very end of the 3rd millennium BC (based on ^{14}C dating)). Almost half of the EBA faunal assemblage belongs to mixed phases and are not included within this study (Benecke, 2012). Domestic animals including sheep, goat, cattle and pigs are always the dominating animals in comparison to wild ones throughout the EBA. Abundance of each domestic animal species, however, increases or decreases from period to period.

Faunal remains from Maydos-Kilisetepe, Çanakkale, includes ca. 4,000 identified specimens that are dated to the EBA III (2080/2060 BC (^{14}C dated)) and the late EBA III/early MBA (2080-1945 BC (^{14}C dated)). The assemblage is comprised of domestic and wild mammals, birds and molluscs (Seçmen, 2018). In both periods, goat and sheep are abundant domestic animals and the number of wild animals is always insignificant in comparison to domestic animals.

Yenibademli Höyük, Gökçeada, provides a faunal assemblage of ca. 12,600 identified specimens that is dated to the EBA II. Domestic and wild mammals, reptiles, bird, fish and molluscs comprises the assemblage (Gündem, 2010). During the period, sheep and goat are the dominating animals.

The faunal assemblage of Troy, Çanakkale, consists of ca. 19,400 identified specimens that were yielded from occupation phases of Troy I-III and is dated to the EBA, (ca. 2900-2200/2150 BC). It includes domestic and wild mammals, reptiles, birds, fish and molluscs (Gündem, 2010). The dominating animals are sheep and goat throughout the EBA.

Demircihöyük, Eskişehir, provides a faunal assemblage including ca. 65,000 identified specimens is dated to the EBA I (3000-2700 BC), EBA II (2700-2400 BC) and the MBA. It consists of domestic and wild mammals (von den Driesch & Boessneck, 1987). In the all three periods, sheep and goat are the dominating domestic animals.

The animal remains from Küllüoba, Eskişehir, consist of ca. 5,800 identified specimens that are dated to the EBA (3000-2000 BC). However, the animal bones from the EBA II and EBA III were collected and studied together, since the assemblage size of the EBA III is very little. The remains include domestic and wild mammals (Gündem, 2010). In both groups, sheep and goat are the abundant animals.

Ulucak Höyük, İzmir, provides a faunal assemblage of ca. 1,800 identified specimens that are dated to the EBA II. The assemblage includes domestic and wild mammals, birds, reptiles and molluscs (Gündem, 2010). During the EBA II, sheep and goat are the dominating domestic animals.

Animal remains from Çukuriçi Höyük, İzmir, includes ca. 830 identified specimens that are dated to the EBA I (2900-2750 BC (^{14}C dated)). The assemblage includes domestic and wild mammals (Horejs et al., 2011). Similar to other sites, sheep and goat are the dominating domestic animals here as well.

Karataş-Semayük, Antalya, yields a faunal assemblage that includes ca. 1,600 identified species and ca. 300 of them are mixed materials that are not included in this study. The assemblage is dated to the EBA (ca. 3000-2000) and the MBA. The assemblage includes abundantly domestic mammals (Hesse & Perkins, 1974).

The faunal assemblage from Aphrodisias-Pekmez, Aydın, includes ca. 950 identified specimens that are dated to the EBA. It includes domestic and wild mammals and turtle (Crabtree & Monge, 1986).

Zooarchaeological analysis on animals remains will be investigated to understand changes in animal husbandry practices that can be related to the particular climatic event. To do it following changes will be search for:

1. Favouring domestic animals with less food and water requirements to avoid adverse impacts and limitations of less water availability and altered natural pastures;
    a. A decrease in sheep to goat ratio;
    b. An increase in sheep/goat to cattle ratio.
2. An increase in number of hunted wild animals, in particular, fallow deer and wild boar, to remedy the lack in food and diversify meat source;
3. Favouring or disfavouring pigs and wild boars depending on some factors.
    a. An increase in amount of pigs and wild boars, since they are carnivore and prolific as a cheap alternative for meat procurement;

b. A decrease in amount of pigs and wild boars, since they live in forested environment with water and are not suitable for a pastoralist economy.

This study focuses on changes in distribution and number of domestic animals, sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*) and pig (*Sus domesticus*), and wild animals, fallow deer (*Dama dama*) and wild boar (*Sus scrofa*) and the ratios of *Ovis aries* to *Capra hircus* and *Ovis aries*/*Capra hircus* to *Bos taurus*.

Table 10 demonstrates zooarchaeological data from the western Anatolian sites focusing on mentioned domestic and wild animals. However, the data has some problems to discuss.

At Küllüoba, the animal remains from the EBA II and III were studied together, since the EBA III assemblage is very little. This study aims at observing changes in animal management in each period separately, and therefore, Küllüoba EBA II/III assemblage is not included within this study.

At Aphrodisias-Pekmez, all faunal remains from possibly different periods of the EBA were collected and studied together and this makes this assemblage useless for this study. Thus, Aphrodisias-Pekmez assemblage is excluded from this study.

The MBA faunal assemblage from Karataş-Semayük is represented by only 2 animal bones. Therefore, this assemblage is not included as well.

Moreover, similar to archaeobotanical data, sizes of assemblages from different sites vary greatly. Therefore, to make all assemblages comparable with each other, relative abundance of animal species in each assemblage was calculated and presented in Table 11.

To overcome the adverse impacts of water scarcity and deteriorated natural pastures, sedentary agriculturalists are expected to favour domestic animals with less food and water requirements. Therefore, changes in domestic animal preference will be examined through ratios of sheep to goat and sheep/goat to cattle. A decrease in

Table 10. Number and distribution of domestic animals including *Ovis aries*, *Capra hircus*, *Bos taurus* and *Sus domesticus* and wild animals including *Dama dama* and *Sus scrofa* throughout the EBA across western Anatolia. EBA III L.: Late EBA III, KG: Kanlıgeçit (Benecke, 2012), TRY: Troy (Gündem, 2010), DH: Demircihöyük (von den Driesch & Boessneck, 1987), KO: Küllüoba (Gündem, 2010), ÇH: Çukuriçi Höyük (Horejs et al., 2011), K-S: Karataş-Semayük (Hesse & Perkins, 1974), YB: Yanibademli Höyük (Gündem, 2010), UH: Ulucak Höyük (Gündem, 2010), M-K: Maydos-Kilisetepe (Seçmen, 2018), A-P: Aphrodisias-Pekmez (Crabtree & Monge, 1986).

Period	EBA I						EBA II					
Site	KG	TRY	DH	KO	ÇH	K-S	KG	YB	TRY	DH	UH	K-S
Ovis aries	73	452	1248	34	28	6	75	335	185	2370	62	54
Capra hircus	12	200	474	12	47	2	15	118	44	934	23	34
Ovis aries/Capra hircus	429	4631	8977	358	417	49	515	3145	1627	22919	454	448
Total *Ovis aries/Capra hircus*	514	5283	10699	404	492	57	605	3598	1856	26223	539	536
Bos taurus	432	2701	5877	173	154	92	620	1434	797	8979	200	563
Sus domesticus	403	2550	1484	21	82	24	611	918	479	3529	177	18
Total domestic animals	**1349**	**10534**	**18060**	**598**	**728**	**173**	**1836**	**5950**	**3132**	**38731**	**916**	**1177**
Dama dama	20	161	638	6	77	0	8	680	161	1124	228	0
Sus scrofa	30	64	62	0	7	0	65	4	10	174	8	0
Total wild animals	**50**	**225**	**700**	**6**	**84**	**0**	**73**	**684**	**171**	**1298**	**236**	**0**
Total domestic and wild animals	**1399**	**10759**	**18760**	**604**	**812**	**173**	**1909**	**6634**	**3303**	**40029**	**1152**	**1117**

Table 10. (continued)

Period	EBA II-III	EBA III				EBA III L./MBA				EBA
Site	KO	KG	M-K	TRY	K-S	KG	M-K	DH	K-S	A-P
Ovis aries	273	39	14	119	2	3	21	288	0	20
Capra hircus	66	5	6	16	1	0	6	75	0	22
Ovis aries/*Capra hircus*	2322	256	236	607	9	28	346	2184	0	182
Total *Ovis aries*/*Capra hircus*	2661	300	256	742	12	31	373	2547	0	224
Bos taurus	1441	722	36	206	25	20	74	767	2	114
Sus domesticus	680	263	57	437	1	81	109	497	0	0
Total domestic animals	**4782**	**1285**	**349**	**1385**	**38**	**132**	**556**	**3811**	**2**	**338**
Dama dama	38	6	5	99	0	2	14	107	0	48
Sus scrofa	8	21	3	3	0	1	3	28	0	125
Total wild animals	**46**	**27**	**8**	**102**	**0**	**3**	**17**	**135**	**0**	**173**
Total domestic and wild animals	**4828**	**1312**	**357**	**1487**	**38**	**135**	**573**	**3946**	**2**	**511**

Table 11. Relative abundance and distribution of *Ovis aries*, *Capra hircus*, *Bos taurus*, *Sus domesticus*, *Dama dama* and *Sus scrofa* and the ratios of *Ovis aries* to *Capra hircus* and *Ovis aries/Capra hircus* to *Bos taurus* throughout the EBA in western Anatolian sites. Abbreviations refer to Table 10.

Period	EBA I						EBA II			
Site	KG	TRY	DH	KO	ÇH	K-S	KG	YB	TRY	DH
Ovis aries	5.22%	4.20%	6.65%	5.63%	3.45%	3.47%	3.93%	5.05%	5.6%	5.92%
Capra hircus	0.86%	1.86%	2.53%	1.99%	5.79%	1.16%	0.79%	1.78%	1.33%	2.33%
Ovis aries/Capra hircus	30.66%	43.04%	47.85%	59.27%	51.35%	28.32%	26.98%	47.41%	49.26%	57.26%
Total *Ovis aries/Capra hircus*	36.74%	49.10%	57.03%	66.89%	60.59%	32.95%	31.69%	54.24%	56.19%	65.51%
Bos taurus	30.88%	25.10%	31.33%	28.64%	18.97%	53.18%	32.48%	21.62%	24.13%	22.43%
Sus domesticus	28.81%	23.70%	7.91%	3.48%	10.1%	13.87%	32.01%	13.84%	14.5%	8.82%
Total domestic animals	96.43%	97.91%	96.27%	99.01%	89.66%	100%	96.18%	89.69%	94.82%	96.76%
Ovis aries : Capra hircus	**6.1:1**	**2.3:1**	**2.6:1**	**2.8:1**	**0.6:1**	**3:1**	**5:1**	**2.8:1**	**4.2:1**	**2.5:1**
Total *Ovis aries/Capra hircus* : *Bos taurus*	**1.2:1**	**1.96:1**	**1.8:1**	**2.3:1**	**3.2:1**	**0.6:1**	**0.98:1**	**2.5:1**	**2.3:1**	**2.9:1**
Dama dama	1.43%	1.5%	3.4%	0.99%	9.48%	0%	0.42%	10.25%	4.87%	2.81%
Sus scrofa	2.14%	0.59%	0.33%	0%	0.86%	0%	3.4%	0.06%	0.3%	0.43%
Total wild animals	3.57%	2.09%	3.73%	0.99%	10.43%	0%	3.82%	10.31%	5.18%	3.24%

Table 11. (continued)

Period	EBA II		EBA III				EBA III L./MBA		
Site	UH	K-S	KG	M-K	TRY	K-S	KG	M-K	DH
Ovis aries	5.38%	4.83%	2.97%	3.92%	8%	5.26%	2.22%	3.66%	7.3%
Capra hircus	2%	3.04%	0.38%	1.68%	1.08%	2.63%	0%	1.05%	1.9%
Ovis aries/*Capra hircus*	39.41%	40.11%	19.51%	66.11%	40.82%	23.68%	20.74%	60.38%	55.35%
Total *Ovis aries*/*Capra hircus*	46.79%	47.99%	22.87%	71.71%	49.90%	31.58%	22.96%	65.1%	64.55%
Bos taurus	17.36%	50.4%	55.03%	10.08%	13.85%	65.79%	14.81%	12.91%	19.44%
Sus domesticus	15.36%	1.61%	20.05%	15.97%	29.39%	2.63%	60%	19.02%	12.6%
Total domestic animals	79.51%	100%	97.94%	97.76%	93.14%	100%	97.87%	97.03%	96.58%
Ovis aries : Capra hircus	**2.7:1**	**1.6:1**	**7.8:1**	**2.3:1**	**7.4:1**	**2:1**	**-**	**3.5:1**	**3.8:1**
Total *Ovis aries*/*Capra hircus* : *Bos taurus*	**2.7:1**	**0.95:1**	**0.4:1**	**7.1:1**	**3.6:1**	**0.5:1**	**1.6:1**	**5:1**	**3.3:1**
Dama dama	19.79%	0%	0.46%	1.4%	6.66%	0%	1.48%	2.44%	2.71%
Sus scrofa	0.69%	0%	1.6%	0.84%	0.2%	0%	0.74%	0.52%	0.71%
Total wild animals	20.48%	0%	2.06%	2.24%	6.86%	0%	2.22%	2.97%	3.42%

sheep to goat ratio and an increase in sheep/goat to cattle ratio may signal drought conditions.

According to Figure 71 and Table 11, in the EBA I, the number of animals differs highly. In all settlements, except Karataş-Semayük, sheep and goat are the dominant animals. At Karataş-Semayük, cattle are abundant. In the EBA II, sheep and goat are still the main animals in all settlements, except Karataş-Semayük and Kanlıgeçit. At Karataş-Semayük, cattle are still the major animal and at Kanlıgeçit, cattle and pig, being of equal frequencies, are more than sheep and goat. In the EBA III, sheep and goat are dominant at Troy and Maydos-Kilisetepe only. At Karataş-Semayük cattle are abundant. In the late EBA III/MBA, sheep and goat are the dominant animals at Demircihöyük and Maydos-Kilisetepe. At Kanlıgeçit pigs are abundant. In summary, although some settlements show similar patterns, there is not a general regional pattern. It seems that each settlement behaves uniquely in animal preference and management.

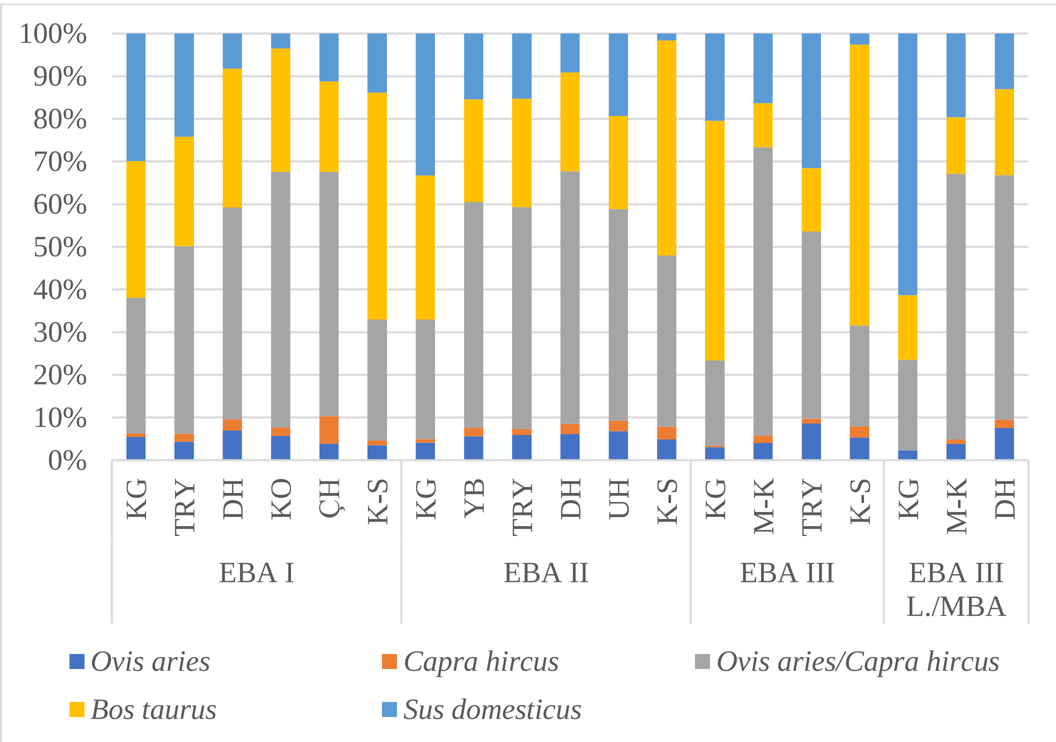

Figure 71. Relative abundances of domestic animals through time across the region. Abbreviations refer to Table 10.

Similar to archaeobotanical data, observing changes in zooarchaeological data in settlement basis changes can provide a better understanding. Table 12 shows distribution and relative abundance of animals through time in each settlement that was continuously occupied, in particular in the EBA III and the late EBA III/MBA. Table 13 shows, changes in animal preference in respect to previous period. Under drought conditions, a decrease in sheep to goat ratio and an increase in sheep/goat to cattle ratio are expected. Regarding Table 13, sheep to goat ratio does not show any evidence for a possible drought event in the late EBA III/MBA as it has been suggested. Only at Kanlıgeçit there is a considerable decrease in ratio, since no goat bones could be identified. On the other hand, the sheep/goat to cattle ratio at Troy increases by 44% at the transition from the EBA II to EBA III and the ratio at Kanlıgeçit increases by 295% at the transition from the EBA III to late EBA III/MBA. In summary, results suggest a possible environmental and climatic stress starting at the end of the EBA II and continued in the EBA III.

Another measure taken against drought conditions is relying on wild animals more in human diet. Figure 72 shows changes in relative abundance of domestic and wild animals in each settlement through time. Figure 72 shows that at almost all sites, domestic animals are always the major animals and at Karataş-Semayük, no wild boars and fallow deer could be identified in any period. In the EBA II, the importance of wild animals in human diet decreases in respect to the EBA I. However, in the EBA III, relative abundance of wild animals in human diet slightly increases (See Table 13). This trend continued in the late EBA III/MBA. In particular, the amount of fallow deer increases by 9% and 37% at Kanlıgeçit and Troy respectively at the transition of the EBA II to EBA III and 224% and 74% at Kanlıgeçit and Maydos-Kilisetepe respectively at the transition from the EBA III to the late EBA III/MBA (See Table 13). These results suggest an increasing need for wild animals in diet. On the other hand, it should be noted that the increase in fallow deer at Troy might have a ritualistic purpose as well (Gündem, 2010, p. 18). Overall, changes in preference of wild animals versus domestic animals show that importance of wild animals in human diet starts to increase in the beginning of the EBA III and continued in the late EBA III/MBA.

Table 12. Distribution and relative abundance of animal species in western Anatolian sites through time. Abbreviations refer to Table 10.

Period	EBA I			EBA II			EBA III				EBA III L. /MBA	
Site	KG	TRY	K-S	KG	TRY	K-S	KG	M-K	TRY	K-S	KG	M-K
Ovis aries	5.22%	4.20%	3.47%	3.93%	5.6%	4.83%	2.97%	3.92%	8%	5.26%	2.22%	3.66%
Capra hircus	0.86%	1.86%	1.16%	0.79%	1.33%	3.04%	0.38%	1.68%	1.08%	2.63%	0%	1.05%
Ov. a./Cp. h.	30.66%	43.04%	28.32%	26.98%	49.26%	40.11%	19.51%	66.11%	40.82%	23.68%	20.74%	60.38%
Total *Ov. a./Cp. h.*	36.74%	49.10%	32.95%	31.69%	56.19%	47.99%	22.87%	71.71%	49.90%	31.58%	22.96%	65.1%
Bos taurus	30.88%	25.10%	53.18%	32.48%	24.13%	50.4%	55.03%	10.08%	13.85%	65.79%	14.81%	12.91%
Sus domesticus	28.81%	23.70%	13.87%	32.01%	14.5%	1.61%	20.05%	15.97%	29.39%	2.63%	60%	19.02%
Total domestic animals	96.43%	97.91%	100%	96.18%	94.82%	100%	97.94%	97.76%	93.14%	100%	97.87%	97.03%
Ov. a. : Cp. h.	**6.1:1**	**2.3:1**	**3:1**	**5:1**	**4.2:1**	**1.6:1**	**7.8:1**	**2.3:1**	**7.4:1**	**2:1**	**-**	**3.5:1**
Total *Ov. a./Cp. h.* : *Bos t.*	**1.2:1**	**1.96:1**	**0.6:1**	**0.98:1**	**2.3:1**	**0.95:1**	**0.4:1**	**7.1:1**	**3.6:1**	**0.5:1**	**1.6:1**	**5:1**
Dama dama	1.43%	1.5%	0%	0.42%	4.87%	0%	0.46%	1.4%	6.66%	0%	1.48%	2.44%
Sus scrofa	2.14%	0.59%	0%	3.4%	0.3%	0%	1.6%	0.84%	0.2%	0%	0.74%	0.52%
Total wild animals	3.57%	2.09%	0%	3.82%	5.18%	0%	2.06%	2.24%	6.86%	0%	2.22%	2.97%

Table 13. Changes in relative abundance of animals in western Anatolian sites in respect to the previous period. Abbreviations refer to Table 10.

Period	EBA I → EBA II			EBA II → EBA III			EBA III → EBA III L./MBA	
Site	KG	TRY	K-S	KG	TRY	K-S	KG	M-K
Ovis aries	-25%	33%	39%	-24%	43%	9%	-25%	-7%
Capra hircus	-8%	-28%	163%	-51%	-19%	-14%	-100%	-38%
Ovis aries/Capra hircus	-12%	14%	42%	-28%	-17%	-41%	6%	-9%
Total *Ovis aries/Capra hircus*	-14%	14%	46%	-28%	-11%	-34%	0%	-9%
Bos taurus	5%	-4%	-5%	69%	-43%	31%	-73%	28%
Sus domesticus	11%	-39%	-88%	-37%	103%	63%	199%	19%
Total domestic animals	-0.3%	-3%	14%	2%	-2%	-1%	0%	-1%
Ovis aries : Capra hircus	**-18%**	**86%**	**-47%**	**56%**	**77%**	**26%**	**-100%**	**50%**
Total *Ovis aries/Capra hircus* : *Bos taurus*	**-18%**	**19%**	**49%**	**-57%**	**55%**	**-50%**	**273%**	**-29%**
Dama dama	-71%	226%	-	9%	37%	-	224%	74%
Sus scrofa	59%	-49%	-	-53%	-33%	-	-54%	-38%
Total wild animals	7%	148%	-88%	-46%	33%	-	8%	32%

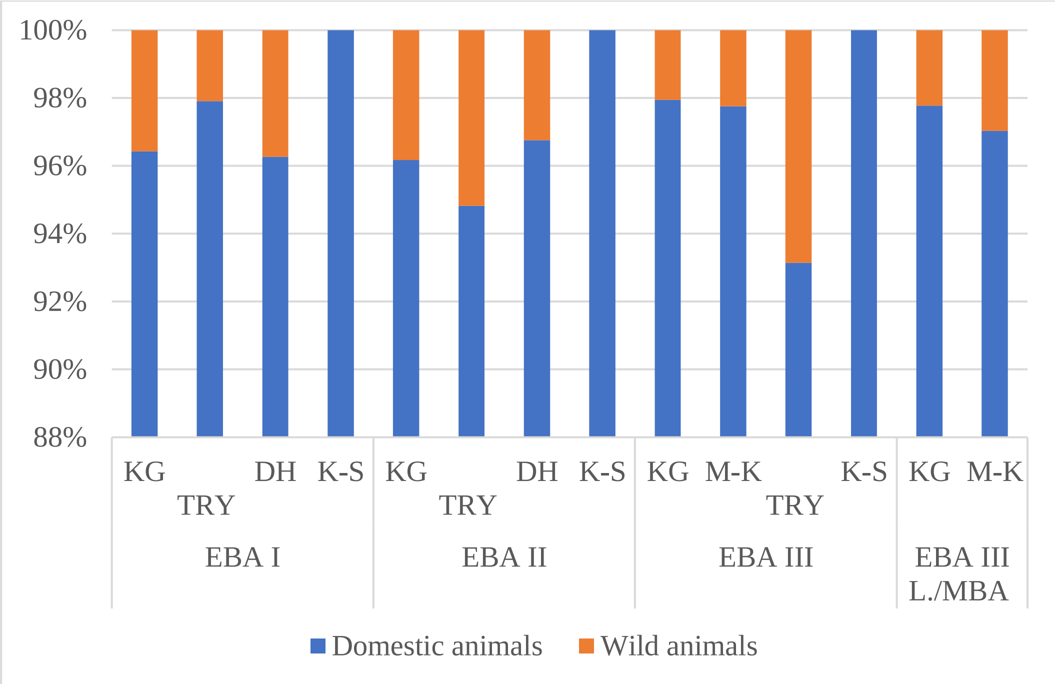

Figure 72. Relative abundance of domestic and wild animals throughout the EBA in western Anatolian sites. Abbreviations refer to Table 10.

Changes in both domestic pig and wild boar can shed light on climatic and environmental stress. Figure 73 shows changes in relative abundance of animals focusing on *Sus domesticus* and *Sus scrofa*. According to Figure 73 (also see Table 13), in the EBA II, both wild boar and pig increase at Kanlıgeçit. However, at Troy and Karataş-Semayük total number of wild boar and pig decreases in this period. In the EBA III, number of pigs increases at Karataş-Semayük and considerably at Troy where wild boar, however, decreases. On the other hand, total number of pig and wild boar decreases at Kanlıgeçit. In the EBA III L./MBA, pig greatly increases at Kanlıgeçit and Maydos-Kilisetepe, although number of wild boars decreases in both settlements. Moreover, Seçmen (2018, p. 35) states that after the earlier 2nd millennium BC, the number of domestic pigs starts to decrease. Due to increased availability of pig at Troy in the EBA III, this period is interpreted as a stress period by Gündem (2010, p. 18), since pig breeding is an easier way to produce much meat.

In summary, the results from sites show an increase in pig and a decrease in wild boar from the EBA III onwards, in particular in the late EBA III/MBA. This can point to either a decreasing need for wild boar, since domestic pig can meet the meat need or an environmental deterioration that caused a decrease in wild boar and an increase in domestic pig to overcome loss in meat sources due to that decrease. Whatever the reason for this, an increase in domestic pig most likely suggests a stress period already started in the EBA III and continued to the late EBA III/MBA.

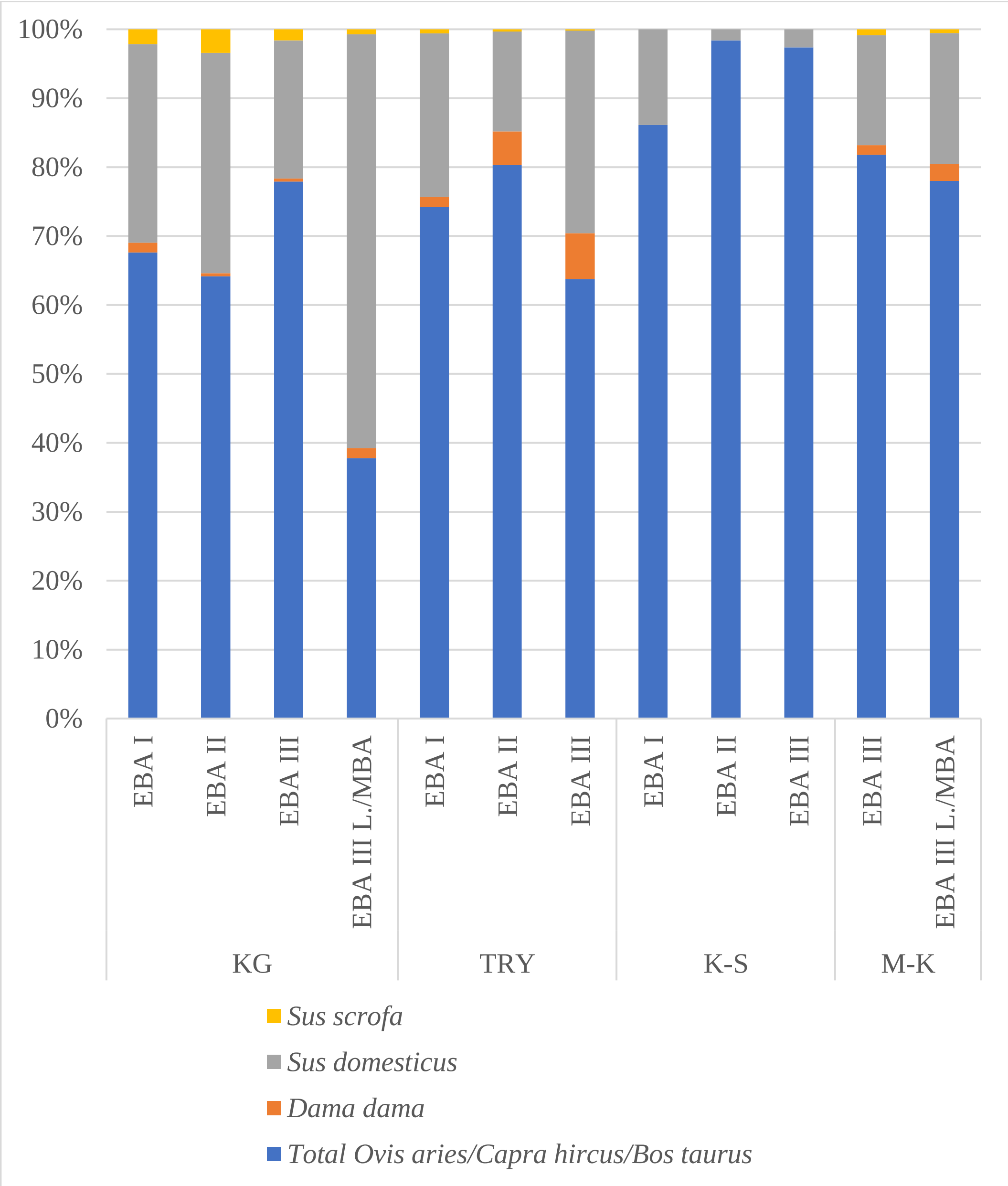

Figure 73. Changes in relative abundance of animals focusing on *Sus domesticus* and *Sus scrofa* in settlements through time. Abbreviations refer to Table 10.

6.1.3. Changes in Social and Political Structure of Western Anatolian Societies under Aridity

It has been suggested that the 4.2 ka BP climatic event and its impacts first affected agricultural and animal husbandry practices and then, led to social unrest, conflicts, migrations and collapse. To understand if western Anatolian societies experienced those, information from excavated key western Anatolian sites that were already discussed in chapter 4 and several archaeological survey projects in will be investigated. For this study, surveys projects in Gelibolu Peninsula, Marmara Sea, Balıkesir-Manisa, Büyük Menderes, Beycesultan hinterland, Yenişehir-İznik and Eskişehir regions will be examined.

Social and political changes that can be related to the climatic event will be search for through:

1. Contemporaneous abandonment of a large number of settlements in marginal areas.
    a. Adopting nomadism with a pastoralist economy that can be confirmed through a decrease in sedentary settlement number and an increase in archaeology less visible site number that were temporarily inhabited by nomads;
    b. Migration to refugia and aggregation into larger settlements being already powerful and having a better access to limited resources that can be testified through an increase in site number and extent and population of such settlements.

As already discussed in chapter 4, at the end of the 3rd millennium BC, Anatolian societies including western Anatolian societies, experienced major transformations. In the late EBA III, monumental buildings disappeared, long-distance exchange network collapsed, representations of ruling elites disappeared and many settlements were severely destructed and abandoned. The correlation between the timing of the climatic event and the major transformations and turmoil period experienced by the western Anatolian societies suggest a causal relationship between them similar to the wider eastern Mediterranean region (Massa, 2014; Massa & Şahoğlu, 2015).

Figure 74 shows EBA settlements that were occupied during 2300-1900 BC, i.e., suggested drought period and whether or not they underwent a destruction within the period. The majority of settlements, including Kanlıgeçit, Troy, Seyitömer, Aphrodisias-Pekmez and Karataş-Semayük, were destroyed at the end of the 3rd millennium. In particular, as shown in Figure 74 and Figure 75, proportion of settlements with evidence for destruction has two different peaks, one at 2550-2450 BC and the second at 2250-1950 BC. In particular, the proportion of destroyed settlements increases from the 24th century BC, reaches a peak in the 21st century BC and continues in the 20th century BC as well (Massa, 2014; Massa & Şahoğlu, 2015). Contemporaneous destruction of a large number of settlements might be due to conflicts between sedentary agriculturalists for limited arable land and water resources.

Besides individual site destructions, archaeological surveys contribute to a better understanding of abandonment and continuity of settlement in regional scale. A study focusing on the central and western Anatolia provides a *longue durée* perspective on changes in settlement patterns including the EBA through examination of 11 archaeological survey projects in western and central Anatolia (Massa, 2014). In Figure 76, chosen surveys areas are demonstrated and surveys with numbers between 1 and 7 are located in western Anatolia that are focused within the study. Massa (2014) chose surveys to analyse regarding some criteria to avoid methodological limitations as much as possible (Figure 77):

1. Proximity to a well-stratified site;
2. Degree of detail in the publication;
3. The survey methodology;
4. The coverage of EBA materials and settlements.

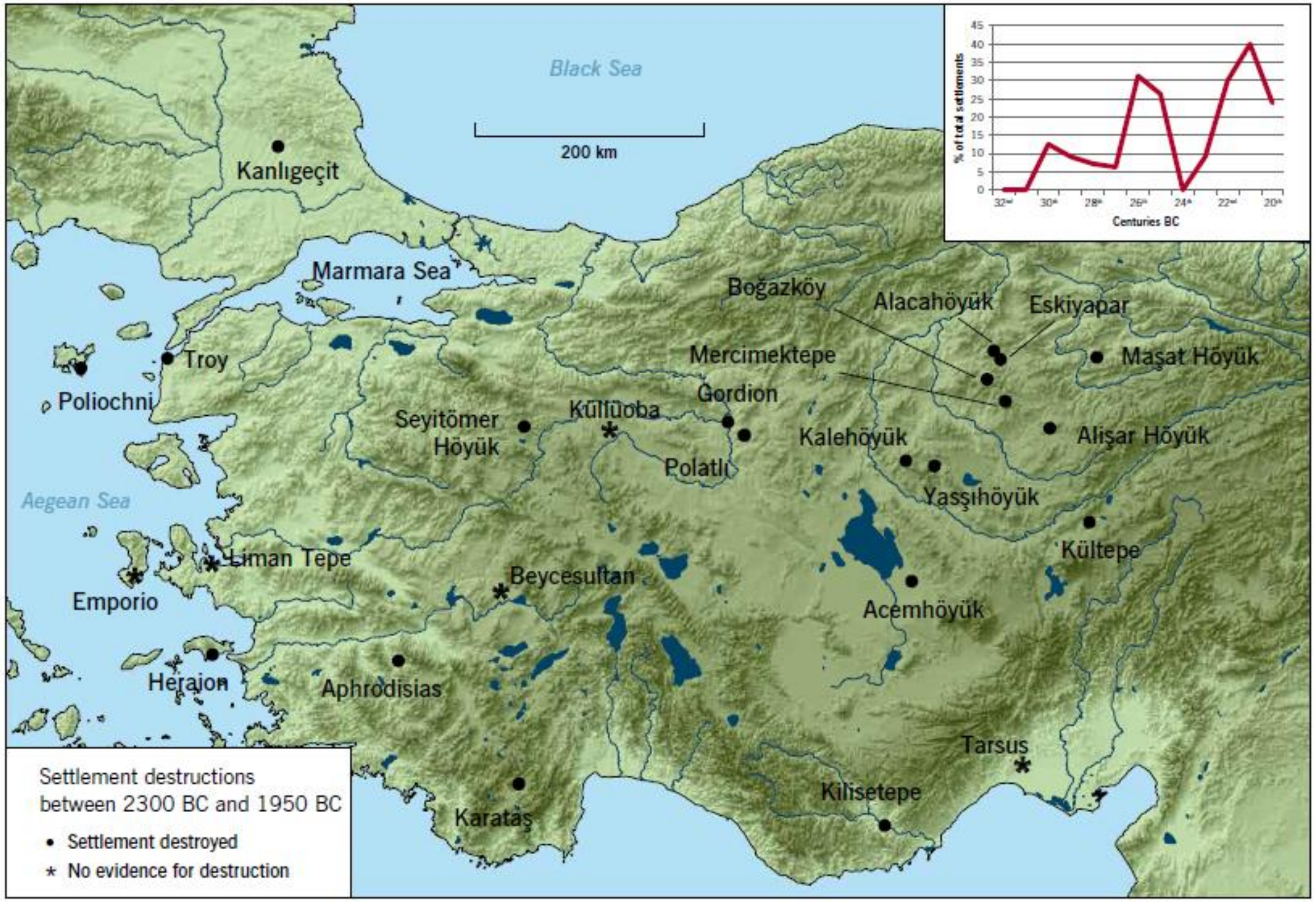

Figure 74. Map showing sites that cover 2300-1900 BC period and present evidence for destruction in this period in western and central Anatolia. The graph on the top right shows proportion of sites with destruction layers throughout the EBA (Massa, 2015, Fig. 11).

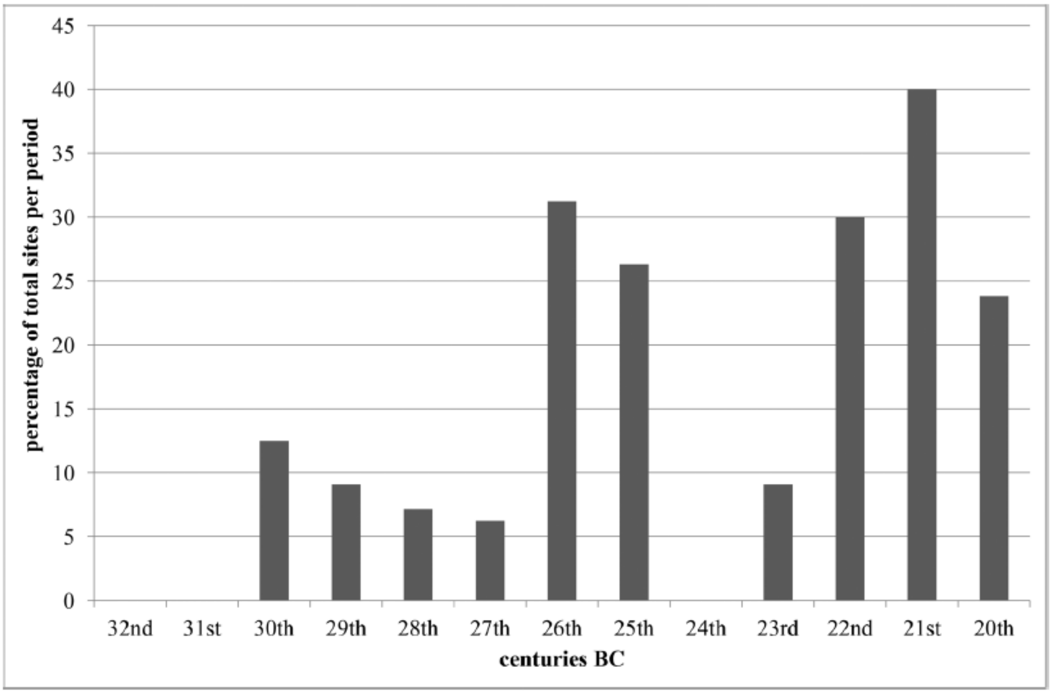

Figure 75. Graph showing proportion of destroyed settlement throughout the EBA (Massa, 2014, Fig. 8).

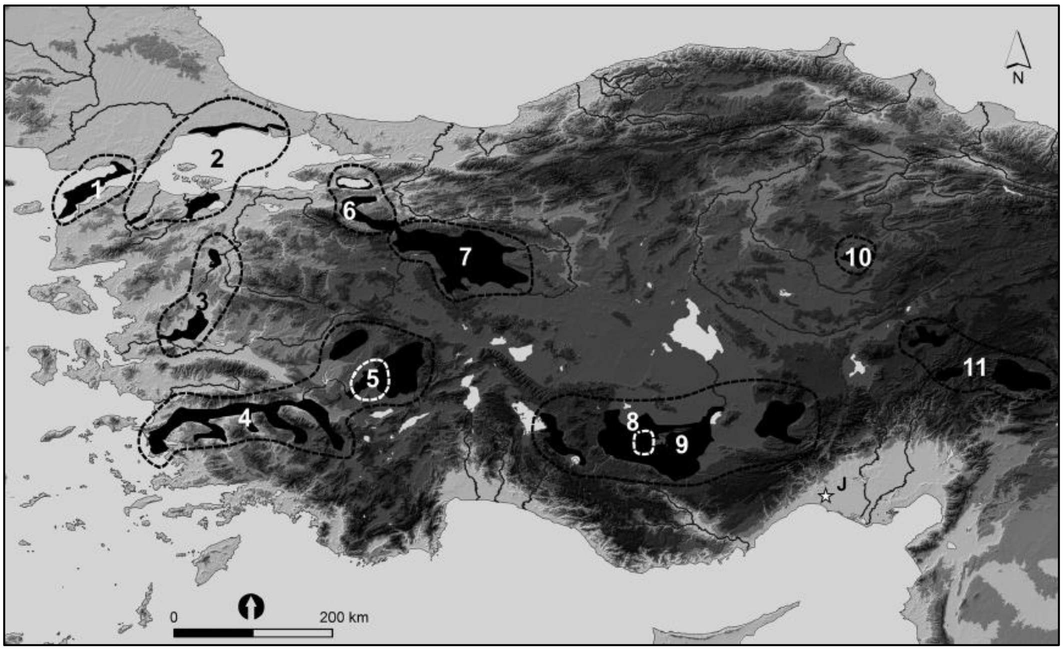

Figure 76. Map showing locations of investigated archaeological surveys (Massa, 2014, Fig. 5). 1. Gelibolu Peninsula, 2. Marmara-Balıkesir, 3. Balıkesir-Manisa, 4. Büyük Menderes, 5. Upper Büyük Menderes, 6. Yenişehir-İzmir, 7. Eskişehir, 8. Çumra plain, 9. Konya-Karaman, 10. Alişar hinterland, 11. Elbistan-Maraş.

Map_no	Survey	Director	Seasons	Area (km2)	Site dens. (x100km2)	Method	Phasing	Site info	Site dimension	Reference
1	Gelibolu Peninsula	Özdoğan	1982	1100	1.2	B	x	x	x	Özdoğan 1986
2	Marmara Sea	Özdoğan	1983-90	1200	1.7	B	x	x		Özdoğan 1983-90
3	Balıkesir-Manisa	French	1960-5	1000	3	B	x	x	x	French 1969
4	Büyük Menderes	Akdeniz	1995	8000	0.9	B	x			Akdeniz 2002
5	Beycesultan hinterland	Abay	2003-9	460	9.8	A	x	x	x	Abay 2011
6	Yenişehir-İznik	French	1960-5	800	2.3	B	x	x	x	French 1967
7	Eskişehir	Efe	1988-95	5800	2.3	B	x	x	x	Efe 1989-95
8	Çumra plain	Baird	1995-99	410	6.8	A	x			Boyer et al. 2006
9	Konya-Karaman	Mellaart	1958	8300	1.5	B	x	x		Mellaart 1963
10	Alişar hinterland	Gorny	1994-9	500	5.2	B	x			Branting 1995-6
11	Elbistan-Maraş	Brown	1962	2000	2.1	B	x	x	x	Brown 1967

Figure 77. Analysed surveys with their methodologies and details of records (Massa, 2014, Fig. 6). Method: A: Systematic extensive and intensive, B: Systematic extensive.

Figure 78 demonstrates that in the EBA II number of settlements greatly increases in comparison to the EBA I. However, in the EBA III (ca. 2400-1950 BC), the number of settlements dramatically decreases in all survey areas and in most extreme cases, 80% of the settlements in Gelibolu peninsula, Marmara-Balıkesir and Upper Büyük Menderes disappeared. In the MBA, however, while number of settlements in some survey areas continues to decrease, in areas such as Büyük Menderes and Upper Büyük Menderes, site numbers increases. The destruction period that is discussed above, clearly overlaps with the dramatic decrease in site numbers during the EBA III (Massa, 2014).

A more detailed investigation of changes in settlement pattern in the Upper Menderes that is based on studies by Abay (2011) and Dedeoğlu (2014) provides a better understanding (Massa & Şahoğlu, 2015). This survey, focusing on both the main valley and highlands, is the only one that specifies the size of the settlement for each period (Figure 79; Dedeoğlu, 2014) and therefore, makes it possible to understand changes in size extent as well, besides site numbers.

As shown in Figure 79, the number of sites considerably increases in the EBA II. However, the EBA III presents a dramatic drop in site numbers and occupied area. In the EBA III, abundantly larger sites in the main valley continued from the previous period and almost all smaller sites both in the main valley and highlands were abandoned. In the MBA, the number of sites in the main valley and highlands increases again. The considerable decrease in the EBA III seems to be linked to the 4.2 ka BP climatic event and its impacts for some reasons. First, considerable number of sites decreased more or less contemporarily in the region. Second, smaller sites in marginal areas in the highlands and the main valley abundantly disappeared. Finally, surviving sites are the larger settlements close to a water resource in the main valley. Moreover, there are no mass burials to indicate sudden and great reduction of population or no evidence for movement of populations to another regions that is testified through a decrease in site numbers in many other regions as well. Regarding this information, the location of surviving settlements near water resources, disappearance of sites in marginal areas, no newly founded settlements

Map_no	Survey	uncorrected						corrected no.sites/no.years						change in respect to previous period (%)				
		LCh	EBI	EBII	EBIII	MBA	LBA	LCh	EBI	EBII	EBIII	MBA	LBA	LCh>EBI	EBI>EBII	EBII>EBIII	EBIII>MBA	MBA>LBA
1	Gelibolu Peninsula	7	14	14	4	3	2	0.5	3.5	4.7	1.0	0.9	0.4	+600%	+35%	-80%	-10%	-50%
2	Marmara-Balıkesir	8	12	13	3	1	??	0.6	3.0	4.3	0.8	0.3	??	+400%	+45%	-80%	-60%	??
3	Balıkesir-Manisa	??	32	30	27	21		??	8.0	10.0	6.8	2.6		??	+25%	-30%	-60%	
4	Büyük Menderes	30	26	81	40	42	56	2.3	6.5	27.0	10.0	12.0	12.4	+180%	+300%	-60%	+20%	+5%
5	Upper B.Menderes	29	41	61	14	56	57	2.2	10.3	20.3	3.5	16.0	12.7	+370%	+100%	-80%	+350%	-25%
6	Yenişehir-İznik	8	5	13	15	9		0.6	1.3	4.3	3.8	1.1		+110%	+230%	-10%	-70%	
7	Eskişehir	35	31	87	81	57		2.7	7.8	29.0	20.3	7.1		+190%	+270%	-30%	-65%	
8	Çumra plain	15	38		7	??	??	1.2	5.4		1.8	??		+350%		-65%	??	??
9	Konya-Karaman	28	c.100		7	35	??	2.2	14.3		1.8	10.0	??	+550%		-85%	+450%	??
10	Alişar hinterland	??	12	27	9	21		??	3.0	9.0	2.3	2.6		??	+200%	-75%	+15%	
11	Elbistan-Maraş	16	12	29	21	26	??	1.2	3.0	9.7	5.3	7.4	??	+150%	+220%	-45%	+40%	??

Figure 78. Changes in uncorrected and corrected (site numbers divided by number of years of each period) site numbers and changes in corrected site numbers in respect to previous period in survey areas from the Late Chalcolithic to the LBA (Massa, 2014, Fig. 7). LCh: Late Chalcolithic, EBA: Early Bronze Age, MBA: Middle Bronze Age, LBA: Late Bronze Age.

in the period, people from these abandoned sites must have not disappeared but more likely shifted to archaeologically less visible socio-economic life-styles such as nomadism in the highlands (Massa & Şahoğlu, 2015). Moreover, archaeological research showed that there was no evidence for aggregation of populations from deserted sites into the survived larger settlements. Whilst some of the populations might have been centralized into some of the survived settlements in the main valley, the total population in the survey area definitely decreased (Dedeoğlu, 2014). Therefore, those people who did not move to the larger settlements must have shifted to pastoralism and inhabited archaeologically less visible sites in the highlands as Massa and Şahoğlu (2015) suggested.

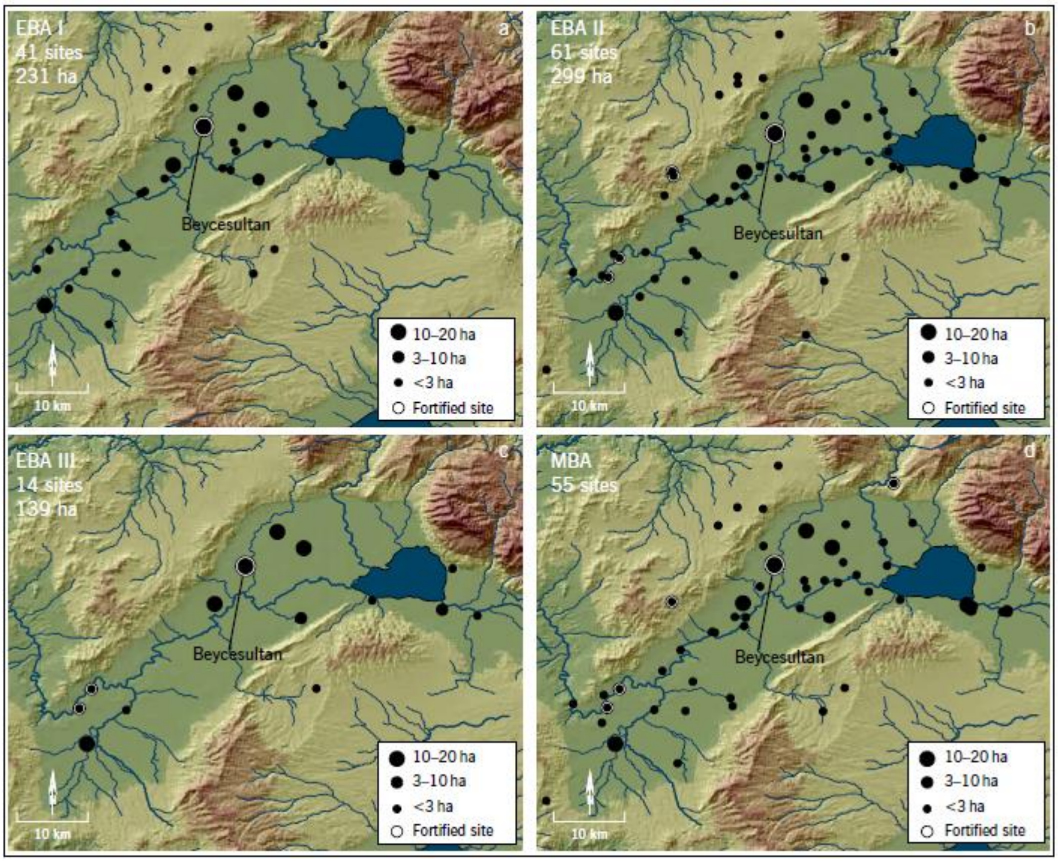

Figure 79. Map showing Upper Menderes survey area and changes in location and size of sites throughout the EBA and the MBA. a. EBA I (3200-2800 BC), b. EBA II (ca. 2800-2400 BC), c. EBA III (ca. 2400-1950 BC), d. MBA (ca. 1950-1650 BC) (Massa & Şahoğlu, 2015, Fig. 7).

In summary, contemporaneous abandonment of large number of settlements in many regions that coincides with large number of settlement destructions in Anatolian peninsula suggests a crisis period in the EBA III. In particular, disappearance of smaller sites in marginal areas and the main valleys and survival of larger settlements close to a water resource clearly point to a crisis period during the EBA III in Upper Menderes region as well. As Massa (2014) states, regarding no mass burials, no newly founded settlements in Upper Menderes case, no considerable increase in neighbouring areas where these people could settle, the explanation of disappearance of thousands of people can be shifting to a pastoralist economy and nomadism that are archaeologically less visible.

CHAPTER 7

DISCUSSION

This thesis aims at understanding if the 4.2 ka BP event and societal changes in western Anatolia at the end of the 3rd millennium BC are causally related through integrated examination of palaeoenvironmental, bioarchaeological and archaeological data. As discussed in chapter 3, palaeoenvironmental analysis on several western Anatolian proxies clearly presents the record of the 4.2 ka BP event that seems to reach a peak around 4200 calBP. Examination of archaeobotanical, zooarchaeological and archaeological data evidences that western Anatolian societies responded to the drought event in various ways through changes in agricultural and animal husbandry practices and changes in regional settlement patterns.

There are only five palaeoenvironmental archives that cover the 4.2 ka BP event period (Figure 80 and Figure 81). All proxies, except the stalagmite record from Kocain Cave where the event is interpreted as a cooling event, provides a record of the 4.2 ka BP event as a drought event.

The archives with more concrete evidence for the event are clustered in the northwestern Anatolia that means the coastal region and southwestern Anatolia significantly lack palaeoenvironmental analysis. Moreover, the temporal resolution of the studies is abundantly low. Only the analysis on stalagmite in Uzuntarla Cave has a very high resolution of 2.6 years. However, the record of the event starts 4100 BP that means it does not cover the entire event period. Therefore, it is not possible to reach an ultimate conclusion on the precise timing of the event in the region but the results seem to concentrate around 2200-2000 BC with a starting date ca. 2450 BC and an end date ca. 1950 BC.

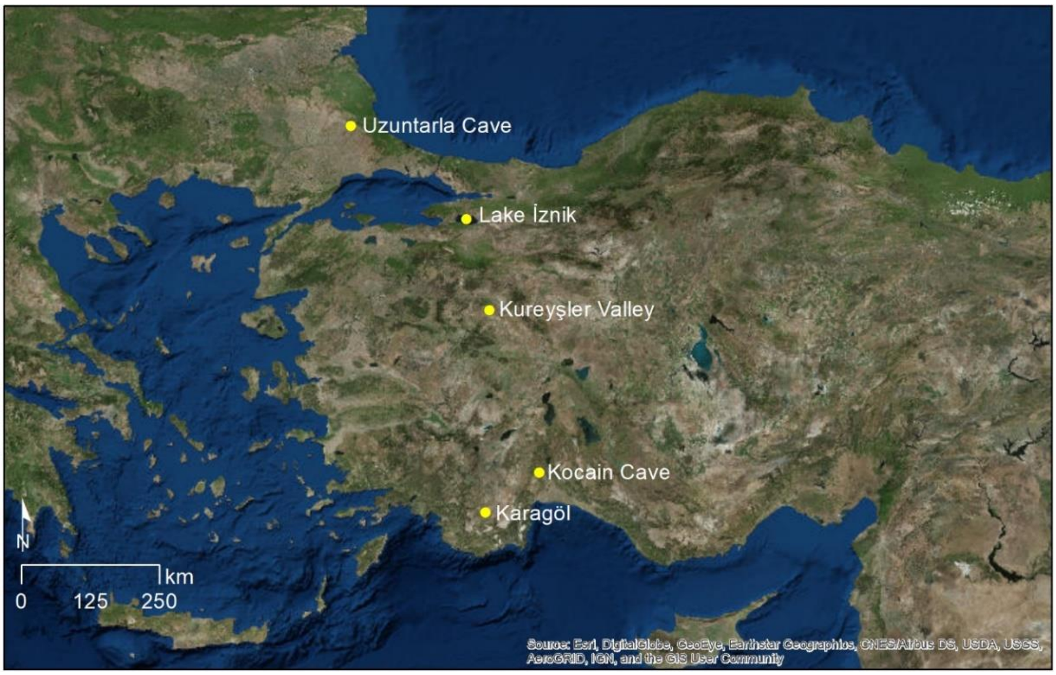

Figure 80. Map showing sites with palaeoenvironmental data that has the record of the 4.2 ka BP event period in western Anatolia.

Site	Analysis	Evidence	Period	Resolution	Reference
Uzuntarla Cave, Kırklareli	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on stalagmite	A drop in $\delta^{13}C$ values and an increase in $\delta^{18}O$ values Less rainfall, increased temperature	ca. 2050-1950 calBC (based on Th dates)	2.6 years	Göktürk, 2011 Massa & Şahoğlu, 2015
Lake İznik, Bursa	Geochemical, mineralogic and palynological analysis on sediment cores	Low lake level, very low or lack of deposition and/or eroison and forest retreatment	ca. 4.4-4.2 ka calBP (based on ^{14}C AMS and Pb-Cs dates)	Low	Ülgen et al., 2012 Miebach et al., 2016
Kureyşler Valley, Kütahya	Stable ($\delta^{18}O$) isotope and palynological analysis on sediment cores		ca. 4200 calBP (based on ^{14}C dates)	Low	Ocakoğlu et al., 2019
Kocain Cave, Antalya	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on stalagmite	Low $\delta^{13}C$ values and high $\delta^{18}O$ values	ca. 2260 BC and lasted for ca. 80 years (based on Th dates)	2.3 years	Göktürk, 2011
Elmalı Basin (Karagöl), Antalya	Paleoenvironmental investigation on lake sediments	High lake level and large extent of lakes	ca. 2000 BC (based on paleoenvironmental and archaeological interpretation)	200-300 years?	Foss, 2006 Massa & Şahoğlu, 2015

Figure 81. Sites with palaeoenvironmental data having a record of the 4.2 ka BP event in western Anatolia.

As discussed in chapter 6, “Responses to the 4.2 ka BP Event in western Anatolia”, changes in agricultural and animal husbandry practices of western Anatolian societies and changes in regional settlement patterns seem to be possible responses to the drought event.

There are only five western Anatolian sites with archaeobotanical data that provides information on the agricultural practices throughout the EBA and the beginning of the MBA, ca. 3000-1900 BC (Figure 82). However, only Troy and Küllüoba present a long-term perspective on the subject. Table 14 shows the summary of evaluation of archaeobotanical analysis at Troy and Küllüoba. Some results show that Troy and Küllüoba responded in a similar way to the event.

Figure 82. Map showing western Anatolian sites that provide archaeobotanical data for agricultural practices in the EBA and the beginning of the MBA.

According to the analysis results, at Troy, the ratio of wheat to barley decreases by 83% in the EBA III (Table 4). At Küllüoba, the ratio of wheat to barley decreases by 96% in the late EBA II and by 8% in the EBA III and the ratio of glumed wheat to free threshing wheat increases by 16% in the EBA III (Table 4). The results from

Küllüoba show a stress period already started in the late EBA II and continued in the EBA III that is supported by the results from Troy as well. On the other hand, both sites do not show any evidence for a stress period in the late EBA III/MBA, i.e., suggested drought period.

Table 14. Overall evaluation of archaeobotanical analysis at Troy and Küllüoba.

Period	EBA II		EBA III		EBA III L. /MBA	
Site	TRY	KO	TRY	KO	TRY	KO
A decrease in wheat : barley	X	X	X	X		
An increase in glumed wheat : free threshing wheat		X		X		
An increase in drought-tolerant pulses				X		X
An increase in fodder for animals		X		X		X
Increased diversity of crops		X		X	X	X
Crops grew under aridity					X	

At Küllüoba, the relative abundance of drought-tolerant pulses gradually increases in the EBA III and the late EBA III/MBA. In particular, the consumption of bitter vetch considerably increases through the periods. An increase in relative abundance of drought-tolerant pulses seems to point to a drought event from the EBA III onwards.

Crops became more diverse at Küllüoba from the early EBA II onwards and at Troy in the late EBA III/MBA. Considering broad range of crops and the increase in the relative abundance of pulses, societies tried to buffer the risk of total crop failure from the late EBA II onwards.

The relative abundance of crops used as animal fodder including pulses increases starting from the late EBA II onwards at Küllüoba. Although it cannot be certainly determined if these pulses were mainly grown for animal or human consumption, an increase in such crops suggest an increasing need for more food, in particular pulses, from the late EBA II onwards.

Comparison of isotope analysis results of barleys from Troy II and Troy IV clearly shows that barleys in Troy IV, i.e., the late EBA III/MBA, grew under water scarcity, although the results do not signal for a severe drought event.

In summary, as Table 14 shows, changes in agricultural practices at Küllüoba start to show evidence for a possible drought event already in the late EBA II that continued in the EBA III. Although, diversity of crops and the relative abundance of pulses increase in the late EBA III/MBA, the ratios of wheat to barley and glumed wheat to free threshing wheat do not show any evidence for a drought event. At Troy, the ratio of wheat to barley shows signals of a drought event in the EBA III and isotope analysis on barleys demonstrates a slight water scarcity in the late EBA III/MBA. It seems that Troy does not provide much evidence for a drought event. However, it should be reminded that archaeobotanical data from Troy is restricted and majority of changes cannot be examined at this site. Overall, it seems that from the late EBA II onwards, both sites in the coastal region and northwestern Anatolia suffered from a drought event.

There are more sites in western Anatolia that provide EBA faunal assemblages (Figure 83). However, only Kanlıgeçit, Maydos-Kilisetepe, Troy and Karataş-Semayük out of 10 sites provide a long-term understanding on the animal husbandry practices in western Anatolia. The sites with zooarchaeological data are abundantly located in the north of western Anatolia. The summary of zooarchaeological analysis in western Anatolia is presented in Table 15.

According to analysis results, in the EBA II, the sheep to goat ratio at Kanlıgeçit and Karataş-Semayük decreases by 18% and 47% respectively, but it increases at Troy (Table 13). In the EBA III, the sheep to goat ratio increases at Kanlıgeçit, Troy and Karataş-Semayük. In the late EBA III/MBA, only at Kanlıgeçit, the ratio significantly decreases due to the absence of goats. However, it should not be forgotten that there are animal bones that could not be identified if they belong to a goat or a sheep and therefore, the result from Karataş-Semayük might be misleading.

Figure 83. Map showing western Anatolian sites that provide archaeozoological data for animal husbandry practices in the EBA and the beginning of the MBA.

Table 15. Overall evaluation of zooarchaeological analysis at Kanlıgeçit, Troy, Maydos-Kilisetepe and Karataş-Semayük.

Period	EBA II			EBA III			EBA III L./MBA	
Site	KG	TRY	K-S	KG	TRY	K-S	KG	M-K
A decrease in sheep : goat	X		X				X	
An increase in sheep/goat : cattle		X	X		X		X	
An increase in wild animals	X	X			X		X	X
Evaluation of wild boar and pig				X	X	X	X	X

On the other hand, at Maydos-Kilisetepe the sheep to goat ratio increases. These results suggest a possible environmental deterioration in the EBA II experienced by Kanlıgeçit and Karataş-Semayük. There are no signs of a drought event in the EBA III and only Kanlıgeçit seems to point to a possible drought event in the late EBA III/MBA. However, this conclusion is not definitive on its own. Overall evaluation of all changes will provide a comprehensive understanding on the subject.

The sheep/goat to cattle ratio increases at Troy and Karataş-Semayük in the EBA II. In the EBA III, it increases only at Troy. In the late EBA III/MBA, the ratio increases by 273% at Kanlıgeçit (Table 13). These results point to a possible drought event in the EBA II that continued in the EBA III and the EBA III/MBA. However, these results are based on very site-specific changes in animal preference. An overall evaluation of changes will provide a better understanding.

The change in the relative abundance of wild animals is observed best at settlement basis. At Troy the relative abundance of wild animals significantly increases in the EBA II and then, increases in the EBA III as well. The relative abundance of wild animals at Kanlıgeçit increases in the EBA II and the late EBA III/MBA but decreases in the EBA III. At Maydos-Kilisetepe, the relative abundance of wild animals increases in the late EBA III/MBA. Interpreting these results all together to draw a conclusion is not possible, since Kanlıgeçit seems to present conflicting strategies. Only Troy shows a reliable increase through time. As a general conclusion, dependence on the wild animals seems to increase already in the EBA II and continued in the EBA III and the late EBA III/MBA.

The relative abundance of wild boar and pigs varies by site. It is not possible to suggest a regional trend. Site-based interpretation can provide some meaningful insights. At Kanlıgeçit, the relative abundance of wild and pigs increases in the EBA II and decreases in the EBA III. In the late EBA III/MBA, the relative abundance of pig slightly decreases but that of wild boar significantly increases. Already discussed in chapter 5, both pig and wild boar require forested environment and higher water availability. On the other hand, pigs can be fed as an alternative cheap meat source. Moreover, similar to wild boars, fallow deer require a forested environment as well. Keeping this in mind, in the EBA II, there must have been favourable environmental conditions, while in the EBA III, a drop in all three species suggests a possible drought event. In the late EBA III/MBA, as pigs decrease, wild boars increase and the relative abundance of fallow deer significantly increases that suggest favourable conditions for the wild animals. On the other hand, these can suggest a stress period as well and the society started to be more depended on the wild animals due to the failure in domestic animal husbandry. Therefore, the results from Kanlıgeçit suggest unfavourable environmental conditions in the EBA III and the late EBA III/MBA.

At Troy, the relative abundance of pig and wild boar decreases in the EBA II and in the EBA III, as wild boars slightly decrease, pigs significantly increase. According to the changes in species, the EBA II was not favourable in terms of environmental conditions. However, the relative abundance of fallow deer, that also requires forested environment, significantly increases in the EBA II and continued to increase in the EBA III. The increase in fallow deer might be interpreted as a consequence of cultural preference, since it had clear ritualistic functions in the later phases of Troy (Gündem, 2010). Therefore, the decrease in both wild boar and pig can be due to either unfavourable environmental conditions or increasing contribution of fallow deer to the human diet, besides its ritualistic purposes. In the EBA III, as the relative abundance of wild boar decreases, the relative abundance of pig with fallow deer significantly increases. This period at Troy is interpreted as a stress period (Gündem, 2010) that might be related to the 4.2 ka BP event.

At Maydos-Kilisetepe, in the late EBA III/MBA, the relative abundance of pig increases, as that of wild boar decreases. On the other hand, the relative abundance of fallow deer increases ca. 75% (Table 13). It seems that Maydos-Kilisetepe has a trend that is similar to that of Troy in the EBA III. Therefore, a stress period can be suggested for the late EBA III/MBA Maydos-Kilisetepe as well.

Karataş-Semayük has a different trend than other sites. It should be reminded that there are only pigs and there are not any wild boars or fallow deer at the site. The relative abundance of pig decreases in the EBA II and increases in the EBA III. Similar to the cases at Troy and Maydos-Kilisetepe, this may point to a crisis period in the EBA III that can be related to the 4.2 ka BP event. However, the data from Karataş-Semayük is very restricted that it is not possible to reach a reliable conclusion.

In summary, as seen in Table 15, changes in animal preference through the EBA vary by site. Each site seems to act uniquely in each period. The signals from Karataş-Semayük that can be related to a drought event should be interpreted sceptically. On the other hand, at Troy, overlapping changes point to a drought event in the EBA III. Changes at Kanlıgeçit suggest a drought event in the late EBA III/MBA and results from Maydos-Kilisetepe seem to support it. Regarding the information from Kanlıgeçit, Maydos-Kilisetepe and Troy, a drought event started in the EBA III and continued into the late EBA III/MBA.

Investigation of several survey projects and key sites in western Anatolia shed light on changes in socio-political changes in EBA societies that can be related to the 4.2 ka BP event. Analysis on sites in the Anatolian peninsula that cover 2300-1900 BC, i.e., suggested drought event, focusing on destruction evidence shows that starting from the 24th century BC, majority of sites in western Anatolia were destroyed by large fire disasters. In particular, the proportion of destroyed settlements reaches a peak in the 21st century BC. These destructions can be interpreted as a result of conflicts between sedentary agriculturalists for limited arable land and water sources.

According to the results of analysis of seven survey projects in western Anatolia, in the EBA II, in all areas the number of sites increases by ranging from 25% to 270%. However, in the EBA III (2400-1950 BC), the number of sites dramatically decreases in all region. In particular, the number of sites decreases by 80% in Gelibolu Peninsula, Marmara-Balıkesir and Upper Büyük Menderes regions and 60% in Büyük Menderes region. Moreover, the number of sites still continues to decrease in some regions after 1950 BC, i.e., the MBA as well.

The increase in the proportion of destroyed settlements in 2300-1900 BC and large number of site abandonments in the all survey regions in western Anatolia in the EBA III, 2400-1950 BC seems to agree on a crisis period that might be linked to the 4.2 ka BP event. Moreover, lack in mass burials or evidence for migration of large populations from a region to another (Massa, 2014), people who had substantially abandoned sites must have shifted at archaeologically less visible sites that were related to a more mobile life-style with a pastoralist economy as in northern Syria (Wossink, 2009).

Figure 84 shows locations of sites with palaeoenvironmental, zooarchaeological and archaeobotanical data that confirms a drought event, i.e., the 4.2 ka BP event and Table 16 shows the results of archaeobotanical and zooarchaeological analysis and changes in the regional settlement patterns in western Anatolia from the EBA II onwards all together.

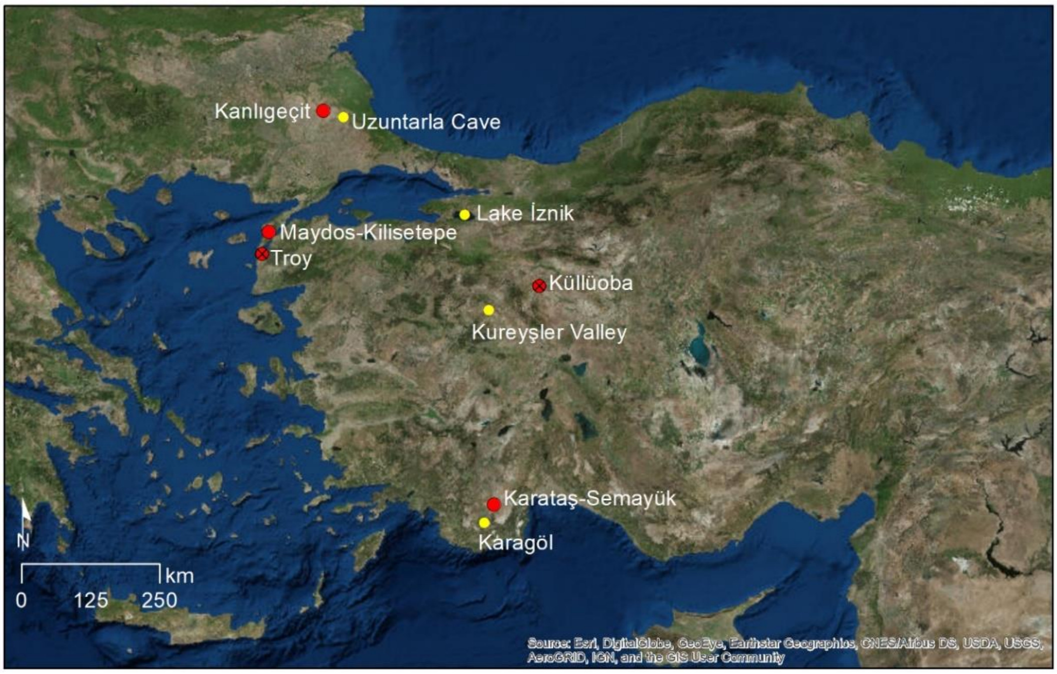

Figure 84. Map showing sites that provide palaeoenvironmental, zooarchaeological and archaeobotanical data for the 4.2 ka BP event in western Anatolia. Yellow dots: sites with palaeoenvironmental data, Red dots: sites with zooarchaeological data, Red dots with a cross: sites with both zooarchaeological and archaeobotanical data.

According to Table 16, some settlements, such as Kanlıgeçit and Troy, show strong evidence for a drought event and on the other hand, some such as Küllüoba, Maydos-Kilisetepe and Karataş-Semayük partial, i.e., give weak, or no evidence for the very same event. All these responses considered together; settlements seem to provide conflicting results regarding the presence of a common drought event. However, explaining these results is not that simple and factors that will be discussed in details later in this chapter can provide come explanations. The microclimate of the regions where some sites, such as Karataş-Semayük, are located might be such that buffers

Table 16. Summary of changes that can be related to the 4.2 ka BP event in western Anatolian sites from the EBA II onwards. Abbreviations refer to Table 2 and Table 10.

Responses	Period	EBA II (ca. 2500-2400/2300 BC)				EBA III (ca. 2400/2300-2200 BC)				EBA III L./MBA (ca. 2200-1950 BC)			
	Site	KG	TRY	KO	K-S	KG	TRY	KO	K-S	KG	M-K	TRY	KO
Changes in agricultural practices	A decrease in wheat : barley		X	X			X	X					
	An increase in glumed wheat : free threshing wheat			X				X					
	An increase in drought-tolerant pulses							X					X
	An increase in fodder for animals			X				X					X
	Increased diversity of crops			X				X				X	X
	Crops grew under aridity											X	
Changes in animal husbandry practices	A decrease in sheep : goat	X			X					X			
	An increase in sheep/goat : cattle		X		X		X			X			
	An increase in wild animals	X	X				X			X	X		
	Evaluation of wild boar and pig					X	X		X	X	X		
Changes in regional settlement patterns	Destroyed in 2300-1900 BC					X	X		X	X		X	
	Survey areas in western Anatolia					A decrease in the number of sites in all survey areas.							

the impacts of the event and therefore, these sites provide weak evidence for a drought event.

In addition, the societies in some sites, for example Troy, Küllüoba and Maydos-Kilisetepe, might have followed different subsistence strategies and for example, received crops or animals from smaller sedentary sites or exchanges crops and animals with pastoralists in highlands. Therefore, they were able to cope with the adverse impacts of the drought event and in some cases, were able manage to survive the crisis period without destruction.

Moreover, it is possible that some societies at some sites, such as Troy, did not have to change their managements of both agriculture and animal husbandry. In some cases, changes in either animal or plant preference might have been enough to overcome the impacts of the aridity. Furthermore, as in the case of EBA III Troy, changes in the husbandry of only some animals were sufficient to buffer the impacts.

Since the results of changes in agricultural and animal husbandry practices and changes in regional settlement patterns are majorly site-specific, a more meaningful explanation can be derived through overall interpretation of different responses from different sites.

Overlapping changes in agricultural and animal husbandry practices and changes in regional settlement patterns points to a disturbance in the EBA III (ca. 2400/2300-2200 BC) and the late EBA III/MBA (ca. 2200-1950 BC). The duration of the disturbance period seems to correlate with the record of the 4.2 ka BP event, ca. 2450-1950 BC, in the region. Therefore, contemporaneous changes in agricultural and animal husbandry practices and changes in regional settlement patterns seems to be the result of a common event and the 4.2 ka BP climatic change appears as a strong factor behind these changes.

Although the 4.2 ka BP event is a strong driver that seems to explain societal changes in western Anatolia at the end of the 3rd millennium BC, there could be another factor in play as well. As previously stated, at the end of the 3rd millennium BC the long-distance exchange network collapsed and the relations between western and central Anatolia drastically decreased. In the early MBA, after the crisis period, as central Anatolia with inner western Anatolia developed closer contact with Mesopotamia both culturally and possibly politically, the coastal region of western Anatolia became a part of the Aegean (Şahoğlu, 2005; Fidan et al., 2015). Although the true reason why western Anatolia was not active in this new exchange network is not known, changing needs and demands for raw materials may explain it. In the beginning of the MBA, a new exchange network between central Anatolia and Mesopotamia was established and tin possibly from Afghanistan and other goods were the basis of it. Possibly local tin in Anatolia was not enough to meet the increasing demand and therefore, tin from other regions was provided through this new network by Assyrians in Mesopotamia. As a result, the exchange routes moved eastward and western Anatolia lost its importance (Şahoğlu, 2005) and experienced a crisis period that was suggested by analysis on bioarchaeological and archaeological data. The region became active again in the MBA in the time of Hittites in central Anatolia and Minoans in the Aegean (Şahoğlu, 2005; Fidan et al., 2015). However, to find out the real reason for the decreased engagement of western Anatolia with new exchange network in the beginning of the MBA more studies are needed.

Even though this research detected changes in subsistence strategies and settlement patterns that could be causally linked to the 4.2 ka BP event, there are some important problems regarding the data.

The major problems in linking the palaeoenvironmental and archaeological data is the difference in temporal and spatial scales and resolution. Palaeoenvironmental studies focus on changes through thousands of years, whereas archaeological studies deal with changes in centuries, decades and even years. Therefore, the temporal resolution of palaeoenvironmental studies are majorly coarse in comparison to archaeological studies and sometimes it is hard to establish a good chronological correlation. Similarly, the timing of the event is not very clear in the region. As discussed above, the palaeoenvironmental analysis is based on proxy data from 4 sites and only 3 of them, Uzuntarla Cave, İznik Lake and Kureyşler Valley, present clear evidence for the 4.2 ka BP event and its impacts in the region. The temporal resolution of these three studies are very low, except Uzuntarla Cave where the entire event is not recorded. Thanks to high resolution data from Uzuntarla Cave, it can be securely said that the event ended ca. 1950 BC. However, the beginning of the event is not clear. According to the analysis on Lake İznik, it started ca. 4400 BP, i.e. 2450 BC, with a low temporal resolution. The results from Kureyşler Valley just point to a date ca. 4200 BP that is possibly when the event reached a peak. The timing of the event in western Anatolia seems to be conflicting with the suggested event period in the eastern Mediterranean region that is mostly accepted as 4.2-3.9 ka BP. Could the event have started ca. 200 years earlier in western Anatolia? Although it may not be known exactly how many years earlier it started, it possibly started earlier than 4200 BP. There are some other palaeoenvironmental studies show that the event started earlier, ca. 2300 BC in Anatolia and the eastern Mediterranean (cf. Nar Lake by Dean et al., 2015; Tecer Lake by Kuzucuoğlu et al., 2011; Northwestern Aegean by Kuhnt et al., 2008 and Ehrmann et al., 2007). Moreover, changes in bioarchaeological data strongly suggest a drought event in the EBA III (ca. 2440/2300-2200 BC).

Another problem is the different spatial scale of archaeological and palaeoenvironmental studies. Palaeoenvironmental studies generally benefit from interpolation and extrapolation of limited number of proxies to determine a general climatic reconstruction for an entire region. However, impacts of a drought event differs from region to region depending on microclimate and in order to understand exactly how a drought event affected a site, palaeoenvironmental investigation should be performed in the close vicinity of the site. In western Anatolia, there are only 3 sites, where palaeoenvironmental studies were done, with clear evidence for the 4.2 ka BP event and they are clustered in north of the study area and only two of them are in the close vicinity of an archaeological site. As shown in Figure 84, settlements at Kanlıgeçit and Küllüoba are closer to a site where palaeoenvironmental studies were done and are expected to be affected by the climatic change. On the other hand, due to the lack of palaeoenvironmental data in the coastal region, the past climate there where Troy and Maydos-Kilisetepe are located is not very well-known and has to depend on extrapolation of other proxy data from different sites. In summary, palaeoenvironmental studies should be performed in the close vicinity of sites to determine the past climatic change and its impacts in very local scales and to establish better relationships between the impacts of the event and responses to it.

Archaeological data and methodologies have some problems and limitations as well. The major problem in archaeological studies is the significant lack in absolute dating. The dating in an archaeological excavation and as well as bioarchaeological study is majorly based on archaeological stratigraphy that is very coarse in temporal resolution. For the scope of this study, the dating is of major importance to make sure for example, a change in plant or animal preference that can be related to a drought event that exactly coincides with the 4.2 ka BP event. Only the assemblages from Kanlıgeçit and Maydos-Kilisetepe are ^{14}C dated and therefore, analysis on them can provide highly reliable results. The rest of the bioarchaeological assemblages are dated according to the archaeological stratigraphy and changes in those assemblages can be less securely linked to the climatic event. Moreover, the analysis of plant remains from Küllüoba signals for a drought event already in the EBA II (ca. 2500-2400/2300 BC) that is based on archaeological stratigraphy. Çizer (2015) emphasizes the need for a ^{14}C dating at Küllüoba to locate the analysed assemblage chronologically and mentions that the assemblage might belong to a later period that coincides with the 4.2 ka BP event.

Although archaeobotanical and zooarchaeological studies significantly contribute to a better understanding of human responses to a climate change, the number of such specialist studies are very limited in western Anatolia. A few sites provide very well studied data and its interpretation (cf. Çizer, 2015; Gündem, 2010). Moreover, sites generally provide either archaeobotanical studies or zooarchaeological studies that prevents studying and interpreting both studies together at the same site. In western Anatolia, only two sites, Küllüoba and Troy, provide both archaeobotanical and zooarchaeological data. Thus, changes in plant and animal preferences through time at Troy can be compared. However, due to the small assemblage size of EBA III Küllüoba, the assemblages from the EBA II and III were collected and studied together. Therefore, such a comparison is not possible at Küllüoba. More archaeobotanical and zooarchaeological investigations in particular at a same site will considerably contribute to a better and more reliable understanding on the subject.

Similar to the archaeological excavations and bioarchaeological studies, archaeological surveys have some problems and limitations as well. First of all, the dating in surveys completely depends on archaeological ceramics and small finds that are collected from the surface of sites and therefore, is very coarse. As discussed in chapter 6, “Responses to the 4.2 ka BP event in western Anatolia”, the survey methodology and recorded details of sites differ by projects. It means that each survey project yields different kind of information in different details regarding visited sites. Moreover, survey projects in western Anatolia abundantly target to explore mounds in the main valleys that means highlands, camp sites and other archaeologically less visible sites and human activities were majorly ignored. In western Anatolia, only Büyük Menderes Survey Project aims at visiting and locating sites in highlands, besides the sites in the main valley. The methodology and the detail of recording of surveys in western Anatolia are majorly lacking of some significant information for the investigation of human responses to a climatic change.

Both archaeological excavations and surveys focus on sedentary settlements in main valleys and therefore, provide insights on social, political and economic structure of sedentary agriculturalist societies in main valleys. It provides highly biased results on features of ancient societies and creates a huge gap in knowledge on different socio-economic structures and subsistence strategies by ignoring, for example, more mobile societies living in highlands or flat settlements in main valleys. Archaeological studies show that sites yield many plant and animal remains and lead a very straightforward conclusion that sedentary societies majorly practice agriculture and animal husbandry. However, they might have followed more complicated subsistence strategies that are less visible. Better knowledge in past socio-economic structures and subsistence strategies will contribute to a more realistic and reliable reconstruction of human-environment interaction and changes in subsistence strategies as a consequence of a drought event.

The complexity of human behaviour is one of the most important factors affecting responses to a drought event. The current knowledge on ancient societies and their behaviour is limited to several archaeological excavations, partially on surveys and interpretation of data that they have provided. Apparently, investigation of bioarchaeological data provides some insights on changes in plant and animal preference and reflects human decisions under changing conditions in one way or another. However, investigation of bioarchaeological data has an environmental deterministic approach that does not take other factors that might have affected human decision into consideration. In the case of Troy, the increase in fallow deer seems to be related to a drought event from the environmental deterministic perspective. However, considering the ritualistic meaning of fallow deer in later occupation phases of Troy, the increase in earlier periods might have been a cultural preference as well (Gündem, 2010). This can be the case for some other plant and animal preferences (cf. plant preference at Yenibademli Höyük in the EBA II (Oybak-Dönmez, 2005)) at other sites as well. Therefore, a better knowledge on human behaviour in the past and how it could influence human decision is of major importance as well to avoid a very straightforward environmental deterministic approach.

CHAPTER 8

CONCLUSION

Palaeoenvironmental and archaeological studies have attested a correlation between the 4.2 ka BP climatic change and the turmoil period in the eastern Mediterranean at the end of the 3rd millennium BC. It has been suggested that the climatic impacts led to a social unrest, conflicts, migration of populations and in some cases, a societal collapse following a disturbance in agriculture and animal husbandry. Several synthetic analyses on the subject have provided insights on the impacts of the particular climate change and different human responses to it.

The aim of this study was to examine if there is a causal relationship between the 4.2 ka BP event and major changes in social, economic and political structure of western Anatolian societies at the end of the EBA and to understand different responses to the particular climatic event. To do this, the methodology of this study focused on the investigation and interpretation of palaeoenvironmental, bioarchaeological and archaeological data together.

In the first step, the palaeoenvironmental data from western Anatolia, namely analyses from Uzuntarla Cave, Lake İznik, Kureyşler Valley, Karagöl in the Elmalı Basin and Kocain Cave, were investigated to determine the timing and intensity of the event in the region. Except the proxy from Kocain Cave, all proxies present impacts of the 4.2 ka BP event that caused a reduction in rainfall and led to a severe drought event in the region. Unfortunately, the timing of the event in the region is not crystal clear. Although Uzuntarla Cave provides a date with high resolution for the end of the event, ca. 1950 BC, the beginning of it is placed sometime around 2450 BC with low resolution through analysis on Lake İznik. Other studies coarsely point to ca. 4200 BP that was possibly the peak of the drought event. Therefore, it seems that the event occurred sometime between ca. 2450-1950 BC and reached a peak around ca. 2200 BC in western Anatolia.

In the second step, changes in agricultural and animal husbandry practices were examined to determine if there were changes as a response to the drought event, since both activities directly depend on water availability. Limited number of sites that are Küllüoba, Troy, Kanlıgeçit, Maydos-Kilisetepe and Karataş-Semayük, provide a long-term perspective on plant and animals preferences of western Anatolian sites. Analysis on plant remains from Küllüoba and Troy shows signals of a drought event that started in the EBA III (ca. 2400/2300-2200 BC) and continued into the late EBA III/MBA (ca. 2200-1950 BC). The plant assemblage from Küllüoba even suggests that a drought event already began in the late EBA II (ca. 2500-2400/2300 BC). Increase in barley, glumed wheat, drought tolerant pulses and fodder for animals, increased diversity of crops and presence of crops that grew under aridity were the indicators of a drought event. Similarly, analysis on animal remains at Troy, Maydos-Kilisetepe, Kanlıgeçit and Karataş-Semayük presents impacts of a drought event that started in the EBA III and continued into the late EBA III/MBA. Drought conditions were reflected in an increase in goat and wild animals, a decrease in cattle and changes in wild boars and pigs.

In the third place, to understand changes in social and political structures of societies, regional settlement patterns were investigated. Archaeological excavations and surveys indicate an increase in destroyed settlements starting from the 24th century BC that reaches a peak in the 21st century BC and a dramatic decrease in site number in every survey area in western Anatolia between ca.2300-1900 BC. The overlapping changes seem to be related to the drought event. These changes were most likely the result of conflicts between societies for limited arable land and water sources and shifting of population into more mobile life-styles with a pastoralist economic interest to overcome the failure in agriculture.

Considering the timing of the event in the region, ca. 2450-1950 BC and changes in plant and animal preference and regional settlement patterns that occurred ca. 2400/2300-1950 BC, the 4.2 ka BP event appears as a strong factor that could cause societal changes at the end of the 3rd millennium BC. Therefore, a causal relationship between the 4.2 ka BP event and major changes in western Anatolian societies at the end of the 3rd millennium BC can be suggested. However, it should not be forgotten that there could be other possible factors contributing to it such as changing economic interests of Anatolian societies and relations between different regions in the beginning of the MBA as discussed in the previous chapter.

Although a causal relationship between the particular climate change and societal change in western Anatolia can be suggested, stronger evidence is always needed to go beyond a coarse correlation between these two phenomena. In linking palaeoenvironmental and archaeological studies, dates with high resolution for both studies are of major importance to propose exact causal relationships. In particular, absolute dating in archaeological studies should be strongly encouraged. Microclimatic conditions prevailing to the region of each site could accentuate or buffer impacts of a global climate change such as the 4.2 ka BP event. Therefore, when interpreting impacts of a climatic change on a site, climatic conditions in the close vicinity should be considered through conducting local palaeoenvironmental investigations as much as possible. In particular, new palaeoenvironmental projects should be initiated in the coastal region.

Moreover, there is definitely a huge need for more specialist studies including archaeobotanical and zooarchaeological investigations. Such analysis considerably contributes to a better understanding of impacts of a climatic change on past societies through shedding light on past subsistence strategies, dietary habits and so on.

Furthermore, to improve the knowledge on different subsistence strategies and socio-economic structures, more survey projects that does not target only mounds in the main valleys but also camp sites, rock shelters and so on in highlands should be initiated.

At last but not least, the complexity of human behaviour should always be taken into consideration to avoid a pure environmental deterministic approach and not to forget that there can always be another factor behind human decision.

Apparently, the knowledge on the climate change-human interaction in particular focusing on the 4.2 ka BP event in western Anatolia should be significantly enhanced. New archaeological studies in collaboration with researchers from other disciplines that focus on palaeoenvironmental reconstruction and specialist studies including archaeobotany and zooarchaeology will definitely contribute to a better understanding. There are some important points that should be highlighted regarding such studies.

First of all, an archaeological project that wants to enlighten the 4.2 ka BP event and related human responses must have a very clear research question and some hypotheses to test. Researchers focusing on palaeoenvironment and the analysis of plant and animal remains should be involved in the project from the very beginning and through exchanging ideas a proper research methodology should be defined.

After specifying what kind of information will be sought for the aim of the project through the methodology, the project should be initiated and palaeoenvironmental, bioarchaeological and archaeological research focusing on the questioned time period, ca. 2300/2200-1900 BC, should be pursued simultaneously. Palaeoenvironmental data should be collected in the close vicinity of the site to address the issue of local microenvironment and microclimate and analysis of it should be done with absolute dating and high resolution as much as possible and as well as, considering the archaeological period in focus.

Bioarchaeological studies, in particular archaeobotanical studies require definitely specialist researchers from the collection to the analysis due to the nature of remains. Moreover, such remains from a site should be collected from all over the site as much as possible in order to accept them as representative remains from the site and contexts of such remains must definitely specified. Furthermore, bioarchaeological remains should be ^{14}C dated and absolute dating should be considered instead of archaeological stratigraphy in analysis. Isotope analysis of both animal and plant remains is very promising for providing vital information that cannot be produced through other ways. Besides taxonomic classification, isotope analysis should be performed on bioarchaeological remains. As show in pervious chapters focusing on western Anatolia, sites generally provide either archaeobotanical analysis or zooarchaeological analysis. Instead of this, projects should aim simultaneous investigations on plant and animal remains to compare changes in different remains and to cross-check results of each analysis with the other one.

Besides these, one of the most significant aspects is to provide some archaeological background to non-archaeologist specialists such as botanists, palaeoenvironmental researchers and so on. Because it is not important to present only the occurrence of different species and their numbers that is the common information provided by specialists in particular in western Anatolia but also their interpretation in the archaeological context. Presence of for example bitter vetch does not contribute to the subject. However, its interpretation considering its context and other crops that were found together with can provide some insights on its role in human activity on the site.

For archaeological research, data can be collected through an excavation or a survey that is based on the research question of the project. In an archaeological excavation, grids that will be excavated should be specified for the aim of the project and considering hypotheses on what kind of responses are expected on a site. Absolute dating is a must for excavations and the information that is yielded from them as well. In archaeological surveys the survey methodology and its focus should fit with the aim of the project.

Considering possible human responses to a drought event, besides larger mounds in the main valleys, smaller sites both in the main valleys and highlands and as well as, camp sites, rock shelters and other kind of site should be targeted as well. Moreover, recording of site should be practiced considering what kind of information is needed, for example, changes in site in each period, to interpret and to reach some meaningful conclusions. At the end, the key activity is to put all palaeoenvironmental, bioarchaeological and archaeological data together and cross-check and interpret each result from each study and then, trying to draw some reliable conclusions.

In conclusion, different strands of analysis on palaeoenvironmental and bioarchaeological data and archaeological excavations and surveys clearly propose contemporaneous changes that can be linked to a drought event. Therefore, a causal relationship between the 4.2 ka BP climatic event and major societal changes in western Anatolia and as well as, the eastern Mediterranean region at the end of the 3rd millennium BC looks plausible. However, to draw more reasonable and accurate conclusions, the understanding of such a relationship should be improved through more studies with an interdisciplinary focus that approach the issue from different aspects in the region.

REFERENCES

Abay, E. (2011). Preliminary Report on the Survey Project of Çivril, Baklan and Çal Plains in the Upper Meander Basin, Southwest Anatolia. *Ancient Near Eastern Studies, 48,* 1-87.

Anderson, D. G., Maasch, K. A., Sandweiss, D. H., & Mayewski, P. A. (2007). Climate and culture change: exploring Holocene transitions. In D. G. Anderson, K. A. Maasch & D. H. Sandweiss (Eds.), *Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transitions* (pp.1-23). Burlington: Elsevier.

Arrivabeni, M. (2012). Post-Akkadian settlement distribution in the Leilan Regional Survey. In H. Weiss (Ed.), *Seven Generations Since the Fall of Akkad* (pp.261-278). Wiesbaden: Harrasowitz Verlag.

Arz, H. W., Lamy, F., & Pätzold, J. (2006). A pronounced dry event recorded around 4.2 ka in brine sediments from the northern Red Sea. *Quaternary Research, 66,* 432-441.

Bachhuber, C. (2014). The Anatolian Context of Philia Material Culture in Cyprus. In A. B. Knapp & P. van Dommelen (Eds.), *The Cambridge Prehistory of the Bronze and Iron Age Mediterranean* (pp. 139-156). New York: Cambridge University Press.

Bar-Matthews, M., & Ayalon, A. (2011). Mid-Holocene climate variations revealed by high-resolution speleothem records from Soreq Cave, Israel and their correlation with cultural changes. *The Holocene, 21*(1), 163-171.

Benecke, N. (2012). Haustierhaltung und Jagd. In M. Özdoğan & H. Parzinger (Eds.), *Die frühbronzezeitliche Siedlung von Kanlıgeçit bei Kırklareli: Ostthrakien während des 3. Jahrtausends v. Chr. im Spannungsfeld von anatolischer und balkanischer Kulturentcwicklung* (pp. 249-266). Darmstadt: Philipp von Zabern.

Berkelhammer, M., Sinha, A., Stott, L., Cheng, H., Pausata, F. S. R., & Yoshima, K. (2012). An Abrupt Shift in the Indian Monsoon 4000 Years Ago. *Geophysical Monograph Series, 198,* 75-87.

Bilgen, N. (2011). Seyitömer Höyük. In V. Şahoğlu & P. Sotirakopoulou (Eds.), *Karşıdan Karşıya: MÖ 3. Bin'de Kiklad Adaları ve Batı Anadolu* (pp. 208-211). İstanbul: Sakıp Sabancı Üniversitesi Sabancı Müzesi.

Bilgen, N., & Bilgen, Z. (2015). Orta Tunç Çağ Yerleşimi (IV. Tabaka). In N.A. Bilgen (Ed.), *Seyitömer Höyük I* (pp. 119-186). İstanbul: Arkeoloji ve Sanat Yayınları.

Bilgen, N., Bilgen, Z., & Çırakoğlu, S. (2015). Erken Tunç Çağ Yerleşimi (V. Tabaka). In N.A. Bilgen (Ed.), *Seyitömer Höyük I* (pp. 119-186). İstanbul: Arkeoloji ve Sanat Yayınları.

Blum, S. W. E. (2006). Troia an der Wende von der frühen zur mittleren Bronzezeit – Troia IV und Troia V. In M. O. Korfmann (Ed.), *Troia - Archäologie eines Siedlungshügels und seiner Landschaft* (pp. 145-154). Mainz am Rhein: Verlag Philipp von Zabern.

Blum, S. W. E., & Riehl, S. (2015). Troy in the 23rd century BC – environmental dynamics and cultural change. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp.181-203). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Boyer, P., Roberts, N., & Baird, D. (2006). Holocene Environment and Settlement on the Çarşamba Alluvial Fan, South-Central Turkey: Integrating Geoarchaeology and Archaeological Field Survey. *Geoarchaeology: An International Journal, 21*(7), 675-698.

Bozyurt, O., & Özdemir, M. A. (2014). The relations between north Atlantic oscillation and minimum temperature in Turkey. *Procedia – Social and Behavioral Sciences*, *120*, 532-537.

Carlos, J., & Garcia, M. (2015). Climatic change or sociopolitical transformation? Reassessing late 3rd millennium BC in Egypt. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp.1-16). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Cordova, C. E., & Lehman, P. H. (2005). Holocene environmental change in southwestern Crimea (Ukraine) in pollen and soil records. *The Holocene, 15*(2), 263-277.

Cullen, H. M., & deMenocal, P. B. (2000). North Atlantic Influence on Tigris-Euphrates Streamflow. *International Journal of Climatology*, *20*, 853-863.

Cullen, H. M., deMenocal, P. B., Hemming, S., Hemming, G., Brown, F. H., Guilderson, T., & Sirocko, F. (2000). Climate change and the collapse of the Akkadian empire: Evidence from the deep sea. *Geology, 28*(4), 379-382.

Çevik, Ö. (2007). The Emergence of Different Social Systems in Early Bronze Age Anatolia: Urbanisation versus Centralisation. *Anatolian Studies*, *57*, 131-140.

Çiner, A. (2003). Türkiye'nin Güncel Buzulları ve Geç Kuvaterner Buzul Çökelleri. *Türkiye Jeoloji Bülteni*, *46*(1), 55-78.

Çizer., Ö. (2015). *Archaeobotanical investigations of plant cultivation and husbandry practices at the Early Bronze Age settlement Küllüoba in West-Central Turkey: Considerations on environment, climate and economy*. Oxford: British Archaeological Reports Ltd.

Crabtree, P., & Monge, H. (1986). Faunal Analysis. In M. Joukowsky (Ed.), *Prehistoric Aphrodisias I: Excavations and Studies* (pp. 180-190). Rhode Island/Louvain: Brown University/Érasme.

Darkot, B., & Tuncel, M. (1978). *Ege Bölgesi Coğrafyası*. İstanbul: İstanbul Üniversitesi Edebiyat Fakültesi Matbaası.

Dean, J. R., Jones, M. D., Leng, M. J., Noble, S. R., Metcalfe, S. E., Sloane, H. J., Sahy, D., Eastwood, W. J., & Roberts, C. N. (2015). Eastern Mediterranean hydroclimate over the late glacial and Holocene, reconstructed from the sediments of Nar lake, central Turkey, using stable isotopes and carbonate mineralogy. *Quaternary Science Reviews, 124,* 162-174.

Dedeoğlu, F. (2014). Yukarı Menderes Havzası Bölgesel Yerleşim Analizi: Erken Tunç Çağı'nda Sosyo-ekonomik Örgütlenmedeki Değişim ve Dönüşüm Süreçleri. In Ö. Çevik & B. Erdoğu, *Tematik Arkeoloji Serisi 1: Yerleşim Sistemleri ve Mekân Analizi* (pp. 19-42). İstanbul: Ege Yayınları.

deMenocal, P. B. (2001). Cultural Responses to Climate Change During the Late Holocene. *Science, 292,* 667-673.

Drysdale, R., Zanchetta, G., Hellstrom, J., Maas, R., Fallick, A., Pickett, M., Cartwright, I., & Piccini, L. (2006). *Geology, 34*(2), 101-104.

Duru, R. (2008). *MÖ 8000'den MÖ 2000'e Budur-Antalya Bölgesi'nin Altıbin Yılı*. Antalya: Suna-İnan Kıraç Akdeniz Medeniyetleri Araştırma Enstitüsü.

Duru, R., & Umurtak, G. (2009). Bademağacı 2008 Yılı Kazıları/Excavations at Bademağacı in 2008. *Anmed, 7,* 15-21.

Duru, R., & Umurtak, G. (2010). Bademağacı 2009 Yılı Kazıları/Excavations at Bademağacı in 2009. *Anmed, 8,* 19-25.

Duru, R., & Umurtak, G. (2011). Bademağacı 2010 Yılı Kazıları/Excavations at Bademağacı in 2010. *Anmed, 9,* 7-15.

Efe, T. (2007). The Theories of the 'Great Caravan Route' between Cilicia and Troy: The Early Bronze Age III Period in Inland Anatolia. *Anatolian Studies, 57,* 47-64.

Ehrmann, W., Schmiedl, G., Hamann, Y., Kuhnt, T., Hemleben, C., & Siebel, W. (2007). Clay minerals in the late glacial and Holocene sediments of the northern and southern Aegean Sea. *Palaeogeography, Palaeoclimatology, Palaeoecology, 249,* 36-57.

Erkanal, H. (2011). The Coastal Western Anatolia and the Cyclades during the 3rd Millennium BC: Introduction. In V. Şahoğlu & P. Sotirakopoulou (Eds.), *Karşıdan Karşıya: MÖ 3. Bin'de Kiklad Adaları ve Batı Anadolu* (pp. 116-122). İstanbul: Sakıp Sabancı Üniversitesi Sabancı Müzesi.

Erkanal, H., & Şahoğlu, V. (2016). Liman Tepe, an Early Bronze Age Trade Center in Western Anatolia: Recent Investigations. In E. Pernicka, S. Ünlüsoy & S.W.E. Blum (Eds.), *Early Bronze Age Troy: Chronology, Cultural Development, and Interregional Contacts* (pp. 157-166). Bonn: Dr. Rudolf Habelt GmbH.

Ersoy, Y., Güngör, Ü., & Cevizoğlu, H. (2011). 2009 Yılı Klazomenai Kazısı. In A. N. Toy, H. Dönmez & Ö. Ötgün (Eds.), *32. Kazı Sonuçları Toplantısı 4. Cilt* (pp. 169-183). Ankara: T.C. Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü.

Ezer, S. (2014). Külepe-Kanesh in the Early Bronze Age. In L. Atici, F. Kulakoğlu, G. Barjamovic & Fairbairn, A. (Eds.), *Current Research at Kültepe-Kanesh: An Interdisciplinary and Integrative Approach to Trade Networks, Internationalism, and Identity* (pp. 5-23). Atlanta: Lockwood Press.

Finné, M., Holmgren, K., Sundqvist, H. S., Weiberg, E., & Lindblom, M. (2011). Climate in the eastern Mediterranean, and adjacent regions, during the past 6000 years – A review. *Journal of Archaeological Science*, *38,* 3153-3175.

Fidan, E. (2012). Küllüoba İlk Tunç Çağı Mimarisi. *Masrop*, *7,* 1-44.

Fidan, E., Sarı, D., & Türkteki, M. (2015). An Overview of the Western Anatolian Early Bronze Age. *European Journal of Archaeology*, *18*(1), 60-89.

Fiorentino, G., Caracuta, V., Calcagnile, L., D'Elia, M., Matthiae, P., Mavelli, F., & Quarta, G. (2008). *Palaeogeography, Palaeoclimatology, Palaeoecology, 266,* 51-58.

Fiorentino, G., Caratuca, V., Quarta, G., Calcagnile, L., and Bonacossi, D. M. (2012). Palaeoprecipitation Trends and Cultural Changes in Syrian Protohistoric Communities: Contribution of δ^{13}C in Ancient and Modern Vegetation. In J. Kneisel, W. Kirleis, M. Dal Corso, N. Taylor & V. Tiedtke (Eds.), *Collapse or Continuity? Environment and Development of Bronze Age Human Landscapes* (pp. 17-33). Bonn: Verlag Dr. Rudolf Habelt GmbH.

Foss, P. W. (2006). The Hacımusalar Project Regional Survey: landscape and settlement investigations in the Elmalı Basin. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.691.8455&rep=rep1&type=pdf (21.04.2018)

Francke, A., Wagner, B., Leng, M. J., & Rethemeyer, J. (2013). A Late Glacial to Holocene record of environmental change from Lake Dojran (Macedonia, Greece). *Climate of the Past*, *9,* 481-498.

Frumkin, A. (2009). Stable isotopes of a subfossil *Tamarix* tree from the Dead Sea region, Israel, and their implications for the Intermediate Bronze Age environmental crisis. *Quaternary Research, 71*, 319-328.

Galicki, S. J., & Doerner, J. P. (2010). Holocene Lake Evolution in the Elmalı Basin, Southwestern Turkey. *Physical Geography*, *31*(3), 234-253.

Genz, H. (2015). Beware of environmental determinism: the transition from the Early to the Middle Bronze Age on the Lebanese coast and the 4.2 ka BP event. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp. 97-111). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Göktürk, O. M. (2011). *Climate in the Eastern Mediterranean through the Holocene inferred from Turkish stalagmites*. Unpublished dissertation (Bern University).

Göktürk, O. M., Fleitmann, D., Badertscher, S., Cheng, H., Edwards, R. L., Leuenberger, M., Fankhauser, A., Tüysüz, O., & Kramers, J. (2011). Climate on the southern Black Sea coast during the Holocene: implications from the Sofular Cave record. *Quaternary Science Reviews*, *30*, 2433-2445.

Gündem, C. Y. (2010). *Animal Based Economy in Troia and The Troas during the Maritime Troy Culture (c. 3000-2200 BC) and a General Summary for West Anatolia*. Unpublished dissertation (Tübingen University).

Hesse, B., & Perkins, D. (1974). Faunal Remains from Karataş-Semayük in Southwest Anatolia: An Interim Report Faunal Remains from Karatas-Semayuk in Southwest Anatolia: An Interim Report. *Journal of Field Archaeology*, *1*(1/2), 149-160.

Horejs, B., Galik, A., Thanheiser U., & Wiesinger, S. (2011). Aktivitäten und Subsistenz in den Siedlungen des Çukuriçi Höyük. Der Forschungsstand nach den Ausgrabungen 2006-2009. *Praehistorische Zeitshcrift, 86*, 31-66.

Höflmayer, F. (2015). The southern Levant, Egypt, and the 4.2 ka BP event. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp.113-130). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Höflmayer, F., Dee, M. W., Genz, H., & Riehl, S. (2014). Radiocarbon Evidence for the Early Bronze Age Levant: The Site of Tell Fadous-Kfarabida (Lebanon) and the Early Bronze Age III Period. *Radiocarbon*, *56*(2), 529-542.

Huang, C. C., Pang, J., Zha, X., Su, H., & Jia, Y. (2011). Extraordinary floods related to the climatic event at 4200 a BP on the Qishuihe River, middle reaches of the Yellow River, China. *Quaternary Science Review*, *30*, 460-468.

Kaniewski, D., Paulissen, E., Van Campo, E., Al-Maqdissi, M., Bretschneider, J., & Van Lerberghe, K. (2008). *PNAS, 105*(37), 13941-13946.

Kaniewski, D., van Campo, E., Guiot, J., le Bruel, S., Otto, T., & Baeteman, C. (2013). Environmental Roots of the Late Bronze Age Crisis. *Plos One, 8*(8), 1-10.

Kashima, K. (2002). Environmental and climatic changes during the last 20,000 years at Lake Tuz, central Turkey. *Catena*, *48*, 3-20.

Korfmann, M. (1983). *Demircihüyük: Die Ergebnisse der Ausgrabungen 1975-1978 Band I: Architektur, Stratigraphie und Befunde*. Mainz am Rhein: Philipp von Zabern.

Korfmann, M. (2006). Troia – Archäologie eines Siedlungshügels und seiner Landschaft. In M. O. Korfmann (Ed.), *Troia - Archäologie eines Siedlungshügels und seiner Landschaft* (pp. 1-12). Mainz am Rhein: Verlag Philipp von Zabern.

Kouka, O. (2013). "Minding the Gap": Against the Gaps: The Early Bronze Age and the Transition to the Middle Bronze Age in the Northern and Eastern Aegean/Western Anatolia. *American Journal of Archaeology*, *117*(4), 569-580.

Kuhnt, T., Schmiedl, G., Ehrmann, W., Hamann, Y., & Andersen, N. (2008). Stable isotopic composition of Holocene benthic foraminifers from the Eastern Mediterranean Sea: Past changes in productivity and deep water oxygenation. *Paleogeography, Palaeoclimatology, Palaeoecology, 268,* 106-115.

Kulakoğlu, F. (2012). Kültepe-Kaneš: A Second Millennium B.C.E. Trading Center on the Central Plateau. In S.R. Steadman & G. McMahon (Eds.), *The Oxford Handbook of Ancient Anatolia* (pp. 1012-1030). New York: Oxford University Press.

Kulakoğlu F., & Öztürk, G. (2015). New Evidence for International Trade in Bronze Age Central Anatolia: Recently Discovered Bullae at Kültepe-Kanesh. *Antiquity*, *89*(343).

Kuzucuoğlu, C., Dörfler, W., Kunesch, S., Goupille, F. (2011). Mid- to late-Holocene climate change in central Turkey: The Tecer Lake record. *The Holocene, 21*(1), 173-188.

Lemcke, G., & Sturm, M. (1997). *δ^{18}O and Trace Element Measurements as Proxy for the Reconstruction of Climate Change at Lake Van (Turkey): Preliminary Results*. In N. H. Dalfes, G. Kukla & H. Weiss (Eds.), Third Millennium BC Climate Change and Old World Collapse. New York: Springer.

Leroy, S. A. G., Kakroodi, A. A., Kroonenberg, S. B., Lahijani, H. A. K., Alimohammadian, H., & Nigarov, A. (2013). Holocene vegetation history and sea level changes in the SE corner of the Caspian Sea: relevance to SW Asia climate. *Quaternary Science Reviews, 70*, 28-47.

Leroy, S. A. G., Lóper-Merino, L., Tudryn, A., Chalié, F., & Gasse, F. (2014) Late Pleistocene and Holocene palaeoenvironments in and around the middle Caspian basin as reconstructed from a deep-sea core. *Quaternary Science Reviews, 101*, 91-110.

Leroy, S. A. G., Marret, F., Gilbert, E., Chalié, F., Reyss, J.-L., & Arpe, K. (2007). River inflow and salinity changes in the Caspian Sea during the last 5500 years. *Quaternary Science Reviews, 26*, 3359-3383.

Lionello, P., Malanotte-Rizzoli, P., Boscolo, R., Alpert, P., Artale, V., Li, L., Luterbacher, J., May, W., Trigo, R., Tsimplis, M., Ulbrich, U., & Xoplaki, E. (2006). The Mediterranean Climate: An Overview of the Main Characteristics and Issues. In P. Lionello, P. Malanotte-Rizzoli and R. Boscolo (Eds.), *Mediterranean Climate Variability* (1-26). Amsterdam: Elsevier.

Lloyd, S., & Mellaart, J. (1962). *Beycesultan Volume 1*. London: The British Institute of Archaeology at Ankara.

Manning, S. W. (2017). Comments on Climate, Intra-regional Variations, Chronology, the 2200 B.C. Horizon of Change in the Eastern Mediterranean Region, and Socio-political Change on Crete. In F. Höflmayer (Ed.), *The Late Third Millennium in the Ancient Near East: Chronology, C14, and Climate Change* (pp.451-490). Chicago: The Oriental Institute of the University of Chicago.

Mashkour, M. (2003). Tracing Ancient Nomads: Isotopic Research on the Origins of Vertical 'Transhumance' in the Zagros Region. *Nomadic People, 7*(2), 36-47.

Masi, A., Sadori, L., Zanchetta, G., Baneschi, I., & Giardini, M. (2013). Climatic interpretation of carbon isotope content of mid-Holocene archaeological charcoals from eastern Anatolia. *Quaternary International, 303*, 64-72.

Massa, M. (2014). Destructions, Abandonments, Social Reorganisation and Climatic Change in West and Central Anatolia at the End of the Third Millennium BC. *Arkeoloji'de Bölgesel Çalışmalar Sempozyum Bildirileri, YAS, 4*, 89-123.

Massa, M. (2016). *Networks before Empires: cultural transfers in west and central Anatolia during the Early Bronze Age*. Unpublished doctoral dissertation (University College London).

Massa, M., & Şahoğlu, V. (2015). The 4.2ka BP climatic event in west and central Anatolia: combining palaeoclimatic proxies and archaeological data. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp.61-78). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Massa, M., & Palmisano, A. (2018). Change and Continuity in the Long-Distance Exchange Networks between Western/Central Anatolia, Northern Levant and Northern Mesopotamia, c. 3200-1600 BCE. *Journal of Anthropological Archaeology, 49*, 65-87.

Mayewski, P. A., Rohling, E. E., Stager, J. C., Karlén, W., Maasch, K. A., Meeker, L. D., Meyerson, E. A., Gasse, F., van Kreveld, S., Holmgren, K., Lee-Thorp, J., Rosqvisr, G., Rack, F., Staubwasser, M., Schneider, R. R., & Steig, E. J. (2004). Holocene climate variability. *Quaternary Research, 62*, 243-255.

Mellink, M. J. (1974). Excavations at Karataş-Semayük and Elmali, Lycia, 1973. *American Journal of Archaeology*, *78*(4), 351-359.

Miebach, A., Niestrath, P., Roeser, P., & Litt, T. (2016). Impacts of climate and humans on the vegetation in northwestern Turkey: palynological insights from Lake İznik since the Last Glacial. *Climate of the Past, 12*, 575-593.

Migowski, C., Stein, M., Prasad, S., Negendank, J. F. W., & Agnon, A. (2006). Holocene climate variability and cultural evolution in the Near East from the Dead Sea sedimentary record. *Quaternary Research, 66,* 421-431.

Ocakoğlu, F., Çilingiroğlu, Ç., Potoğlu Erkara, İ., Ünan, S., Dinçer, B., & Akkiraz, M. S. (2019). Human-climate interactions since the Neolithic period in Central Anatolia: Novel multi-proxy data from the Kureyşler area, Kütahya, Turkey. *Quaternary Science Reviews, 213,* 1-17.

Oybak-Dönmez, E. (2005). Early Bronze Age Crop Plants from Yenibademli Höyük (Gökçeada), Western Turkey. *Environmental Archaeology, 10,* 39-49.

Oybak-Dönmez, E. (2006). Liman Tepe (İzmir) Erken Tunç Çağı Tarla Bitkileri. In A. Erkanal-Öktü, E. Özgen, S. Günel, T. A. Ökse, H. Hüryılmaz, H. Tekin, N. Çınardalı-Karaaslan, B. Uysal, F. A. Karaduman, A. Engin, R. Spieβ, A.

Aykurt, R. Tuncel, U. Deniz & A. Rennie (Eds.), *Hayat Erkanal'a Armağan: Kültürlerin Yansıması* (pp. 541-553). İstanbul: Homer Kitabevi ve Yayıncılık.

Özdoğan, M. (2011). The Dynamics of Cultural Change in Anatolia: A Supra-Regional Perspective. In Ü. Yalçın (Ed.), *Anatolian Metal V* (pp. 21-30). Bochum: Deutschen Bergbau-Museum.

Özgüç, T. (1963). Early Anatolian Archaeology in the Light of Recent Research. *Anadolu*, *7*, 1-21.

Özgüç, T. (1986). New Observations on the Relationship of Kültepe with Southeast Anatolia and North Syria during the Third Millennium B.C. In J. Canby, E. Porada, B. Ridway & T. Stech (Eds.), *Ancient Anatolia: Aspects of Change and Cultural Development: Essays in Honor of Machteld J. Mellink* (pp. 31-47). Madison: University of Wisconsin Press.

Parker, A. G., Goudie, A. S., Stokes, S., White, K., Hodson, M. J., Manning, M., & Kennet, D. (2006). A record of Holocene climate change from lake geochemical analyses in southeastern Arabia. *Quaternary Research*, *66*, 465-476.

Pustovoytov, K., Schmidt, K., & Taubald, H. (2007). Evidence for Holocene environmental changes in the northern Fertile Crescent provided by pedogenic carbonate coatings. *Quaternary Research*, *67*, 315-327.

Regev, J., de Miroschedji, P., & Boaretto, E. (2012a). Early Bronze Age Chronology: Radiocarbon Dates and Chronological Models from Tel Yarmuth (Israel). *Radiocarbon*, *54*(3-4), 505-524.

Regev, J., de Miroschedji, P., Greenberg, R., Braun, E., Greenhut, Z., & Boaretto, E. (2012b). Chronology of the Early Bronze Age in the Southern Levant: New Analysis for a High Chronology. *Radiocarbon*, *54*(3-4), 525-566.

Renfrew, C., Boyd, M., & Ramsey, C. B. (2012). The oldest maritime sanctuary? Dating the sanctuary at Keros and the Cycladic Early Bronze Age. *Antiquity*, *86*, 144-160.

Riehl, S. (1999). *Bronze Age Environment and Economy in the Troad: The Archaeobotany of Kumtepe and Troy*. Tübingen: Mo Vince Verlag.

Riehl, S. (2017). Regional Environments and Human Perception: The Two Most Important Variables in Adaptation to Climate Change. In F. Höflmayer

(Ed.), *The Late Third Millennium in the Ancient Near East: Chronology, C14, and Climate Change* (pp. 237-260). Chicago: The University of Chicago Press.

Riehl, S., & Marinova, E. (2016). The Interplay of Environmental Change, Socio-political Stress and Human Resilience at Early to Middle Bronze Age Troy. In E. Pernicka, S. Ünlüsoy & S.W.E. Blum (Eds.), *Early Bronze Age Troy: Chronology, Cultural Development, and Interregional Contacts* (pp. 319-336). Bonn: Dr. Rudolf Habelt GmbH.

Riehl, S., Pustovoytov, K. E., Weippert, H., Klett, S., & Hole, F. (2014). Drought stress variability in ancient Near Eastern agricultural systems evidenced by $\delta^{13}C$ in barley grain. *PNAS*, *111*(34), 12348-12353.

Roberts, N., Brayshaw, D., Kuzucuoğlu, C., Perez, R., & Sadori, L. (2011). The mid-Holocene climatic transition in the Mediterranean: Causes and consequences. *The Holocene*, *21*(1), 3-13.

Roberts, N., Eastwood, W.J., Kuzucuoğlu, C., Fiorentino, G., & Caracuta, V. (2011). Climatic, vegetation and cultural change in the eastern Mediterranean during the mid-Holocene environmental transition. *The Holocene, 21*(1), 147-162.

Roberts, N., Jones, M. D., Benkaddour, A., Eastwood, W. J., Filippi, M. L., Frogley, M. R., Lamb, H. F., Leng, M. J., Reed, J. M., Stein, M., Stevens, L., Valero-Garcés, B., & Zanchetta, G. (2008). Stable isotope record of Late Quaternary climate and hydrology from Mediterranean lakes: the ISOMED synthesis. *Quaternary Science Reviews 27*, 2426-2441.

Roberts, N., Reed, J. M., Leng, M. J., Kuzucuoğlu, C., Fontugne, M., Bertaux, J., Woldring, H., Bottema, S., Black, S., Hunt, E., & Karabıyıkoğlu, M. (2001). The tempo of Holocene climatic change in the eastern Mediterranean region: new high-resolution crater-lake sediment data from central Turkey. *The Holocene*, *11*(6), 721-736.

Robinson, S. A., Black, S., Sellwood, B. W., & Valdes, P. J. (2006). A review of palaeoclimates and palaeoenvironments in the Levant and Eastern Mediterranean from 25,000 to 5000 years BP: setting the environmental background for the evolution of human civilisation. *Quaternary Science Reviews*, *25*, 1517-1541.

Rosen, A. M. (1997). The Geoarchaeology of Holocene Environments and Land Use at Kazan Hoyuk, S.E. Turkey. *Geoarchaeology: An International Journal, 12*(4), 395-416.

Rosen, A. M. (2007). *Civilizing Climate*. Lanham: AltaMira Press.

Sadori, L., Giardini, M., Gliozzi, E., Mazzini, I., Sulpizio, R., van Welden, A., & Zanchetta, G. (2015). Vegetation, climate and environmental history of the last 4500 years at lake Shkodra (Albania/Montenegro). *The Holocene, 25*(3), 435-444.

Sariş, F., Hannah, D. M., & Eastwood, W. J. (2010). Spatial variability of precipitation regimes over Turkey. *Hydrological Sciences Journal – Journal des Sciences Hydrologiques*, *55*(2), 234-249.

Sazcı, G. (2001). Muhtemelen Tapınma Amaçlı Bir Yapı: G6 Karesindeki Megaron. In J. Latacz, P. Blome, J. Luckhardt, H. Brunner, M. Korfmann & G. Biegel (Eds.), *Troia: Düş ve Gerçek* (pp. 384-390). İstanbul: Homer Kitabevi ve Yayıncılık.

Sazcı, G., & Treister, M. (2006). Troia Gold – Die Schätze des dritten Jahrtausends vor Christus. In M. Korfmann (Ed.), *Troia: Archäologie eines Siedlungshügels und seiner Landschaft* (pp. 209-218). Mainz am Rhein: Philipp von Zabern.

Schmidt, R., Müller, J., Drescher-Schneider, R., Krisai, R., Szeroczyńska, K., & Barić, A. (2000). Changes in lake level and trophy at Lake Vrana, a large carstic lake on the Island of Cres (Croatia), with respect to palaeoclimate and anthropogenic impacts during the last app. 16,000 years. *Journal of Limnology, 59*(2), 113-130.

Schmidt, A., Quigley, M., Fattahi, M., Azizi, G., Maghsoudi, M., & Fazeli, H. Holocene settlement shifts and palaeoenvironments on the Central Iranian Plateau: Investigating linked systems. *The Holocene, 21*(4), 583-595.

Schoop, U-D. (2011). Some Thoughts on Social and Economic Development in Western Anatolia during the Fourth and Third Millennium BC. In N. Bilgen, R. von der Hoff, S. Sandalcı & S. Silek (Eds.), *Archaeological Research in Western Central Anatolia: Proceedings of the Third International Symposium of Archaeology in Kütahya, 8th-10th March 2010* (pp. 29-45). Kütahya: Dumlupınar University.

Schwartz, G. M. (2007). Taking the Long View on Collapse: A Syrian Perspective. In C. Kuzucuoğlu & C. Marro (Eds.), *Sociétés humaines et changement climatique à la fin du troisième millénaire: une crise a-t-elle eu lieu en Haute Mésopotamie?, Actes du Colloque de Lyon (5-8 décembre 2005)* (pp.45-67). Istanbul: Institut Français d'Études Anatoliennes-Georges Dumézil.

Schwartz, G. M. (2017). Western Syria and the Third- to Second-Millennium B.C. Transition. In F. Höflmayer (Ed.), *The Late Third Millennium in the Ancient Near East: Chronology, C14, and Climate Change* (pp.87-120). Chicago: The Oriental Institute of the University of Chicago.

Seçmen, M. (2018). *Maydos Kilisetepe Höyüğü'nün Tunç ve Erken Demir Çağlarında Memeli Hayvanlara Dayalı Besin ve Üretim Ekonomisi*. Unpublished MA thesis (Çanakkale Onsekiz Mart University).

Sensoy, S., Demircan, M., Ulupınar, Y., & Balta, İ. (2008). Türkiye İklimi. Retrieved from https://www.mgm.gov.tr/FILES/genel/makale/13_turkiye_iklimi.pdf (22.06.2018).

Staubwasser, M., & Weiss, H. (2006). Holocene climate and cultural evolution in late prehistoric-early historic West Asia. *Quaternary Research, 66*(3), 372-387.

Stevens, L. R., Ito, E., Schwalb, A., & Wright Jr., H. E. Timing of atmospheric precipitation in the Zagros Mountains inferred from a multi-proxy record from Lake Mirabad, Iran. *Quaternary Research*, *66*, 494-500.

Steadman, S. R. (2012). The Early Bronze Age on the Plateau. In S. R. Steadman & G. McMahon (Eds.), *The Oxford Handbook of Ancient Anatolia* (pp. 229-259). New York: Oxford University Press.

Steadman, S. R., McMahon, G., Ross, J. C., Cassis, M., Geyer, J. D., Arbuckle, B., & von Baeyer, Madelynn. (2013). The 2009 and 2012 Seasons of Excavation at Çadır Höyük on the Anatolian North Central Plateau. *Anatolica*, *34*, 113-167.

Steadman, S. R., McMahon, G., Ross, J. C., Cassis, M., Şerifoğlu, T. E., Arbuckle, B. S., Adcock, S. E., Alpaslan Roodenberg, S., von Baeyer, M., & Lauricella, A. J. (2015). The 2013 and 2014 Excavation Seasons at Çadır Höyük on the Anatolian North Central Plateau. *Anatolica*, *41*, 87-213.

Steadman, S. R., Ross, J. C., McMahon, G., & Gorny, R. L. (2008). Excavations on the North-Central Plateau: The Chalcolithic and Early Bronze Age Occupation at Çadır Höyük. *Anatolian Studies*, *58,* 47-86.

Steadman, S. R., Şerifoğlu, T. E., McMahon, G., Seloyer, S., Hackley, L. D., Yıldırım, B., Lauricella, A. J., Arbuckle, B. S., Adcock, S. E., Tardio, K., Dinç, E., & Cassis, M. (2017). Recent Discoveries (2015-2016) at Çadır Höyük on the North Central Plateau. *Anatolica*, *43*, 204-250.

Stevens, L. R., Wright Jr., H. E., & Ito, E. (2001). Proposed changes in seasonality of climate during the Late glacial and Holocene at Lake Zeribar, Iran. *The Holocene, 11*(6), 747-755.

Şahin, F. (2014). Küllüoba Orta Tunç Çağı'na Geçiş Dönemi: Mimarisi ve Çanak Çömleği. In H. Dönmez (Ed.), *30. Arkeometri Sonuçları Toplantısı* (pp. 39-54). Ankara: Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü.

Şahoğlu, V. (2005). The Anatolian Trade Network and the Izmir Region during the Early Bronze Age. *Oxford Journal of Archaeology, 24*(4), 339-361.

Şahoğlu, V. (2008). Liman Tepe and Bakla Tepe: New Evidence for the Relations between the Izmir Region, The Cyclades and the Greek Mainland during the Late Fourth and Third Millennia BC. In H. Erkanal, H. Hauptmann, V. Şahoğlu & R. Tuncel (Eds.), *Proceedings of the International Symposium: The Aegean in the Neolithic, Chalcolithic and the Early Bronze Age* (pp. 483-501). Ankara: Ankara Üniversitesi Basımevi.

Şahoğlu, V. (2012). Liman Tepe. In O. Bingöl, A. Öztan & Taşkıran, H. (Eds.), *Anadolu: Dil ve Tarih-Coğrafya Fakültesi 75. Yıl Armağanı* (pp. 219-230). Ankara: Ankara Üniversitesi Basımevi.

Thompson, L. G., Mosley-Thompson, E., Davis, M. E., Henderson, K. A., Brecher, H. H., Zagorodnov, V. S., Mashiotta, T. A., Ping-Nan, L., Mikhalenko, V. N., Hardy, D. R., & Beer, J. (2002). Kilimanjaro Ice Core Records: Evidence of Holocene Climate Change in Tropical Africa. *Science, 298*, 588-593.

Türkeş, M. (1996). Spatial and Temporal Analysis of Annual Rainfall Variations in Turkey. *International Journal of Climatology, 16*, 1057-1076.

Türkeş, M., & Erlat, E. (2003). Precipitation Changes and Variability in Turkey linked to the North Atlantic Oscillation during the Period 1930-2000. *International Journal of Climatology, 23*, 1771-1796.

Türkeş, M., & Tatlı, H. (2009). Use of the standardized precipitation index (SPI) and a modified SPI for shaping the drought probabilities over Turkey. *International Journal of Climatology, 29*, 2270-2282.

Ülgen, U. B., Franz, S. O., Biltekin, D., Çağatay, M. N., Roeser, P. A., Doner, L., & Thein, J. (2012). Climatic and environmental evolution of Lake İznik (NW Turkey) over the last ~4700 years. *Quaternary International, 274*, 88-101.

Ünlüsoy, S. (2006). Vom Reihenhaus zum Megaron – Troia I bis Troia II. In M. O. Korfmann (Ed.), *Troia - Archäologie eines Siedlungshügels und seiner Landschaft* (pp. 133-144). Mainz am Rhein: Verlag Philipp von Zabern.

Verheyden, S., Nader, F. H., Cheng, H. J., Edwards, L. R., & Swennen, R. (2008). Paleoclimate reconstruction in the Levant region from the geochemistry of a Holocene stalagmite from the Jeita cave, Lebanon. *Quaternary Research*, *70*, 368-381.

von den Driesch, A., & Boessneck, J. (1987). Gesamtergebnis der Untersuchungen an den Tierknochenfunden vom Demircihüyük. In M. Korfmann (Ed.), *Demircihüyük: Die Ergebnisse der Ausgrabungen 1975-1978 Band II Naturwissenscahftliche Untersuchungen* (pp. 52-66). Mainz am Rhein: Verlag Philipp von Zabern.

Wagner, B., Lotter, A. F., Nowaczyk, N., Reed, J. M., Schwalb, A., Sulpizio, R., Velsecchi, V., Wessels, M., & Zanchetta, G. (2009). A 40,000-year record of environmental change from ancient Lake Ohrid (Albania and Macedonia). *Journal of Limnology, 41*, 407-430.

Wasylikowa, K., Witkowski, A., Walanus, A., Hutorowicz, A., Alexandrowicz, S. W., & Langer, J. J. (2006). Palaeolimnology of Lake Zeribar, Iran, and its climatic implications. *Quaternary Research, 66*, 477-493.

Warner, J. (1994). *Elmalı-Karataş II: The Early Bronze Age Village of Karataş*. Bryn Mawr: Department of Classical and Near Eastern Archaeology.

Weiberg, E., & Finné, M. (2013). Mind or Matter? People-Environment Interactions and the Demise of Early Helladic II Society in the Northeastern Peloponnese. *American Journal of Archaeology*, *117*(1), 1-31.

Weiss, H. (2017). Seventeen Kings Who Lived in Tents. In F. Höflmayer (Ed.), *The Late Third Millennium in the Ancient Near East: Chronology, C14, and Climate Change* (pp.131-162). Chicago: The Oriental Institute of the University of Chicago.

Weiss, H. (2015). Megadrought, collapse, and resilience in late 3rd millennium BC Mesopotamia. In H. Meller, H. W. Arz, R. Jung & R. Risch (Eds.), *2200 BC – A climatic breakdown as a cause for the collapse of the old world?* (pp.35-47). Halle (Saale): Landesamt for Denkmalpflege und Archäologie Sachsen-Anhalt, Landesmuseum für Vorgeschichte.

Weiss, H. (2014). The Northern Levant during the Intermediate Bronze Age: Altered Trajectories. In M. L. Steiner & A. E. Killebrew (Eds.), *The Oxford*

Handbook of the Archaeology of the Levant: c. 8000-332 B.C.E. (pp.367-387). Oxford: Oxford University Press.

Weiss, H. (2012). Quantifying Collapse: The Late Third Millennium Khabur Plains. In H. Weiss (Ed.), *Seven Generations Since the Fall of Akkad* (pp.1-24). Wiesbaden: Harrassowitz Verlag.

Weiss, H., Courty, M. -A., Wetterstrom, W., Guichard, F., Senior, L. Meadow, R., & Curnow, A. (1993). The Genesis and Collapse of Third Millennium North Mesopotamian Civilization. *Science, 261*, 995-1004.

Weninger, B., Clare, L., Gerritsen, F., Horejs, B., Krauß, Linstädter, J., Özbal, R., & Rohling, E. J. (2014). Neolithisation of Aegean and Southeast Europe during the 6600-6000 calBC period of Rapid Climate Change. *Documenta Praehistorica, 41*, 1-31.

Wick, L., Lemcke, G., & Sturm, M. (2003). Evidence of Lateglacial and Holocene climatic change and human impact in eastern Anatolia: High-resolution pollen, charcoal, isotopic and geochemical record from the laminated sediments of Lake Van, Turkey. *The Holocene, 13*(5), 665-675.

Wiener, M. H. (2014). The Interaction of Climate Change and Agency in the Collapse of Civilizations ca. 2300-2000 BC. *Radiocarbon, 56*(4), S1-S16.

Wossink, A. (2009). *Challenging climate change: Competition and cooperation among pastoralists and agriculturalists in northern Mesopotamia (c. 3000-1600 BC)*. Leiden: Sidestones Press.

Wossink, A. (2010). Climate, history and demography: a case-study from the Balikh Valley, Syria. In H. Alarashi, M. Chambrade, S. Gondet, A. Jouvenel, C. Sauvage & H. Tronchére (Eds.), *Regards croisés sur l'étude archéologique des paysages anciens. Nouvelles recherches dans le Bassin méditerranéen, en Asie centrale et au Proche et au Moyen-Orient* (pp.181-192). Lyon: Maison de l'Orient et de la Méditerranée Jean Pouilloux.

Yener, K. A. (2000). *The Domestication of Metals: The Rise of Complex Metal Industries in Anatolia*. Leiden: Brill.

Yener, K. A., Kulakoğlu, F., Yazgan, E., Kontani, R., Hayakawa, Y. S., Lehner, J. W., Dardeniz, G., Öztürk, G., Johnson, M., Kaptan, E., & Hacar, A. (2015). New Tin Mines and Production Sites near Kültepe in Turkey: A Third-Millennium BC Highland Production Model. *Antiquity, 89*(345), 596-612.

Zanchetta, G., van Welden, A., Baneschi, I., Drysdale, R., Sadori, L., Roberts, N., Giardini, M., Beck, C., Pascucci, V., & Sulpizio, R. (2012). Multiproxy record for the last 4500 years from Lake Shkodra (Albania/Montenegro). *Journal of Quaternary Science, 27*(8), 780-789.

APPENDICES

APPENDIX A. SITES WITH PALAEOENVIRONMENTAL EVIDENCE IN THE EASTERN MEDITERRANEAN AND ADJACENT REGIONS

Table 17. Sites with palaeoenvironmental evidence in the eastern Mediterranean and adjacent regions that are discussed in the text. *: Data is taken from Finné et al., 2011; #: Data is taken from Wossink, 2009.

Site	Analysis	Evidence	Period	Resolution	Reference
Tell Leilan, northern Mesopotamia	Micromorphological and physicochemical analysis on soil-stratigraphic units	Increase of dust veil frequency and reduced rainfall	Ca. 2200-1900 BC (based on ^{14}C AMS dates and archaeological chronology)	Low#	Weiss et al., 1993
The Rumailiah River, Syria	Stable ($\delta^{13}C$) isotope analysis on alluvial deposits	Lower winter precipitation	4.2-3.9 calBP (based on ^{14}C AMS dates)	6 years or better*	Kaniewski, et al., 2008
Jeita Cave, Lebanon	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on speleothem	No evidence	No evidence (based on U-Th dates)	10-180 years	Verheyden et al., 2008
Soreq Cave, Israel	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on speleothem	Change in mean annual rainfall of ~400 m (between 700 mm and 300 mm)	Ca. 4200-4050 BP (based on U-Th dates)	3-20 years	Bar-Matthews et al., 2011
Dead Sea shores, Israel	Marine sediment	An abrupt decrease in lake level	Ca. 4.2 calBP and lasted for ca. 300 years (based on ^{14}C AMS dates)	Average 250 years*	Migowski et al., 2006

Table 17. (continued)

Site	Analysis	Evidence	Period	Resolution	Reference
Sedom Cave, Israel	Stable ($\delta^{18}O$ and $\delta^{15}N$) isotope analysis on *Tamarix* tree trunk	A drop of more than 45 m in lake level	Ca. 2200-1900 BC (ca. 4200 BP) (based on C^{14} AMS dates)	Average 3 years*	Frumkin, 2009
Shaban Deep, northern Red Sea	Marine deposit	A major change in textural transition	Ca. 4200 calBP (based on ^{14}C AMS dates)	6-30 years*	Arz et al., 2006
Ebla, Syria	Stable ($\delta^{13}C$) isotope analysis on plant remains	A peak in $\delta^{13}C$ value	Ca. 2200-1750 calBC (based on ^{14}C dates)	25-50 years	Fiorentino et al., 2008
Ebla and Qatna, Syria	Stable ($\delta^{13}C$) isotope analysis on plant remains	High $\delta^{13}C$ values	Ca. 2300-2050 BC (based on ^{14}C dates)	50 years	Fiorentino et al., 2012
33 archaeological sites in the eastern Mediterranean	Stable ($\delta^{13}C$) isotope analysis on barley grains	$\Delta^{13}C$ values above 17‰ $\Delta^{13}C$ values below 17‰ in the Euphrates and Khabur regions	Ca. 4.2 ka BP	No information	Riehl et al., 2014

Table 17. (continued)

Site	Analysis	Evidence	Period	Resolution	Reference
Awafi, United Arab Emirates	Geochemical analysis of a lacustrine sediment	Precipitation minima, desiccation and the deposition of aeolian sand	4200 calBP and lasted for 200 years (based on ^{14}C AMS dates)	Multicentennial*	Parker et al., 2006
Gulf of Oman	Mineralogic and geochemical analysis of a marine core	An abrupt increase in aeolian dust	Ca. 4025±125 calBP and lasted for 300 years (based on ^{14}C AMS dates)	100 years	Cullen et al., 2000
Southwestern Crimea, Ukraine	Pollen and $\delta^{13}C$ analysis of pollen and stratigraphic sections	A decrease in arboreal vegetation and development of carbonate filaments in soil	Ca. 4.2-3.5 ka (based on ^{14}C AMS dates)	No information	Cordova & Lehman, 2005
Caspian Sea	Palynological analyses, lithological and mineralogical analyses of lake sediment	A drop of sea level, the main change in dynocyst assemblages at 4.11 and 3.9 ka calBP and a hiatus and a gypsum crystal layer at 3.9 ka calBP	Ca. 4.11-3.9 calBP (based on ^{14}C AMS dates)	167 years	Leroy et al., 2014 Leroy et al., 2007 Leroy et al., 2013

Table 17. (continued)

Site	**Analysis**	**Evidence**	**Period**	**Resolution**	**Reference**
Lake Zeribar, Iran	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on lake sediment	Lower lake level and increase in *Salix* pollen and decrease of oak pollen	Ca. 4500-3800 calBP (based on ^{14}C AMS dates)	Multicentennial*	Stevens et al., 2001 Wasylikowa et al., 2006
Lake Mirabad, Iran	Mineralogic and stable ($\delta^{18}O$) isotope analysis on sediment core	No evidence	No evidence (based on ^{14}C and ^{14}C AMS dates)	Multicentennial*	Stevens et al., 2006
Qazvin Plain, Iran	Geomorphologic analysis on alluvial sequences	No evidence	No evidence (based on OSL dates)	No information	Schmidt et al., 2011
Northwestern Aegean	Mineral composition analysis and stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on marine core	Decreasing smectite/illite ratios and positive shift in $\delta^{18}O$ value at 4.4 ka and positive shifts in the $\delta^{13}C$ value at around 4 ka BP	Ca. 4.4 ka and 4 ka BP (based on ^{14}C AMS dates)	150-180 years	Ehrmann et al., 2007 Kuhnt et al., 2008

Table 17. (continued)

Site	Analysis	Evidence	Period	Resolution	Reference
Southern Aegean	Mineral composition analysis and stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on marine core	No evidence	No evidence (based on ^{14}C AMS dates)	160-190 years	Kuhnt et al., 2008
Levantine Basin	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on marine core	No evidence	No evidence (based on ^{14}C AMS dates)	80 years	Kuhnt et al., 2008
Lake Dojran, Macedonia/Greece	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis, mineralogic analysis on lake core	A minimum in mean grain size and a peak in $\delta^{18}O$ value	Ca. 4 ka calBP (based on ^{14}C AMS dates)	No information	Francke et al., 2013
Lake Ohrid, Albania/Macedonia	Geophysical, granulometric, biogeochemical, diatom, ostracod and pollen analyses on a lake core	The distinct decrease in carbonate concentration along with a maximum in diatom abundance	Ca. 4100-3600 calBP (based on ^{14}C AMS dates)	30-500 years*	Wagner et al., 2009

Table 17. (continued)

Site	**Analysis**	**Evidence**	**Period**	**Resolution**	**Reference**
Lake Shkodra, Albania/Montenegro	Pollen analysis, ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis, lithological analysis on lake core	Minima in pollen flux and concentration, relatively high $\delta^{18}O$ values, peak of deciduous oaks	Ca. 4100-4000 calBP (based on ^{14}C dates)	Multidecadal	Sadori et al., 2014 Zanchetta et al., 2012
Lake Vrana, Croatia	Mineralogic, geochemical and palynological analysis on lake sediment	The sudden *Quercus ilex* expansion	Ca. 4.2 ka BP (based on ^{14}C AMS dates)	No information	Schmidt et al., 2000

APPENDIX B. SITES WITH PALAEOENVIRONMENTAL EVIDENCE IN ANATOLIA

Table 18. Sites with palaeoenvironmental evidence in Anatolia that are discussed in the text. *: data is taken from Massa & Şahoğlu, 2015; #: Data is taken from Finné et al., 2011; α: Data is taken from Wossink, 2009.

Site	Analysis	Evidence	Period	Resolution	Reference
Uzuntarla Cave, Kırklareli	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on stalagmite	A drop in $\delta^{13}C$ values and an increase in $\delta^{18}O$ values Less rainfall, increased temperature	Ca. 2050-1950 calBC (based on Th dates)	2.6 years	Göktürk, 2011 Massa & Şahoğlu, 2015
Lake İznik, Bursa	Geochemical, mineralogic and palynological analysis on sediment cores	Low lake level, very low or lack of deposition and/or erosion and forest retreatment	Ca. 4.4.-4.2 ka calBP (based on ^{14}C AMS and Pb-Cs dates)	Low	Ülgen et al., 2012 Miebach et al., 2016
Kureyşler Valley, Kütahya	Geochemical, stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis and palynological analysis on land sediments	A negative shift in $\delta^{18}O$, a decrease in TOC, a significant shift in MS curve and a decrease in Pinus pollen and a considerable increase in Poaceae pollen	Ca. 4200 calBP (2220 calBC) (based on ^{14}C dates)	Low	Ocakoğlu et al., 2019
Sofular Cave, Zonguldak	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on stalagmite	No evidence	No evidence (based on Th dates)	5.4 years	Göktürk et al., 2011

Table 18. (continued)

Site	Analysis	Evidence	Period	Resolution	Reference
Kocain Cave, Antalya	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on stalagmite	Low $\delta^{13}C$ values and high $\delta^{18}O$ values	ca. 2260 BC and lasted for ca. 80 years (based on Th dates)	2.3. years	Göktürk, 2011
Elmalı Basin (Karagöl), Antalya	Palaeoenvironmental investigation on lake sediments	High lake level and large extent of lakes	Ca. 2200 BC (based on palaeoenvironmental and archaeological interpretation)	200-300 years?*	Foss, 2006 Massa & Şahoğlu, 2015
Lake Tuz, Konya/Aksaray	Biostratigraphic and lithostratigraphic analysis on deposits of lake side terraces and alluvial fans	Minor formation state of alluvial fans	Ca. 4300 BP (based on ^{14}C AMS dates)	No information	Kashima, 2002
Nar Lake, Aksaray	Mineralogic and stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on lake cores	A high dolomite content	Ca. 4300-4150 BP (based on varve counting and U-Th dates)	Ca. 25 years	Dean et al., 2015

Table 18. (continued)

Site	**Analysis**	**Evidence**	**Period**	**Resolution**	**Reference**
Çarşamba Alluvial Fan, Konya	Mineralogic analysis on sediment cores through and adjacent to 17 mounds	Cessation of alluvial deposition	4500-4200 calBP (based on 14C and OSL dates and archaeological chronology)	300-400 years*	Boyer et al., 2006 Massa & Şahoğlu, 2015
Tecer Lake, Sivas	Mineralogic analysis on lake core	A sudden rise in gypsum and sand content and a drop in organic carbon	ca. 4300-1950 BP (based on ^{14}C AMS dates)	100 years*	Kuzucuoğlu et al., 2011
Lake Van, Van/Bitlis	Stable ($\delta^{18}O$) isotope, geochemical, palynological and charcoal analysis on lake sediments	Increase in $\delta^{18}O$, higher charcoal values and a decrease in pollen percentage, concentration and influx values of *Quercus*	Ca. 4200-3500 BP (based on ^{14}C dates and varve counting before 1990)	10-250 years*	Wick et al., 2003 Lemcke & Sturm, 1996
Arslantepe Höyüğü, an ancient settlement, Malatya	Stable ($\delta^{13}C$) isotope analysis on plant macro-remains	The minimum in juniper record and less precipitation	Ca. 2300-2200 BC (based on archaeological chronology)	No information	Masi et al., 2013

Table 18. (continued)

Site	**Analysis**	**Evidence**	**Period**	**Resolution**	**Reference**
Göbekli Tepe, a prehistoric site, Şanlıurfa	Stable ($\delta^{18}O$ and $\delta^{13}C$) isotope analysis on pedogenic	Cessation of accumulation of carbonate	Ca. 4000 calBP (based on ^{14}C AMS dates)	170-340 years[#]	Pustovoytov et al., 2007
Kazane Höyük, an ancient settlement, Şanlıurfa	Geological analysis on sediments from the vicinity of the mound	Cessation of alluvial deposition	Early 2nd millennium BC (based on archaeological chronology)	Low[α]	Rosen, 1997

APPENDIX C. TURKISH SUMMARY/TÜRKÇE ÖZET

Doğu Akdeniz Bölgesi ve çevre bölgelerde yapılan arkeolojik araştırmalar, MÖ 3. binyılın sonlarında Erken Tunç Çağı toplumlarının büyük değişim ve dönüşümler geçirdiğini göstermiştir. Yine bahsi geçen bölgelerde yapılan paleoçevresel çalışmalar ise yaklaşık GÖ 4200, diğer bir deyişle MÖ 2200 yıllarında gerçekleşmiş ve özellikle kuzey yarımküreyi etkilemiş 4,2 ka iklim olayı (MÖ 2200-1900) olarak bilinen küresel bir iklim değişikliğinin varlığını ortaya koymuştur. Bu iklim değişikliğinin bir sonucu olarak birçok bölgede yıllık yağış miktarları büyük oranda azalmış ve ciddi kuraklık olayları yaşanmıştır. Araştırmacılar, paleoçevresel ve arkeolojik araştırma sonuçlarını birlikte yorumlayarak kuraklığın, ikisi de büyük oranda su mevcudiyetine bağlı olan tarım ve hayvancılık faaliyetlerinin sekteye uğramasıyla toplumsal huzursuzluk, çatışma, insan topluluklarının göçü ve hatta bazı durumlarda toplumsal bir çöküşe neden olduğunu ve bundan yola çıkarak da 4,2 ka iklim olayı ve Erken Tunç Çağı toplumlarının yaşadığı büyük değişimler arasında bir ilişkinin olduğunu öne sürmektedirler.

Benzer şekilde MÖ 3. binyılın sonlarında Orta ve Batı Anadolu Erken Tunç Çağı toplumlarının sosyal, ekonomik ve siyasal yapılarında da büyük değişimler gerçekleşmiştir. Hemen hemen tüm Anadolu'da yapılan paleoçevresel çalışmalar, 4,2 ka iklim olayının ve etkilerinin Batı Anadolu da dahil olmak üzere Anadolu'nun çeşitli bölgelerinde görüldüğünü ortaya koymuştur. Bu tez, Batı Anadolu'da 4,2 ka iklim olayı ve Erken Tunç Çağı toplumlarının yaşadığı büyük toplumsal değişimler arasında bir neden-sonuç ilişkisi olup olmadığını anlamayı amaçlamaktadır. Bu ilişkiyi anlamak için ise Batı Anadolu Bölgesi'nden elde edilen paleoçevresel, biyoarkeolojik ve arkeolojik veriler birlikte analiz edilerek yorumlanmıştır.

Doğu Akdeniz ve çevre bölgelerde 4,2 ka iklim olayına ilişkin çok sayıda paleoçevresel kanıt bulunmaktadır. Bu tez kapsamında incelenen ve 4,2 ka iklim olayı ile ilgili bilgi veren merkezler, Kuzey Mezopotamya, Levant, Kızıl Deniz, Basra Körfezi, Karadeniz, Hazar Denizi, İran Platosu, Yunanistan ve Balkanlar'da yer almaktadırlar. Bu merkezlerde, bahsi geçen iklim olayının kaydının olup olmadığı, kaydı var ise ne tür vekil veri aracılığıyla kaydedildiği, vekil veri üzerinde yapılan analizler, bu analizlerin sonuçları, yani iklim değişikliğinin etkileri, ne kadar bir süre zarfında gerçekleştiği ve zamansal çözünürlüğü incelenmiştir. Bu veriler aracılığıyla özellikle 4,2 ka iklim olayının etkilerinin yaşandığı zaman aralığı ve bu verinin zamansal çözünürlüğü ve bölgedeki su mevcudiyetinin nasıl etkilediğinin anlaşılması amaçlanmıştır. Böylelikle bu iklim değişikliğinin ve neden olduğu öne sürülen toplumsal değişimlerle zamansal olarak gerçekten örtüşüp örtüşmediği ve böylelikle de bu iki olgu arasında bir neden-sonuç ilişkisi olup olmadığı anlaşılmaya çalışılmıştır. İklim olayının zamanlaması ve etki süresi, bölgeden bölgeye ve hatta aynı bölge içinde yer alan merkezden merkeze farklılık göstermektedir. Fakat genel olarak iklim olayının, GÖ 4,2 ka-3,9 ka arasında gerçekleştiğini söylemek mümkündür.

Bahsi geçen bölgelerde, iklim değişikliği ve yaşanan toplumsal değişimler arasında bir ilişki olup olmadığını anlamak için MÖ 3. binyılın sonunda gerçekleşmiş olan sosyal, ekonomik ve siyasi değişimler ve kuraklığa karşı olası toplumsal tepkiler, çeşitli arkeolojik çalışmalar üzerinden incelenmiştir. İklim olayıyla bağlantılı olduğu öne sürülen toplumsal değişimler Kuzey Mezopotamya, Batı Suriye, kıyı Levant, Mora Yarımadasının kuzeydoğusu, Kiklad Adaları ve Girit'te incelenmiştir. Bu incelemelerde toplumların geçirdikleri ve 4,2 ka iklim olayıyla ilişkili olabilecek değişimler belirlenmiştir. Genel olarak, MÖ 3. binyıl sonlarında, yani Erken Tunç Çağı'ndan Orta Tunç Çağı'na geçişte, bazı bölgelerde büyük değişimler görülmezken bazı bölgelerde bölgesel yerleşim düzenlerinde değişimler, yerleşimlerin tahrip ve terk edilmesi, materyal kültürde değişimler, siyasi merkezileşmenin dağılması gibi durumlar yaşanmıştır. İklim değişikliğiyle bağlantılı olabilecek çeşitli toplumsal tepkiler şunlardır:

1. Kurak ve yarı kurak bölgelerde siyasi çöküş ve bölgesel terk etmeler;
2. İnsanların, su kaynaklarının bol ve daimî olduğu yerlere göç etmesi;
3. Marjinal bölgelerde yaşayan tarım toplumlarının göçebe hayata geçmesi;

4. Farklı geçim kaynaklarına sahip toplumların birbirleriyle sosyal ağlar kurmaları.

Doğu Akdeniz ve çevre bölgelerde olduğu gibi Anadolu'da da çok sayıda paleoçevresel çalışmalar yapılmıştır. Bu çalışmalar, Kuzeybatı Anadolu'da Uzuntarla Mağarası (Kırklareli), İznik Gölü (Bursa), Kureyşler Vadisi (Kütahya); Karadeniz Bölgesi'nde Sofular Mağarası (Zonguldak); Akdeniz Bölgesi'nde Kocain Mağarası (Antalya) ve Elmalı Havzası'nda Karagöl (Antalya); Orta Anadolu'da Tuz Gölü (Konya/Aksaray), Nar Gölü (Aksaray), Çarşamba Deltası (Konya) ve Tecer Gölü (Sivas); Doğu Anadolu'da Van Gölü (Van Bitlis) ve Arslantepe (Malatya); Güneydoğu Anadolu'da ise Göbekli Tepe (Şanlıurfa) ve Kazane Höyük'te (Şanlıurfa) gerçekleştirilmiştir. Benzer şekilde, Anadolu'da da iklim olayının başlangıcı ve süresi merkezden merkeze değişiklik göstermektedir. Bahsi geçen merkezlerden, Kocain Mağarası ve Sofular Mağarası dışındaki tüm merkezler, 4,2 ka iklim olayını kurak bir dönem olarak kaydetmişlerdir. İklim değişikliği, genellikle düşük zamansal çözünürlükle GÖ 4300/4200-4000 yılları arasına tarihlenmektedir.

Batı Anadolu'da Erken Tunç Çağı'nı yaklaşık MÖ 3000-2000 arasındaki döneme tarihlemek mümkündür. Buna göre Erken Tunç Çağı kronolojisi şu şekildedir:

- Erken Tunç Çağı I: MÖ 3000-2700/2600
- Erken Tunç Çağı II: MÖ 2700/2600-2300
- Erken Tunç Çağı III: MÖ 2300-2000

Bahsi geçen dönem içinde özellikle Erken Tunç Çağı II'nin ortalarından itibaren, yaklaşık olarak MÖ 2500'ten itibaren Batı Anadolu ve Orta Anadolu'da önemli gelişmeler yaşanmıştır. Bunlar kısaca şu şekildedir:

1. Aşağı ve yukarı şehirlerden oluşan ve bir savunma duvarıyla çevrilmiş büyük ve düzenli yerleşimlerin ortaya çıkması;
2. Yukarı yerleşimlerde idari amaçla kullanılan anıtsal yapıların inşa edilmesi;
3. Seçkinlerden oluşan bir yönetici sınıfının ve sosyal sınıfların ortaya çıkması;
4. Her iki bölgede de bir merkezileşme sürecinin yaşanması;

5. Çömlekçi çarkının batıya doğru yayılması;
6. İnsanların beslenme alışkanlığında birtakım değişikliklerin olduğuna işaret eden ve genellikle sıvı tüketimiyle alakalı olan çark yapımı tabaklar, depas, tankard, gaga ağızlı testiler ve Suriye şişelerinin ilk kez ortaya çıkması ve oldukça büyük bir bölgeye yayılması;
7. Metalürjik üretim ve süsleme tekniklerinde büyük gelişmeler yaşanması ve kalaylı tuncun ilk kez kullanılması;
8. Anadolu'nun Kuzey Mezopotamya'dan başlayan, Güneydoğu Anadolu'dan geçerek Orta ve Batı Anadolu'ya uzanan ve oradan da Trakya, Kikladlar ve Kıta Yunanistan'a kadar giden hem kara ve hem de deniz rotalarına sahip bir uzun mesafe değiş tokuş ağının önemli bir parçası haline gelmesi.

Erken Tunç Çağı toplumları, yukarıda bahsedilen gelişkin özelliklerini, Batı Anadolu'nun önemli merkezleri içinde sayılan, Truva, Liman Tepe, Demircihöyük, Küllüoba, Seyitömer, Beycesultan, Bademağacı ve Karataş-Semayük gibi yerleşimlerden elde edilen bilgilere göre MÖ 3. binyılın sonlarında büyük oranda kaybetmişlerdir. Anıtsal yapılar kaybolmuş ve çok sayıda yerleşim büyük yangınlarla tahrip edilerek terk edilmiştir ve Orta Tunç Çağı'na geçiş döneminde iskân edilen yerleşim sayısı oldukça azdır. Diğer bir deyişle, Batı Anadolu Erken Tunç Çağı toplumları, MÖ 2200-2000 civarlarında, büyük bir değişim yaşamışlardır. Bu tür büyük değişim ve dönüşümlerin yaşanması ve zamansal olarak 4,2 ka iklim olayıyla çakışıyor olması bu iki olgu arasında bir ilişki olduğu fikrini öne sürmektedir.

Batı Anadolu'da 4,2 ka iklim olayı ve iklim olayına yönelik toplumsal tepkiler paleoçevresel, biyoarkeolojik ve arkeolojik veri aracılığıyla değerlendirilmiştir. Bu iki olgu arasındaki ilişkiyi anlamak için bahsi geçen veri kümelerini kullanan çeşitli yöntemler bulunmaktadır. Bu tez kapsamında izlenen yöntem, kısaca paleoçevresel, biyoarkeolojik ve arkeolojik verinin birlikte yorumlanmasından oluşmaktadır.

Batı Anadolu'daki paleoçevresel veriler, İznik Gölü, Kureyşler Vadisi, Kocain Mağarası ve Elmalı Havzası ve Batı Anadolu'da bulunmamakla birlikte bölgeye yakınlığı ve yüksek çözünürlüklü analiz sonucu nedeniyle çalışmaya dahil edilen

Trakya'da bulunan Uzuntarla Mağarası'ndan elde edilmiştir. Uzuntarla Mağarası'nda dikitlerin, İznik Gölü ve Elmalı Havzası'nda bulunan Karagöl'den elde edilen gölsel çökellerin ve Kureyşler Vadisi'nden ele geçirilen karasal çökeller üzerinde yapılan çeşitli analizler, bölgede 4,2 ka iklim olayının etkilerini ve bu etkilerden biri olan kuraklığın kaydını açıkça göstermektedirler. Bu veriler, iklim olayının bölgedeki zamanlaması ve etkilerinin tam olarak anlaşılabilmesi için daha detaylı olarak incelenmişlerdir. Buna göre iklim olayı, bölgede düşük zamansal çözünürlükle en erken MÖ 2450 başlamış ve en geç yüksek zamansal çözünürlükle yaklaşık MÖ 1950 yılında son bulmuştur. Fakat bu verilerin oldukça yerel ve merkez bazlı olduğunu unutmamak gerekmektedir. Bölgenin geneli için kesin ve yüksek çözünürlüklü bir tarih verilemese de bu iklim olayını kapsayan dönem süresince (MÖ 2200-2000) Batı Anadolu'nun daha kurak hale gelmiş olduğu anlaşılmaktadır.

Kuraklığın Batı Anadolu Erken Tunç Çağı toplumları üzerindeki etkileri, bu tez kapsamında iki ana kısımda incelemiştir:

- Tarım ve hayvancılık faaliyetlerindeki değişimler;
- Toplumların sosyal ve siyasi yapılarındaki değişimler.

Tarım ve hayvancılık faaliyetlerinde gerçekleşen değişimleri anlayabilmek için Yeni Yenibademli Höyük, Truva, Küllüoba, Liman Tepe ve Çukuriçi Höyük'ten elde edilen arkeobotanik veriler değerlendirilmiştir. Tarımsal ürünlerde kuraklık nedeniyle bir değişim olup olmadığını anlayabilmek için elde edilen veri kümesinde şunlar incelenmiştir:

1. Kuraklığa dayanıklı ekinlerin miktarının artması;
    a. Arpa : buğday oranının düşmesi
    b. Kavuzlu buğday : kavuzsuz/çıplak buğday oranının artması
    c. Kuraklığa dayanıklı tahılların sayısının artması
2. Kuraklık nedeniyle büyük çağlı ekin kaybına karşı bir önlem olarak ekilen bitki çeşidinin arttırılması;
3. Kuraklık şartları altında yetişen bitkilerin olması (izotop analizi sonuçlarına göre);

4. Azalan otlaklar nedeniyle hayvan yemi olarak kullanılan buğday ve tahılların miktarının artması.

Bölgede hayvancılık faaliyetlerinde değişimler ise Kanlıgeçit, Yenibademli Höyük, Maydos-Kilisetepe, Truva, Demircihöyük, Küllüoba, Ulucak Höyük, Çukuriçi Höyük, Aphrodisias-Pekmez ve Karataş-Semayük'ten elde edilen arkeozoolojik verilerden üzerinden değerlendirilmiştir. Bu veri kümesinde aşağıdaki değişimler incelenmiştir:

1. Daha az yiyecek ve suya ihtiyaç duyan evcil hayvanların sayısının artması;
    a. Koyun:keçi oranının azalması
    b. Koyun/keçi:sığır oranının artması
2. Av hayvanı sayısında, özellikle alageyik ve yabani domuz, sayısında artış;
3. Evcil domuz ve yaban domuzunun miktarının artması ya da azalması.
    a. Yem olarak her şeyi yiyebilen ve çok hızlı üreyip büyüyen ve ucuz bir et kaynağı olan evcil domuz sayısının artması
    b. Sulak ve ormanlık alanda yaşamaya evrimleşmiş ve kırsal ekonomi için elverişli yaban domuzu ve evcil domuz sayısının azalması

Toplumların sosyal ve siyasi yapılarındaki değişimler ise arkeolojik kazı ve yüzey araştırması verileri üzerinden incelenmiştir. Gelibolu Yarımadası, Marmara Denizi, Balıkesir-Manisa, Büyük Menderes, Beycesultan art bölgesi, Yenişehir-İznik ve Eskişehir Bölgelerinde yapılan yüzey araştırmaları ve Truva, Demircihöyük, Seyitömer, Küllüoba, Liman Tepe, Beycesultan, Bademağacı ve Karataş-Semayük kazılarından elde edilen bilgiler bölgede yaşamış olan Erken Tunç Çağı toplumlarının sosyal, ekonomik ve siyasi gelişim ve değişimleriyle ilgili bilgi sağlamaktadır. İncelenen değişimler şunlardır:

1. Marjinal bölgelerde çok sayıda yerleşimin eşzamanlı olarak terk edilmesi
    a. Toplumların göçebeliğe geçmesi nedeniyle daimî yerleşim sayısında azalma ve arkeolojik olarak daha az görünür türde olan geçici yerleşimlerin sayısında artış

b. Toplumların su miktarı ve doğal kaynakların daha çok olduğu bölgelere göçmesi ve daha güçlü ve kısıtlı kaynaklara erişimi olan daha büyük yerleşimlere toplanması

Bu tez kapsamında daha önce de bahsedildiği gibi Batı Anadolu Bölgesi çalışma bölgesi olarak seçilmiştir. Bu tez kapsamında bölge sadece topografisi ve iklim olarak değil Erken Tunç Çağı'ndaki kültürel gelişim de göz önüne alınarak tanımlanmıştır. Buna göre Batı Anadolu, kuzeyde Marmara Denizi, güneyde Akdeniz, batıda Ege Denizi ve doğuda Türkmen Dağı ve Emirdağ ve güneydoğuda ise Sultan Dağları'yla sınırlanmaktadır.

Bu tez kapsamında bu bölgeye odaklanılmasının iki sebebi bulunmaktadır. Birincisi, bölgenin, büyük göller ve nehirler gibi bol su kaynağına sahip olmaması ve yıl boyunca düzensiz ve değişken bir yağış rejimine olması ve böylelikle olası bir kuraklığa karşı hassas bir bölge teşkil etmesidir. İkinci sebep ise bölgede yapılan çok sayıda paleoçevresel, biyoarkeolojik ve arkeolojik çalışmaların, insan-iklim değişikliği etkileşiminin çalışılabilmesi için kullanışlı veri kümeleri sunmasıdır. Bu iki durum göz önüne alındığında Batı Anadolu, 4,2 ka iklim olayı ve MÖ 3. binyıl sonlarında Erken Tunç Çağı toplumlarının yaşadığı büyük toplumsal değişimlerin arasındaki ilişkinin araştırılması için elverişli bir bölge olarak görünmektedir.

Batı Anadolu konuyu çalışmak için nispeten iyi bir bölge olsa da paleoçevresel, biyoarkeolojik ve arkeolojik verilerin doğası ve bu farklı veri kümelerini bir araya getirerek yorumlamaya dayalı araştırma yönteminin güçlü ve zayıf yanları, bu çalışmanın sonuçlarını kısıtlayan ve etkileyen bazı unsurlara mahal vermektedir.

Öncelikle, bölgede yapılan paleoçevresel araştırmalar, Batı Anadolu'nun güneybatı ve kuzeybatı bölgelerinde yoğunlaşmış ve kıyı kesiminde bu yönde bir çalışma yapılmamıştır. Bu da kıyı bölgesi için güvenilir bir paleoiklim bilgisinin bulunmadığını göstermektedir. Ayrıca bu çalışmaların zamansal çözünürlüğü oldukça düşüktür ve bu da 4,2 ka iklim olayının zamanlamasının ve süresinin belirlenmesi ile ilgili sorunlara sebep olmaktadır.

İkinci olarak bölgede arkeobotanik ve zooarkeolojik çalışmalar nispeten daha fazla olsa da bu tür çalışmalar genellikle paleoçevresel veri bulunmayan kıyı bölgesinde yoğunlaşmışlardır. Buna ek olarak, 4,2 ka iklim olayı dönemine denk gelen geç Erken Tunç Çağı III/Orta Tunç Çağı'na geçiş dönemini kapsayan veriler maalesef oldukça kısıtlıdır. Buna ek olarak, incelenen çalışmalar, veri toplama yöntemleri, verilerin analiz edilmesi ve değerlendirilmesi ve sonuçların sunuluş şekliyle oldukça büyük değişkenlik göstermektedir. Bu da farklı merkezlerden elde edilen farklı araştırma sonuçlarının birbirleriyle karşılaştırılmasını oldukça zorlaştırmaktadır. Bunların yanında arkeobotanik ve zooarkeolojik kalıntılar çoğunlukla arkeolojik stratigrafiye göre tarihlendirilmektedir ve çok az sayıda araştırma sonucu radyo-karbon tarihlendirmeye dayanmaktadır. Bu da yerleşimlerde farklı dönemlerden ele geçen bitki ve hayvan türlerinin kesin olarak tarihlendirilememesine neden olmaktadır.

Üçüncü olarak, biyoarkeolojik çalışmalara benzer şekilde arkeolojik yüzey araştırmaları ve kazıların büyük çoğunluğunun mutlak tarihlendirmesi bulunmamaktadır. Özellikle yüzey araştırmaları başta olmak üzere arkeolojik çalışmalar, uzun vadede gerçekleşen toplumsal değişimler için bütüncül bir bakış açısı sağlamaktadır. Fakat bununla birlikte arkeolojide uygulanan yöntemlerin doğası gereği bu tür çalışmalar 4,2 ka iklim olayıyla bağlantılı olabilecek değişimlerle ilgili yanlı sonuçların ortaya çıkmasına neden olabilmektedir.

Son olarak, paleoçevresel, biyoarkeolojik ve arkeolojik verilerin mekânsal ölçekleri ve zamansal çözünürlükleri önemli ölçüde farklılık göstermektedir ve bu da bu tür verilerin bir araya getirilerek birlikte yorumlanmalarıyla ilgili bazı sorunlar yaratmaktadır. Arkeolojik ve biyoarkeolojik çalışmalar yüzyıllık ve hatta on yıllık süreçlerdeki değişimleri anlamaya odaklanırken paleoçevresel çalışmalar çoğunlukla binlerce yıl süren değişimleri incelemeyi amaçlamaktadır. Bu nedenle paleoçevresel çalışmaların zamansal çözünürlüğü arkeolojik çalışmalarınkine göre oldukça düşük kalmaktadır. Böylesi farklı zamansal ölçeklere sahip olan verilerin bir araya getirilmesi, 4,2 ka iklim olayı ve bununla ilişkili toplumsal değişimlerin zamansal olarak tam örtüştürülememesine neden olabilmektedir.

Yukarıda bahsi geçen ve kuraklığın tarımsal faaliyetler üzerindeki etkisi olarak önerilen değişimler, Batı Anadolu merkezlerinden ele geçirilen einkorn, emmer ve durum buğdayları, arpa, burçak, mürdümük, nohut, mercimek, bezelye, bakla ve İspanyol mürdümük gibi çeşitli bitki kalıntılarına odaklanılmıştır. Daha fazla sayıda arkeobotanik veri sağlayan merkez bulunmasına rağmen analizlerde genellikle Truva ve Küllüoba'daki değişimler incelenmiştir. Çünkü yalnızca bu iki yerleşim farklı dönemler arasında karşılaştırma yapmayı sağlayacak şekilde veri sağlamaktadır. Arkeobotanik verilerde yapılan analizlere göre Erken Tunç Çağı II'den itibaren Küllüoba kuraklığın olduğuna dair bazı işaretler vermektedir be bu işaretler, Erken Tunç Çağı III'te de devam etmektedir. Geç Erken Tunç Çağı III/Orta Tunç Çağı'na geçişte ise iki merkez de kuraklığa dair çok fazla işaret vermemektedir. Yalnız, bu dönemde Truva'dan elde edilen arpaların izotop analizi bu dönemde bu bitkilerin nispeten kurak bir ortamda yetiştiğini göstermektedir.

Yukarıda bahsedilen Batı Anadolu yerleşimlerden elde edilen zooarkeolojik kalıntılar üzerinde yapılan analizlerde ise koyun, keçi, sığır, evcil domuz, yaban domuzu ve alageyik miktarındaki artış ve azalış yorumlanmaya çalışılmıştır. Arkeobotanik veri veren merkezlere benzer şekilde daha fazla sayıda yerleşim zooarkeolojik veri sağlamasına rağmen bu tez kapsamında Kanlıgeçit, Maydos-Kilisetepe, Truva ve Karataş-Semayük gibi farklı dönemler boyunca değişimleri gösteren yerleşimlere odaklanılmıştır. Yapılan analiz sonuçlarına göre ise Truva verileri Erken Tunç Çağı III'te bir kuraklığın etkileri görülmeye başlandığını Kanlıgeçit ve Maydos-Kilisetepe verileri ise kuraklığın geç Erken Tunç Çağı/Orta Tunç Çağı'na geçişte devam ettiğini göstermektedir. Karataş-Semayük ise hiçbir dönemde hemen hemen kuraklığın hiçbir etkisini göstermemektedir.

Arkeolojik kazı ve yüzey araştırmalarının analizleri de kuraklıkla ilgili çeşitli bilgiler sağlamaktadır. Batı ve Orta Anadolu'da kazısı yapılmış olan ve MÖ 2300-1900 zaman aralığı, yani 4,2 ka iklim olayı dönemi, boyunca iskân görmüş yerleşimlerin bu dönemde tahribata uğrayıp uğramadığı araştırılmıştır. Buna göre MÖ 24. yüzyıldan itibaren tahrip edilmiş yerleşimlerin sayısında bir artış başlamış ve MÖ 21. yüzyılda ise zirveye ulaşmıştır. Çok sayıda Batı Anadolu merkezi bu dönemde büyük yangınlarla tahrip edilmiştir. Bu yıkım tabakaları, kuraklığın bir sonucu olarak tarım toplumları arasındaki çatışmalarla ilişkili olarak yorumlanmaktadırlar.

Yukarıda bahsi geçen arkeolojik yüzey araştırmaları da konuyla ilgili çeşitli bilgiler sağlamaktadır. Bu yüzey araştırmalarına göre araştırma yapılan tüm bölgelerde Erken Tunç Çağı II'de yerleşim sayıları artarken Erken Tunç Çağı III'te (MÖ 2400-1950) ise tüm bölgelerde yerleşim sayıları büyük oranda azalmaktadır. Örneğin, Gelibolu Yarımadası ve Marmara-Balıkesir Bölgeleri'nde yerleşim sayıları %80 oranında Yukarı Menderes Bölgesi'nde ise %60 oranlarında azalmıştır. Yerleşim sayılarındaki bu düşüş bazı bölgelerde Orta Tunç Çağı'nda da devam etmiştir.

Yüzey araştırmalarının gösterdiği sonuçlar ve tahrip edilen çok sayıda yerleşim göz önüne alındığında MÖ 2400-1950 yılları arasında yaşanmış ve 4,2 ka iklim olayıyla bağlantılı görünen bir kriz dönemine işaret etmektedir. Bu bölgelerde yaşayan ekonomisi tarıma dayalı yerleşik toplumlar, kuraklık nedeniyle tarımsal ürünlerdeki kayıplarını telafi etmek için büyük olasılıkla kırsal bir ekonomi benimseyerek göçebe yaşam biçimine geçmiş olmalılardır. Bu olasılık, bu denli çok sayıda yerleşimin ve insanın ortadan kaybolmasını açıklayabilecek diğer olasılıklar olan toplu mezarların yokluğu ve çok sayıda insanın bir bölgeden diğer bir bölgeye göçüne dair herhangi bir kanıt olmamasıyla da desteklenmektedir.

Bir kuraklığa işaret eden tüm bu tepkiler bir araya getirildiğinde Erken Tunç Çağı III'te (MÖ 2400/2300-2200) başlayan geç Erken Tunç Çağı III/Orta Tunç Çağı'na (MÖ 2200-1950) geçişte devam eden bir kuraklığa işaret etmektedir. Bu dönem de 4,2 ka iklim olayıyla örtüşüyor görünmektedir. Böylelikle 4,2 ka iklim olayı ve Erken Tunç Çağı toplumlarının MÖ 3. binyılın sonlarında yaşadıkları büyük toplumsal değişimler arasında bir neden-sonuç ilişkisi önermek mantıklı görünmektedir.

Böylesi bir ilişki öne sürülebilirken yukarıda bahsi geçen, bu çalışmanın sonuçlarını etkileyen unsurların da göz önünde bulundurulması gerekmektedir. Öncelikle daha önce de bahsedildiği gibi paleoçevresel ve arkeolojik çalışmaların birbirleriyle ilişkilendirilmesinde bazı problemler bulunmaktadır. Öncelikle paleoçevresel ve arkeolojik çalışmaların zamansal çözünürlükleri oldukça farklıdır. Bu nedenle bazı durumlarda bu farklı iki tür çalışma arasında iyi bir kronolojik ilişki kurmak zor olabilmektedir. Daha önce de bahsedildiği gibi ne yazık ki bölgedeki paleoçevresel ve arkeolojik çalışmalar çoğunlukla düşük zamansal çözünürlüğe sahip bulunmaktadırlar. Bu da bu farklı zamansal çözünürlüklü çalışmaların kronolojik olarak karşılaştırmasını zorlaştırmaktadır. Bu durum kısmen Batı Anadolu için de geçerli durumdadır.

Bir diğer sorun ise paleoçevresel ve arkeolojik çalışmaların mekânsal ölçeğinin de önemli oranda farklı olmasıdır. Paleoçevresel çalışmalar, genelde birkaç merkezden elde edilen verilerden yola çıkarak geniş bir bölge için genel bir geçmiş iklim bilgisi sağlamaktadır. Fakat bir kuraklığın etkileri, mikro iklimsel özelliklerden dolayı bölgeden bölgeye ve hatta merkezden merkeze büyük farklılıklar gösterebilmektedir. Bu nedenle bahsi geçen kuraklığın bir arkeolojik merkezi nasıl etkilediğini tam olarak anlayabilmek için paleoçevresel çalışmaların o merkezin oldukça yakın bir bölgesinde gerçekleştirilmesi gerekmektedir. Bu göz önüne alındığında Batı Anadolu’da arkeolojik ve biyoarkeolojik veri sağlayan bir merkezin yakınında olan sadece iki paleoçevresel veri sağlayan merkez bulunmaktadır. Bu da arkeolojik, biyoarkeolojik ve paleoçevresel verilerde gerçekleşen değişimlerin birbiriyle tam doğru olarak ilişkilendirilememesine neden olabilmektedir.

Daha önce de bahsedildiği gibi Batı Anadolu’daki arkeolojik kazı ve yüzey araştırmalarında tarihlendirme ezici oranda arkeolojik stratigrafiye dayanmaktadır. Çok az sayıda merkez mutlak bir tarihlendirme sağlamaktadır. Bu da bir merkezden elde edilen verinin yerleşim bazında ve bahsi geçen iklim olayıyla ilişkilendirilmesinde yanlı sonuçlara neden olabilmektedir.

Bir diğer başlıca sorun, arkeobotanik ve zooarkeolojik çalışılmaların bu tür insan-iklim değişikliği etkileşimlerinin daha iyi anlaşılmasına oldukça büyük bir katkı sağlamasına rağmen bu tür çalışmaların sayısı bölgede oldukça azdır. Bu durumda varılan sonuçların yerleşim düzeyinde ve yanlı olmasına neden olabilmektedir ve bölgedeki genel eğilimle ilgili bilgi elde edilmesine engel olmaktadır. Bunlarla birlikte aynı merkezde gerçekleştirilen arkeobotanik ve zooarkeolojik çalışmalar, sonuçların birbirleriyle de karşılaştırılabilmesi sonucu daha güvenilir bir sonuç sağlama potansiyeline sahiptirler. Fakat bu tür yerleşimler Batı Anadolu'da neredeyse hiç bulunmamaktadırlar.

Arkeolojik kazı ve yüzey araştırmalarında tarihlendirme ve çalışma yöntemleri de bu tür çalışmaların sonuçlarının güvenilirliğini etkileyebilmektedir. Özellikle, Batı Anadolu'da gerçekleştirilen yüzey araştırmalarının çoğunluğu, Büyük Menderes Yüzey Araştırması Projesi hariç, insan-iklim değişikliği çalışmalarına katkıda bulunacak düzeyde ayrıntılı araştırma ve kayıt yapmamaktadır. Buna ek olarak iki arkeolojik çalışma türü de ezici çoğunlukla ana vadilerde bulunan höyük yerleşimlerini araştırmayı amaç edinmişlerdir. Bu durum da Batı Anadolu Erken Tunç Çağı toplumlarının sosyal, ekonomik ve siyasi yapısının oldukça yanlı bir biçimde sadece yerleşik hayata uyum sağlamış tarım toplumları üzerinden aktarmaktadır. Fakat bu dönemde bu tür toplumlar yanında farklı geçim kaynaklarına ve farklı hayat tarzlarına sahip, dağlık bölgelerde yaşayan toplumlar da olmalıdır. Hem bu tür toplumların yapısını hem de tarım topluluklarıyla ne tür bir ilişkiye sahip oldukları ile ilgili bilgi ne yazık ki yoktur. Erken Tunç Çağı toplumlarının düşünüldüğünden daha karmaşık bir geçim ekonomisine sahip olabileceği fikri tamamen yok sayılmaktadır ve tarım toplumlarının yaşadığı yerleşimlerde ele geçen hayvan ve bitki kalıntılarındaki değişimlere göre kuraklıktan etkilendikleri sonucuna varılmaktadır. Bu oldukça yanlı bir sonuçtur.

Önemli bir diğer unsur olarak oldukça karmaşık olan insan davranışları, bir kuraklığa verilen tepkileri ya da nedeni kuraklığa bağlanan değişimleri önemli ölçüde etkileyebilmektedir. Geçmişte yaşamış toplumlarla ve insan davranışlarıyla ilgili bilgi arkeolojik kazılar ve kısmen de yüzey araştırmalarıyla kısıtlıdır. Biyoarkeolojik çalışmalar, bitki ve hayvan türlerindeki çeşitli değişimlerle insanların kuraklığa tepkileri hakkında bilgi sağlamaktadırlar. Fakat bu tür çalışmalar katı bir çevresel deterministik yaklaşıma sahiptirler ve insanların kararlarını ve tepkilerini etkilemiş olabilecek diğer unsurları göz önüne almamaktadırlar. Batı Anadolu'daki bazı yerleşimlerdeki bitki ve hayvan kalıntılarındaki değişimler ya da farklı tercihler kültürel bir tercihin sonucu gibi görünmektedirler. Bu nedenle, geçmiş insan davranışları ile ilgili bilgilerin geliştirilmesi ve bunların insanların verdikleri kararlarda ve tepkilerde ne kadar etkili olduklarının daha iyi anlaşılması böylesi bir katı çevresel deterministik yaklaşımın önüne geçme potansiyeline sahiptir.

Sonuç olarak, Batı Anadolu'da yapılan paleoçevresel, biyoarkeolojik, arkeolojik çalışmalar göz önünde bulundurulduğunda bir kuraklıkla ilişkilendirilebilecek eş zamanlı değişimlerin olduğu görülmektedir. Buna göre 4,2 ka iklim olayı ve Batı Anadolu'daki Erken Tunç Çağı toplumlarının MÖ 3. binyılın sonlarında geçirdiği büyük toplumsal değişimler arasında bir neden-sonuç ilişkisi olduğunu söylemek akla yatkın görünmektedir. Bununla birlikte daha doğru ve güvenilir sonuçlara ulaşmak için bölgede yapılan konuyu farlı yönlendiren değerlendiren ve disiplinler arası bir yaklaşımı benimseyen çalışmaların sayısının arttırılması gerekmektedir.

APPENDIX D. TEZ İZİN FORMU/THESIS PERMISSION FORM

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : Bal

Adı / Name : Çağlayan

Bölümü / Department : Yerleşim Arkeolojisi

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) : The Impact of the 4.2 ka BP Event in Western Anatolia: An Evaluation through Palaeoenvironmental and Archaeological Data

TEZİN TÜRÜ / DEGREE**:** **Yüksek Lisans** / Master ☒ **Doktora** / PhD ☐

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. ☒
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months**. ***** ☐

***** *Enstitü Yönetim Kurulu kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir.*
A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.

Yazarın imzası / Signature .... **Tarih** / Date ……………………….