Botanical Aspects of the Environment and Economy at Tell Tayinat from the Bronze to Iron Ages (ca. 2.200 – 600 BCE), in south-central Turkey

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ABSTRACT

The Eastern Mediterranean Basin including Northern Levant has a long history of archaeological research. Despite of this, archaeobotanical data from Bronze and Iron Age settlements in this region are relatively scarce. Tell Tayinat is a multi-period site in the Amuq Valley, Northern Levant, which was occupied during the Early Bronze Age and Early Iron Age. This dissertation addresses the archaeobotanical analysis of plant macro-remains including a detailed set of stable carbon and nitrogen isotopic signatures of crops from Tell Tayinat. The analyses intend to document crop management strategies as well as the composition of plant community from the Early Bronze Age IVB (ca. 2350 and 2200 BCE) and the Iron Age (ca. 1200 – 600 BCE). The general aim of the present dissertation is to increase our understanding of the diachrony of agricultural production and of the growing conditions of crop plants of Tell Tayinat as well as the wider Northern Levant. Furthermore, this dissertation offers a systematic contextualization of the investigated archaeobotanical data into the local and regional culture, politics, climate and environment.

Tell Tayinat is characterized by a wealth of plant macro-remains with a fine-scaled chronological sequence of succeeding occupational phases. This allows studying the crop management strategies and disentangling the potential impact of climate degradation on plant community composition during the end of 3rd and 2nd millennia BCE. Overall, the archaeobotanical investigation at Tell Tayinat indicated that the inhabitants used a similar range of crops during the Early Bronze and Iron Ages.

During the Early Bronze Age, barley (*Hordeum vulgare*) was proportionally dominant over other crops plants. In Iron Age I, water-demanding free-threshing wheat (*Triticum aestivum*) became predominant over barley. Bitter vetch (*Vicia ervilia*), emmer (*Triticum dicoccum*), and lentil (*Lens culinaris*) are other typical crop plants in Iron Age I. In contrast, the assemblage of wild/weedy plant taxa differed dramatically between Early Bronze and Iron Ages. A possible explanation might

be that the local vegetation around Tell Tayinat was disrupted by environmental and/or climatic factors during early phase of the Iron Age I.

To test whether the local archaeobotanical findings at Tell Tayinat was in line with other settlements in the Near East, the available archaeobotanical data from several other sites has been compiled. This compilation was used to look for general, i.e. across-sites, patterns that might allow us to determine changes in the agricultural production during the Late Bronze-Iron Age transition. My results demonstrate that several features of the crop assemblage at Tell Tayinat are in accordance with the regional developments recognized in the published archaeobotanical records. There is a definitive change from wide-spread use of barley to free-threshing wheat in the Levant. Additionally, the stable isotopes of carbon and nitrogen from Tell Tayinat and the Near Eastern sites have been studied to find possible trends toward increasing aridity in the region during the Late Bronze-Iron Age transition. The stable carbon and nitrogen isotope results from Tell Tayinat show a small decrease for both barley and free-threshing wheat during the Iron Age I. This decreasing trend in stable isotope values coincides with the regional climatic change towards increasing aridity during this transitional period.

During the Iron II and III, the crop repertory of Tell Tayinat included some new taxa such as almond and pistachio. Also, the samples are devoid of hulled wheats, chaff remains as well as lentil and other leguminous crops. Additionally, there is no evidence for the introduction of summer crops such as sesame (*Sesamum indicum*) and millets. This is in contrast to Cilician sites at the seaward side of the Amanos Mountains where these crop plants were already present in the later periods of Iron Age.

Regionally, the occurrences of field crops, spices/condiments and trees were studied to comprehend the alternations of crop production in the larger scale. It is argued that during the 1st millennium BCE, the regional variability of crop production was linked to the increasing connectedness of trade

networks across the Eastern Mediterranean basin as well as the emergence of territorial empires such as the Assyrians and the Urartians.

Earlier archaeological approaches on subsistence and diet largely focused on quantitative evaluations of food resources and nutritional values of the studied population and tended to neglect the role of food within the wider cultural context. Recently, however, archaeological research is increasingly exploring how past food practices were interwoven by culturally expressive behaviors in the material record. Food does not only provide an essential biological constant to sustain life but also is an important representation of social status, gender roles, religious and ethnic affiliations. This thesis includes a novel contextual analysis of archaeobotanical remains as a representation of past food practices into cultural practices. Specifically, the contextual analysis of archaeobotanical remains of the newly excavated ruins of a Neo-Assyrian temple, Building XVI, aims to document the food consumption practices in a symbolically charged urban setting from the "Sacred Precinct" of Tell Tayinat. The archaeobotanical analysis demonstrates that the plant remains to the west of the monument are rich in food preparation waste while the deposits inside the temple only consist of pure crop concentrations, *albeit* in low counts. Contextual analysis of plant remains in the Neo-Assyrian Sacred Precinct provided potential insights of human crop use from such similar contexts in the Near East.

KURZFASSUNG

Der östliche Mittelmeerraum einschließlich der nördlichen Levante hat eine lange Tradition in der archäologischen Forschung. Trotzdem sind archäobotanische Daten aus bronze- und eisenzeitlichen Siedlungen in dieser Region relativ selten. Tell Tayinat ist eine bekannte Ausgrabungsstätte mit mehreren Bauperioden im Amuq-Tal, nördliche Levante, die in der frühen Bronze- und frühen Eisenzeit besiedelt war. Diese Dissertation befasst sich mit der archäobotanischen Analyse von pflanzlichen Makroresten, einschließlich detaillierter Analysen von stabilen Kohlenstoff- und Stickstoffisotopensignaturen von Nutzpflanzen des Fundorts. Die Analysen dienen der Dokumentation der Anbaustrategien der Nutzpflanzen und von der Zusammensetzung der Pflanzengesellschaften aus der Frühen Bronzezeit IVB (ca. 2350 und 2200 v. Chr.) und der Eisenzeit (ca. 1200 - 600 v. Chr.). Das allgemeine Ziel der vorliegenden Dissertation ist es, unser Verständnis für die Entwicklung der landwirtschaftlichen Produktion und die Anbaubedingungen der Nutzpflanzen von Tell Tayinat sowie der nördlichen Levante zu verbessern. Darüber hinaus bietet diese Dissertation eine systematische Kontextualisierung der untersuchten archäobotanischen Daten in die lokale und regionale Kultur, Politik, Klima und Umwelt.

Tell Tayinat zeichnet sich durch eine Fülle von pflanzlichen Makroresten mit einer fein abgestuften chronologischen Abfolge aus aufeinanderfolgenden Kulturschichten aus. Dies ermöglicht es, die Strategien des Nutzpflanzenanbaus und die möglichen Auswirkungen einer Klimaverschlechterung am Ende des 3. und 2. Jahrtausends v. Chr. zu untersuchen. Die archäobotanischen Untersuchungen in Tell Tayinat zeigten, dass die Bewohner in der frühen Bronze- und Eisenzeit eine ähnliche Auswahl an Nutzpflanzen anbauten.

In der frühen Bronzezeit war Gerste (*Hordeum vulgare*) proportional dominant gegenüber anderen Kulturpflanzen. In der Eisenzeit I wurde Weichweizen (*Triticum aestivum*) häufiger als Gerste gefunden. Linsen-Wicke (*Vicia ervilia*), Emmer (*Triticum dicoccum*) und Linse (*Lens culinaris*) sind weitere typische Kulturpflanzen in der Eisenzeit I. Im Gegensatz zu den Kulturpflanzen

unterschied sich die Zusammensetzung der Taxa von Wild- und Unkrautpflanzen zwischen der frühen Bronze- und Eisenzeit dramatisch. Eine mögliche Erklärung dafür könnte eine Störung der lokalen Vegetation um Tell Tayinat durch Umwelt- und/oder Klimafaktoren in den frühen Phasen der Eisenzeit I sein.

Um zu testen, ob die lokalen archäobotanischen Funde in Tayinat im Einklang mit anderen Siedlungen im Nahen Osten stehen, wurden die verfügbaren archäobotanischen Daten aus mehreren anderen Standorten gesammelt. Diese Sammlung wurde verwendet, um nach allgemeinen, d.h. standortübergreifenden Mustern zu suchen, die es uns ermöglichen könnten, Veränderungen in der landwirtschaftlichen Produktion während des Übergangs der späten Bronze-Eisenzeit zu bestimmen. Meine Ergebnisse zeigen, dass mehrere Merkmale der Zusammenstellung der Kulturpflanzen mit der anerkannten, veröffentlichten, archäobotanischen regionalen Entwicklungen übereinstimmen. In der Levante vollzieht sich mit großer Wahrscheinlichkeit eine Abwendung von der weit verbreiteten Verwendung von Gerste hin zum Weichweizen. Darüber hinaus wurden die stabilen Isotope von Kohlenstoff und Stickstoff von Tell Tayinat und den Standorten im Nahen Osten untersucht, um mögliche Trends zur Erhöhung der Trockenheit in der Region während des Übergangs in der späten Bronze- zur Eisenzeit zu finden. Die Isotopenuntersuchungen des stabilen Kohlen- und Stickstoffs zeigen einen leichten Rückgang sowohl bei der Gerste als auch beim Weichweizen in der Eisenzeit I. Dieser abnehmende Trend bei den stabilen Isotopenwerten deckt sich mit dem regionalen Klimawandel in Richtung zunehmende Trockenheit in dieser Übergangszeit.

In der Eisenzeit II und III enthielt die Auswahl an Kulturpflanzen von Tell Tayinat einige neue Taxa wie Mandel und Pistazie. Des Weiteren gibt es keinen Spelzweizen, Spelzreste, Linsen oder andere Leguminosen. Darüber hinaus gibt es keine Hinweise auf die Einführung von Sommerkulturpflanzen wie Sesam (*Sesamum indicum*) oder Hirsen. Dies steht im Gegensatz zu den kilikischen Standorten auf der seewärtigen Seite des Amanos-Gebirges, wo diese Kulturpflanzen bereits in den späteren Perioden der Eisenzeit vorhanden waren.

Regional wurden das Vorkommen von Feldfrüchte, Gewürze und Bäume untersucht, um die Produktionsmuster der Kulturpflanzen in größerem Maßstab zu verstehen. Es wird argumentiert, dass während des 1. Jahrtausends v. Chr. die regionale Variabilität der pflanzlichen Erzeugung mit der zunehmenden Vernetzung der Handelsnetze im gesamten östlichen Mittelmeerraum sowie mit der Entstehung territorialer Reiche wie der Assyrer und der Urarier verbunden war.

Frühere archäologische Studienansätze zum Thema Subsistenzwirtschaft und Ernährung konzentrierten sich weitgehend auf quantitative Bewertungen der Nahrungsressourcen und Nährwerte der untersuchten Bevölkerung und vernachlässigten die Rolle der Ernährung im breiteren kulturellen Kontext. In jüngster Zeit untersuchen archäologische Forschungen jedoch zunehmend, wie frühere Ernährungspraktiken mit kulturellem Verhalten in den materiellen Fundstücken verwoben wurden. Nahrungsmittel stellen nicht nur eine wesentliche biologische Konstante für die Lebenserhaltung dar, sondern sind auch ein wichtiger Indikator für sozialen Status, Geschlechterrollen, religiöse und ethnische Zugehörigkeiten. Diese Doktorarbeit beinhaltet eine neuartige kontextuelle Analyse archäobotanischer Überreste als Darstellung vergangener Lebensmittelpraktiken in kulturellen Praktiken. Konkret zielt die kontextuelle Analyse archäobotanischer Überreste der neu ausgegrabenen Ruinen eines neuassyrischen Tempels, Gebäude XVI, darauf ab, die Ernährungsgewohnheiten in einer symbolisch aufgeladenen städtischen Umgebung aus dem "Sacred Precinct" von Tell Tayinat zu dokumentieren. Die archäobotanische Analyse zeigt, dass die archäobotanischen Funde im Westen des Monuments reich an Speiseresten sind, während die Funde im Inneren des Tempels ausschließlich aus unverarbeiteten Kulturpflanzen bestehen, wenn auch in geringen Mengen. Die kontextuelle Analyse von den archäobotanischen Funden im neuassyrischen heiligen Bezirk lieferte potenzielle Erkenntnisse über die Nutzung menschlicher Pflanzen aus ähnlichen Kontexten im Nahen Osten.

DECLARATION OF OWN CONTRIBUTION

Chapter 6 is originally a manuscript which will be published in Archaeology and History in Lebanon journal in a special edition in summer 2019. This manuscript is a joint product of the present author and S. Riehl, titled "*Subsistence in post-collapse societies: patterns of agro-production from the Late Bronze Age to the Iron Age in the Northern Levant and beyond"*. Figure 52 and 53 has been produced by S. Riehl; otherwise the rest of figures in this chapter were created by D. Karakaya. Hanan Charaf and Lynn Welton (editors of the journal) helped to improve the language of the manuscript. The full citation and the contributions of both D. Karakaya and S. Riehl were presented below.

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Nr.	**Accepted publication yes/no**	**List of authors**	Position of candidate in list of authors	Scientific ideas by the candidate (%)	Data generation by the candidate (%)	Analysis and Interpretation by the candidate (%)	Paper writing done by the candidate (%)
1	yes	Karakaya, Doga; Riehl Simone	First	50	75	50	90

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CHAPTER 1. GENERAL INTRODUCTION

1.1 RESEARCH FRAMEWORK and OBJECTIVES

> "As archaeologists, we have a professional responsibility to present our prehistories in ways that make distorted appropriations of the past as difficult as possible, and, as scientists, we need to work with models that expose our implicit assumptions concerning human roles and capabilities to critical reflection and hypothesis testing" (Brumfiel, 1992).

Investigating past subsistence systems is a particularly important research interest and numerous archaeobotanical studies contributed to this topic over the decades covering the area of the ancient Near East (e.g. Charles & Bogaard, 2001; Miller, 1997; McCorriston & Weisberg, 2002; van Zeist, 1999, Riehl, 2009a). Processualism has notably improved the theoretical (e.g. systems theory) and methodological (e.g. sampling) potential of the studies on subsistence and dietary practices in archaeology. The main emphasis of processualism (alternatively referred to as ecosystemic approach[1]) was to examine adaptive cultural adjustments to alternating natural environments in search for cross-cultural predictive laws and generalizations from a behavioral-ecological perspective (Binford, 1968; Flannery, 1972). In doing so, the subsistence systems of past societies was reconstructed through various methods such as quantitative resource optimization analyses (e.g. "Least effort hypothesis") and maximization strategies, focusing the evaluation of the nutritional intake of past populations (e.g., Ellison, 1981; Ellen, 1982).

The use of ethnographic analogies as a method of archaeological inference has been widely discussed in archaeological literature (Binford, 1965; Hodder 2012). The contemporary

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[1] The ecosystemic explanations are not restricted to the processualism. In the same line, resilience thinking (or resilience theory) recently gained popularity among scholars to develop models of social change from within another ecosystemic understanding of change (Folke, 2006). Resilience theory was originally developed in community ecology to explore the response mechanisms of complex natural ecosystems to external stress factors, this conceptual framework aims to disentangle the cause-and-effect relationship among the components of a structured, ordered system, and may it be ecological plant community or human society.

ethnographic and ethnohistoric (e.g., Jewish Bible) accounts of pre-industrial farming communities are an important source to investigate past subsistence systems in archaeobotany (e.g., Hillman, 1981, 1984a, 1985; G. Jones 1987, 1992; N. Miller 1984; N. Miller & Smart 1984; see Hodder, 2012, p. 114 for symbolic potency of crop processing activities). However, in general, it is assumed that the ethnographic analogies on subsistence systems (e.g. transhumance, tree-crop specialization, bare fallowing and crop rotation) between contemporary pre-mechanized agricultural communities and to those in the past, become circumstantial when lacking the analysis of inherent social and cultural contexts of past populations (Hodder, 1982, 2012; Halstead, 2014). Concerning this issue, Halstead notes that:

> "… Traditional practice was highly variable, however, and demonstrably shaped also by medium-term historical contingencies … and cultural preferences and by short-term tactical decision-making. These influences must be disentangled to enable judicious use of recent practices as analogies for the past" (2014, p. 2).

Hodder (1982, p. 13) is more optimistic on this issue; particularly for the type of analogies that he calls *relational*. This term refers that ethnographic analogies can be useful tools "to define the relevant cultural context for social and ecological behavior" if the relevant contexts used for the comparison could be specified and if it is combined with a general theory of practice (e.g. *habitus*) (Hodder, 1982, p. 5).

Several studies on modern indigenous communities demonstrated that cultural values are deeply entrenched in how people perceive their environment (e.g., Novellino, 2003; Ohneku-Tierney, 1993). For instance, marginality is usually conceived from a dualistic perspective between resource-rich and –poor environments (e.g., Wilkinson, 1994). However, cultural factors would also be significant in the perception of the environment for ancient communities (Riehl, 2017). Simone Riehl stresses this fact from within archaeobotany; that such perspectives on environmental marginality[2] are cultural constructs and not fixed analytical categories:

> “Archaeological literature often provides authoritative valuation on ancient Near Eastern landscapes. Characterizations such as “marginal environments”, “environmental constraints” that act on ancient societies or statements such as “the need to import wood due to a lack of local tree vegetation” … or “feeding animals with stored barley … to maintain higher numbers of animals than otherwise permitted by restricted summer grazing” … nourish our view of the ancient Near East as a meagre landscape with an impoverished flora in a modern sense. We thus judge on environmental conditions that would set limitations to a western way of life, thus in a very classical sense we use an argumentation that constructivism rejects (Riehl, 2019, p. 176).

In close connection, the essential meaning of subsistence has gathered substantial skepticism in archaeological thinking (Boserup, 1965; Sahlins, 1972). The “mere subsistence” is by no means a neutral term for food-getting but a rhetorical one indicating a “utopian representation of a world without ostentation and cupidity” for the Victorian observers of the 19th century (A. Sherratt, 1999):

> “… Subsistence is not an autonomous domain, but is best considered as one aspect of a larger set of relationships … Although masquerading as a neutral, descriptive term, ‘subsistence’ is in fact heavily freighted with intellectual baggage. It has two principal uses in modern English: to describe the economies of far-away regions, and to specify an element of allowable *per diem* expenses after second-class travel by rail. Its use in the latter context clearly has a moral content: it is a bureaucratic warning against the temptation to potlatch … Food behaviors (and other forms of consumption) are not so environmentally or economically determined as to be fully predictable, but not so arbitrary as to preclude useful comparison. Values are socially constructed, but they are constructed for similar reasons in different cultures. […] ‘Added-value’ is always the impression of meaning as well as simply the manufacture of a commodity: it carries an imprinted message (however much that message can be interpreted by its ultimate recipients)” (A. Sherratt, 1999, p. 32).

This reactionary approach engages an intellectual position against the neo-evolutionary thinking in archaeology, favoring agency-based models to emphasize the indigenous motivations in the formation and reproduction of social and cultural structures (Ur, 2014).

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[2] Sahlins’ remarks are worth to be noted: “… The remote and exotic environments that have become cultural theater of modern hunters have an effect on Europeans most unfavorable to the latter’s assessment of the former’s plight. Marginal as the Australian or Kalahari Desert is to agriculture, or to everyday European experience, it is a source of wonder to the untutored observer ‘how anybody could live in a place like this’. The inference that the natives manage only to eke out a bare existence is apt to be reinforced by their marvelously varied diets … Ordinarily including objects deemed repulsive and inedible by Europeans, the local cuisine lends itself to the supposition that the people are starving …” (1972, p. 6).

The processual conceptualization of subsistence regards it as “timeless” and “culture-free”, thereby reducing the human behavior into quantitative measures of nutritional intake. For this reason, A. Sherratt suggests shifting the study of subsistence from “the realm of calculable determinism of economics into the interpretative domain of culture” to integrate subsistence into a larger cultural and social context of ancient societies (Sheratt, 1999, p. 33; see also Twiss, 2007, 2012; Palmer & van der Veen, 2002; Hodder, 2012, p. 101 for theoretical discussions).

In regard to his criticism to “mere subsistence”, it concerns a necessity to diverge from old interpretations to the political developmental model, centered on consumption of organic resources, Sherratt’s overall emphasis provides an essential axis for further investigations on subsistence, food behaviors and value-creation. Social archaeology of food aims to serve this purpose by providing enhanced understanding of individual and/or communal motivations around the notion of foodways (Hastorf, 2016; Twiss, 2012; Bray, 2003) in connection to the cultural anthropological literature (e.g. Tierney and Ohnuki-Tierney, 2012; Mintz and du Bois, 2002 for an overview). The notion of foodways is significant to comprehend diverse material and symbolic dispositions of food practices in the cultural milieu; as an alternative to positivistic understanding of subsistence and diet. In this manner, Pearson observes that “[t]he literature has been dominated until recently by questions about production, subsistence, husbandry and ecology, with only scant attention paid to the fact that culture is constructed through consumption and not just through production. Foodways, along with other forms of material culture consumption, serve to materialise, temporalise, spatialiase and substantiate human culture” (2003, p.1).

Foodways, on this conceptual level, can be understood as “all of the activities, rules, contexts, and meanings that surround the production, harvesting, processing, cooking, serving, and consumption of those foods" (Peres, 2017, p. 423). More specifically, according to Appadurai, food renders "a peculiarly powerful semiotic device" in every spheres of the life which is capable of "bearing the load of everyday social discourse" and "the daily creation of food, its inherent connection to landscape, and its symbolic potency make it a medium rife for exploitation and for the communication of both homogenizing and differentiating social messages" (Appadurai, 1981, p. 494).

In connection to Appadurai's emphasis on semiotics, Hastorf and Johannessen argued that "foodways are not just a passive reflection of social relations and cultural values but they are also an arena for action and social negotiation" (1993, p. 116). Moreover, food and beverages are targeted to be destroyed by ingestion and leave no or little trace in archaeological record. Michael Dietler (2011) and Yannis Hamilakis (1999) stress the importance of another concept to relate archaeological inferences to the subjectivity and the construction of identity in the past: "*embodied material culture*". Dietler (2011, p. 179) elaborately summarizes an archaeological perspective of food, agency and structure as follows;

> "[…] This fact lends them a heightened symbolic and affective resonance in the social construction of the self … Moreover, given that eating and drinking are social acts that must be repeated virtually every day for biological survival, they occupy a salient place among the various routinized practices that … serve to inculcate habitus – that is, the set of embodied dispositions that structure action in the world and that unconsciously instantiate social roles and cultural categories and perception of identity and difference. Furthermore, because sustaining this process of consumption requires continual replenishing production through both agricultural and culinary labour, this domain of material culture is one where the intimate linkages between the domestic and political economy are especially evident."

"The intimate linkages between domestic and political economy" may perhaps require more attention for this introductory section. Political economy, as it is used today in political sciences, refers to "an analysis of social relations based on unequal access to wealth and power" (Hirth, 1996, p. 205). The social structure is not superimposed over human actors (Eisenstadt, 1988) but "continually created by their actions; in most situations people act subconsciously according to these structures but often are aware of them and can creatively manipulate them for social purposes" (Ur, 2014, p. 3). Therefore, as Blumfiel asserts that, in archaeology "… we must recognize that culturally based behavioral 'systems' are the composite outcomes of negotiation between positioned social agents pursuing their goals under both ecological and social constraints" (1992, p. 551). Fuller and Stevens suggest the importance of studying the political economy in archaeobotany; through which "surplus staple resources" are extracted from local communities by non-food producing elites and specialists (2009, p. 37);

> "… One particular aspect that needs to be further explored is how the demands of increasing social complexity impact on the organization of food-producing households, or indeed whether they alter their structure at all. Ethnographic studies do suggest that major socio-economic change filters down to the household level … while archaeologists have long been aware that changes within settlement patterns are also indicative of such change … What have been neglected are the intricacies of the relationships between general structure of economy and the organization of the individual components that contribute to it, the households. We believe archaeobotany can help to detect when centralized political power affected the organization of agricultural production".

To sum up, Elizabeth Brumfiel recapitulates all of these perspectives within an explanatory framework by considering cultural systems as "contingent and negotiated, the composite outcome of strategy, counterstrategy and the unforeseen consequences of human action" unlike processualism's emphasis on adaptive capabilities (1992, p. 559). On one hand, human actors are the active agents in the reproduction of the social structures; "… human actors devise complex strategies to solve their problems and meet their goals, and these strategies are neither random nor shaped solely by differential survival either at the population level as ecosystem theorists would have it, or at the level of the individual as more recent evolutionary culture theorists claim …". On other hand, it is true that natural ecosystems determine the costs and benefits of different production strategies while in contrary to the processualists, accessibility of resources and power depend based on gender, class and factional affiliations. Lastly, and perhaps more importantly, she declares faith for "cross-cultural generalizations" by stating that "… the discourse of social negotiation can be studied cross-culturally; similar ecological and social strategies should leave broadly similar imprints on material culture" (1992, p. 560). As a result, comprehending the nature of economic organization would be crucial to investigating the degree of active participation of social actors (e.g. authorities, peasants, specialists, merchants) into food production and consumption, in regards to obtaining material benefits, to recognize the cumulative efforts of these agents in actively transforming the landscape for food production (Erickson, 2006, p. 348), to develop strategies in times of social and environmental crises (Riehl, 2009a; Marston, 2011) or to use the plants in symbolic and rhetorical purposes to transmit differentiating and homogenizing messages (Winter, 2003; N. Miller, Jones, & Pittman 2015). Plant subsistence as an integral part of "foodways" reflects the interconnectedness of food getting to the larger set of social, cultural, economic and environmental characteristics of any given society independent of the level of social complexity (A. Sherratt, 1999).

Seen in this way, the present study aims to answer what the dynamics of human crop preferences were during the Bronze and Iron Ages, and why and when certain crop plants occurred more often than others in the archaeobotanical record of the Near East. The present inquiry assumes that the recognition of local, site-specific patterns of agro-production with a synthesis of regional crop data can produce an avenue to disentangle social, environmental and climatic constraints over agricultural resources during the Bronze and Iron Ages in the Near East.

Three research objectives of this dissertation are classified along these lines;

1) Defining the local patterns of agro-production at Tell Tayinat and in the Amuq Valley during Bronze and Iron Ages;

In this respect, Tell Tayinat and its sister site Tell Atchana (Fig. 1) have been used as case-studies for determining change and continuity in plant subsistence and foodways during the Bronze and Iron Ages in the fertile plain of the Amuq Valley. Tell Tayinat is a multi-period site which has been occupied in the Early Bronze Age VI of the late 3rd millennium BCE, and after a *hiatus* of occupation during the Middle and Late Bronze Ages, when the settlement shifted to nearby Tell Atchana, resettled during the Iron Age ca. 1.200 to 600 BCE (see Table 1 for a general chronology of the Near East). Both sites are located 700 meters to each other in the fertile plain called the Amuq along important trade routes which connected the coastal

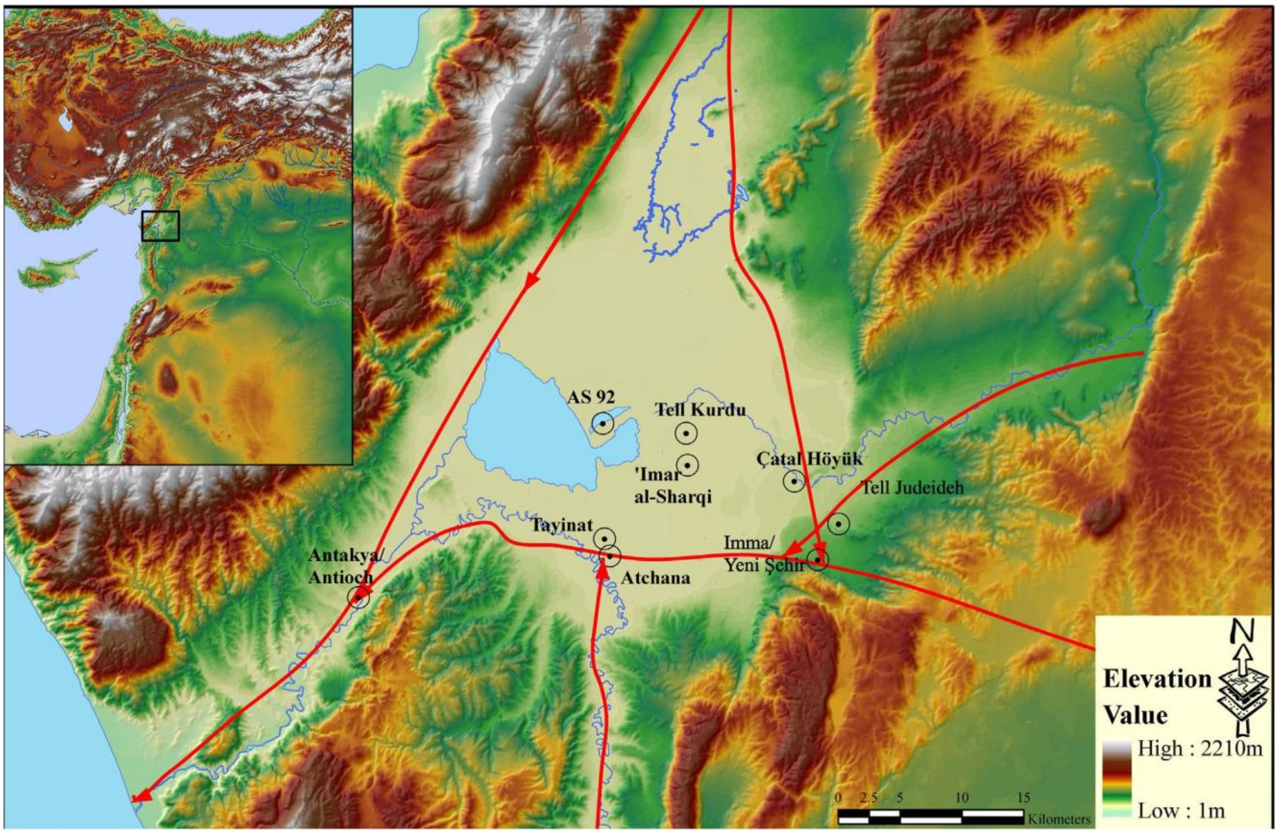

Figure 1 The geographical position of Tell Tayinat and other major settlements in the Amuq Valley. (Graphic courtesy: S. Batiuk, after Batiuk 2013).

northwestern Syria to the inner parts of the Mesopotamia. Therefore, Tell Tayinat and its sister site Tell Atchana of the 2nd millennium BCE are in a geographically and historically strategic position to investigate the region-wide historical developments in the Near East (Fig. 2).

The history of crop husbandry still remains relatively obscure despite the lengthy history of archaeological research (Haines, 1971; Woolley, 1955; Braidwood & Braidwood, 1960) and textual evidence in this region (Wiseman, 1953; Zeeb, 2001). The history of agricultural practices in the Amuq Valley remains poorly understood from only a few archaeobotanical reports. Tell Judaidah which is a multi-period site at the Afrin Valley, east of the Amuq Valley, was initially excavated during the OI excavations only reported of plant impressions on the inner surface of pottery sherds (Helbaek, 1960). This was the only study conducted for a long period. Later after the re-commencement of targeted investigations at Tell Atchana and Tell Tayinat, more archaeobotanical research had been undertaken. Tell Atchana plant assemblage has been reported by Riehl (2010), Çizer (2006) and Stirn (2013). Thus far, the Tell Tayinat plant assemblage is only known from the master thesis of Capper (2013).

2) Defining the regional patterns of crop use and dissemination during the Bronze and Iron Ages across the Near East;

As more and more plant data has been produced in recent years, the necessity to synthesize the regional plant developments has emerged as another important accomplishment in the 2000's-history of the archaeobotany. This coincides well with the new digital age of super

Archaeological phases			Syria-Palestine	Tell Tayinat sequence	Anatolia	Upper Mesopotamia		Lower Mesopotamia
"Urban Revolution"			Late Chalcolithic - Uruk Colonies		Late Chalcolithic - Uruk Colonies	Late Chalcolithic - Uruk Colonies		Late Uruk (3300-3100)
3000	Early Bronze Age	I	Amuq G					Jemdet Nasr (3100-2900)
						Nineveh 5	Early Dynastic period	I (2900-2750)
		II	Amuq H					II (2750-2600)
2500		III		?				III (2600-2350)
			Ebla 2500-2300 Amuq I Sakkanakku in Mari	EBAIV occupation		Urkesh and Nawar		Akkad (2350-2200)
2200		IV	Amuq J					Gutians (2200-2120)
	intermediate Bronze Age							Ur III (2120-2000)
2000	Middle Bronze Age		Amorites					
			Mari (1850-1750)	? ?	Old Assyrian colonies (1900-1750)	Old Assyrian kingdom (1950-1750)		Isin (2017-1794) Larsa (2025-1763)
			Yamhad kingdom (1800-1600) *Hyksos?!*	Alalah VII	Old Hittite kingdom (1650-1550)			Babylon (1894-1595)
1500	Late Bronze Age		Egyptian and Mitannian rule (1550-1370)	Alalah IV	Middle Hittite period Kizzuwatna (1550-1370)	Mitannian rule (1550-1360)		Kassites (1600-1150)
1200			Egyptian and Hittite rule (1370-1190)	Alalah III	Hittite Empire (1370-1190)	Middle Assyrian kingdom (1360-1050)		
			Aramean and Sea Peoples intrusions					Isin II (1150-1025)
1000	Iron Age	I	Arameans (1100-720) Neo-Hittites (1100-720)	Iron Age occupation	Phyrgia (750-650) Lydia (650-550) Urartu (800-600)			Various dynasties (1025-725)
		II				Assyrian empire (900-615)		Assyrian rule (725-625)
		III						Chaldeans (625-539)
500			Persian empire (550 BC onwards)					

Table 1 An overall chronological sequence of the Near East from the Late Chalcolithic (ca. 4000 BCE) to the Achaemenid period (ca. 500 BCE) (modified after Liverani, 2014).

computers providing the ease of processing immense data points, or as widely known the "Big Data" approach, and the emergence of online database platforms which provide new opportunities to disseminate the plant data, easier and quicker for every scholar. This trend was reflected in several synthesizing studies of recent years that delivered the region-wide character of plant subsistence, and crop dissemination patterns across the Near East (e.g. Riehl, 2009a, 2010b; Colledge, Conolly, & Shennan, 2005).

In case of the second objective, contemporary archaeobotanical research can greatly benefit from a *longue durée* approach by investigating the linkages between the domestic and political economies during the Bronze and Iron Ages in the Near East. Leaving aside the question as to whether the identification of the political economy in plant macro-remains is truly possible or not, the impact of the development of complex socio-political structures on subsistence base of food-producing communities has been previously largely addressed in American archaeology (e.g., Hastorf, 1993). However, the same issue has only been marginally studied in archaeobotanical studies in the Near East (e.g., Rosenzweig, 2018; Charles & Bogaard, 2001; Hald, 2010; Fuller & Stevens, 2009; McCorriston, 1998; Rosenzweig & Marshton, 2018) rather more attention has been devoted to the palaeoenvironmental reconstructions and subsistence strategies. Also in these studies, a greater emphasis was concentrated on the Northern Mesopotamian agricultural economy rather than the Levant (see Riehl, 2009a for a synthetical approach) where historical, climatic,

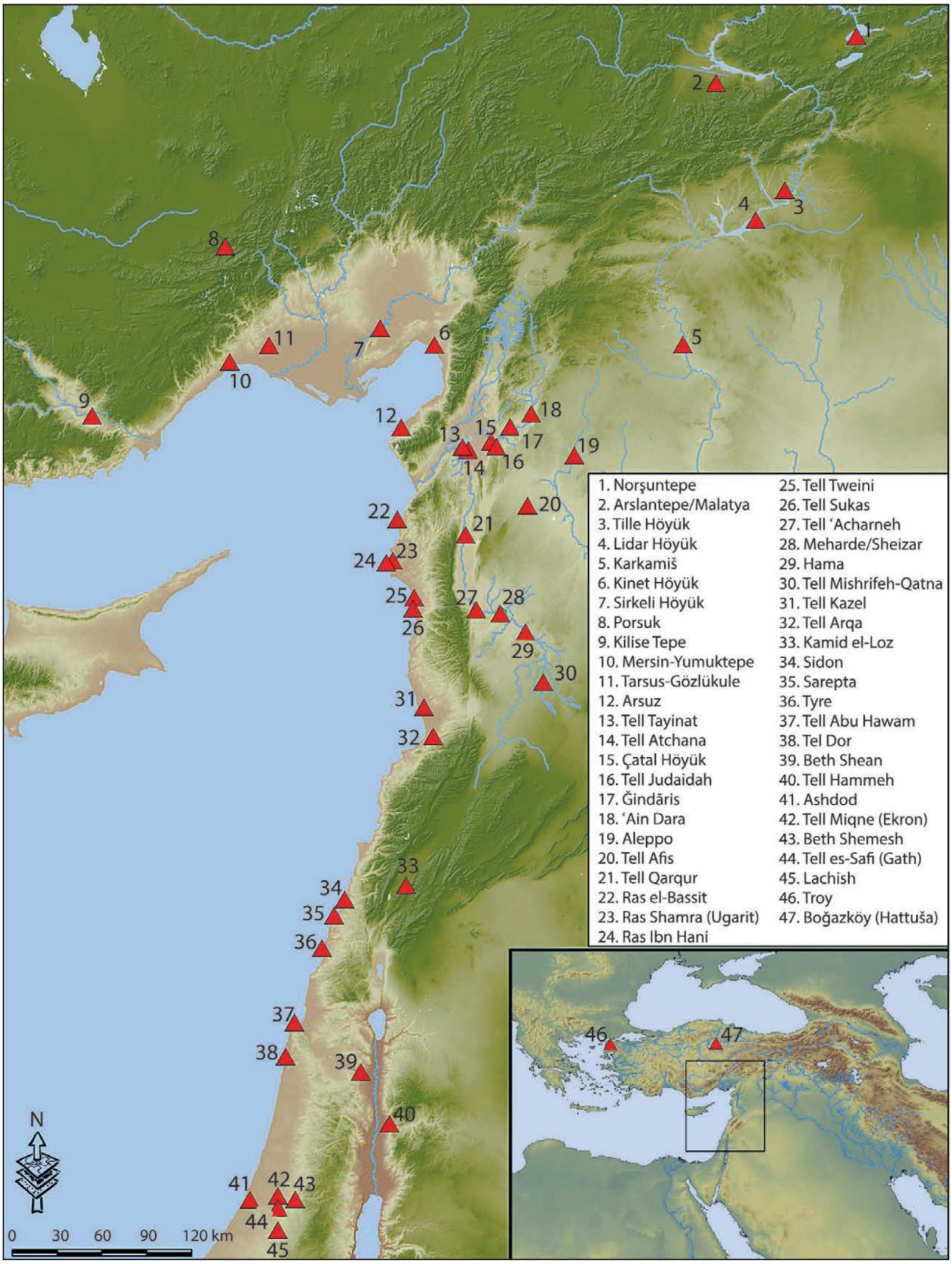

Figure 2 The archaeological settlements in the Northern Levant mentioned in the text (Graphic courtesy: S. Batiuk; after Welton et al. 2019).

and environmental settings were different than in the Levant. The topography of the Levantine/Eastern Mediterranean landscapes is highly heterogeneous whereby plant communities are temporally and spatially fragmented by diverse climatic, environmental and/or anthropogenic factors (Halstead, 1987). For this reason, the Mesopotamian models concerning the agro-production cannot be critically extrapolated to the Levantine conditions.

A second objective within this same generalizing framework is dissemination of economically (also symbolically) important plants across the Near East. Food globalization or transference of crop plants, spices, and botanical exotics from one region to another has been investigated by numerous authors for various time periods (e.g. Watson, 1983). Several comprehensive studies in archaeobotany were basically focused either on the Neolithic period for dissemination of domesticated crops (e.g., Colledge, Conolly, & Shennan, 2005; see also M. Jones et al., 2011; Boivin, Fuller, & Crowther 2012) or on the classical and medieval times in which the archaeobotanical data is more abundant (e.g. van der Veen, 2008; van der Veen & Morales, 2015).

Nonetheless, early centuries of the 1st millennium BCE represent an interesting time frame to understand the connections between the Bronze Ages and classical periods. Developing from the collapse of the Late Bronze Age territorial states, on the one hand, the 1st millennium BCE becomes a period of continuity indicating the strong cultural and material connections with the Late Bronze Age. On the other hand, the 1stmillennium is a period of increasing global networks or as sometimes called globalization, reestablishment of the interregional trade networks (and maritime routes were established more decisively in comparison to the Late Bronze Age), the emergence of powerful imperial domains which covers larger geographical stretches than ever achieved before. The role of plants remains poorly understood in this early stage of global encounters from an archaeobotanical perspective.

3) Investigating the plant macro-remains from the Sacred Precinct of Tell Tayinat to identify ceremonial food consumption;

Commensality and feasting are two other notions which gathered substantial attention in past decades (e.g. several contributions in Dietler & Hayden, 2001; Twiss, 2012; Pollock, 2003; Schmandt-Besserat, 2001). Archaeologists usually examine the production and processing stages from the contexts where the food has been prepared such as hearths and kitchen floors and discarded like midden and pit fills (Gumerman, 1997, p. 120). Direct evidence of food consumption, on the other hand, is more difficult to reconstruct from the archaeological data. Identification of feasting and commensal events provides the opportunity to understand how food was consumed.

Michael Dietler asks an important question in relation to the role of feasting and commensality in complex societies; "What role might feasting play in societies that have developed such institutions, are no longer small in population or community size, and have acquired the means to produce more permanent markers of social prestige on a relatively substantial scale?" (2003, p. 271). There is a growing trend in archaeological literature to focus on micro-politics of ancient societies as negotiated in the arena of everyday life rather than investigating the macro-evolutionary processes (Bray, 2003, p. 2). Commensality concerns one type of such micro-politics in reference to the physical expression of the *food sharing* whether it is practiced in a lavish feast, religious ceremonies or a mundane domestic meal (Pollock, 2003, p. 18, 2012, p. 4). Concurrently –and fortunately-, there is a great number of discrete sources of information on commensal eating and feasting in archaeology. The visual and textual data on feasting and commensality in the Near Eastern iconography, including visual imagery on seals, scarabs, cultic objects as well as ceramic assemblages and contemporary written records, are common sources to identify commensality and feasting activities (Pollock, 2003; Zuckerman, 2007; Collon,1992). This emergent area of research, therefore, ordained to provide potentially significant knowledge to understand the foodways and political statecraft as will be demonstrated in the Neo-Assyrian Sacred Precinct at Tell Tayinat.

1.2 ORGANIZATION of THE MONOGRAPH

The succeeding chapters, therefore, will provide an overall understanding of plant subsistence and foodways of the ancient Near Eastern societies. *Chapter 2* and *3* are two introductory chapters that focus on the archaeological and environmental background of the studied site. *Chapter 2* conveys a general view for the earlier archaeological research at Tell Tayinat as well as in other sites in the Amuq Plain from the Chalcolithic to the Iron Age. *Chapter 3* includes the historical settings and in addition contemporary climatic, environmental conditions in northwestern Syria. More specifically, the socio-political developments in the studied site and the region will be summarized in this chapter to place the site into a larger historical framework. Furthermore, the chapter pursues to develop an understanding for the overall discussion of the landscape changes in the Mediterranean region during the Holocene. These discussions mostly focused on the establishment of typical maquis vegetation in the Mediterranean region and the anthropogenic and/or climatic reasons behind the changes in the past vegetation. This is followed by describing the present environmental and climatic conditions in the region, focusing and taking into consideration primarily the studies on the Amuq Plain and its surroundings.

Chapter 4 describes the methodology used in this dissertation. It provides a general introduction to the methods in archaeobotany and of those undertaken in this dissertation. Because of the reason that every chapter has its own “Materials and Methods” section to describe the methodological approaches and materials handled to study the research questions in particular to that individual chapter, only a general description of the methods will be provided in chapter 4. Taphonomy is central in the interpretation of archaeobotanical samples; therefore, the literature was reviewed in this chapter. For this reason, an understanding of taphonomic conditions and processes remain critical for developing a better archaeobotanical evaluation. This and the following sections in this chapter, furthermore, include primary information on the quantitative methods used in this dissertation, as well as the summary of stable isotope studies in plant biochemistry and archaeobotany. The methodological limitations for both archaeobotanical and stable isotope data are described in this chapter.

Given that agriculture was the principal productive system to sustain a functioning economy in the agrarian world of the ancient Near East, understanding the crop husbandry becomes a central aspect, especially in the discussions of societal collapse and sustainability of food resources during the transitional periods. *Chapter 5* aims to fill the knowledge gap on subsistence strategies in the Amuq through archaeobotanical investigation of the Tayinat plant assemblage. This research at the end provided a detailed dataset of plant taxa with phase-by-phase precision, according to the ceramic chronology while some of those plants in the dataset had been reported for the first time in the Amuq in the present research.

The focus of this chapter is the two transitional periods which had attained considerable attention during the last decades. The first period under consideration covers the late 3rd millennium BCE or the Early Bronze Age IVB according to the north Syrian chronology (see Table 1). At the same time, this period coincides with the so-called Intermediate Bronze Age in the southern Levant chronology which is characterized with region-wide settlement abandonments in certain parts of the Near East (e.g. H. Weiss, 2015), although opposing opinions are also present (Marro & Kuzucuoğlu, 2007). The second transitional period concerns the Late Bronze Age to Iron Age transition. The transition from the Late Bronze to the Iron Age is a long-debated and remarkably complex period which is still gathering considerable attention in archaeological literature. The well-established territorial states collapsed, retreated or completely vanished from history. Overall, this section aims to determine whether any changes in the crop and wild plant assemblages of Tell Tayinat happened during these two transitional periods in combination with the published plant datasets of Tell Atchana.

Concurrently, the role of climate and human adaptation to the climate degradation was analyzed by the archaeobotanical and stable carbon isotope results within this chapter. Global climate change today becomes focused and is of growing public concern and intense debates over the sustainability of food resources in modern societies. The release of greenhouse gases into the atmosphere and the steady increase of human-generated carbon dioxide levels are recognized to be the outcome of the increasing human impact on the earth’s climate. The increasing number of studies in archaeology becomes interested in the causal link between climatic degradation and cultural evolution (e.g., Staubweiser & H. Weiss, 2005). This interest started to generate more archaeological research of past climate change events and their impact on human communities (e.g., Kaniewski et al., 2013).

A common problem to link climatic to societal change, on the other hand, is to identify the magnitude and temporal resolution of climatic degradation. This is due to the low chronological resolution of several paleoclimate proxies and spatial variation of climatic archives across the Near East. These two aspects hinder the comparability of cultural developments in geographically discrete areas to climate (Marro & Kuzucuoğlu, 2007; Riehl, 2009a; Roberts et al., 2011a; Knapp & Manning, 2016; see further Butzer, 2012 for a critical assessment). For this reason, archaeobotanical studies are particularly important to understand the coping mechanisms of human communities in the face of past climatic instabilities (Riehl, 2009a). In this section of *Chapter 5*, the aim is to make a detailed discussion of palaeoclimatic records; mainly focusing on what these records demonstrate for past climatic changes and how palaeoclimatologists and other scholars explain the past climatic events as driver of social change.

Chapter 6 is concerned with two aspects in relation to the demise of the Late Bronze Age territorial states from an archaeobotanical and stable isotopic perspective. Firstly, the cycle of urban decline and regeneration is a recurrent pattern in the archaeological records of the Near Eastern societies (Yoffee, 1995). However, our knowledge of agricultural change during such periods of collapse and regeneration remain rather fragmentary (Foxhall, 1995). The adherents of a climatic decline hypothesis suggest a catastrophic tone favoring famine and food shortage explanations during the Late Bronze/Iron Age transition (ca. 1200 BCE) although in most cases chronological imprecision becomes problematic for these proxy records to pinpoint the exact duration and the conditions for such explanations. This discrepancy makes any climatically-derived conclusions on socio-cultural aspects unfounded (see Knapp & Manning, 2016 for this issue). In this chapter, a regional survey of plant evidence has accomplished to comprehend the changes in the crop choices during the LBA/IA transition period. Stable carbon isotope determination of charred barley remains additionally implemented, to provide direct information on the water availability of this crop, to understand whether any decrease or increase in water uptake was discernible regionally, or not.

Chapter 7 aims to provide a general overview of crop use and introductions across the diverse sub-regions of the Near East as reflected in the archaeobotanical record of Tell Tayinat and beyond. The geographical and periodical distributions of some economically important crops have been studied in this chapter together with the new archaeobotanical results from Tell Tayinat.

On the other hand, *Chapter 8* focuses on the contextual analysis of archaeobotanical remains in a cultic monument at Tell Tayinat. This chapter aims to deliver the contextual analysis of carbonized plant remains from the newly discovered monument, Building XVI, to develop an understanding of commensality in ancient religious practices. More importantly, this chapter aims to interpret the plant data in relation to their contextual occurrences in and around Building XVI and to establish a broader perspective to disentangle the food consumption practices in the “Sacred Precinct” of Tayinat.

The final *Chapter 9* includes the summary of the inferences derived from the analysis of archaeobotanical results of Tell Tayinat and the region in general. The periods under investigation of this inquiry are particularly significant to comprehend the region-wide developments of subsistence change, not only in plant use, but also in agricultural decision-making and food consumption. Therefore, this chapter of the dissertation summarizes the concluding remarks derived from the plant data and their interpretations from climatic, environmental, social perspectives.

CHAPTER 2. ARCHAEOLOGY of TELL TAYINAT

2.1 HISTORY of ARCHAEOLOGICAL INVESTIGATIONS IN THE AMUQ VALLEY

Amuq Valley has a long history of archaeological research. Tell Tayinat as well as some other sites in the Plain, including Çatal Höyük and Tell Judaidah, were subject to archaeological excavations in the 1930's by a team from the University of Chicago's 'Oriental Institute'called "Syrian-Hittite expedition" (Haines, 1971). Also, Tulail al-Sharqi, Tell Tayinat al-Saghir and Tell Kurcoğlu and Wadi al-Hammam were sounded by this expedition team (Yener, 2005, p. 5). Another team of excavators, which was led by Sir Leonard Woolley, had visited the site of Tell Atchana and some other sites in the Plain. Because of this reason, Schwartz and Akkermans note that these excavations remain the most informative source of evidence for understanding the temporal developments in northwestern Syria (2009, p. 201).

The survey project undertaken by Robert Braidwood in the 1930's when he was a graduate student in the OI had accomplished to provide one of the most foundational cultural sequences for northwestern Syria (Braidwood & Braidwood, 1960). The ceramic sequence of Amuq helped to establish a concrete basis for the relative chronology of the western Syrian settlements allowing the cross-cultural comparison with the neighboring regions. In the late 1990's the cultural sequence of the Amuq sites has been refined by a new survey project launched with the cooperation of several institutions and universities, the leading institution was again the University of Chicago's 'Oriental Institute' (OI). This region-wide archaeological survey, the Amuq Valley Regional Project (AVRP), aimed to document the settlement dynamics and ceramic chronology of the sites in the Amuq Plain (Yener et al., 2000; Gerritsen et al., 2008). This survey project further elaborated the seminal account of the

Braidwoods[3] (Braidwood & Braidwood, 1960) and enlarged the number of identified sites in the Valley from 178 to over 400 settlements, chronologically ranging from Neolithic to Islamic periods (Yener, 2005).

Those sites occupied in the Amuq before the mid-1st millennium BCE with some degree of archaeological information are listed below;

For Tell Tayinat, see *section 2.2* and *2.3* below.

Tell Kurdu in the Afrin Valley (west of the Amuq) represents the oldest excavated settlement in the Amuq. This 15-hectare settlement was occupied during the 6th and 5th millennia BCE. The archaeological investigation first realized by the OI team in 1938 (Braidwood & Braidwood, 1960); further targeted excavations were carried out between 1996 and 2001 (Özbal, 2012).

Tell es Sheikh is another Chalcolithic site excavated by Ahmet Dönmez in two consecutive years (1948-49). This excavation yielded evidence for Ubaid type ceramics (Woolley, 1955, p. 8).

Tabara al Akrad, a site close-by to Tell Atchana only known from a sondage by Sinclair Hood is characterized by Uruk type ceramics as well as the Early Bronze Age pottery of the Levant. Findings of Khirbet Kerak pottery had also been reported in the final levels (Woolley, 1955, pp. 8-9).

Tell Judaidah is an important site overlooking the Afrin and the Amuq valleys. The site was excavated by the OI team and provides a long sequence of occupation. Therefore, the pottery evidence had been used to establish the Amuq Sequence by Robert Braidwood.

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[3] See Gerritsen et al., 2008 for the most recent assessment of Amuq Sequence after the AVRP completed.

Çatal Höyük is located near Tell Judaidah at the intersection point between the Afrin and Amuq Valleys. It is also the second largest Iron Age II settlement in the region with 10 ha in size. Haines (1971) reports that the physical characteristics of the mound may have changed as a result of surface erosion and other geological factors. This site has also a long occupational history uninterrupted during the Bronze and Iron Ages like Tell Judaidah.

Sir Leonard Woolley visited the site of Tell Atchana (ancient Alalakh) after the completion of his ground-breaking research at the ancient city of Ur in southern Mesopotamia. After his work at Ur, in 1935, his renewed research interest was to "trace early cultural relations between the Aegean and the Asiatic mainland, throwing light if possible, upon the development of Cretan civilization and its connections with the great civilization of Nearer Asia; this meant that my search must be conditioned by political and economic history, by harbours and overland trade-routes" (1955, p. 1). The excavations at Tell Atchana yielded several potentially significant results for the Near Eastern history, although the finds had usually suffered from poor provenance and stratigraphy, and were subject to debates over the years. After the initial excavations of Leonard Woolley, further excavations are still being conducted at Tell Atchana by the Koç University since 2000 (Yener, 2013).

Toprakhisar is the newest excavation project in the region conducted by the Archaeological Museum of Hatay and the Mustafa Kemal University. This salvage excavation started to produce valuable data for the MBA levels so far, whilst the occupation sequence is much longer than a possible start during the Chalcolithic. The location differs from any other excavation in the region. It is located on the Kuseyr Plauteau (alternatively Jebel al-Aqra in Arabic in Altinözü County of Hatay Province). The mountainous and undulating topography of this area is the most intriguing reason for the importance of the site (Akar & Kara, 2018).

Al-Mina (modern Tell Sheikh Yusuf) is a small (1 ha.) but important trade hub in the Orontes Delta. The excavations by Leonard Woolley at this site produced a considerable amount of Greek Geometric pottery, suggesting being the exemplary of the interaction zone between the Near Eastern and the Greek worlds during the seventh century BCE, although more recent excavations show evidence for its greater Levantine character in terms of pottery and architectural remains (Osborne, 2013, p. 783).

2.2 EARLIER ARCHAEOLOGICAL RESEARCH AT TELL TA'YINAT

2.2.1 Excavations

The Oriental Institute of the University of Chicago's Syrian-Hittite expedition lasted four seasons from 1935 to 1938 and achieved to document five distinct architectural phases of the Iron II and III levels on the site (Harrison, 2014b)[4]. These architectural phases were then named as "Building Periods". These excavations primarily focused on the "West Central Area" -as the excavators called it- on the upper mound where the large exposures of the Iron II and III levels (Amuq Phase O, ca. 900 – 550 BCE) had been uncovered.

The Syrian-Hittite expedition, most famously, identified the Building I which was *the bit-hilani* palace of the Tayinat. The *bit-hilani* type is characteristic of the Syro-Anatolian states (Akkermans & Schwartz, 2009, p. 368). These public buildings have usually a porticoed entryway, with one to three columns, which were elaborately carved. This entryway connects to the long side of a rectangular central room. To the south, a *megaron*-style temple (Building II) was uncovered which was also constructed during the Second Building Period; more specifically ca. 825 – 720 BCE. Another *bit-hilani* palace Building IV, and Building VI were

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[4] The mound physically changed after the end of initial research of OI teamin 1938. Over the years, the mound was allocated toagriculture and grazing which left a distinct mark on the composition of modern vegetation on the mound. Additionally, a farmstead and a cotton factory have been built on top, more specifically on the Assyrian palace to the south of the mound, despite the strict legal regulations of the modern Turkish state.

also assigned to this period. All these buildings were part of a larger complex connected with Courtyard VIII. This complex has an entrance through a large gate (Gateway XII) from the southwest. A second gate (Gateway VII) is located on the eastern edge of the upper mound. Two other gateways were also found in the lower town (Harrison, 2014b, pp. 405-6). They all are assigned to the Second Building Period which was the most extensively and well-preserved level uncovered during the OI excavations. On the other hand, this period ended, most likely, after the annexation of the town by the Neo-Assyrian Empire in 738 BCE (Osborne, 2013, p. 781).

This level is also distinct from the earlier First Building Period although the architectural evidence is more fragmentary. Two more buildings had been identified by the Chicago excavations on this level. These fragmentary monuments are listed as Buildings XIII and XIV and were uncovered under the floors and walls of several structures of the Second Building Period. These buildings are of a considerably large structure, but their floor plans are not reminiscent to a *bit-hilani*. The foundations of Building XIII were constructed by deeply-cut through, vertically-faced trenches, filled with unbaked brick. This construction technique remains identical to the technique used on other excavated buildings in the West Central Area. Some finds of unproven origin, such as Luwian Hieroglyphic inscriptions, two large column bases and carved basalt orthostats, found in the secondary and tertiary contexts of the Second Building Period, were most probably part of this Building Period (Harrison, 2007a, p. 63).

The annexation of the town by Assyrians also follows a change in the urban layout of Tayinat. The Third and Fourth Building Periods largely account for the renovations of the Buildings I and II and subsequent Neo-Assyrian construction activity in the town. During Building Period III, a large elevated structure in rectangular form, Platform XV was built to the northwest of

Building I. The latter monument and the bit-hilani palace have shown evidence of continued occupation in Building Period IV, but the adjacent temple (Building II) had been abandoned (Haines 1971). Also, a new complex, an Assyrian-style palatial complex, Building IX was constructed at the southeastern part of the upper mound[5] during this period. Haines (1971) also assigned the pavement (Floor 1) of the adjacent Gateway VII to this occupation phase (cf. Harrison, 2016, p. 31).

During the final occupation phase, Building Period V, the excavators identified Building X as another architectural addition to the urban layout of Tayinat. Building X is a series of walls to the northeast of Building IX possibly functioning as retaining walls.

2.2.2 Test Trenches

A series of soundings on the upper mound were carried out by the Syrian-Hittite expedition. These soundings produced the earlier history of occupation on the site. According to these soundings, the habitation was extended to the 3rd millennium BCE levels. Evaluations of the ceramic evidence show that the pre-Iron Age occupation lasted during the Amuq Phases H, I, J (Haines, 1971).

2.3 TAYINAT ARCHAEOLOGICAL PROJECT (TAP)

Since 2004, the University of Toronto's Tayinat Archaeological Project (TAP) undertakes interdisciplinary research concerning the emergence of complex social, political and economic institutions in the Early Bronze Age, as well as the demise and regeneration of social complexity during the Iron Age, in this historically important region (Harrison, 2007a). The specific goals undertaken in the first years were to define physical characteristics

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[5] Today, the architectural remains of this complex reside under the cotton factory on the upper mound.

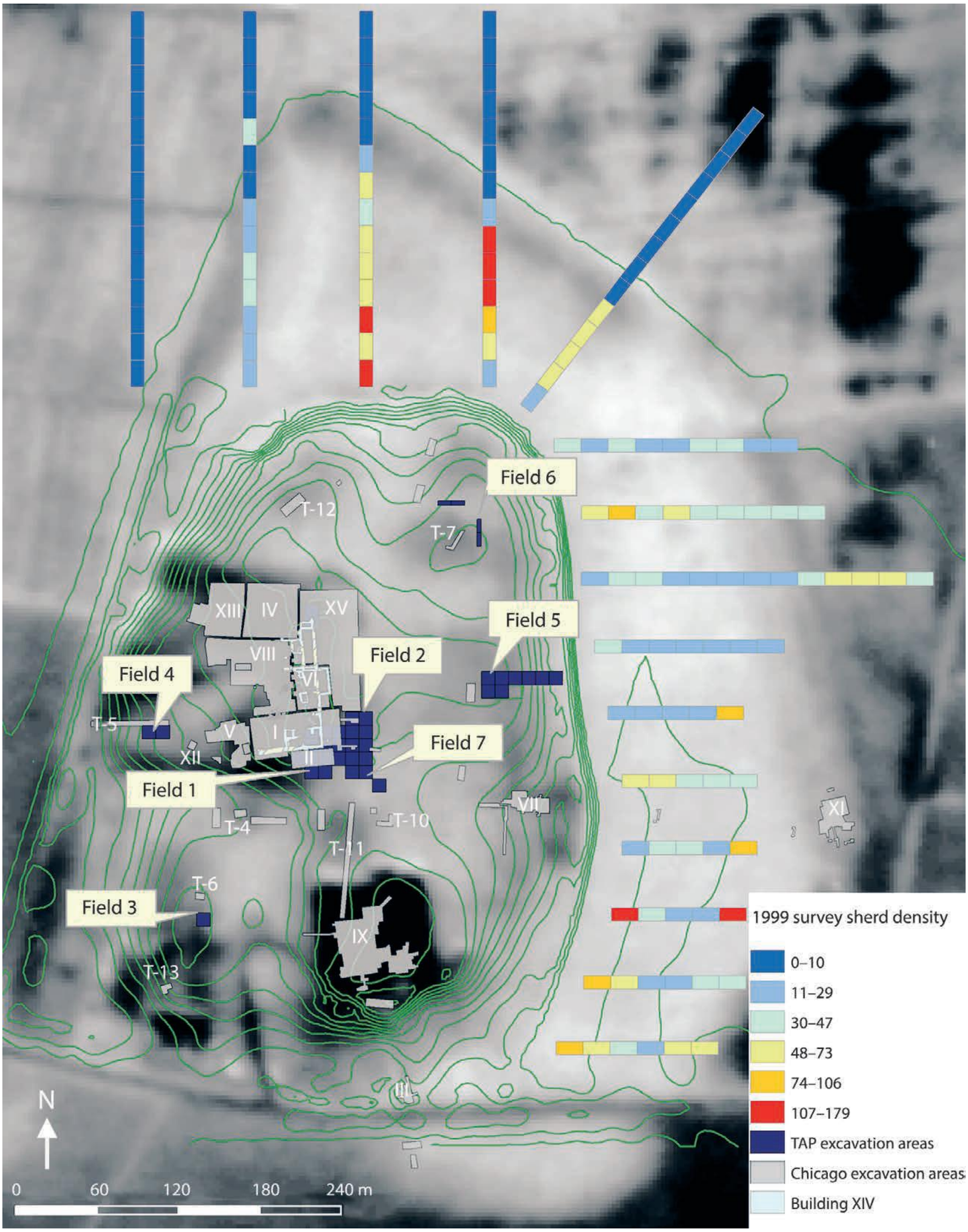


Figure 3 Topographic map of Tell Tayinat showing the principal excavation areas and surface pottery collection in the lower settlement by density. Grey areas and Roman numbers demonstrate the excavation areas and attested building numbers by the Oriental Institute team (Graphic courtesy: S. Batiuk, after Welton et al. 2019).

of the mound, to document all visible architectural remains on the site and the sub-surface remains by remote sensing, to assemble extensive collections of archaeobotanical, faunal, ceramic and other artefactual remains and to integrate the findings in a relational database (Harrison, 2007a). The excavations in 2004 and 2005 first targeted to uncover what remained from the initial excavations of the Syrian-Hittite expedition. This aim was achieved by designing two excavation areas called Field 1 and 2 roughly to the south of the West Central Area as designated by the OI team.

One of the specific goals of the resumed excavations by the University of Toronto was to have a better understanding on the stratigraphic sequence of Early Bronze and Iron Age levels on the site (Harrison, 2012). The longest stratigraphic sequence excavated so far had been attained from Field 1, which contained nine superimposed sequential phases (see below *section 2.3.1* for details). According to relative chronology based on ceramic evidence, the occupation at Tayinat primarily covers EBA IVB –and possibly the earliest occupation was at EBA III coinciding with mid-3rd millennium BCE regarding soundings and shard finds, but EBA III and EBA IVA levels were not uncovered until today. Targeted excavations to uncover these earlier levels will be carried out in the coming seasons. The occupation has resumed on the upper mound with the start of Iron Age I from mid-twelfth into the early tenth centuries. Iron II and III exposures are relatively small but nonetheless informative. Iron II deposits were encountered in Field 7. The deposits most likely date to the 9th or early 8th centuries. Iron III deposits which were uncovered in Field 5, on the other hand, roughly coincide with 7th century occupation of Tayinat (Fig. 3).

2.3.1 *Overview of archaeological findings and chronology at Tell Tayinat*

2.3.1.1 *Early Bronze Age remains at Tell Tayinat*

The EBA levels had been encountered in two excavation areas; Field 1 and 3. The most substantial amount of exposures had been achieved in Field 1; therefore, the primary archaeobotanical investigations focused on this area. However, to mention briefly, the excavations in Field 3 started in 2005 "to confirm the presence of EBA remains … and to clarify the depth and accessibility of these remains" (Harrison, 2007a, p. 6). The excavation team reached the EBA levels at the depth of 2 meters in G4.72 while the exposure was small to a limited 2 x 10 m sondage. A series of walls, a plaster installation and an intact *pithos* had been uncovered from this sondage.

2.3.1.1.1 Field 1 excavations

The EBA levels in the Field 1 (Fig. 4) contain several well-preserved archaeological features. FP 9, which is identified as the earliest occupational layer unearthed at the site so far, includes mixed deposits of EBA III and EBA IV from a relatively limited exposure. The remains of FP 8b consist of a destruction layer of a well-preserved EBA building with *in-situ* ceramics on the floors and one and half meter-high walls. FP 8a, on the other hand, contains the destruction debris accumulated within this particular building (Welton, 2014, p. 342).

Welton (2014) observes that the remains of FP 7 constitute a phase of ephemeral post-occupational debris with no permanent architectural elements, but only pits and surrounding fill deposits were recovered. FP 7 dates to the later part of the Amuq Phase J in the sequence of Braidwood. It is observed that the fill deposits are stratigraphically younger than the pit deposits which represent the terminal EBA occupation at the site (Welton, 2014, pp. 341-2).

The investigations on animal bones are still limited. Although preliminary, Lipovitch (Welton et al., 2011) analyzed some 3.500 animal bones from the EBA levels of Tayinat. According to his analysis, FP 8 is characterized by the predominance of ovicaprid and unidentified medium-sized mammals with a substantial amount of fish bones (29.4 % of the bone assemblage). Also interesting is the thermal alteration of the bones which was considered as unusually high (9.9%) by the zooarchaeologist of Tayinat. FP 7 results also indicate that the majority of the remains are mammalian bones. Fish bones, 11% of the identified specimen, had also been recovered from the sorting of heavy fractions alongside a few bones of birds, turtle/tortoise and one fragment of an amphibian bone. As usual, ovicaprids represent the

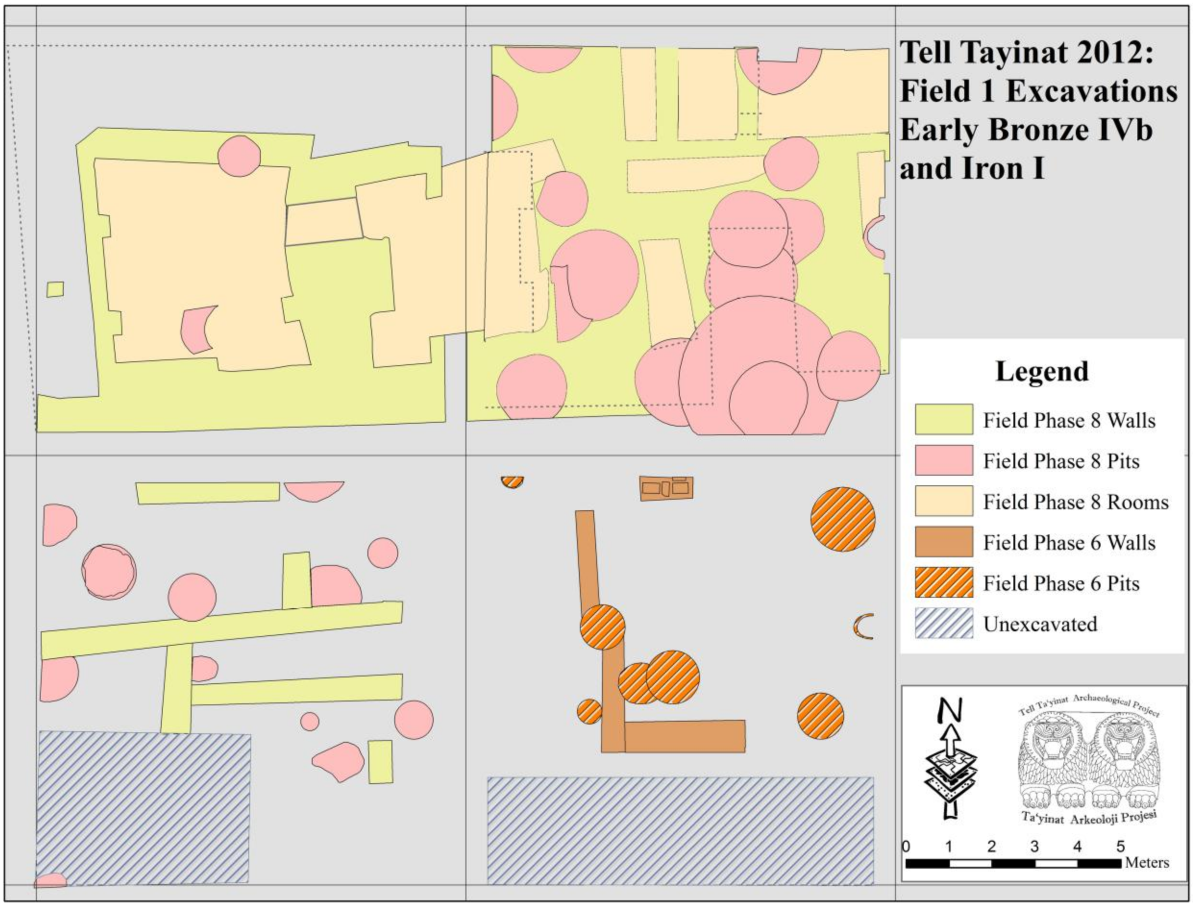


Figure 4 **The topplan of Early Bronze Age (FP8) in 2012 and some archaeological exposures of Iron Age I phases (FP6) at Tell Tayinat (after Harrison, 2012, unpublished seasonal report. Retrieved from http://sites.utoronto.ca/tap/assets/2012report_eng.pdf).**

largest portion of the identified animal bones while larger mammals such as *Bos* are represented with only forty-five fragments (2.2 % of the total). Lipovitch argues that the finds of *Cervus elaphus,* as also recorded in the FP 8, suggest the continuation of hunting large game animals during the FP 7.

2.3.1.2 Iron Age I remains at Tell Tayinat

2.3.1.2.1 Field 1 excavations

The largest exposure of Iron I levels has been documented in Field 1 (Fig. 5 & 6). In 2004, an excavation team opened two 10 x 10 trenches (G4.55 and G4.56) to document what remained intact after the Syrian-Hittite excavation. These trenches are just located on top of the *megaron*-style temple Building II which was first uncovered by Syrian-Hittite excavations. However, over the years, only a fragmented stone surface is left intact from this monument. Fortunately, this structure sealed a well-preserved sequence of Iron Age I remains with a wealth of pottery and other material culture. In the following year in 2005, two more 10 x 10 trenches (G4.65 and G4.66) had been opened up to the south of the former ones to expand the area of research (Harrison 2007a: 87).

The extent of Iron I occupation at Tayinat is estimated as ca. 12 ha. The Iron Age I levels had been delineated into a four-phased stratigraphic sequence (FP 6 – 3) since the same sequence was documented in other excavation areas and neighboring sites in the region (Harrison 2007: 88) (see Table 2 for an overview of regional chronology). A series of pits and silos with fragmentary wall segments and surfaces had been unearthed from these areas (Harrison, 2007a, p. 87, 2014b, p. 399). FP 6 and 5 represents the earliest occupation at the site. These two phases are heavily disturbed by later building activity. However, Harrison (2007a, p. 87) observes a large storage silo (G4.56:153/154; Fig. 7) with several smaller pits distributed between these larger silo-like features. The remains from FP 4, instead, only recovered in the

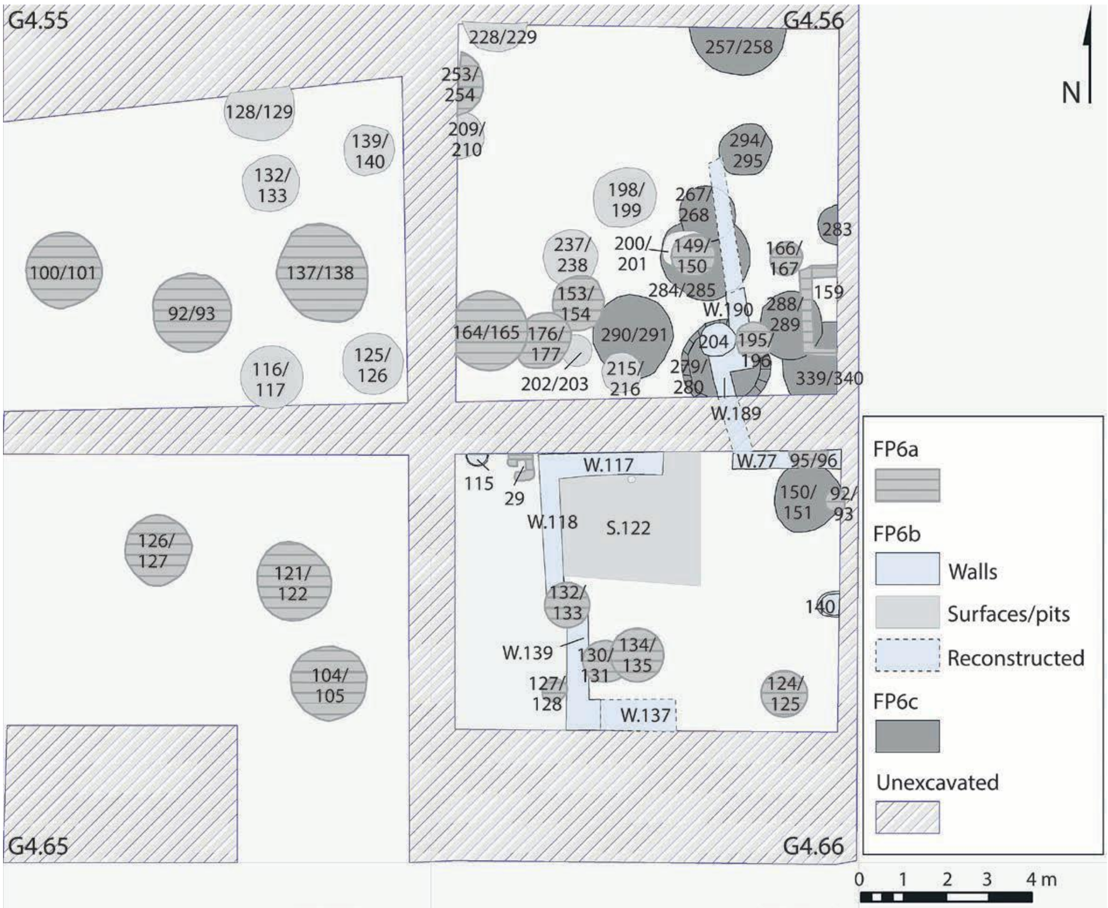


Figure 5 **The topplan of FP6 and associated subphases with locus numbers (Graphic courtesy: L. Welton; after Welton etl. 2019).**

two northern squares, include a well-preserved rectilinear structure (G4.56:23) and a stone pavement or platform (G4.56:20). It is apparent that this level was much damaged due to later building activity to construct the foundation of Building II and extensive pitting activity during FP 3 (Fig. 8). This phase of the sequence is characterized by several pit features which was best identified with two pits in G4:55. No walls or free-standing structures had been uncovered. The FP 2 was assigned to the foundation deposits of Building II which was roughly dated to the late 9th or early 8th centuries BCE. The last phase (FP 1) in the sequence consists of the post-occupational plow zone and topsoil (Harrison, 2007a, pp. 87-88).

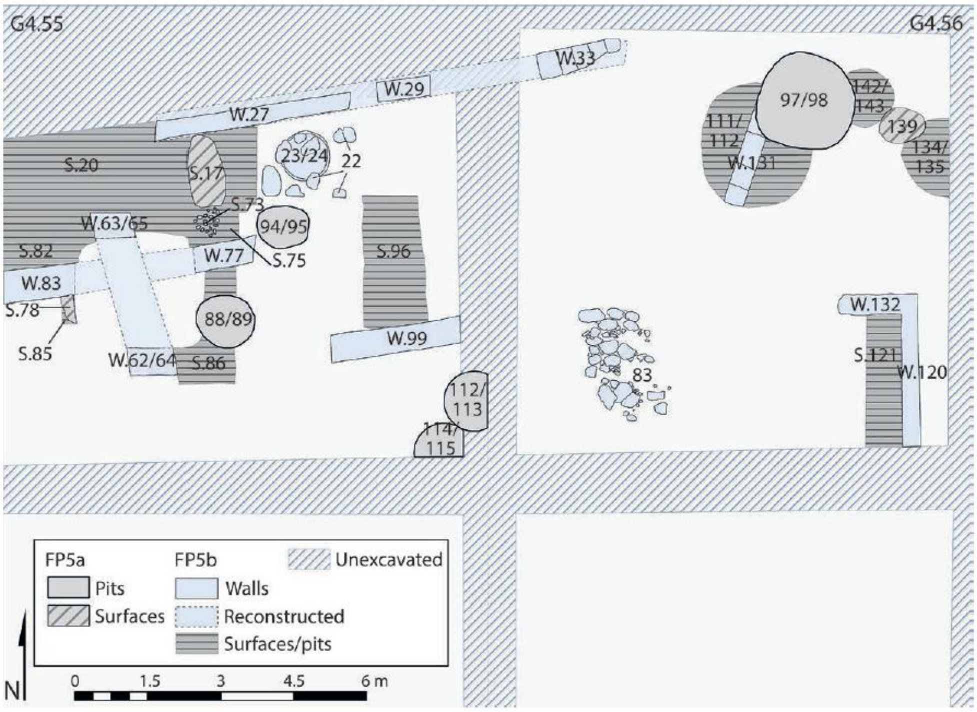


Figure 6 The topplan of FP5 and associated subphases with locus numbers (Graphic courtesy: L. Welton; after Welton et al. 2019).

Figure 7 Silo structure (G4.56:111/112) with dividing wall (G4.56:131) in FP5; arrow points north (Photo courtesy: S. Batiuk, after Welton et al., 2019).

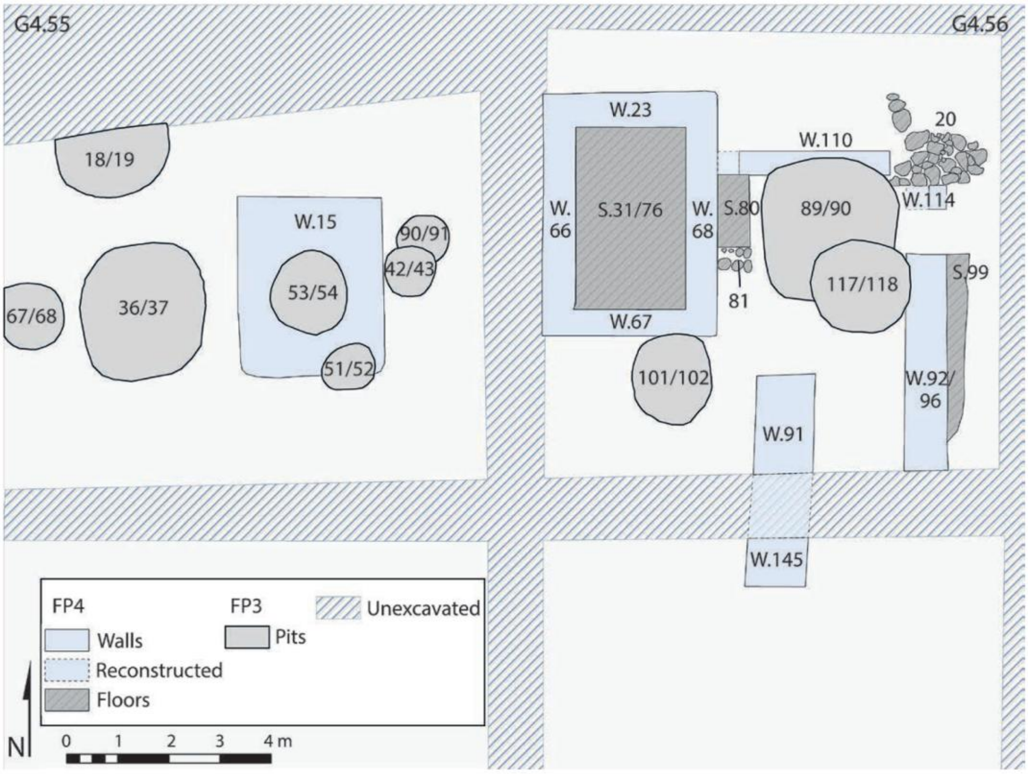
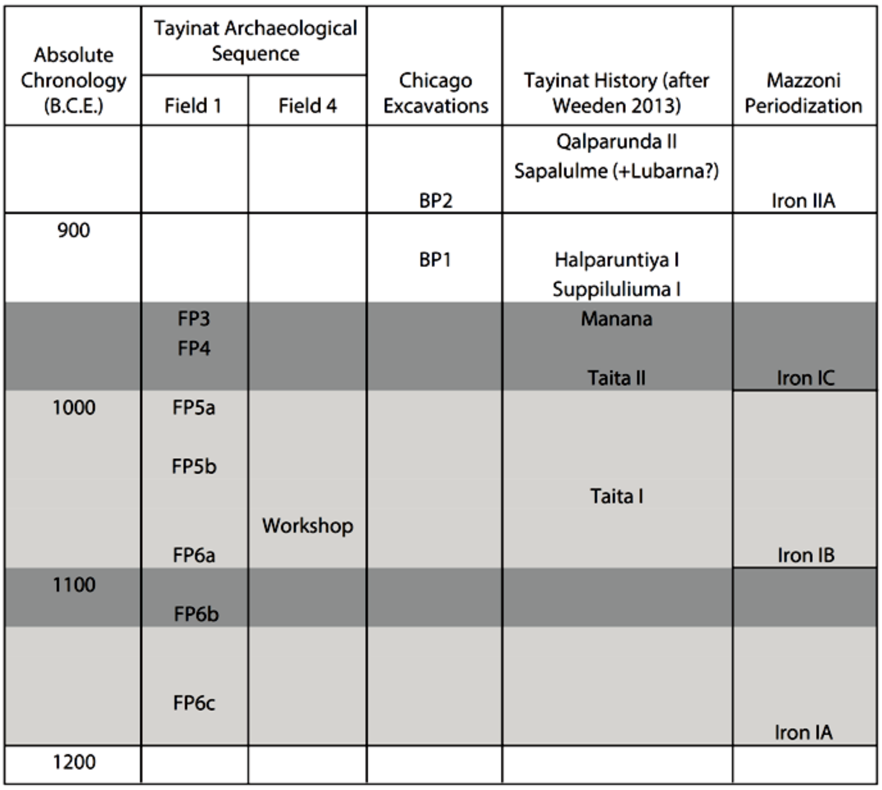


Figure 8 The topplan of Field Phase 4 and 3 (Graphic courtesy: L. Welton; after Welton et al., 2019).



Absolute Chronology (B.C.E.)	Tayinat Archaeological Sequence		Chicago Excavations	Tayinat History (after Weeden 2013)	Mazzoni Periodization
	Field 1	Field 4			
			BP2	Qalparunda II Sapalulme (+Lubarna?)	Iron IIA
900			BP1	Halparuntiya I Suppiluliuma I	
	FP3 FP4			Manana Taita II	Iron IC
1000	FP5a FP5b FP6a	Workshop		Taita I	Iron IB
1100	FP6b				
	FP6c				Iron IA
1200					

Table 2 Iron Age I chronological sequence at Tell Tayinat showing the field phases and subphases in Field 1 (after Welton et al., 2019).

2.3.1.2.2 Field 2 excavations

Another excavation area which was opened in the West Central Area of the Syrian-Hittite excavations, specifically in the location of the previously excavated Building I, is Field 2. According to Harrison (2007a, p. 90), “the primary objectives of the excavation in this area, identified as Field II, were to determine whether anything remained of Building I, and then to excavate the earlier levels associated with Building XIV, and thereby better establish the stratigraphic relationships between these two structures”. The archaeological remains recovered from this field are most probably dated to the later Iron I and the earlier Iron II although more precise dating still awaits clarification (see Harrison, 2007a for a discussion of periodization of archaeological finds).

In regards to this purpose, a 10 x 10 square (G4.35) was opened in 2005 where a series of large mudbrick walls had been found. In the subsequent years of 2006 and 2007, the excavation area was enlarged with two more 10 x 10 meters squares (G4.45 and G4.46) to the south and east. These squares also link Field 1 and Field 2. More significantly, the excavations starting from the 2005 excavation season revealed the remains of a particularly large structure with 3-meter-walls on average immediately 15-20 cm below the modern topsoil. This structure has a grid layout with no entry ways. The probes had been opened in Squares G4.35 and G4.45 to find floors and to uncover the depths of these walls. The probes did not produce any surfaces or floors corresponding to the use phase of this structure, but the foundations of the walls had been reached at the depth of 3 meters. This indicates that there was once a massive building in this location which can be attributed to Building XIV of Syrian-Hittite excavations (Harrison, 2007a, p. 90, 2007b, p. 5, 2009a, p. 179).

2.3.1.2.3 Field 4 excavations

This area of excavation yielded a metal workshop in square G4.34 with several features and artifacts dating to earlier Iron I. The square is located to the western part of the upper mound. Harrison (2014b, p. 400) and Roames (2011) report that the chemical analyses of the metal slags and the debitage which had shown that iron smiting, copper smelting and copper alloying were all performed in this location. The workshop seems to be non-specialized to a certain metal and produced both utilitarian and prestige objects (Roames, 2011, p. 154, see Welton et al., 2019 for the most recent assessment).

This field was omitted from the archaeobotanical investigation. The samples gathered from this location were rich in carbonized plant materials. Therefore, they were scanned in hope of finding the plant materials of archaeobotanical importance. However, the samples do not contain seeds and fruits, but pure charcoals, which is understandable since the location had been used as a metal workshop.

2.3.1.3 Iron Age II remains at Tell Tayinat

2.3.1.3.1 Field 2 excavations

The excavations of TAP for Iron II levels are still limited. TAP opened a new trench in 2007 to expand the excavations in Field 2 to go further east and to uncover layers not previously disturbed by the Syrian-Hittite expedition. TAP recovered a shard-strewn surface. This surface contains ceramic finds of Red-Black Burnished Ware (Iron II). It is stratigraphically sealed by an expansive cobble-stone surface which also covers the area south and west to the small tripartite temple (see the *section 8.2* below for detailed description of Building XVI).

2.3.1.3.2 Field 7 excavations

In 2011 and 2012, the Toronto team continued to excavate south of the monument and revealed several sizeable sculptures and archaeological features buried under the cobble-stone surface in Field 7. These sculptures include the torso and head of Šuppiluliuma II (likely the Patinean king Sapalulme mentioned by Assyrian king Shalmaneser III, who was part of the anti-Assyrian coalition of Syro-Anatolian states), an elaborately carved stone lion, a basalt statue base depicting the master and animal motif and a column base with figures of a winged bull and sphinx (Harrison, 2014b, p. 407).

It is argued, that most likely there was a large gate complex, providing entrance to the upper citadel once during the Iron II. Harrison (2014b, p. 407) observes that "[…] Thus far only the uppermost traces of the gate have been excavated, and therefore its plan remains unclear. Nevertheless, deep probes to the southwest of the gate area indicate a steep slope to the south in this part of the site, likely part of a trough or shoulder that helped to elevate and separate the northern part of the upper mound from the rest of the settlement, forming a citadel-like acropolis". This gate complex was most possibly modified or removed during the Assyrian occupation of the site. In the 2017 excavation season, the Toronto team had found another sizeable statue belonging to a female figure, but unfortunately it lacks any inscriptions unlike the statue of Šuppiluliuma II.

Two squares (G4.68 and G4.69) which were opened in 2012 are also interesting. These squares are located to the south of G4.58. A cobble-stone surface had been reached at the depth of 2 m in G4.68 which partly continues in the southeastern part of G4.69. Excavators suggest that this cobble-stone surface could be a road that reaches to the southwest of the gate complex.

2.3.1.4 Iron Age III remains at Tell Tayinat

2.3.1.4.1 Field 2 excavations

Recent excavations have unearthed an exceptionally well-preserved structure at the heart of the upper mound in 2008. Building XVI, as named by the TAP team, is elegantly positioned in a larger monumental complex including the renowned *bit-hilani* palace of Tayinat (Building I) to the west and an adjacent temple to the southwest (Building II). This building measured 9 x 21 m in size. On the other hand, both the Syrian-Hittite and TAP excavations have unearthed several Hieroglyphic Luwian fragments on the cobble-stone surface in the vicinity of Building XVI (Harrison, 2014b, p. 406).

For a thorough description of Building XVI, see *sub-section 8.2*.

2.3.1.4.2 Field 5 excavations

Field 5 was designed as a step-trench along the northeastern slope of the upper mound in 2008 (Fig. 9). The aim of opening new squares over this area was “to investigate the archaeological sequence in a part of the site not explored by the Syrian-Hittite Expedition, particularly the Iron III (ca. 725 – 600 BCE) and later phases of Tayinat’s occupational history” (Harrison, 2016).

Two 10 x 10 m squares (F5.98 and F5.99) were opened in this excavation area in 2008 which revealed part of the remains of a Late Assyrian courtyard-style building. During the next season in 2009 the area was extended to the south and east with two other squares. The remains, so far, represent three small rooms, partly plastered, and flanked to the north by another larger room (courtyard). This layout possibly forms an internal courtyard of the building. The eastern part of the building has suffered from slope erosion. To the north of F5.98, a layer of pottery and animal bone concentration had been uncovered. The pottery finds include Cypro-Geometric and Cypro-Phoenician imports, large amount of Red slipped Burnished Ware as well as some other ware types indicative of the late 8th-7th centuries BCE. There are also several small finds such as stamp seals and clay bullae which may indicate an administrative function according to the excavators (Harrison, 2016).

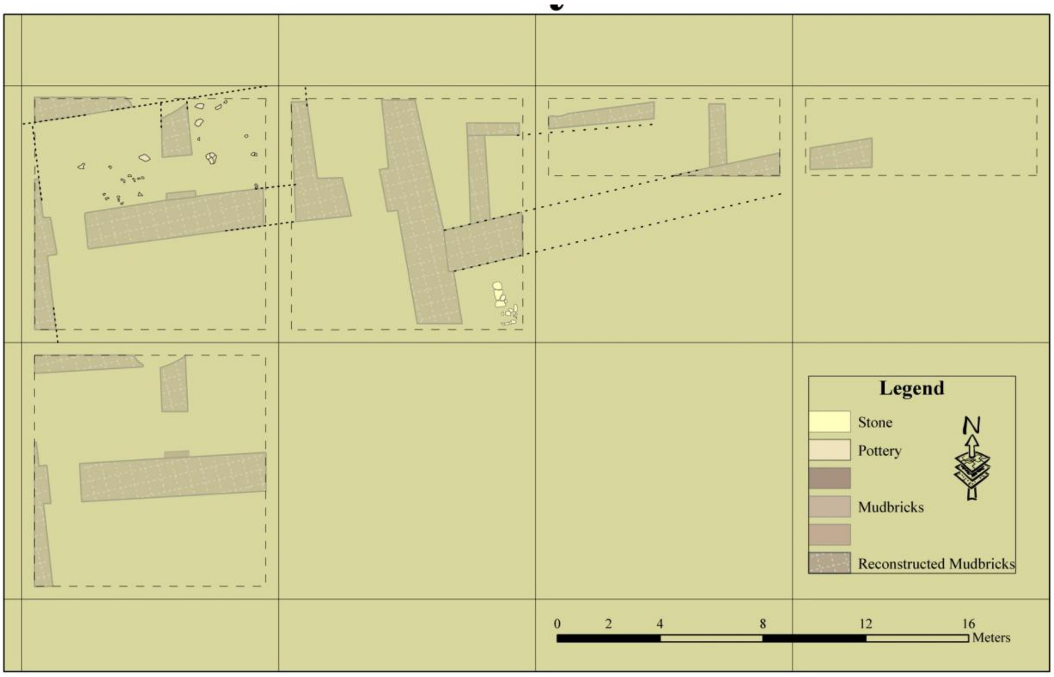


Figure 9 The topplan of Field 5, the "Courtyard Building" (Harrison, 2012, unpublished seasonal report. Retrieved from http://sites.utoronto.ca/tap/assets/2012report_eng.pdf).

2.3.2 Computational Research in the Ancient Near East Project (CRANE)

One of the primary goals of TAP among others is to provide an outline of the region-wide developments in climatic and environmental dynamics during the Early Bronze and Iron Ages. Concurrently, another large-scale data project, Computational Research in the Ancient Near East (CRANE) initiative, directed by Timothy Harrison of the University of Toronto, has been implemented to create "a multi-disciplinary consortium, made up of archaeologists, historians, palaeoenvironmentalists and computer scientists, that seeks to facilitate the creation of such a collaborative scholarly framework" in (Harrison, 2018) including six important sites in the Orontes Watershed, Tell Tayinat, Zincirli, Tell Acharneh, Tell Nebi Mend and Qatna and Tell Qarqur.

The project goal aims to complement the data integration from different study fields of archaeological research at Tayinat and at sites along the Orontes Watershed. This focus of research enables the researchers to investigate every aspect of ancient societies in a more holistic perspective as the acquisition had become easier through the implementation of a computational platform in cooperation with the University of Chicago, called Online Cultural and Historical Research Environment (OCHRE). Since being operational, this platform serves to provide a “data-warehouse” to the heterogeneous datasets which integrate ways to study the same research problems from disparate data types of various archaeological disciplines.

Other aims include “to develop a fully integrated, temporally and spatially controlled cultural and palaeoenvironmental record for the Eastern Mediterranean that can support complex analyzes of heterogeneous datasets drawn from this record in both space and time”; “model forward and inverse simulations of past human-environment dynamics and a range of social practices, including both climatic and anthropogenic impacts based on parameters supplied by empirical datasets”; “create spatially accurate and realistic 3D visualizations of reconstructed ancient landscapes and human activity based on empirical data and the output of simulated scenarios” (Harrison, 2018, p. 1).

2.3.3 Surveys and corings

Prior to the resumed excavations of the University of Toronto in 2004, a surface collection survey in 1999 had been initiated to uncover the physical properties of the mound (Batiuk et al. 2005). According to the findings of this survey, the site formed ca. 18 ha in size in the upper mound, with a lower town (ca. 20 ha.) which extends to the north, east and south-east of the mound. To the west of the mound, no shards were present in the surface collection which indicates that most probably the Orontes River would have flowed to the side of the mound during the Iron Age (Batiuk, 2007, p. 56). The lower town is nowadays buried under sedimentary deposits of the Orontes River and colluvial deposits from uplands about 6 to 3 meters in places. Due to difficulties to remove this alluvial fill to reach the occupational levels, the excavations have not yet focused on the lower town.

Additionally, in the 2002-2003 field seasons, a magnetometry survey had been conducted to better understand the physical properties of the lower town of Tayinat. This study revealed that the Iron Age levels of the lower town are basically constructed with mudbrick and not stones. Batiuk reports that most probably the stratigraphy includes multiple phases of Iron Age occupation in the lower town. Furthermore, it is also known that the city walls are conspicuously narrower with 2.5-3 meters in width in comparison to the regular 5-m-wide city walls of contemporary sites (2007, pp. 54-55).

More interestingly, TAP launched a coring program to determine the full extent of the lower mound. This study confirms the earlier findings of Haines (1971) that the lower town is located about 2-3 m below the surface levels. During this coring program initiated in 2004 and continued in 2005, the cores produced archaeological deposits reaching a depth of 8 m below the modern topsoil at the eastern sector of investigation. However, the accumulation of cultural deposits at the western sector of the base of the upper mound seem to differ since this area only showed evidence of sand and shell deposits. According to the excavators, these findings can suggest the presence of a relic water channel or lake bed to the west of the site (Harrison 2007a, p. 6).

Also surprising is the soil data where this coring program brought to light some interesting results for the past environmental settings. To the west, north and east of the mound, the consistent trend is the appearance of coarse-ground sand grains at about 3 m-depth which extends further to the southwest to a nearby small mound called as Tayinat el-Shaghir. According to Batiuk, “the bands of sand extends too far around the mound and the grains were too large to have been deposited by river sediments, rather they appear to be the result of a body of still water: a small shallow lake” (2007, p. 56). This possibly indicates that the town was moated during its Iron Age II occupation in the early 9th century which also fits well the presence of thinner city walls as well as the textual and visual description (Balawat Gates) of Shalmaneser’s campaign to the land of Unqi.

Another recent survey launched by James Osborne aiming to comprehend; “a) settlement density as reflected by the differential concentration of artefacts; b) detect the presence of elite and non-elite neighborhoods through analysis of find distributions; and c) determine differences in functional use of space as indicated by the nature of the finds” (2017, p. 92).This study revealed that the occupation density was much denser in certain areas of the lower town regarding the distribution of artefacts across the sampled areas. Moreover, the pottery evidence mostly belongs to Iron Age II and III periods roughly covering ninth, eight and seventh centuries BCE. Largely two ceramic traditions appear in the pottery assemblage; Common Ware and Red Slipped Burnished Ware while the Assyrian Palace Ware was only minimally represented. Osborne observes that the find density of these two ware traditions were spatially distributed unevenly indicating possible status differentiation between elites and non-elites in the town (Osborne, 2017, pp. 100-1).

CHAPTER 3. HISTORICAL, ENVIRONMENTAL and CLIMATIC SETTINGS OF NORTH SYRIA

3.1 GEOGRAPHY

The geographical terms Levant and north Syria are somewhat problematic when defining the geographic extent and limits of these derivations. Suriano describes the term Levant as stretching three prominent components, including the coastal Mediterranean region, the great Syro-African Rift, and the vast desert which lay on the east of these geographic units (2014, p. 9). According to him, the northernmost limit of the region is the Amuq Plain extending south up to the north coast of the Sinai Peninsula. The Syro-African Rift represents a long geographical trough, covering the Orontes, the Beka'a and Jordan Valleys, before extending further southward to reach the East African Rift. To the east, Suriano (2014) regards the Jebel el-Bishri and Euphrates River as the eastern boundary of the northern Levant while to the south, the Litani River in Lebanon marks the southern boundary for the northern Levant (see Mantellini, Micale & Peyronel, 2013 for the delimitation of northern Syria including the archaeological surveys in the region).

The topography of coastal northern Syria including modern Turkey and Lebanon, on the other hand, is characterized by a series of mountain chains which is located parallel to the Eastern Mediterranean coast in N – S direction. From north to south, the mountains discontinuously follow each other while the Rift Valley extends further north up to Kahramanmaraş to join to another depression unit there. Brice describes that "in consequence of relatively low elevation and discontinuous structure of mountains in this section, the climatic influence of the Mediterranean extends here more noticeably and more deeply into the interior than anywhere farther south" (1966, p. 204). Brice (1966, p. 203) notes that

> “[…] the mountain ranges are in general only slightly folded, and have been splintered and separated by cross-rifting into distinct blocks of very varying height and geological constitution; the rift valley ranges in elevation from 3,600 feet above to 2,600 feet below the sea level, is drained by four different river systems, and sometimes takes the form of a broad trough, sometimes of a narrow ravine; finally, the hills of Trans-Jordan and Anti-Lebanon may form a high and broad barrier as in mount Hermon, or may decline to an insignificant swell of the ground, as between Antakya and Aleppo”.

Suriano classifies the geography of the northern Levant into two parts defining the Orontes river for the lower half and the uplifted block (the Lebanon and Anti-Lebanon Mountains) with mountain ranges for the upper half (2014, p. 10). The Orontes River is the major hydrological system in the northern Levant originating from the Beka’a Valley. The water of the uplands of the Lebanon and Anti-Lebanon Mountains drains to the south. It immediately enters its first regulator, the Lake Homs, in the Homs Valley between the towns of Homs and Hama (ancient Hamath). Following, the Orontes River enters the ill-drained Ghab Valley before reaching the Amuq Plain between Jebel Akra and the Kurt Dag mountain system (Brice, 1966, p. 209).

3.2 HISTORICAL DEVELOPMENTS

3.2.1 Late Chalcolithic-Early Bronze Age: The emergence of urbanism

The emergence of early urban centers often varies from one region or period to another. The influence of Southern Mesopotamian developments in the north (western Syria and Northern Mesopotamia) is still a matter of debate. There are three models in the development of urban centers in north Syria; 1) Elites emulated southern Mesopotamian symbols and technologies of authority in order to legitimize and intensify their own positions while the complex centers developed on their own; 2) North Syrian participation to the southern Mesopotamian demand for trade goods and raw materials; 3) Direct interference in the politics of northern Syrian centers to secure the trade routes of raw materials such as metals, timber and stone

(Akkermans & Schwartz, 2009, p. 277). Akkermans and Schwartz notes that the third aspect is unlikely to be the reason for the development of early urban centers in northern Syria since the direct interference with military campaigns are only evident from 24th century BCE, when the urban centers had already emerged in northern Syria. The first and second model of development would most likely apply to different regions in the wider northern part of Syria. The trade would be important for the middle Euphrates region while according to the authors the second applies more to the Khabur and western Syria (2009, p. 277).

The advent, of the first urban centers, which seem to be a later phenomenon in this region, occurred during the mid-3rd millennium BCE (Oates et al., 2007; Stein, 2004; Akkermans & Schwartz, 2009; Lawrence & Wilkinson, 2015). Lawrence and Wilkinson (2015) and Wilkinson et al. (2014) investigate the "urbanization process" through archaeological surveys undertaken in Northern Mesopotamia and northern Syria. They define two phases of urbanization in the northern Mesopotamia. The first covers the Late Chalcolithic (4.400 – 3.000 BCE) and the second phase coincides with the latter part of the Early Bronze Age (mid-3rd millennium BCE). These two phases differ from each other by size, spatial organization, settlement layout and regional developmental trajectories (Lawrence & Wilkinson, 2015, p. 334). According to their observations, there are three pathways of urban development: the first one is the older urban centers growing gradually to become the nucleus of satellite sites. Secondly, the endogenous upstarts, as the authors call it, represent the reorganization of local settlement patterns and movement from external population reservoir towards older towns. Lastly exogenous upstart means the movement from external population reservoir towards previously smaller towns. They also recognized that the exogenous upstarts tend to locate in marginal locations ("zone of uncertainty" as Wilkinson previously conceptualized) where the rain-fed agriculture must be supplemented with irrigation agriculture to sustain the plant economy.

Some of the features of early urbanization have already been observed in northern Syria during the “Uruk Expansion” in the Late Chalcolithic (Yoffee, 1995; Mazzoni, 2000a; Stein, 2012). The Uruk influence outside of southern Mesopotamia remains smaller. The “true” Uruk colonies with strong southern Mesopotamian character are largely concentrated in the Middle Euphrates valley, at sites like Habuba Kabira and Jebel Aruda, which were new foundations on virgin soil. To the west and north of this region the evidence of Uruk influence is more fragmentary and not identical to the southern Mesopotamian developments (Stein, 2012). The excavated sites in this region demonstrate a mixture of local and Uruk materials (Akkermans & Schwartz 2009, p. 203). Stein (2012) argues that even though some ideological and administrative elements had reached to Northern Mesopotamia during this period, the political system shall be conceived decentralized since the monumental art, the size of palaces and temples remained insignificant comparatively to Southern Mesopotamia.

The 5th millennium site Tell Kurdu shows evidence of “Ubaid-like” ceramics which were the continuation of northern Mesopotamian influences in the region (Özbal, 2012, p. 326). This evidence shows that the Amuq sites have had already some connections with the other regions of the Near East. Regarding the 4th millennium developments, the archaeological sites in Amuq represent the main providers of information of “Uruk Expansion” for northwestern Syria during the fourth millennium BCE, whilst there are still only few sites investigated compared to the Khabur sites and to the west of the Euphrates (Akkermans & Schwartz, 2009). According to the Amuq sequence, this period coincides to Phase G that roughly covers the timespan between Late Chalcolithic to the EBA II period. Although Tell Kurdu is already abandoned in Phase F, Welton argues that there was a continuity of settlement patterns in the Amuq in addition a sort of settlement hierarchy had been identified. Imar es- Shargi emerges as the dominant settlement of the valley with smaller satellite settlements which do not exceed 2-4 ha in size (2011, p. 20). The Amuq F period is predominated with local chaff-faced pottery in the earlier fourth millennium BCE while a few beveled rim bowls were also present in late F strata.

3.2.2 Early Bronze Age III: The second urban revolution in northern Syria

The subsequent Ninevite 5 (ca. 3.100 – 2.550 BCE) period corresponds to the Late Chalcolithic-Early Bronze Age transition. The Ninevite 5 was a period of increasing social complexity in southern Mesopotamia, but there is little evidence of state formation and urbanism in the north of Syria. However, from the mid-3rd millennium onwards a phenomenon, called the “second urban revolution” by Akkermans and Schwartz (2009), becomes apparent in the archaeological record in the north of Syria. The emergence of early urban centers in the north of Syria seems to have happened during this period with the establishment of settlement hierarchies including regional capitals, secondary centers and small villages. The towns were heavily fortified; occasionally earthen ramparts or glacis were constructed while large-scale administrative complexes evidence the political and economic powers of these early states.

The pottery sequence had been known from the site of Tell Judaidah. Braidwood and Braidwood argue that during this phase, there is strong evidence of the emerging administration in the form of the first appearance of cylinder seals, an increase in the standardization of the pottery and the existence of a metal industry (1960, p. 259; pp. 300-313). Sequentially, the chaff-tempered pottery of Phase F is replaced by wheel-made, mineral tempered “Plain Simple Ware” in Amuq G. More importantly, this is the only Early Bronze Age phase where no ceramic evidence had been found at Tell Tayinat.

Nonetheless, the settlement hierarchies further changed to develop into a three-tiered system when Tayinat turned to be the dominant settlement, along with some moderately-sized and smaller sites in the Amuq Phase H. Unlike the concentration of sites in the central part of the valley in Phase G, starting from Amuq H, the sites became more dispersed along the southern edge of the plain, possibly indicating a reorientation along the trade routes (Welton 2011, p. 20). The pottery evidence from this phase had been investigated in four sites; Tell Judaidah, Çatal Höyük, Tell Tayinat and Dhahab. Welton informs that "[…] This period was marked by the continuation of Plain Simple Ware and the remainder of the standard Phase G cultural assemblage, along with substantial appearance of Red Black Burnished Ware, a distinctive and highly burnished pottery type" (2011, p. 22).

There is greater continuity in ceramic assemblage between Phase I and J. The main difference among these two phases are to be found in the relative occurrences of the various ware types which is characterized by the sharp decline in Red-Black Burnished Ware (Welton 2014, p. 343). The recent excavations at Tayinat helped to clarify the Braidwood sequence with additional data about Phase J. Although Tayinat was presumably the biggest settlement in the Amuq Valley, the exact size of the EBA settlement is still unknown as the remains are largely hidden under the later archaeological and sedimentary deposits (Welton et al., 2011, Welton, 2011, 2014).

The most relevant documentary and archaeological information to understand the socio-cultural settings of the second half of third millennium BCE, had been unearthed from the site of Ebla (modern Tell Mardikh) which is situated about 60 km south of Aleppo. A large concentration of cuneiform tablets had been found in the destroyed palace G of Ebla[6]. These documents are mostly administrative records of a royal household and demonstrate the presence of a highly organized political entity. The Eblaite texts also refer to the political struggle among Ebla and Mari. Both sites possibly compete to control resources and/or trade

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[6] According to the ceramic periodization of the north Syria, the Level IIB1 at Ebla when the palace G is burned down, is contemporaneous with the EBAIVA period in regional periodization. In regard to the Amuq sequence, this coincides to the Amuq I while the subsequent period at Ebla, Level IIB2, is simultaneously occupied in Amuq Phase J or the EBAIVB (Welton, 2011, p. 20).

networks. But at the same time, the texts mention a town called *A-la-la-hu* in the Amuq Valley over which the Eblaite state possessed control. Despite earlier understandings for this site to be the nearby Tell Atchana because of the better-known textual attestations to Alalakh in the kingdom of Mukish in the Middle Bronze Age texts, the recent excavations and refinement in ceramic repertoire, at both sites, revealed that this Eblaite reference most probably indicate a contemporaneous settlement at Tell Tayinat during the Early Bronze Age IVA (Welton, 2011, p. 19).

3.2.3 Early Bronze Age IV: Urban crisis at the end of the 3rd millennium BCE

The end of the 3rd millennium BCE demonstrates evidence of urban decline, collapse, and region-wide abandonment, although in varying degrees among the regions of northern Syria. Tayinat also had been abandoned during the the Early Bronze Age IVB period which roughly coincides, sometime after, or during 2.200 BCE. While more detailed explanations of stress factors over complex societies will be described below in *Chapter 5*, two collapse events need to be mentioned here since they are central in the discussions of transitional societies. The first is the fall of the Old Kingdom of Egypt. In this case, the power of political authority declined sharply for the benefits of provincial rulers while many small polities emerged in the Nile Delta subsequently and continued their prominence until the Middle Kingdom rulers reunite the land (Tainter, 1999, pp. 1006-7).

The second event is the Akkadian collapse in northern Mesopotamia. In the Khabur region in northern Syria, region-wide abandonment of settlements was the most evident. This process happened either synchronously or just after the Akkadian presence in northern Mesopotamia about 2.200 BCE (Akkermans & Schwartz 2009, p. 283). Tell Leilan and other settlements in its environs in the Khabur plains were totally abandoned, simply leaving no trace of resettlement for the next 300 years (Weiss et al., 1993). Additionally, other sites such as Chuera, Tell Beydar and other middle Khabur sites were abandoned during this period.

On the other hand, archaeological and survey data demonstrates contrasting settlement trajectories during the late 3rd millennium BCE in northern Mesopotamia (Ur, 2010, 2015). The continuity of habitation is discernible in some other Khabur, Middle Euphrates sites and at the Lebanese coast during the post-Akkadian period (Akkermans & Schwartz, 2009; Marro &Kuzucuoglu, 2007; Cooper, 2006; Genz, 2015). These sites with continuation of habitation are Tell Hamoukar and Tell Brak (Ur, 2012) as well as Tell Mozan (Pfälzner, 2010) in the Khabur basin and several sites in the middle Euphrates (Cooper, 2006). On the other hand, the evidence of disintegration of the urban system in western Syria is culminated at the end of the 3rd millennium ca. 2.000 BCE at sites like Ebla, Sweyhat, Selenkahiye and many others (Akkermans & Schwartz 2009, p. 283). Schwartz (2017, p. 114), however, indicates that there were discernible changes in settlement organization at Ebla, but no complete abandonment of the site. He suggests a longue duree approach to comprehend major transformations appearing as distinct clusters of abandonment, site reduction and political fragmentation which were rare and culminated basically in the late 3rd millennium and mid-second millennium BCE (2017, p. 114). What the survey results demonstrate is that the arid margins east of the Ebla-Hama line had been deserted during this transitional period as seen in the Middle Bronze I. The same trend is also visible to the east of the Qatna region where there is a substantial reduction of settlements at the beginning of the Middle Bronze Age (2017, p. 116).

The apparent changes in urban structure at the surviving sites have been noted in several studies (Ur, 2010, 2012; Pfälzner, 2010, 2012). Pfälzner conceives the contraction of urban settlement at Tell Mozan as an urban crisis rather than “a collapse”. According to him (2010, 2012), the urban crisis was caused due to the inefficiency of the centrally administrated political organization to maintain social order. In connection, the non-Semitic Hurrian names of rulers appear in the post-Akkadian period at Tell Mozan (Urkesh) and Tell Brak (possibly ancient Nagar). These sites continued to be powerful political centers during the post-Akkadian period, but the reduction of their sizes is evident in the archaeological records. Akkermans and Schwartz (2009, p. 286) argue that the control of trade routes would have been an important factor for the continuity of settlement at Tell Mozan. Mari was another powerful center in the middle Euphrates confluence and became another exception. Most probably this site had survived in the post-Akkadian period because of its commercial and economic significance for the trade networks. The post-Akkadian period stretching well into the first century of the MBA (ca. 2.250 – 1.900 BCE) is termed as the period of *shakkanaku* rulers where prosperity is evidenced by monumental building projects at Mari. However, Akkermans and Schwartz note that "[…] even at Mari, there may have been a period of difficulty, considering abandonment of the 'eastern palace' and the assumed century long break in textual documentation between the end of the *shakkanaku* period (twentieth century BCE) and the era of the king Yahdun-lim" (2009, p. 297).

3.2.4 Middle Bronze Age: The prevalence of Amorite kingdoms

Middle Bronze Age is marked by the increasing internationalism founded through seizure of political control by Semitic Amorite kings and the prevalence of the Akkadian in the succeeding periods, as the common diplomatic language over Sumerian, of the previous era. Various text records mention this group of nomadic folks as threatening the political order of the Ur III dynasty in southern Mesopotamia. Overall, certain characteristics of MBA societies are distinguishable in comparison to the earlier periods. During the MBA I period (c. 2.000 – 1.800 BCE), marked differences in ceramic typology as well as in architectural layout of towns and houses has been identified (Akkermans & Schwartz, 2009). Nonetheless, the MBA is characterized by ceramic mass-production; with different painted traditions containing similar motifs and shapes. Akkermans & Schwartz (2009, p. 323) argue that this characteristic in Syria may “indicate the frequent communication of decorative ideas throughout the eastern Mediterranean world in this period”. Such international contacts with the eastern Mediterranean are also apparent from the Mari texts in which rulers from Mesopotamia, Levant and Minoan Crete were exchanging gifts and commodities among each other. Moreover, the site layout of the MBA cities shows an emphasis to defense structures such as the fortifications systems (incl. the mudbrick enclosures of inner and outer towns, earthen or stone rampart or glacis).

Several texts had been uncovered from the MBA I such as those from Kültepe/Kanesh. Kültepe which is situated in central Anatolia, in the Province of Kayseri, became an important trade hub for the Assyrian merchants of the town of Assur, a city which was named after the name of the national deity. As extant texts demonstrate, the Assyrian merchants brought textile and tin, in exchange of silver and gold, from their Anatolian counterparts (Michel, 2008).

These texts, although mostly valued for long-distance trade and with no particularly descriptive for the agricultural production, also mention a certain king named Anum-Hirbi who ruled a kingdom which possibly covered south-central Turkey, roughly the lands between Kültepe and Mari (J. Miller, 2001). In western Syria, Ebla’s prosperity renewed during the MBA I (Akkermans & Schwartz, 2009). Earlier during this period, the occupation at Tell Tayinat had abandoned in the late 3rd millennium BCE and with the beginning of MBA, a new settlement was founded at Tell Atchana (ancient Alalakh). Although the timing and significance of this settlement shift is still poorly understood, Alalakh continued to be the largest settlement in the Amuq Valley during the subsequent Middle Bronze and Late Bronze Ages until the beginning of the 13th century. Several transformations in the site function, use of space and layout are revealed by the targeted excavations. This town was the capital of a small polity called the kingdom of *Mukish* in contemporary texts. This kingdom first became the vassal of a larger polity called Yamkhad kingdom centered in Aleppo during the MBA (Akkermans & Schwartz, 2009).

3.2.5 Late Bronze Age: The international politics of the Amarna Age

The Late Bronze Age is a period of expanding networks of international connections and affairs. This is the first period in human history when the territorial empires emerged, and the political configuration was comparatively stable for 400 years until 1200 BCE. Some actors of the LBA political scene were already controlling their lands for some time, like Egypt in the Nile Valley and Babylon in Southern Mesopotamia. Hittites in central Anatolia and Mitanni in Northern Mesopotamia were new powers in the political scene and appeared first at the beginning of the LBA. There were Minoans based in Crete and after their collapse, the Mycenaean civilization started to control the lands and sea routes of today’s Greece (Cline, 2014).

The 14th and 13th centuries, the last two centuries of the LBA are particularly interesting. Both centuries are usually called the Amarna Age in order to refer to increasing social and economic connections between different empires of the Near East. A new sort of international relationships was established between the LBA kings who depended on trade and gift exchanges among the royal households. At the same time, coastal Syrian towns were extensively involved in the international maritime trade. Ugarit was a capital town of coastal Syria and a powerful trade hub. The two LBA shipwrecks, Uluburun and Gelidonya are also examples of this maritime trade not least the textual evidence of long-distance trade (Akkermans & Schwartz, 2009).

Alalakh became part of the Mitanni Empire during the 15th and 14th centuries. When Hittites ran sacked the city alongside many other kingdoms in the northern Levant after the military campaign of Šuppiluliuma I ca. 1350 BCE, the Hittite king reorganized the political dependencies of the small kingdoms in the region by implementing his sons as viceroys at Karkemish for political and military control and in Aleppo for religious and judicial affairs (Harrison, 2009a, p. 172).

Hittite activities at Alalakh had been documented with the foundation of a casemate fortress in the northwestern sector of the mound. This so-called "Northern Fortress" was partly excavated by Sir Leonard Woolley. It is argued that this building had replaced the entire palatial complex of local elites and was a testimony of Hittite hegemony on the site (Akar, 2013, p. 42). On the other hand, recent excavations at Alalakh revealed another building with the same layout in the southwestern sector of the tell. This strengthens the archaeologically attested military role for Alalakh during Hittite occupation (see Akar, 2013 for a detailed description).

According to Yener (2013, p. 19) and Beckman (1992, p. 45), Mukish -or at least south of the Amuq- was most possibly incorporated into the Ugaritic kingdom and was governed by a Hittite governor, regarding the overall lack of its reference in the list of vassal kingdoms, contributing to the War of Qadesh and Murshili II's account on his father's policy, was to punish Mukish for its lack of cooperation. The recent archaeological radiocarbon assessments demonstrate that the final habitation at the site (Level 1) is dated to the 14th century, whilst the occupation continued into the 13th century in the "Temple" area. It is highly possible that this area was still in use in mid-12th century considering the occurrence of Late Helladic IIIC pottery finds (Yener, 2013, pp. 20-1).

3.2.6 Iron Age I: Collapse and regeneration of social complexity

The transitional period between the Late Bronze to Iron Age is characterized by a number of conflagrated and abandoned sites, although the timing of these conflagrations is an open issue and still no consensus reached in the literature (Dever, 1992). The site abandonment process has been recognized in various regions of the Near East, most notably in the Central Anatolia and the Levant. Overall, Akkermans and Schwartz define that “the Iron Age was marked by new political and economic developments drawing Syria into a network of international affiliations even wider than that of the Late Bronze Age” (2009, p. 361). Nonetheless, this development seems to be gradual, the regeneration of complexity appears to have been a later phenomenon with the beginning of the first millennium BCE. According to the Syrian chronology of Mazzoni (2000b), the Iron Age of Syria is divided into three subsequent periods; Iron I is ca. between 1.200 – 900, Iron II between ca. 900 – 700 and Iron III between ca. 700 – 550 BCE. Iron I in the Near East and the Aegean is the most poorly documented phase and conventionally called as the Dark Ages regarding the overall absence of textual evidence (Akkermans & Schwartz, 2009; Snodgrass, 1983).

Whatever the real cause(s) of the collapse were, the emerging picture in post-1.200 BCE Near East was that the great empires of the LBA either retreated to their heartlands (Egypt, Assyria) or totally vanished from history like the Hittites and Myceneans (Cline, 2014). Nonetheless, in contrast to the long-lasting paradigm of a catastrophic break designated with the decline of sophisticated Late Bronze Age urban life and literacy in the Near East and the Aegean, the accumulating archaeological (Harrison, 2014b; Venturi, 2010) and epigraphic finds (Hawkins, 2009, 2011; Weeden, 2013) demonstrates evidence for continuity of architectural and material culture traditions in the late 2nd millennium in the northern Levant. This has also been observed in some settlements of the southern Levant after two imperial powers, the Hittites and Egypt retreated from the Levant during the post-1.200 BCE period

(Dever, 1992; Porter, 2016). It is highly probable that the Egyptian control over certain locations in the southern Levant had continued until the end of the 20th dynasty and until the last quarter of 12th century.

Although the Hittite Empire crumbled and eventually completely vanish from the history at the end of LBA, the increasing evidence for continuity of Hittite culture and material evidence is manifested in the northern Levant, which distinguishes from the surrounding areas, from Central Anatolia and the southern Levant. Mazzoni suggests that two towns Karkemish and Hama had most probably a central role during this period for the transference of Hittite cultural elements into the succeeding centuries (2000b, p. 32). More importantly, the dynastic lines at Karkemish enjoyed increasing political autonomy during the last decades of the 13th centuries alongside some other appendage kingdoms (e.g. Tarhuntassa) in northern Syria. That consolidation of power at the hands of the more and more independent viceroys, against the weakening imperial center at Hattusas, opened up more active interventions. There is also evidence of continuity of the dynastic control of the viceroys after the collapse of the Hittite in early 12th century. Two seal impressions discovered at Lidar Höyük in 1985 demonstrate the line of viceroys extended to fifth generation contemporaneous to the final ruler of the Hittites, Šuppiluliuma II (Harrison, 2009a, p. 172; Weeden, 2013, p. 6).

What becomes apparent from the settlement data during the Iron Age I is that the settlement system had recovered at different rates across the Near East (Dever, 1992; Porter, 2016). In common, the regional surveys demonstrate a general increase in the number of settlements in the Levant in contrast to the overall decline of settlements in the LBA. One of the most striking developments is the expansion of the small rural settlements into topographically and climatically-challenging landscapes like those of the Central Highlands and Transjordan in the southern Levant (Bloch-Smith & Nakhai, 1999). Similarly, the settlement system around

Ugarit (Ras Shamra) changed decisively in the Iron Age when this town which was an important trade center and vassal to the Hittite Empire in 13th century BCE, was not reoccupied for the following centuries. However, the occupation continued in some smaller settlements including Tell Tweini and several others in the same region (Porter, 2016).

The Amuq Plain was no exception in this trend. The number of settlements had almost doubled to 47 settlements in the Iron Age I. Harrison states that “of the 30 LB (or Amuq Phase M) sites that have been identified by surface survey, 17 also preserved evidence of early Iron Age (Amuq Phase N) occupation, or almost two-thirds of the LB sites, suggesting significant settlement continuity between two periods” (2009a, p. 175). Furthermore, he informs that about 75 % of all known Amuq N sites were new settlements. Additionally, the 75 % of Amuq N sites were occupied during the later Iron II (Amuq Phase O) indicating strong settlement continuity among periods. But the aggregate settled area diminishes to 4.76 ha in Late Bronze Age (Phase M) to 3.61 in Iron Age I and 3.63 in Iron II (Harrison, 2009a, p. 175).

Recent discoveries of the temple of the Storm-God at Aleppo citadel radically changed our view on the developments, of the later Iron I period in the northern Levant. Excavators at Aleppo citadel have unearthed some beautifully preserved orthostats furnishings and the outer walls of the Storm-God temple. These monuments celebrate the achievements of a king named Taita who declares to be the king of the lands of Pala/istin or Wala/istin. These two names were previously normalized as WaDasatini while this particular attestation had been found in two different inscriptions at Tell Tayinat (Hawkins, 2009, 2011, Weeden, 2013). No exact dates can yet be established for his reign but in respect to palaeographic parallels, Hawkins locates his reign to sometime after the 11th or 10th century BCE (2009, 2011).

This finding in the northern Levant invoked a renewed interest to the problem of Philistines' origin and their distribution through which Tayinat was somewhat at the center of discussions (Singer, 2010; Harrison, 2007a). The reason was that there are some other textual references which mention, about the land of Walistin, which was most probably another rendering of the Taita's "Palistin" (Weeden, 2015 for diverse spellings of the word; Dinçol et al., 2015 for another mention in the region). A fragmentary Luwian inscription (Tell Tayinat Inscription I) bears the same "Walastin" recovered during the Syrian-Hittite excavations at Tell Tayinat. According to Harrison (2009a), Tayinat would have been the capital town of this kingdom regarding its prominent size in comparison to other settlements in the Amuq and the presence of large monumental buildings such as Building XIII and XIV superimposed on the earlier Iron Age levels. These monuments were most probably stratigraphically simultaneous in regard to the paleoegraphic observations of Hawkins for the Luwian inscription at Aleppo (Hawkins, 2009; Galil, 2014).This and other evidences show that it is highly likely that there existed an extensive kingdom during the earlier Iron Age which was more or less covering the geographical area of the former territories of the LBA vassal kingdoms of Mukish, Niya and Nuhasse, in addition to Aleppo roughly coincides to the administrative territories of the LBA Aleppo after its reorganization by the Hittite king Šuppiluliuma II (Hawkins, 2009; Harrison, 2009a).

Concurrently, the Iron I phases of Tayinat produced a considerable amount of locally-manufactured Myceanean IIIC:1 pottery. This particular ware tradition largely appears in the Aegean and in Cyprus starting from Late Helladic III (ca. 1.400 BCE) period. Janeway (2006) argues that a number of diagnostic shards in Myceanean IIIC:1 demonstrates an Aegeanizing influence at Tell Tayinat. The same Aegean-inspired pottery tradition appears also at Tell Afis, a close-by site in Idlib region, 50 km SW of Aleppo (Venturi, 2010, p. 5). On the other hand, Venturi describes that the new settlements in the northern Levant with some evidence of Aegean-inspired pottery demonstrate low-level of urban organization which lacks coherent urban layout and fortifications and was largely characterized by domestic units, open areas and massive use of silos. This trend is different than other sites in the Levant where the material culture related to the Sea Peoples has been found (2010, p. 9).

The Tayinat ceramic assemblage mostly includes the shallow rounded bowls and deeper bell-shaped bowls (skyphoi); the latter is also the most common pottery type found at Tell Afis. Some vessel types of the Myceanean IIIC:1 ware also appear at nearby sites such as Çatal Höyük and Tell Judaidah in the Amuq (Harrison, 2014b, p. 399) as well as at Tell Afis (Venturi, 2013, p. 235). At the same time, this potting tradition had been identified in at least eighteen other sites in the Amuq Valley. Another LBA potting tradition, Hittite Monochrome Ware, had also been recovered from the site (Harrison, 2014b, p. 399). More importantly, the ceramic assemblage was progressively replaced by Red Slipped Burnished Ware tradition over the course of the Iron I (Harrison, 2007a, p. 89).

Figure 10 Loomweights in pit G4.56:196 found *in situ* (Photo Courtesy: D. Lumb, as appeared in Welton et al., 2019, p. 299).

Meanwhile, other types of material culture also reflect some Aegean derivations at the site. Aegean-type loom-weights are the most obvious of such derivations including the figurines and potters' marks. The cylindrical, non-perforated loom-weights (Fig. 10) appear from earlier Iron I phases on at Tayinat (Harrison, 2007a). On the other hand, that heavier emphasis on pig consumption, usually accepted as a distinctive feature of Philistine sites, in the southern Levant had not been recorded in the faunal remains at Tayinat. According to the zooarchaeological investigations, the dominance of ovicaprids prevail in the assemblage as commonly recognized in other Near Eastern sites while no increase in the pig bones are discernible (Lipovitch, 2006-2007).

3.2.7 Iron Age II: The formation of the Syro-Anatolian states

After the dust had settled in Iron II in the 10th and 9th centuries BC, the emerging picture in northern Syria, where once roughly the former territories of Hittites were, that of a balkanized political landscape with several petty kingdoms and of incursions from possibly nomadic Aramean populations as recorded in Middle Assyrian and later Aramean textual sources (Niehr, 2014; Sader, 2000) emerged. These new states are usually called by different names such as Syro-Anatolian, Neo-Hittite or Luwian-Aramean kingdoms in the literature. It is thought that the main ethnic component of these petty states would be the Luwian and Aramean, but possibly different ethnic stocks were also present (Welton et al., 2019). Luwian affiliations are somewhat emerged in the archaeological records culminated in the polities centered on Carchemish, Masuwari (later Til-Barsib), Hamath, Melid, Kummuh and Gurgum (Akkermans & Schwartz 2009, p. 367).

The excavations in the Assyrian homeland provided a wealth of textual records about the political entities in the region (Grayson, 1991). These records do not only provide information about Assyrian military campaigns to distant regions, but also include information on the historical geography of the Levant. Regarding this evidence, the earliest surviving reference in the Neo-Assyrian texts for the Amuq was recovered from the reign of Ashurnasirpal II following a military campaign to the Orontes Valley (Galil, 2014, p. 88). Tayinat was mentioned as the capital town -called *Kunulua*[7] or alternatively *Kinalia,* and possibly biblical *Calno*- of a small Syro-Anatolian kingdom governed by Lubarna, variously mentioned as Patina in the Neo-Assyrian textual records (Harrison & Osborne, 2012). Galil (2014, p. 77) asserts that this shift from *Palistin*- to *Pat(t)in* is highly reasonable in the transference of the word from Hieroglyphic Luwian to cuneiform Akkadian.

Akkermans and Schwartz (2009, p. 366) note that these polities may have had certain kin affiliations to the Hittite dynastic line just as evidenced at Carchemish. More importantly, these polities emulated Hittite monumental architecture and sculpture, all share the same iconographic repertoire with the use of guardian figures, like lions and sphinxes at gates, orthostats aligned on the base of the walls and other artistic details. Besides the artistic parallels among these polities, Osborne (2015, p. 11) states that

> "[…] In each case the city is subdivided into three sectors: a walled lower city, a walled acropolis, and a palace compound, access to each of which was controlled by gateway structures. The increasingly restrictive accessibility as one passed from outside through the city toward the palace was intended to emphasize the prestige of the palaces' occupants".

Moreover, the Assyrian records demonstrate the three-tiered settlement hierarchy in the territories of Syro-Anatolian kingdoms comprising a royal city, secondary fortified centers and smaller rural settlements (Osborne, 2013, pp. 776-779). Many Iron Age settlements which are situated on top of Bronze Age layers were surrounded by an extensive lower town while some of them demonstrate clear indications for central planning in layout (Casana, 2010).

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[7] Other candidates for the capital town of this Syro-Anatolian kingdom were 'Ain Dara, Tell Jindaris, Çatal Höyük and Tell Kuna'na mentioned by several authors (see Harrison & Osborne, 2012), but according to Harrison and Osborne (2012) the newest textual reference on Kunulua found from a temple context at Tell Tayinat confirms conclusively its location at Tell Tayinat.

Liverani's (1992, p. 138) topographical analysis from Assyrian military accounts demonstrates that every royal city contains three fortified towns and every fortified town approximately 20 villages. Osborne (2013, p. 779) suggests that this was a durable settlement pattern of hierarchy which was also recognized in Patina and its northern neighbor Sam'al after a native royal inscription of mid-8th century date. Regarding the AVRP survey in the Amuq, there are 55 additional sites which have been recorded and which were dated to the early 1st millennium BCE (2015, p. 13). On regional level, it is indicated that the pottery assemblage of Tayinat had close similarities with the Levantine and northwestern Syria, rather than the Anatolian traditions (Osborne, 2013, p. 781).

3.2.8 Iron Age III: Neo-Assyrian expansion in the 1st millennium BCE

The 1st millennium BCE witnessed the expansion of the Neo-Assyrian Empire when Assyrians became the dominant power in the international arena. The Neo-Assyrian Empire invaded much of the Near East and Egypt during mid-8th and 7th century BCE and established a powerful empire which stretches a far greater territorial distance than ever encountered before. Assyrian aggression over the Syro-Anatolian states resulted in the integration of these small polities into the imperial rule in a gradual manner. Neo-Assyrians referred to the Syro-Anatolian kingdom of Carhemish as Hatti in general, but this toponym became to represent the whole other Syro-Anatolian realm in later centuries (Radner, 2000).

The proliferation of small settlements has been recorded during the period in question regarding the regional surveys carried out in Northern Mesopotamia (Parker 2003: 536, footnote 84 for other references). Comparing the Late Bronze Age, Ur and Osborne (2016) identify a 125 % increase in the number of sites which were small settlements with an average of 2.63 ha. The authors interpret this pattern as the reflection of the forced emigration which was intensively employed by the Assyrian administration to stabilize the political upheavals in the conquered regions and to boost the agricultural productivity in the heartland of Assyria (Osborne, 2015, p. 15; Ur & Osborne, 2016)

Tayinat was annexed into the Assyrian Empire in 738 BCE by Tiglath-pileser III. During this period, the kingdom is alternatively referred to as either Patina or Unqi. Textual records show that Tiglath-pileser accused the king of Unqi for breaking the loyalty oath with Assyria. Consequently, after the city was ransacked by Neo-Assyrians, the population had been forcefully deported elsewhere. The Assyrian king then declared that he installed an eunuch as governor and transformed the town into a provincial capital. In a separate fragment, the Assyrian king also states that he forcefully settled 600 captives from the city of Amlatu and 5.400 other captives from the city of Der into several cities of Unqi (Harrison, 2012).

3.3 LOCAL CLIMATE AND ENVIRONMENT IN THE AMUQ VALLEY

3.3.1 Geology and geomorphology

The region is located at the intersection of the African-Arabian and Eurasian plates (Anatolian platelet). The lower Orontes basin covers approximately 4317 km^2 within the Provinces of Hatay, Gaziantep, Kilis, Osmaniye and Kahramanmaras. The largest portion of this basin is in the Province of Hatay. The average altitude is 387 m while the highest elevation is 2.240 m at Migir Tepe in the Amanos Mnts. The lowest altitude is at sea-level in Samandag County of the Province of Hatay (Özsahin & Atasoy, 2015, p. 135). The coastal line near Samandağ County (or the deltaic zone of the Orontes) had altered over the millennia regarding the recent geomorphological assessments of well-preserved sea-level markers belonging to the late Pleistocene. Doğan and his colleagues (2012) identified two notable increases in the Quaternary history of the shoreline corresponding to sea-level changes during ca. 72 ka and 53 ka.

The Amuq Plain or sometimes referred as valley, a low-lying depression at 80-100 mts. (a.s.l), is located along the northern delimination of the Dead Sea Fault Zone (Casana & Wilkinson, 2005). This seismically active zone is called Hatay–Kahramanmaras fault. There are three geomorphological units in the Basin. These are mountain, plateau and plain (Özsahin & Atasoy, 2015). The Amuq is enveloped by a series of limestone hills and basaltic ranges to the eastern and southern ends while the Amanus Mountains (Turkish: Nur or Gavur Mountains) shape the landscape to the west. The Amuq is covered by Quaternary deposits (Altunel, 2009, p. 1314) while the sedimentation was highly variable throughout the Holocene (Casana & Wilkinson, 2005, p. 29). The Amanos range is predominantly composed of non-calcareous rocks with no significant limestone formations in contrast to other Levantine regions where most of the mountains are calcareous. Pridotite and serpentine rocks occur in several outcrops in the Amanos Mnts. marking the boundary of a shallow Levantine Sea of Miocene Age (Mill, 1994, pp. 338-9).

The Amanos range forms the border between the Plains of Cilicia and the Amuq. It consists of several important passes that connect Syria to Anatolia. The routes from Cilicia and central Anatolia to Syria by Hasanbeyli (the mountainous road over the Amanos overlooking the Islahiye Valley) or Belen (Syrian Gates) passes, the Bahçe Pass (Amanic Gates) from the north and from the coast at Süveydiye (the old name of the County of Samandag) in the deltaic zone of the Orontes, at Latakia and Tripoli, all converge to reach Aleppo, and eventually from Aleppo to the Euphrates River, which is the shortest route to cross the desert. This route was of particularly importance for the past towns along the road to achieve historically a greater level of significance, being the principal gateway between the eastern Mediterranean and Mesopotamia. On the contrary, the travelling routes from north to south or *vice versa* were always more problematic. The coastal plains are basically too broken to allow continuous travels. Therefore, the most uninterrupted travel route aligned east of the mountains to the desert margin (Brice, 1966, p. 206; Suriano, 2014, p. 11).

3.3.2 Hydrogeography and water potential

The Orontes River section from Tell Tayinat flows westwards to the city of modern Antioch, to reach the Mediterranean Sea about 30 km downstream of Antakya. The Orontes is characterized by strong meandering as soon as it enters the Amuq (Bridgland et al., 2012; Suriano, 2014, p. 11). Flowing downstream of Antakya, the Orontes enters in a high-relief area between the mountains of Kızıldağ and Jebel el-Akra. The flow rate of the Orontes varies seasonally. It flows at a rate of 200 cubic metres per second during February and March, but after these high seasons, the rate of flow progressively decreases to below 50 cubic metres from July to December (Brice, 1966, p. 210).

Two other streams cross the Plain from the north, Karasu River, and from the northeast, Afrin River, once forming the Lake of Antioch before its drainage as part of a governmental program was implemented by the modern Republic of Turkey. It is reported the drainage was completed in the 1970’s. But historically, the Lake of Antioch and surrounding wetlands have been mentioned in several texts as early as the Late Antiquity (see Eger, 2011 for a full discussion). The Lake of Antioch was a shallow body of water with surrounding marshlands, the coverage of wetlands were fluctuating regularly during the summer months when the lake shrank. The shrinkage turned the northern part of the lake into marshes (Kara & Tiryakioglu, 2012). The lake covered an area of 31.000 hectares of which 2/3 of this area was composed of marshlands during the 1950’s.

In the 1960’s Brice observes that “[…] The stretch of water [The Lake of Antioch – DK] is not held back by any obvious topographic barrier, and it may have accumulated in consequence of a disturbance in the drainage following an earthquake, for the district is notoriously liable to seismic action, and the massive silting of the suburbs of classical Antioch would indicate that the Orontes has been retarded in this section of its course at some time during the Christian epoch” (Brice, 1966, p. 210). His observation coincides well with the recent geomorphological assessment of Wilkinson (1999), Casana and Wilkinson (2005) and historical records (Eger, 2011) on the development of the Lake of Antioch (see below section 3.4). Atasoy and Gecen reports that the plain at the Reyhanli County (to the east of the Amuq) is separated by a fault thereby elevated about 100-150 meters than the Amuq. The increase in elevation eventually affected the flows of the rivers towards the plain floors (2014, p. 24).

From a similar perspective, the Orontes river channel, in the deltaic zone, was most possibly dredged deep enough to allow small marine vessels to reach as far as Antioch. The archaeological site Al-Mina was a thriving trade port during the Iron Age and the Crusader periods (Brice, 1966, p. 211). Although speculative without more definite information, at least two LBA texts on the grain shipments by sea to the Hittite heartland there is mention of *Mukish* as the origin of exportation of grains to *Ura*, possibly another town in the Cilician plain, demonstrating that the region was already part of the maritime activity in the LBA (Knapp, 1991).

3.3.3 Soils

Akman reports five types of soils recognized in the Amanos Mnts. Erosional soil on the marls has been identified at the lower altitude (0-400 m.) between Iskenderun and Ulucinar. He reports that this erosional soil represents a single horizon. It is heavily calcareous, and the organic matter content is very low. The permeability of this soil type is also very low. Terra rossa, typical Mediterrenean red soil, is found on calcareous bedrock in the high rainfall zone, but with particularly intense solar radiation, on the S and W slopes of the Amanos. This soil type has a brown color when covered under the forest vegetation, but it gains red color in the areas where the vegetation is degraded. The third type is the calcareous brown soil. The fourth type of soil is found in mid- and high altitudes of the Amanos; is the brown forest soil under the forests of *Pinus brutia* and *Quercus pseudocerris*. Akman (1973) reports that this soil type is biologically active and also rich in humus. It is identified on serpentine, and ophiolite bedrocks. He identifies leached brown soils under the forests of *Fagus orientalis* from 1.200 m in the north of the Amanos where the rainfall exceeds 1.500 mm within the humid and sub-humid zone. This soil type is rich with organic humus content.

As for the vegetation (see below subsection 3.3.5), the soil types of the Amuq is less known. In general, Özşahin and Atasoy report that soil moisture is xeric since the annual average soil temperature is 15 – 22 ^{o}C up to 50 cm depth. They define the soil temperature regime as thermic. The authors define 7 soil series and 8 soil textures in the Lower Orontes basin (2015: 141-2, Table 2). Poorly developed horizons of entisols and inceptisols are widespread in the lower Orontes Basin. These two soil series composes the 73.43% of the basin according to the study of Özşahin and Atasoy (2015). The alluvial sedimentary soils are composed of entisols as identified in the Amuq and the deltaic zone of the Orontes (Özşahin & Atasoy, 2015, p. 145) while inceptisols are largely documented on the slopes of the Amanos. Atasoy and Geçen (2014) report that the alluvial soils prevailing the west of Reyhanlı County, in this case, they suggest that this part of the Reyhanlı plain resembles the Amuq. However, to the east of the Reyhanli County, due to diverse topography, the various types of soils as described above by Akman appear on the Reyhanlı Plain.

3.3.4 Climate

The bimodal Mediterranean climate determines the precipitation regime in the region, with winters having most of the annual rainfall, while summers are almost completely dry. Due to the complex topography of the region, the annual rainfall is not evenly distributed within the

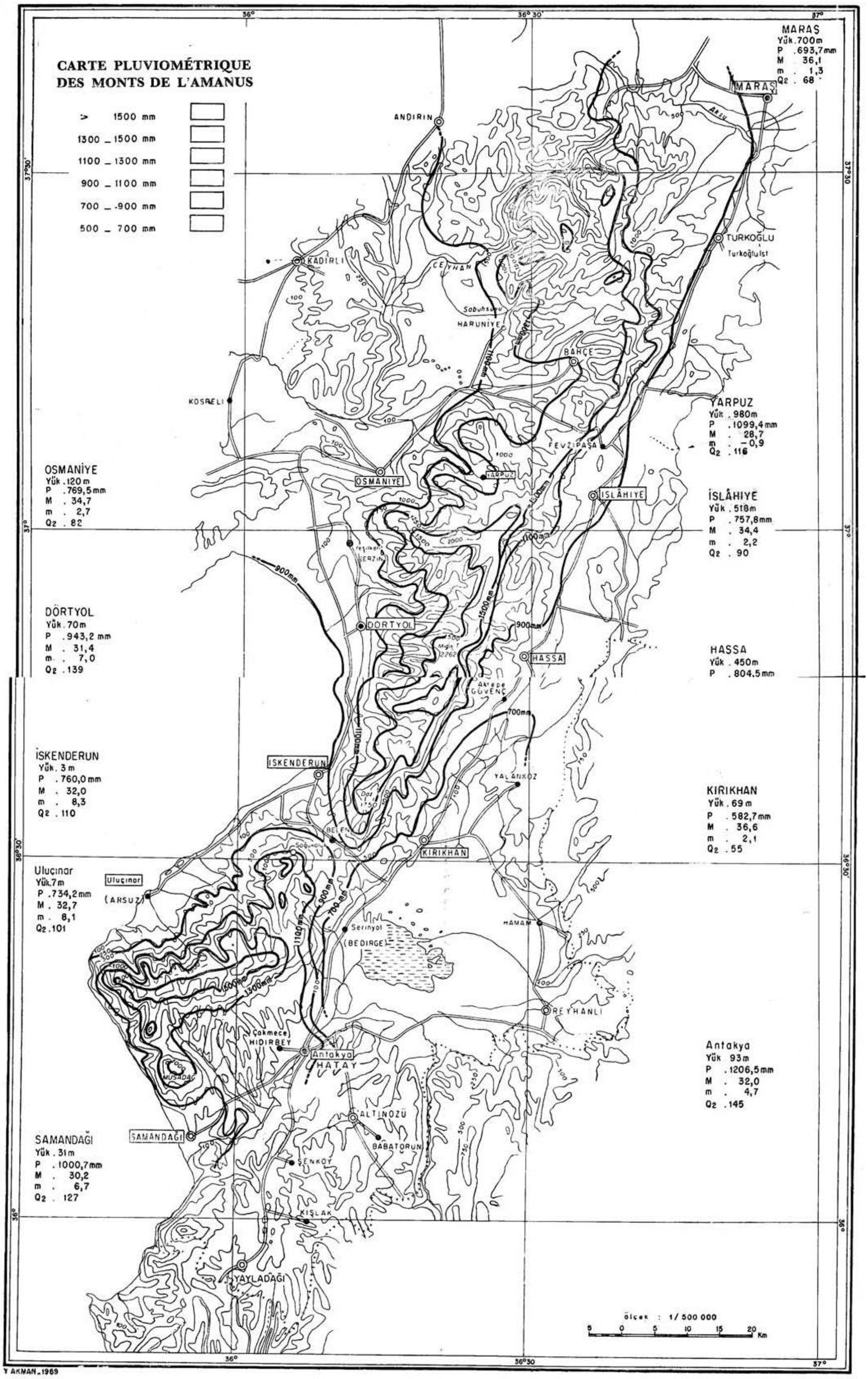

Figure 11 The topographical map of the Amuq Valley and rainfall isohyets (after Akman, 1973).

Stations	Altitude (m)	Mean monthly rainfall												Annual rainfall (mm)	Observations	
		1	2	3	4	5	6	7	8	9	10	11	12			
Samandag	31	158	145	121	78	50	30	11	6	61	86	64	190	1000.7	Seaward	east to the Amanos
Antakya	93	185	194	167	151	62	40	4	8	45	57	63	217	1206.5		
Kirikhan	69	142	103	80	37	12	41	0	0	6	25	53	135	582.7	Leeward	
Hassa	450	173	148	106	63	25	6	0	1	22	28	51	183	804.5		
Islahiye	518	167	133	97	63	40	6	0	0	10	28	56	164	757.8		
Maras	700	136	128	96	62	31	8	1	1	6	37	67	122	693.7		
Ulucinar	7	125	103	100	56	47	15	2	6	29	53	59	142	734.2	Partly leeward	west to the Amanos
Iskenderun	3	120	101	114	72	62	17	3	9	40	71	58	103	760		
Dörtyol	70	119	109	107	114	74	44	24	19	69	65	53	129	943.2		
Osmaniye	120	121	108	90	66	21	7	6	15	63	60	78	137	769.5		
Yarpuz	980	157	186	169	142	76	40	2	5	19	60	70	174	1099.4	Leeward	

Table 3 Monthly and annual means of rainfall from the meteorological stations in the Amuq and neighbouring regions from 1958 to 1967 (except Osmaniye station: 1942-1951) (modified from Akman, 1973, p. 80).

region (Eger 2011). The rainfall sharply fluctuates from 1.200 mm at the Orontes delta to about 500 mm further inland in the eastern part of the plain. Akman's calculations (1973, p. 96) through Emberger's formula indicate that Yarpuz (ca. 1000 m asl.) and Antakya (ca. 80 m asl.) are climatically humid. In sub-humid climatic conditions, Islahiye, Osmaniye and Maras are having cold winters, Samandag and Dörtyol with temperate winters, Iskenderun and Ulucinar are within the warm winters. Kirikhan, on the other hand is at the semi-arid part of the Emberger's scale (Akman, 1973). Despite a lack of meteorological station close to our study site, Tell Tayinat, the annual rainfall amount presumably locates within 900 – 600 mm rainfall isohyets (Fig. 11, see Table 3 for the long-term records from meteorological stations in and around the Amuq Valley).

The variance of the annual rainfall amount and its periodicity also show notable differences as is usually recorded in the Mediterranean region (Atalay, 2012; Blondel et al., 2010; Akman, 1973). For example, Akman (1973, p. 88) reports the amount of annual rainfall differs up to 800 mm at the Antakya meteorological station (mean annual rainfall ca. 1.200 mm per year) during two consecutive years in 1963-64.

The relative humidity is another climatic factor showing marked differences during the summer season (June-July-August). Amanos Mountains block the available moisture to infiltrate into the Amuq Plain; which leads to comparatively drier conditions at the east of the mountains. While the mean of relative humidity is about 80% in the deltaic zone of the Orontes, this variable drops to 60 % further inland in the Amuq Plain and decreasing eastwards. This inland decline generates higher level of evapotranspiration when the water deficit is expected to become prevalent in summer season (Korkmaz & Faki, 2009; Atalay, 2012).

3.3.5 Vegetation

3.3.5.1 Floristic history of the Mediterranean region

The floral landscapes of today's Mediterranean, as reflected from the current biodiversity in the basin, have been typically tropical until the Oligocene, when a mixture of forests and savanna-like environments prevailed. With the onset of Oligocene and specifically from the end of the Miocene and the Pliocene, the typical Mediterranean floras as we know today, have been progressively developed with the establishment of bimodal patterning of a Mediterranean-type climate around ca. 2.8 to 3.2 mya (Blondel et al., 2014, p. 37). Climate changes over Pliocene onwards mark the episodic changes in the floral composition from sub-tropical species (e.g. Lauraceae, Myrtaceae, Palmae, etc.). The species of the genus *Laurus* today for example, represents a relic from when the subtropical conditions prevailed. The Quaternary history of the Mediterranean flora is determined by climatic impact between glacial and interglacial episodes. The Last Glacial Maximum (LGM) has impacted the northern regions of the Mediterranean by the increase in pollens of herbaceous plants, like *Artemisia* and various chenopods. This trend consecutively changed to sub-humid conditions with the start of the Holocene, which leads to the expansion of broad-leaved deciduous trees (Roberts, Meadows, & Dodson, 2001).

Blondel and his colleagues (2014, pp. 32-8) argue that there are five main groups of floristic components which make up the basin's flora today. The Afro-tropical components consist of hard-leaved evergreen species including *Asparagus*, *Capparis*, *Ceratonia*, *Chamaerops*, *Jasminum*, *Nerium*, *Olea* and *Phillyrea* (palaeotropical relicts) and many others from Fabaceae, Moraceae, Myrtaceae and Vitaceae. The Holarctic floristic elements include many deciduous broad-leaved tree genera (e.g. *Platanus orientalis*, *Juglans regia*, *Corylus avellana*, beech) with an extra-tropical northern distribution either from boreal or Holarctic origin, including *Acer*, *Alnus*, *Betula*, *Fagus*, *Quercus*, and *Ulmus*. The third group are the Irano-Turanian components such as *Artemisia*, *Ephedra*, *Haloxylon*, *Pistacia*, *Salsola*, and *Suaeda*. An important aspect is the migration of Irano-Turanian elements into the Mediterranean phytogeograpical zone which intensified when the human impact on Holocene landscapes grew greater. The Saharo-Arabian components encompass taxa adapted to desert and semi-desert conditions, appearing in southern and southeastern localities of the Basin. The distribution of these plants (e.g. some members of Chenopodiaceae family, Zygophyllaceae) coincides with the 150 mm isohyets. The final category is the indigenous components originating in the coastal regions around the Tethys Sea which were scattered between African land mass and the Eurasian supercontinent. These so-called palaeoendemics includes the strawberry tree and several sclerophyllous oaks as well as many genera of *Helianthemum*, *Lavatera*, *Salvia*, *Cupressus*, *Pinus*, and *Juniperus*.

Zohary (1973) and Blondel et al. (2014, p. 37) mention another group, the anthropogenic elements, as indigenous. These floristic elements basically comprise of 1500 segetal and ruderal annuals of which the main area of speciation is thought to be the Mediterranean and the Middle East. Zohary argues that Near East is a center of speciation and more than 30 % of the weeds around the world are endemic to the Near East and the largest center of local weeds are the eastern and southern fringes of the Mediterranean territory and the adjacent borderland with the Irano-Turanian territory. Furthermore, there is two-way traffic in the migration of the weeds that induce many typical Mediterranean weeds such as *Trifolium, Medicago, Vicia, Bromus*, *Erodium* pushed eastwards into Irano-Turanian cultivated lands and many others occurring among Eastern Mediterranean crops are Irano-Turanian by origin (Zohary, 1973).

The Mediterranean-type environments only comprise of 5 % of the Earth's surface while the number of vascular plants present compose 20 % of the total identified species on the earth (Cowling et al., 1996). This situation is basically related to the topographic and climatic diversity of the Mediterranean. Moreover, it should be mentioned that the Mediterranean climate is not bound to the Mediterranean basin, but it is found in four other regions around the globe. These four geographically distant regions are the Cape Region of South Africa, South and Western Australia, southern California and central Chile (Roberts et al. 2001, p. 631). Shared characteristics of these regions are that the floras of all of these regions are plant species which are well-adapted to the summer dryness of the climate.

It should be noted that Turkey itself is spectacular in terms of topographic and climatic variability. This makes Turkey's plant biodiversity almost as rich as the non-Mediterranean Europe with an estimated 8.600 species, of which one third of this amount are endemic plants (Ekim & Güner, 2000, p. 48). In some regions of Turkey, endemic plant species compose 25% of all species recorded. The limitation of Mediterranean-in-Turkey is defined by Zohary (1973) via the distribution range of *Pinus brutia*. This covers the southern and western coastal regions of Turkey where the landscape is fragmented by a series of mountains running in E - W direction to the Aegean coast. This and meandering rivers like Büyük and Küçük

Menderes Rivers in western Anatolia allow the penetration of Mediterranean floristic elements much deeper into inner Anatolia. In contrast, the Taurus Mountain chain aligns parallel to the Mediterranean Sea on the southern Anatolian coast. This topographic situation prevents summer moisture to infiltrate into the inner region north of the Taurus range. Therefore, the south-facing slopes of Taurus are more humid than the drier north-facing slopes which remain under the impact of rain-shadow (Atalay, Efe, & Öztürk, 2014, p. 145). The mean annual temperature in the Mediterranean is about 18 ^{O}C on the coastal belt while at 1000 m high, the temperature drops to 11-12 ^{O}C. The temperature changes daily about 10 ^{O}C between day and night (Atalay & Efe, 2008).

A significant phyto-geographical factor in Turkey has been identified by Davis (1971) after the completion of the first volume of his seminal study, *Flora of Turkey*. Davis observed an oblique belt of floral distribution, which is called the Anatolian Diagonal, running across Inner Anatolia from the northernmost extension located in the southern slopes of the Pontic range (Bayburt – Gümüşhane Provinces in modern Turkey), to south-westwards to the Anti-Taurus ranges when it further bifurcates in the Amanos and in the Cilician Taurus at the southernmost extension. In regard to this floral break, a substantial amount of western species of the Irano-Turanian phyto-geographical region, do not occur in the east of the Anatolian Diagonal while the same is true for the plant species located at the eastern side. It is also indicated that the Diagonal had served as a migration route for the Euxine taxa of the Black Sea coast, to reach as far south as the Amanos (Davis, 1991, p. 26). Davis describes this as stations on the way of migration which ultimately ended up in the Amanos and also there is some evidence of these floral elements further south in the Alouite Mnts in western Syria (Nahal 1962). Ekim and Güner, on the other hand, observed that this significant floral break is mostly occurring due to ecological differences between east and west of the Diagonal, rather than being a result of the palaeo-geological history of Anatolia (1986, p. 76).

As a matter of fact, this type of vegetation exchange among different phytogeographical units is not uncommon in Turkey. There are some other regions in Turkey where the native vegetation contains some geographically distant floristic elements. The alluvial fans of Yeşilırmak and Kızılırmak Rivers create two important foci for the infiltration of Mediterranean elements from the Black Sea coast into the inner regions of Central Anatolia. Moreover, Mediterranean elements are also represented on the western Black Sea coast where the climatic conditions, especially summer drought, become an important factor to prevent the establishment of Euxine forest as found in the eastern regions of the Black Sea coast (Atalay, 2012, p. 19; Ekim & Güner, 2000, pp. 49-51). The history of this penetration of Euxine elements into the Amanos is unknown. Davis (1991, p. 19) argues that these elements might have been trapped in the region during the glacial phases of Pleistocene.

3.3.5.2 Major terrestrial habitat categories in the Mediterranean Basin

The landscape of the Eastern Mediterranean Basin, especially in the Levant, is topographically and climatically heterogeneous with local diversity of habitats occurring in rather close proximities (Cowling et al. 1996, p. 365, Table 3). Blondel et al. (2014) describe this region-wide diversity of habitats as mosaic or patchwork. This is principally justified regarding the bio- and topographic diversity of the region. Forests and woodlands usually favour more open formations due to climatic and edaphic factors rather than dense stands. Turkey, itself alone, comprises of 27 % (21.2 million ha) of the total forested area on the northern shores of the Mediterranean. The forests are highly diverse in their composition, architecture and appearance. On the other hand, the growth form, morphology and phenology of the dominant species are varied in each region (Blondel et al., 2014, p. 119). The magnitude of human and climatic impact on Mediterranean-type environments is also a topic of discussion. Quezel and Medail (2003) estimated that only 15 % of the potential forest vegetation remains conserved today in the Mediterranean region.

The rest of vegetation had been subject to deforestation or soil degradation (Blondel, 2006, p. 716). Blondel describes that there were two consequences of the forest destruction in the Mediterranean region; 1) the replacement of deciduous broad-leaved forests by evergreen sclerophyllous forests and mattorals, "which in combination with increases in habitat patchiness over time, affected both the distribution of populations and species and genetic diversity"; 2) the climatic desiccation of the Mediterranean Basin as a whole and subsequently thinning of the plant cover leads to the dramatic increase in soil erosion (2006, p. 716).

A second plant habitat category is mattorals. These formations have different local names in the region and in other Mediterranean type climates around the globe[8]. The most-widely used term is the maquis which designate the shrubby vegetation (shrublands). Because of diversity of microclimates, substrates, local land-use histories, these formations demonstrate a wide range of structural forms and floristic composition. Basically, mattorals are dominated by shrubs and/or small trees with evergreen thick sclerophyllous leaves and a rich understorey of annuals and herbaceous perennials. This type of vegetation is well-adapted to the factors of anthropogenic and natural disturbance and frequent fire regimes of the Mediterranean; therefore, its initial appearance is considered secondary (Blondel et al., 2014, p. 122).

Steppes and grasslands are also prominent habitat units in the Mediterranean Basin. Many plant species dominate in steppes and grasslands are intrusions from the Irano-Turanian phytogeographical zone. This is explained by the "Zohary's law" which indicates that

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[8] These terms differ as follows; garrigue/garriga in France and Italy; xerovuni and phrygana in Greece; matorral and tomillares in Spain; choresh and maquis in Israel; bath'a throughout the Near East. In other Mediterranean environments; chapparal and coastal sage in California; mattoral and jarral in Chile; fynbos, renosterveld, karroid shrubland and strandveld in South Africa; mallee in southern Australia (Blondel et al., 2014, p. 122). Note Blondel and his colleagues describe also diverse meaning of these terms in case of the vegetation development (2014, pp. 123-4). "The Spanish term tomillares, the Arabic and Hebrew bath'a, and the Greek tern phrygana all refer to much lower formations than the mattorals, but closely related to them floristically and historically. The tomillares of Spain are shrublands characterized by a large number of thyme (Tymus) species (tomillo in Spanish). Phrygana in Greece and Turkey also consists of formations dominated by dwarf shrubs typically 20 – 70 cm tall".

“disturbed areas are generally invaded by colonizing elements coming from the drier habitats in the vicinity rather than from the wetter ones” (Blondel et al., 2014, p. 125). The successful colonization of Irano-Turanian elements has resulted from their lengthy history of adaptation to the disturbed sites like arable fields, human settlements, fire etc.

Abandoned fields (including other human-related landscape features, like fallowed fields, terraces and managed pasturelands) have been considered another habitat type by Blondel et al. (2014, p. 125). According to the authors, the abandoned fields rapidly become foci of colonization by various widespread annuals and biennials at the early stage of succession as well as the re-colonization of the same habitat by herbaceous and woody plants.

Riparian forests are salient habitat categories in the Mediterranean Basin. These habitats contain favourable conditions for diverse woody plants mostly dominated by deciduous trees such as oaks, poplars, elms, alders and willows. Vines such as wild grapes (*Vitis silvestris*), hops (*Humulus lupulus*) and various species of clematis (*Clematis*) are also elements of these habitats (Blondel et al., 2014, p. 127).

The last habitat category under consideration is wetlands. Wetlands in the Mediterranean region are highly diversified in terms of their hydrological regimes including freshwater lakes, alluvial floodplains, deltas, and marshes. Turkey contains almost 1.3 million ha water with approximately 250 bodies of water. These bodies of water fluctuate sharply in water levels and salinity. The freshwater lakes are important aquatic ecosystems for various plants, most of them are also economic plants for human use. Blondel et al. (2014, p. 128) states that

> “A recurrent feature of all coastal Mediterranean aquatic systems is their huge variation in biologically important factors, such as flooding periodicity, water salinity, and soil salinity, which all have profound influence in the structure and dynamics of plant and animal communities. Many of these factors vary enormously during the course of the year, from year to year or even longer periods of time. As a result, plant and animal communities are highly dynamic and do not exhibit long-term predictable successional changes in species composition …”

Temporary marshes are particularly important for plant and human communities in the Amuq (e.g. Eger, 2011). Because of their drying and wetting cycles within the year according to the bimodal climate of the Mediterranean, certain adaptive traits are more prominent among marshland plants such as the short growing cycle, mostly dominated by annuals and biennials as well as the production of large quantities of seeds that remain in the soil for a long period of time (Blondel et al., 2014, p. 132). Of particular importance, all of these abovementioned wetland habitats, in fact, appear significant for the palaeovegetation of the Amuq (see *section 3.3.5.2* below).

3.3.5.1 Amanos Mountains

The contemporary vegetation of the Amanos Mountains is heavily-wooded and exhibits exceptionally high levels of biodiversity[9] in relation to the Anatolian Diagonal (Zohary, 1973; Mill, 1994). Due to this exceptional biodiversity, the flora of Amanos has been under investigation and well-studied (see Wagenitz, 1962 for the history of ecological investigations in the Amanos). Atalay et al. (2014, p. 151) state that;

> “The west facing slopes of Nur [the Turkish name for the Amanos – DK] Mountains form a distinct habitat because there is a general air flow from Gulf of Iskenderun to Antakya – Kahramanmaraş depression. The rising humid and hot air masses coming from Gulf of Iskenderun on the west facing slopes lead to the formation of fog and orographic rain, which supports the growth of broad-leaved forests composed of *Fagus orientalis*, species of *Alnus*, *Acer*, *Castanea*, and *Carpinus* etc. and some hydrophytic shrubs like *Cornus mas*, *Corylus avellana*, *Buxus sempervirens* and so on.”

The flora of the Amanos Mountains largely includes Mediterranean species (about 65%) which were adapted to the bimodal Mediterranean climate. The Irano-Turanian floristic elements are interestingly few (2.5%) in spite of the close distance of this region to the Mesopotamian subzone. Euro-Siberian elements compose 7% in the study area. Akman (1973, pp. 122-3) notes that

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[9] Note the endemism in Amanos Mnts. As a distinctive example, Davis (1971, p. 19) describes *Wulfenia orientalis* of which the other 3 species of the genus only appears in the Alps, east Balkans and west Himalayas.

> "… Malgré la forte pluviométrie assez élevée (800-900 mm. par an) une faible partie seulement est mise à la disposition de végétaux, l'autre partie disparait par ruissellement et par évaporation. Pour cette des espèces des Monts de l'Amanus sont adaptées à cette condition écologique. Elles sont xérophiles. Certaines d'entre elles sont cependant hygrophiles et possèdent des feuilles assez larges favorisant la transpiration, mais elles se trouvent localisées à partir 800 m d'altitude aux expositions N et W. C'est le cas de nombreuses espèces des forets de *Quercus psudocerris, Fagus orientalis, Quercus cerris*".

Akman (1973, p. 123) describes diverse adaptive traits of these plant species such as the species reducing the transpiratory surface (e.g. *Pinus brutia*, *Erica varticillata*), ephemeral leaves (e.g. *Calycotome villosa*, *Genista acanthoclada*, *Spartaum junceum*), with protective hairs on their surface (e.g. *Cistus*, *Ononis* and many genera in Labiateae), cutinization of the leave epidermis for the typical Mediterranean species (e.g. *Ceratonia siliqua*, *Pistacia lentiscus*), leaf orientation for a smaller area of solar radiation (e.g. *Cercis siliquastrum*, *Vitex Agnus-castus*), water reservoir for the warm season (e.g. *Sedum*, *Roularia*, *Umbilicus*), bulbous species with their raciness appear to develop after the first rains in the autumn (e.g. *Muscari*, *Ornithagalum*, *Orchis* and *Iris*), and water-demanding woody plants (e.g. *Fagus orientalis*, *Abies cilicica*, *Quercus cerris*, *Sorbus torminalis*).

Zohary (1973) describes the Amanos vegetation different than the Syro-Libanese and Cyprian sectors with the occurrences of Pinetum nigrae and the *Fagus* forest. Overall, Wagenitz (1962, p. 231), after an expedition in 1957, remarks two aspects of the flora in the Amanos in relation to the neighboring regions;

> "Gegenüber der Flora und Vegetation des übrigen südlichen Anatoliens hat die des Amanus einen besonderen Charakter durch zwei Eigentümlichkeiten. Einmal finden wir eine größere Zahl von Arten, deren Hauptverbreitung in Libanon und Antilibanon liegt und die hier ihre nördlichsten Fundorte besitzen (zum Teil reichen solche Arten nich bis in den cilicischen Taurus) und außerdem beherbergt das Amanus-Gebirge eine Exklave kolchischer und südmitteleuropäischer Laubwaldarten mit der Buche, Fagus orientalis, als wichtigster Art".

According to the geobotanical assessment of Zohary (1973, pp. 156-7), the zonation of the vegetation in the Amanos is typically Mediterranean. The lower zone of Amanos Mountains, the Eu-Mediterranean zone, mainly consists of evergreen maquis elements without well-developed trees from sea level up to 700 mts. The pistachio and carob (the Ceratonieto-Pistacietum) constitute primary elements of evergreen maquis vegetation at the lower flanks of the Amanos Mnt. Where this maquis vegetation is degraded, Pinetum brutiae, leading species is *Pinus brutia* (red pine), rapidly colonizes every possible terrain up to 1.200 mts. Thus, maquis elements occur as undergrowth of *Pinus brutia* forests while regenerating in the southeastern exposures and on basalt tuff (Zohary, 1973, p. 157). The common constituents of the Oro-Mediterranean belt, the middle zone, which extends above the Eu-Mediterranean zone up to the upper limit of timberline at about 1.800 m, include broad-leaved deciduous forests of Euro-Siberian elements such as *Acer platanoides*, *Alnus incana*, *Ostrya carpinifolia*, *Tilia argentea*, *Ulmus glabra* and of Euxine elementssuch as *Fagus orientalis*, *Ilex colchica*, *Juglans regia*, *Rhododendron ponticum*, *Staphylea pinnata* and many woodland herbs (Mill, 1994, p. 339). This is only possible due to the parallel alignment of the Amanos and the direction of moisture-carrying air masses coming from the Mediterranean Sea which create a suitable sub-humid condition for these extra-zonal floristic elements to survive. Mixed forests of *Pinus nigra* and *Quercus cerris* and *Q. petraea* appear on the slopes facing the north without fogs, at the elevation between 1.100 – 1.600 mts. An undergrowth of maquis vegetation also appears in these forests. The higher elevations of this belt correspond mixed coniferous of *Pinus spp.*, *Cedrus libani*, *Abies cilicica* and *Juniperus excels* (Zohary, 1973; Atalay et al. 2014).

Equally significant is that *Cedrus libani* (cedar) grows on the eastern slopes of the Amanos between 500 – 1.800 mts. Atalay and his colleagues (2014: 150) note that cedar is well-adapted to different edaphic conditions while the species is particularly found on the humid slopes open to the prevailing winds, but not tolerant to fog and excessive moisture. Optimal annual rainfall for cedar is over 600 mm. The cedar-in-the-Amanos is found mixed with a large array of other species such as *Quercus cerris*, *Q. petraea*, *Q, libani*, *Fagus orientalis*, *Styrax officinalis*, etc. Additionally, *Abies cilicica* forests are widespread between 1300 and 1500 m, in the Amanos where the formation of fog becomes intense, east of Iskenderun.

Since the Amanos is not high enough in comparison to the Taurus mountain chain, the subalpine and alpine vegetation above the timberline (1.800 – 2.000 meters) is restricted to a short strip of land. In general, Atalay et al. (2014, p. 153) states that the subalpine zones in the Taurus Mnts. are either composed of karstic rocks with shallow soil profile and very sparse floral elements or karstic depressions where thick soil accumulated to allow plant growth. They regard such karstic depressions as important for the many local and micro-habitats in the Taurus. Atalay (2012, p. 27) notes that the vegetation of spiny cushion species develops in the alpine and subalpine zone well, due to insufficient moisture in the high altitudes of the Taurus Mnts. The main herbaceous species in the Anti-Taurus Mnts. as reported in Yurdakulol (1977) are *Astragalus gummifer*, *A. angustifolius*, *Ashodeline taurica*, *Euphorbia kotschyana*, *Barbarea eriopoda*, *Festuca varia*, *Bromus erectus* var. *tricolor*.

Although fragmentary and preliminary in nature, Akman (1973) had recovered two pollen profiles (YA 1 and YA 2) about 50 m to each other, from the turba formations on the Mitisin-Zorkun plateaus near the Province of Osmaniye in the northern part of the Amanos. The preliminary analysis of these profiles shows humid and temperate climate conditions.

3.3.5.2 Amuq Plain

Modern vegetation of the Amuq Plain is less-known in comparison. Following the vegetational transect eastwards from Arsuz, south of Iskenderun towards Aleppo (eventually to Khurasan in Iran), Zohary observes that steppic elements become more prominent when the Amuq approaches the Mesopotamian lowlands (1973, p. 269, Figure 128, Segment A). Zohary (1973, p. 638) describes the rhizomatous *Prosopis farcta*, a perennial segetal, occasionally occupies the cultivated fields and as a leading species usually forms one of the richest plant associations occupying fertile, fine-grained alluvial soils. The rich segetal Prosopidetum farctae community largely dominates the alluvial soils in the Amuq (Zohary, 1973, p. 269). In moister soils this plant community is replaced by Glycyrrhizetum glabrae. Furthermore, stands of thermophilous *Ziziphus lotus* occur in warm, secluded valleys up to 300 meters.

Furthermore, Zohary describes the tabor oak (*Quercus ithaburensis*) as the prominent tree species of the Amuq Plain as well as the Adana Plain to the west. He observes the association *Quercus ithaburensis – Pistacia atlantica* ziziphetosum loti in a fragmentary stage in the Amuq (1973, p. 521). Nonetheless, further north near Bahçe, where the local climatic conditions are relatively drier, Zohary describes the association Pinetum brutiae typicum in the alliance Pinion brutiae. According to his sample record, the following species appear as undergrowth to the dominant species *Pinus brutia*; *Quercus calliprinos*, *Pistacia palaestina*, *Cotinus coggygria*, *Quercus cerris*, *Cercis siliquastrum*, *Phillyrea media*, *Juniperus oxycedrus*, *Rhamnus punctatus*, *Eryngium falcatum*, *Osyris alba*, *Dactylis glomerata*, *Tymbra spicata*, *Stipa bromoides*, *Cistus creticus*, etc..

It is important to note that Zohary conceives the associations of Quercion ithaburensis to be part of two different types of Mediterranean vegetation in the eastern subregion of the Mediterranean phytogeographical zone, in contrast to the western sub-region where only evergreen maquis and forest components occupy the Eu-Mediterrenean zone;

> “The one comprises the true vegetation maquis, thus including the Ceratonio-Pistacion, the Quercion calliprini, Pinion halepensis, the Pinion brutiae. The other is a type of deciduous forest occurring in the same altitudinal zone and comprising mainly the Quercion macrolepidis and Quercion ithaburensis, the former being almost exclusively centred in Anatolia, while the latter has its main centre in Palestine. These two sets are set quite apart from one another, although there is some overlap in their floristic composition and some similarity in their ecological requirements. However, it is the evergreen maquis and forest that occupy the more favourable habitats, that are richer in species, and that manifest the Mediterranean nature more faithfully than do the two alliances of the deciduous oaks” (1973, p. 518).

Concurrently, he elaborates that the presence of deciduous elements may represent "a vegetational relict of a former period[10]. These observations on this particular characteristic of Mediterranean vegetation are also supported with the fact that "quite a number of the components of the evergreen maquis and forests are summer-green trees and shrubs".

Furthermore, Zohary (1973, p. 607) reports the hydrophytes from and near the shores of the lake of Antioch before it was drained. *Potamogeton* spp., *Lemna* spp., *Salvinia natans*, *Ceratophyllum demersum*, *Hydrocharis morsus-ranae*, *Nuphar luteum*, *Nymphaea alba*, *Utricularia vulgaris* are listed as the representative of the Potamotea class. Regarding the Phragmitetea, *Typha australis*, *Phragmites communis*, *Scirpus maritimus*, *S. lacustris*, *Cyperus longus*, *Iris pseudacorus*, *Sparganium neglectum*, *Pulicaria sicula*, *P. dysenterica*, *Lythrum salicaria*, *Glycyrrhiza glabra* were part of the plant communities around the lake.

Another aquatic ecosystem studied in the deltaic zone of the Orontes in Samandağ. The Milleyha wetland ecosystem covers about 100 ha. According to an ecological study conducted by Altay and Öztürk (2012) this area consists of 183 taxa belonging to 48 plant families, specifically the plants adapted to saline soil conditions, the halophytes, were in their focus. They describes three halophytic plant communities in the area; 1) *Phragmites australis* (dom.) with companions *Aeluropis littoralis*, *Bolboschoenus* ([syn.] *Scirpus*) *maritimus*, *Juncus rigidus* and *Polypogon monspeliensis*; 2) *Halimione portulacoides* (dom.) *Limoniu angustifolium*, *Polypogon monspeliensis*, *Arthrocnemum macrostachyum*, *Aeluropis littoralis*, *Juncus rigidus*, *Melilotus messanensis* and *Inula crithmoides*; 3) *Bolboschoenus maritimus* (dom.),*Aeluropis littoralis*, *Polypogon monspelensis*, *Phragmites australis*, *Inula crithmoides*, *Thypa domingensis*.

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[10] See also Blondel et al. (2014, Chapter 7) for more details. Also informative *ibid.*, page 153, Table 7.3 for vicariant series among the Mediterranean oaks.

Ecological assessment of the pasturelands in the northwest of the Amuq (Kirikhan) demonstrate that *Lolium perenne* and *Lotus corniculatus* are decreaser species while *Cynodon dactylon*, *Coronilla varia* and *Dianthus multicaulis* represent the increasers. Any other species in these pasturelands are described as invaders including *Hordeum marinum*, *Alopecurus myosuroides*, *Centaurea iberica* etc. (Cinar et al., 2014).

3.4 PREVIOUS STUDIES IN ENVIRONMENTAL ARCHAEOLOGY IN AMUQ PLAIN AND ITS ENVIRONS

3.4.1 Palynology

To date, only circumstantial evidence exists to comprehend the past vegetation of the Amuq Plain due to lack of local pollen reservoirs suitable for sampling. A small water body at the northeast of the Amuq, Gölbaşı Lake is the only remaining standing water body in the Amuq which is a relic of the larger hydrological system of the Amiq Lake. The pollen coring from this lake site had been undertaken by Henk Woldring (as cited in Riehl 2010a) but the results have never been published.

The overall reconstruction of the Holocene palaeovegetation in regards to pollen indicators and modern vegetation data locates the vegetation of the Amuq Plain within the extended riverine forest and typical maquis elements of the Eu-Mediterranean vegetation zone (Hillman, 2000; van Zeist & Bottema, 1991, p. 43). Charcoal analysis from LBA levels of Tell Atchana show the presence of the oak woodland, as well as riverine trees and possibly some wood resources, from the Amanos (Deckers, 2010). Also significant is the abundance of deciduous oak charcoals which indicate that Zohary’s modern-day observation for the prevalence of oak forests in the Levantine zone was possibly still standing during the LBA.

The palynological studies in the Ghab Valley (van Zeist & Woldring, 1980; Yasuda, Kitagawa, & Nakagawa, 2000), south of the Amuq along the Orontes are the only close-by source of information for the regional palaeovegetation[11]. However, the chronological resolution of this pollen site had become subject of criticism, due to the reservoir effect of determinations from the freshwater mollusk shells (Cappers, Bottema, & Woldring, 1998; Meadows, 2005). In general, although the low-resolution chronology becomes problematic to interpret the pollen data, van Zeist and Woldring (1980) suggested that the Ghab I core covers the transitional period from Younger Dryas to Holocene, reaching this conclusion from the composition of plant taxa identified (the Chenopodiceae chronozone with minimal arboreal influx), although there is only single radiocarbon determination. The supposedly Holocene palaeovegetation in the Ghab II and III cores indicates that oak and pine were the dominant floristic elements with a large diversity of steppic and wetland taxa (van Zeist & Woldring, 1980, p. 118, Figure 3). The Ghab III core of van Zeist and Woldring (1980) indicates that the deciduous oak (*Quercus cerris*-type) had decreased steadily together with the evergreen oak (*Quercus calliprinos*-type) and partially replaced by non-arboreal pollens. The same trend is also visible for the Chenopodiceae and *Artemisia* pollen values. They were replaced by other non-arboreal taxa at the sampling site. Yasuda et al. had obtained their core 25 - 30 km downstream from the core of van Zeist and Woldring' study site. This study demonstrates a different vegetation pattern. The deciduous oak is completely replaced by evergreen oak towards the upper zones of the pollen profile (Yasuda et al., 2000, p. 131). This process is not largely visible in the pollen core of van Zeist and Woldring. On the other hand, both profiles show the increase of olive pollen values at the upper pollen zones.

Nonetheless, perhaps more importantly, the detailed investigations of both palynological studies record the occurrences of the extra-zonal elements (van Zeist & Woldring, 1980).

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[11] It is important to note that the contemporary vegetation of the Alaouite Mnts. and Zawiyé Mnts resemble to that of the Amanos as described by van Zeist and Woldring (1980).

Although van Zeist and Woldring do not discuss this subject in their account, the presence of these relictic floral elements in their pollen record coincides well with the modern ecological studies of Nahal (1962) in the same area; e.g. the presence of hazel (*Corylus*), chestnut tree (*Castanea*) and walnut tree (*Juglans*). Such figure also confirms the results from an eastern pollen site, the Gölbaşı Lake[12] at the border between the Provinces of Adıyaman and Kahramanmaraş in Turkey. Bottema (1986, p. 109, Figure 8) observes *Fagus* in this fossil pollen record, *albeit* in low counts as obviously this tree is in refugia in this environment. Radiocarbon determination locates the earliest occurrence of this Euro-Siberian element to 4th millennium BCE.

3.4.2 Zooarchaeology

The zooarchaeological studies are as limited as the archaeobotanical accounts in the region. The investigations which are carried out at Tell Atchana, Tell Tayinat (as treated in previous sections) and Zincirli form the basis of our understanding on stockherding and animal exploitation. The animal bones recovered from the late 14th century contexts of Tell Atchana demonstrate no distinct signal in the composition of animal species after the Hittite occupation started at the site (Çakırlar et al., 2014). The Zincirli study focuses on the changes in the animal bone assemblage with the annexation of the town into the Assyrian administrative system. The zooarchaeological results indicate a marked process of specialization in animal economy towards husbandry of sheep and cattle, at the expense of goat and pig, during the Assyrian hegemony in Iron III (Marom & Herrmann, 2014).

3.4.3 Geoarchaeology

Wilkinson (1999) suggests a major phase of marsh and lake development during the mid- to late first millennium BCE as the upper layers of lacustrine clays at the tell sites of AS 180 and

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[12] This is a different lake than the Gölbasi Lake in the Amuq.

AS 181[13] have shown. AS 180 (ca. 3 ha), also called Tell Hijar, contains the sherd finds of mid-third to second millennium BCE and sealed below clayey loam deposits by the later lake (Wilkinson, 1999, p. 562). According to his reconstruction from cores drilled at the center of the Lake of Antioch, a certain body of water was present in 6th millennium BCE, which became a marsh environment or a larger lake in the following millennia. Around 4.000 BCE, this body of water became drier, or non-existent, between the beginning of the 4th millennium until the mid-1st millennium BCE (Wilkinson et al., 2001, pp. 200-22). Otherwise Wilkinson characterizes the landscape of the Amuq with dry and wet environments intermingled with each other throughout the Holocene.

Two geological processes were found significant for this development; 1) sedimentation from upland erosion, most probably from the Amanos as recognized in the increasing amount of chromium deposited on the plain and 2) sedimentation from river and canal flooding through avulsion and aggradation (Casana & Wilkinson, 2005). The sedimentological assessment of the Orontes River demonstrated regular aggradation of alluvial sediments into the plain (Wilkinson, 1999, p. 562) which corresponds to the archaeological observations at the lower town of Tayinat. Batiuk (2007) estimates approximately 1 meter of sedimentation per millennia in the lower town of Tell Tayinat. The sediment profile of the Orontes floodplain has been studied by Wilkinson (1999). He describes nine superimposed sediment layers from a N – S drain from east of Tell Atchana. According to his results (1999, Fig. 6a), the base of section A (the layers A7, A8, A9) is clay-rich floodplain deposits and show evidence of an archaeological site of 5th millennium BCE age. The subsequent layers show evidence of ceramic shards which are more abraded in A5 and A6. He locates these two layers to be contemporaneous to the 2nd millennium BCE Tell Atchana. On top of A5, there is a hiatus of sedimentation and there followed higher energy floods with sandy and silty clays which had

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[13] "AS" abbreviation denotes "Amuq Survey" as used in the AVRP survey.

been defined for A4 and A2 with sedimentary hiatus in A3 and A1. He attests the evidence from A4 onwards to the late Roman period (1999, p. 565). According to these results, Wilkinson states that

> “Orontes flood energy levels, as estimated from the Atshana sediments, were low when the lake was low or absent … The rise in lake levels between the early second millennium BC and Roman times therefore corresponds approximately to the period of increased flood energy or channel shift of the Orontes (layers A4-A2)” (1999: 566).

Furthermore, Casana (2008) observes that the settlement types had changed in the late 1st millennium BCE. The detailed sedimentary analysis in three drainage basins in the County of Altinözü (on Kuseyr Plateau or Jebel el-Aqra as alternatively known) demonstrate parallel erosional histories of the sampled sediments culminating during the Antiquity and the Late Antiquity. The increasing erosion detected and dated to the Roman Period coincides with the archaeological survey data for the transformation of the settlement system. The typical mound-based settlement system of the Bronze and the Iron Ages transformed to the small dispersed farmsteads during the Hellenistic and Roman periods. He argues that the initial consequence of this settlement expansion towards uplands was the increased settlement density in the uplands which contributed to further sedimentation through colluvial erosion when vegetation cover had been removed to open up new agricultural zones[14] and pasturelands.

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[14] His observation becomes potentially significant when comparing the magnitude of timber exploitation (and eventually deforestation) in the written records from the antiquity in other regions. Strabo (XIV, vi, 5) reports the timber exploitation in Cyprus; “Eratosthenes says, that anciently the plains abounded with timber, and were covered with forests, which prevented cultivation; the mines were of some service towards clearing the surface, for trees were cut down to smelt the copper and silver. Besides this, timber was required for the construction of fleets, as the sea was now navigated with security and by a large naval force; but when even these means were insufficient to check the growth of timber in the forests, permission was given, to such as were able and inclined, to cut down the trees and to hold the land thus cleared as their own property, free from all payments” (as cited in Brice, 1978, p. 142).

CHAPTER 4. METHODS

This chapter discusses the methodological approaches and limitations undertaken during this dissertation. The chapter has been divided into six sections. The first part describes the overall introduction to data handling in archaeobotany such as sampling strategies, sample size, preservation and taphonomy (section 4.1). The following sections focus, on the description of models to evaluate the plant data in archaeobotany (section 4.2) and on quantitative analysis in archaeobotany (section 4.3). The remaining three sections (4.4, 4.5 and 4.6) introduce the methods used in the present study and their methodological limitations.

4.1 GENERAL INFORMATION ON DATA HANDLING IN ARCHAEOBOTANY

4.1.1 Sampling strategies

Sampling is the principal factor influencing the representativeness and reliability of archaeobotanical datasets. Binford (1964) mentions that selecting correct sampling strategies is fundamental for archaeological investigations. The principal method in which those samples are selected from the archaeological context will also possibly influence every later phase of the analysis and interpretation (van der Veen, 1984). There are four different types of sampling strategies implemented in accordance to the physical characteristics of the site or excavation strategies (M. Jones, 1991). “Haphazard or grab sampling” is the sampling method without a pre-defined sampling strategy of how and where to sample. This is considered ineffective since different contexts would be sampled more often than others; therefore,can create a biased view of the plant evidence. “Purposive and judgment sampling” is another method and this was found the most suitable for the tell sites in the Near East. Since the cultural deposits appear as continuous superimposed layers in most sites, the excavators have to consider their judgment in collecting the samples from particular contexts. However, Riehl

(1999, p. 15) mentions that this could turn to be “presumptuous” if the excavator has little intention to define the context or due to bad documentation of the provenance of the samples. “Interval sampling” is conducted by collecting samples based on even spacing across the sampled unit. This can be implemented with a grid system that provides clear information for the exact provenance of the samples. The last strategy is the “probabilistic or random sampling”. This is different to haphazard sampling as a pre-defined sampling strategy, operational under the conditions that all will-be-sampled units are already known to the excavator (Riehl, 1999). This strategy implies a probabilistic approach because each excavated unit has the same chance to be represented in the dataset (van der Veen, 1982). Riehl rightly puts forward that the archaeobotanists ideally search for a sampling strategy that can be adaptable to all sites; however, certain factors (e.g. physical properties of the site, excavation strategies) often affect the sampling strategies in the Near Eastern archaeology. Therefore, she mentions that different sampling strategies are practiced in most archaeological sites (1999, p. 15).

In relation to the research goal of the excavation, the range of archaeological contexts from where the soil sediments were recovered can also differ. The range of archaeological contexts unearthed and sampled in a settlement is highly related to the excavation strategies handled by the research team. It has been suggested that recovering a wide range of samples from a variety of archaeological contexts would be the best possible sampling strategy to avoid biased conclusions (Dennell, 1972, p. 149). The strategy to reduce accidental patterns in the sample composition is to enlarge the coverage of the sampling vertically and horizontally (Riehl, 1999), but usually it is not possible to sample a whole site to test the reliability of this sampling method. What is mostly assumed is that a large number of samples from the widest possible range of contexts, should be accepted as representative, to get the most diverse range of plant species possible (Riehl, 1999, p. 15). Nevertheless, it is not always expected that all archaeological features yield sufficient amounts of plant remains.

4.1.2 Sample size

An important aspect of archaeobotanical sampling is estimating the required sample size to recover a representative and accurate dataset (van der Veen, 1984). It is generally agreed that the archaeobotanical material represents only a small fraction of what was once present at settlements. Nonetheless, the principal problem is how much volume of soil sediment to extract from a large feature (i.e., silo) since floating all soil sediments within a certain feature would be impossible (van der Veen, 1984).

The minimum sample size of a reliable and representative dataset has been undertaken by van der Veen (1984). Her mathematical model resulted in the estimation of a minimum of 541 seeds/objects in four comparative levels of investigation. These levels of investigation contain; the site as a whole, each occupation phase of the site, each category of features (ditch, pit, postholes etc.) and the individual samples. According to her formulation, the archaeobotanical material would be representative only by including 541 seeds in every level described above. Some other scholars have defined different figures like 100-200 seeds per soil sediment (G. Jones, 1991; Kenward, Hall, & Jones, 1980, p. 3) and 500 seeds per deposit to achieve reliable sampling (Badham & Jones, 1985, p. 25).

4.1.3 Conditions for preservation

Different modes of preservation conditions favor particular types of plants and plant parts in connection to the environmental and cultural contexts preserved in an archaeological site (Miksicek, 1987; van der Veen, 2007). This reflects the importance of the environmental and climatic settings for the preservation of plant evidence. Carbonization is the most widely encountered preservation condition in the Near East while desiccated plant remains were also uncovered in the southern Mediterranean basin and Southern Mesopotamia. This also indicates that for example, carbonization of plants would lead to a differential preservation of some species at the expense of others. Therefore, only a small portion of the actual plants are represented in archaeobotanical assemblages after carbonization. Soft tissues of vegetables such as leaves or tubers, oil-rich seeds with high flammability are less likely to become preserved through charring. For example, comprehensive studies show that desiccated assemblages are 1.5 – 2 times richer in taxa diversity than the carbonized assemblages (van der Veen, 2007).

Boardman and Jones (1990) observed that the effects of charring are varied for different plant components, light chaff fragments such as lemna and palea are likely to be lost in a fire faster, then the chaff components of glume wheats, while the cereal grains survive the charring comparatively better. Plants or plant parts with hardy structures such as cereal and pulse grains, cereal chaffs, shells and stones of fruits are more likely preserved remains. Wright (2003) indicates that the temperature, length of exposure, moisture content, and portions of plants to be exposed to fire area important determinant for the preservation by carbonization. On the other hand, van der Veen observes that the sample composition contains a few larger categories in charred assemblages across different periods. Most other plant remains are represented by chance factor only (2007, p. 978). That means, G. Jones (1992, p. 66) suggests that “preservation is largely related to post-charring conditions both before and after burial – in particular due to mechanical damage and the effects of wetting and drying” of soils.

Mineralized seeds and fruits are frequently encountered in archaeobotanical assemblages. However, these appearances have found no correlation with the archaeological context (Messager et al., 2010) except the cess pits, latrines, sewage systems (Fairbairn et al., 2019;

Jacomet, 2007). There are two sorts of mineralization identified: 1) the first type of remains recovered in archaeological deposits through impregnation with mineral solution (Jacomet, 2007). Messager et al. note that "[T]he organic structures have been replaced or replicated and the plant tissues are hardened, especially by phosphatisation" (2010, p. 25). The second type of mineralization related to those plants which have capacity to produce mineral matter (i.e. biomineralization) usually by biogenic carbonate or silica before the burial of seeds. The genera *Buglossoides* and *Celtis* are known to appear in this way (Messager et al, 2010).

4.1.4 Taphonomy and deposition

Taphonomy, as used in environmental archaeology, indicates the depositional and post-depositional processes leading to preservation of plant macro-remains in cultural debris (Jacomet, 2007). However, before describing the archaeobotanical undertakings of taphonomic and depositional processes, it is necessary to mention the remarks of Binford (1982):

> "… Archaeologists must realize that *there is no necessary relationship between depositional episodes and occupational episodes.* Rates and magnitudes of 'burial' of archaeological remains are generally consequences of processes operating independently or at least semi-independently of occupational episodes. The primary determinants of the 'burial' of archaeological remains are the rates of geological dynamics resulting in surficial deposition of matter. Floods, exfoliation of the walls of a rock shelter, loess deposition, slope wash, etc., are the major determinants of the 'provenience' packages in terms of which we 'see' archaeological associations" (Binford, 1982, p. 16, italics from original text).

Therefore, Binford emphasized the fact that the composition of archaeological assemblages is not solely a product of a cultural system but derives from "interaction between the cultural system and the processes which are conditioning the burial of cultural debris" (1982, p. 17). The source of patterning in any plant assemblage is influenced by diverse factors ranging from particular ways of human-plant interactions in antiquity to the recording of each taxon by the archaeobotanist in the laboratory (Popper, 1988; van der Veen, 2007; G. Jones, 1992). In other words, the plant species represented in archaeobotanical assemblages are affected through various taphonomic processes (i.e., dung burning or crop processing) as well as the effects of post-depositional disturbances such as bioturbation or alluvial processes (Miksicek, 1987, pp. 231-3), constant daily drying and wetting cycle of the soil, and differential preservation of plants under carbonization (G. Jones, 1992). On the other hand, it has been argued that contextual differentiation would be another factor in survival of plant macro-remains in archaeological deposits. Colledge (2001) informs that once the plant remains were deposited in the pits, they suffered less from the post-depositional attrition than the accumulation on the living surfaces due to trampling.

Hubbard and Clapham (1992) describe three distinct groups of deposition according to the relationship between archaeological context and assemblage. In the first group, called "class A", are the archaeological remains that were found *in situ* in the context from which they were recovered (primary deposition). Furthermore, the context in this case should indicate the signs of burning. The second group of findings (class B) represents an assemblage that comesfrom an event (here a burning event) but has been re-deposited from the original context to a secondary one (secondary deposition). The last group (class C) includes the assemblage from diverse charring events and many different activities and is considered the most ubiquitous find class in archaeobotany. Following are the routes of entry of plant remains into an archaeological context, of which the first two represent recurrent daily activities while the other three display rarer events in the formation of an archaeobotanical assemblage:

> "1) First and foremost, plant remains used as fuel, both intentional and "causal" use. "Causal" use refers to the discard into a fire of fine-sieving residues of glume wheats, dehusked on daily basis, as well as of nut shells, fruit stones, and similar. Intentional use represents the deliberate use of chaff and straw of free-threshing cereals as fuel (in Roman Egypt traded for such a purpose), and in arid and semi-arid regions the use of animal dung (which will include chaff and straw remains as well as arable weeds and seeds of grazed vegetation); 2) foods (especially cereal grains and pulses) accidentally burnt during food preparation (e.g. bread baking, cooking, roasting), including parching of glume wheats where practiced); 3) stored foods and fodder destroyed by fire in accidents or in deliberate and/or hostilefires; 4) plants

> destroyed during the cleaning out of grain storage pits using fire; 5) diseased or infested crop seeds that needed to be destroyed" (van der Veen, 2007, pp. 969-8).

It would be advisable not to attest the finding of each plant taxon to a single activity type above, because the same sort of seeds may have been deposited from diverse human activities at different times (Pearsall, 1988, p. 108).

4.2 MODELS FOR EVALUATING ARCHAEOBOTANICAL REMAINS

This section undertakes some models developed within the study of archaeobotany to evaluate the plant evidence in archaeological sites. A characteristic feature of archaeobotanical research is to interpret the temporal and spatial variations of plant assemblages interpreted as a factor of past human activities (G. Jones, 1992, p. 70).

4.2.1 Crop processing

Crop processing is one of the most widely discussed taphonomic processes in archaeobotany. The composition of plants during various stages of crop processing differs among each other according to type of cereal product (e.g., free-threshing wheat and glume wheats) (Hillman 1985, p. 1). Crop processing stages can be, therefore, reconstructed by investigating the relative abundance of grain, processing debris and wild plants found in the archaeobotanical samples (Fuller & Stevens, 2009).

Processing removes the weed seeds, straw, rachis segments and grain-sized stones in a selective manner. Jones' ethnographic research on the crop processing stages revealed that each crop processing stage filters different weedy species and plant components with distinct physiological attributes that can be discriminated by the statistical analysis. It is assumed that through investigating the physiological characteristics of weedy plants found in the archaeobotanical assemblage, it is possible to determine after which processing stage the crop product was brought into the site. This indicates that, for instance, winnowing stage includes a different composition of plants and plant parts than the threshing or coarse sieving stages (Hillman, 1973, 1984; G. Jones, 1984, 1987; Charles & Bogaard, 2001; Popper, 1988). For this, G. Jones (1984, 1987) defined three categories to distinguish the processing stages. Wild seeds are categorized according to: 1) size of seeds (small or big, greater or less than 2 mm), 2) dispersal characteristics (free or headed, dispersed at threshing or still contained in heads, spikes or clusters, 3) aerodynamic features (light or heavy, features that provide for dispersal). Then these variables are coded by combinations of each other that result in six analytical categories to be entered in the statistical analysis

Moreover, ethnographic research has shown that the crop processing stages also have an impact on the relative appearance of two sets of phytosociological groupings of arable weeds (G. Jones, 1992). The ratio of weedy plants associated with the Chenopodietea class, it appears nowadays the spring-sow root-row crops with intensive cultivation, become progressively reduced compared to the Secalinetea class of weeds which are indicators of extensive cultivation when crop processing proceeds from the winnowing to fine sieving. This reduction of the Chenopodietea species is assumed to be related to the seed dispersal mechanism, as this class of weeds is adapted to rapid seed burial in relation to the small seed size or self-burial mechanism. The Secalinetea species, in contrast, are adapted to dispersal by crop through mimicking the growth habit and seed size and shape of crops to be resown together with crop (Bogaard, Jones, & Charles, 2005). Evaluation of crop processing stages from the relative measures of Chenopodietea and Secalinetea classes is hampered by an ecological bias concerning the underrepresentation of spring sowing indicators, as well as signatures of intensive cultivation in crop processing products (an over representations in crop processing by-products instead). A certain problem is that neither Chenopoditea nor Secalinetea species are directly associated with just one of the processing stages or another while these species usually have a wider adaptive range in agricultural habitats and in nature (G. Jones, 1992; Bogaard et al., 2005; Riehl, 1999).

4.2.2 Dung as fuel

Dung burning is an important taphonomic pathway for the seed and fruits to be brought into the site (N. Miller, 1984; N. Miller & Smart 1984). Naomi Miller's contribution (1984) has been notably recognized within experimental archaeology (e.g. Wallace & Charles, 2013; Valamoti & Charles, 2005) in regards to the formation of archaeobotanical assemblages while ethnographic studies had also been undertaken to understand this particular taphonomic pathway (e.g. Anderson & Ertuğ-Yaraş, 1998). Many different types of dung have been identified in a study from Central Anatolia which corresponds to different animals, season and methods of preparation. Dung preparation is an important activity for traditional farming communities, especially in semi-arid and arid environments where the wood resources are scarce and usually stored for the winter season (Anderson & Ertuğ-Yaraş, 1998). Miller (1997, p. 100) describes certain conditions of dung burning in contemporary and prehistoric communities as follows:

> "… (1) plant materials arriving in a settlement are used and deposited in a variety of ways (e.g., cess and trash deposits), (2) burning of fuel routinely occurs in the controlled setting of hearths, ovens, and fireplaces, (3) trash is less likely to be burned within the confines of the settlement, (4) charred remains scattered in the trash deposits that are most analogous to archaeological 'cultural fill' are likely to be remnants of fuel, (5) many seeds persist in burnt dung".

Riehl (1999, p. 25) stresses that "the taphonomic processes that lead to the formation of dung cakes are relatively complicated. Food selection by animals and humans and digestion are the most important filters between the available plants in the environment and the seeds in animal dung". That indicates that the palatability of plants such as taste, smell, toxicity are the determinants of animal selection for feed from nature (Riehl, 1999, p. 25). Similarly, Akeret et al. report that the rate of survival of seeds and fruits in dung of small ruminants is between

0.8 and 55.5% in relation to the size, shape and hardseedednessof the objects (1999, p. 178; see also Wallace & Charles, 2013). Anderson and Ertug-Yaras observe that there is a greater potential for certain plants to be incorporate into the archeobotanical assemblages by dung burning. These are the small-sized wild plants which have a better chance to survive than the large-seeded cereal and pulses; processing the grain increases the chance of destruction in the animal digestive tract; hard-coated wild plants are likely to be preserved and also small wild plants may “escape” the grinding of grain crops,and thereby would have been separated for animal feed (1998, p. 103).

Additionally, it is ethnographically reported that raw dung is mixed with chopped straw and chaff to strengthen the dung matrix (van der Veen, 2007, p. 972; Anderson & Ertuğ-Yaraş, 1998; Charles, 1998). Charles (1998, p. 112) and N. Miller and Smart (1984, p. 18) observe that the examination of the discarded soil matrix from his experimental studies demonstrates that in some cases, there were no seed and chaff remains left, but only the fine ash, when the dung cake had burned until it was spent. That indicates combustion properties, dung type, time of combustion, moisture and contents would have some relevance of identifying dung burning (Wallace & Charles, 2013). Experimental data of Anderson and Ertuğ-Yaraş (1998) show that the potential bias over some plant parts involve the majority of surviving plant objects such as straw (rachis and culm segments) and wild/weedy seeds. On the other hand, cereal grains are poorly preserved after burning.

There are several criteria for identification of dung-originated remains in the archaeobotanical assemblages (Miller & Smart, 1984; Charles, 1998): 1) scarcity of woody plants in the environment, 2) suitable dung-producing animals, 3) the presence of recognizable dung pellets or availability of potential seeds eaten by livestock, 4) the recovery of such items from hearth contexts where the most likely archaeological feature to be used for dung burning, 5) the biology and ecology of non-crop species, time of growing, 6) to compare the non-crop seeds for crop-processing stages to test whether their source origin would be crop processing, 7) grain to chaff ratio which relates to preparation and use for human and animal consumption.

Moreover, dung can have another practical use as fertilizers in arable fields as manure (Miller & Gleason, 1994). Dung burning may become necessary or practical for one period and manuring may turn into a successful management strategy to enhance soil fertility for another period (Miller & Smart, 1984; Charles, 1998). This issue will be mentioned further below in relation to stable nitrogen isotope analysis in *sub-section 4.3.3.2*.

Many researchers often agreed to use methods of seed:wood mass ratios to focus on questions of alterations in landscapes and pasturing or foddering activities (Miller & Marston, 2012). Although the primary argument seems logical at first glance (the sample must include large amounts of seeds rather than charcoal fragments), this indicates a linear relationship between depositions of seeds and charcoals. Due to several unknown variables on how the archaeobotanical assemblages are formed, it is difficult to assess the exact nature of human activity in question. Therefore, an understanding of archaeological context remains critical to this method and cannot be applied if characteristics of a particular context are not well-defined in the field. Valamoti and Charles suggest that considering the glume wheat component of their experimental dung pellets, the remains of spikelets are likely to survive the animal digestive tract and would leave a similar composition like that of cereal dehusking during crop processing activities (2005, p. 531). That being the case, it is difficult to find such homogeneous samples with greater certainty that the sole taphonomic process for fuel use. For this reason, this ratio method can be applied if the human activity was solely aimed for fuel use from certain archaeological contexts like hearths. Even identifying dung use in ovens can be difficult to assess since the ovens can be also used for other activities such as pottery-firing or lime melting. These activities may have required different types of fuel with varying combustibility properties.

Two alternative ways to overcome this difficulty are the physical finds of dung by investigating its contents and the application of spherulite analysis to differentiate the dung burning events from other taphonomic processes (Smith et al., 2018). The first aspect is the most direct evidence for using dung as fuel and animal feed selection. Riehl (2019) identified a hoard of dung containing large amounts of *Rumex* seeds inside the dung from Tel el'Abd representing direct evidence (also Akeret et al. 1999 for Arbon Bleiche 3). The spherulite analysis is another way for a more precise understanding of this taphonomic process. Spherulites are microscopic features developed in the stomach of the ruminants and in their digestive track (N. Miller & Gleason, 1994; Smith et al., 2018). Recent research shows that these microscopic remains, as well as micromorphological analysis of sediments, can be used to reconstruct fuel use patterns across the studied site (Smith et al. 2015, 2018). However, although promising, the applicability of this method is still limited as simply too little is known on the spatial distribution of spherulites, their depositional and survival characteristics in archaeological sites.

4.2.3 The ecological evaluation of plant macro-remains

The reconstruction of the palaeoenvironmental conditions through charred seed records was questioned by numerous authors for several reasons (van Zeist, 1993, p.501; Behre & Jacomet, 1991, p. 83; Cappers, 1995). To start with, the level of identification in archaeobotany is often too rough to place the identified species into coherent ecological categories. van Zeist notes that:

> "… A great number of charred seeds and fruits cannot be identified to the species level. No ecological conclusions can be drawn from seed types which may include species from different habitats … Various species are reported for arable fields as well as for steppe vegetation. This in itself is no surprise as it is assumed that the majority of the original Near Eastern segetal flora stems from steppe vegetation" (1993, p. 501).

Classifying the ancient plants by ecological groupings depends on uniformitarianism principle which means the present ecological characteristics have to be reflected in ancient plants. Behre and Jacomet (1991, p. 83) and Jacomet (2007, p. 827), however, argue that the human-made environments shall be understood differently than natural environments, in which humans create show considerable changes in plant associations. Secondly, only an incomplete list of plant taxa can be studied from archaeobotanical assemblages and this is not truly reflective of past vegetation due to the destructive effect of preservation and burial (Behre & Jacomet, 1991). On the other hand, it is difficult to assess the composition of vegetation through charred seeds since "the relationship between the number of seeds produced and the number of plants reaching maturity is complex" (Bogaard et al., 2016, p. 6). The plant seed production may vary from species to species. For some plants, a few large seeds with a potentially higher seedling survivorship, or many small widely dispersed seeds depending upon ecological circumstances (Bogaard et al., 2016).

Many plants in the Near East are well-adapted to the disturbance caused by climatic, environmental or anthropogenic conditions. In theory, it is expected that the decline of rainfall in semi-arid and arid environments should result in the penetration of drought-adapted wild plants through expanding their range of distribution at the expense of less drought-adapted plants. This is coined by some authors as "Zohary's Law" (Blondel et al., 2014) to refer the ecological assessment of Micheal Zohary for Mediterranean environments. At the same time, the identification of climate-induced changes from archaeobotanical material poses certain limitations. Moreover, it is widely acknowledged that technologically-advanced societies can mitigate the risk of crop failure as a result of potential drought episodes through changing their agricultural management methods (N. Miller, 1997; Marston 2011; Riehl, Bryson, & Pustovoytov, 2008). It is methodologically rather uncertain how to distinguish the climate-induced signals in the plant assemblage, from other environmental and/or anthropogenic factors (cf. Olsvig-Whittaker, 2015). The principal problem to apply to such models of vegetation change is related with abovementioned methodological limitations (e.g. the coarse level of identification to assess the ecological characteristics of ancient plants, the plant adaptation to diverse habitats, intraspecific functional traits of plants in their adaptation).

4.2.4 The economic evaluation of plant macro-remains

As this dissertation is mainly concerns with the local and regional occurrences of crop and wild plants, it shall be justified to start with the problems in gauging the importance of particular crop taxa in human economy. Numerous authors mentioned that the relative importance of crop plants cannot be assessed by investigating the simple figures of proportions and ubiquities, but that sample composition can be the more important factor (Dennell, 1976).

It is difficult to derive conclusions on the economic importance of tree fruits from their differing relative proportions and ubiquities in any plant assemblage (Charles & Bogaard 2001, p. 324; Charles, Pessin, & Hald, 2010, p. 194). For example, the proportion of fig finds would be much higher than any other plants analyzed, but caution has to be taken when interpreting this figure because a single fig fruit usually contains hundreds of seeds. Also, since the fig seeds are extremely small in size, many researchers who do not analyze the smallest fractions of their samples tend to dismiss the recording of this crop taxon. For this reason, the only indication with any scientific rigour would be their presence/absence and geographical distribution across the studied site/region for the arboricultural fruits.

Functional Interpretations of Botanical Surveys (FIBS) is another approach in which ethnoarchaeological knowledge provides the empirical basis for the interpretation of archaeological plant data. FIBS was partly derived from Jones' ethnographic observations in the Greek island of Amorgos and Hillman's research at Aşvan in Eastern Anatolia, Turkey, as well as from modern ecological studies at the University of Sheffield. This approach defines the functional attributes of plants (e.g. maximum canopy height, maximum canopy diameter, leaf area per node to thickness of leaf, specific leaf area, flowering period, stomatal distribution) to reflect the major ecological differences in cultivation methods. This method is basically applied to understand the degree of cultivation intensity (extensive vs. intensive cultivation) in reference to modern agronomic observations (Bogaard et al., 2005, 2018).

There is a long-lasting discussion in archaeobotany whether a site was mainly involved in production of crop plants or it was a regional center attracting the agricultural resources for consumption rather than primarily producing these products (M. Jones, 1984; Valamoti, 2005). This opinion indicates that certain sites which do not involve the production activities have to show assemblages with less chaff remains and limited presence of weed remains, more specifically the lack of early stages of crop processing residues. This is basically identified for the sites in Britain (van der Veen, 2007) where some Iron Age settlements produced plant assemblages rich in weeds and chaff, but some others have more grain-rich samples than average. On the other hand, it is complicated to establish this distinction by just looking at archaeobotanical data as argued by van der Veen and Jones (2006) and Valamoti (2005). The authors mention that the difference between two types of settlement would not have been related to function, but to scale of how to handle the crop products. The grain-rich samples are often formed through accidental inclusions of plants in where the grain is handled in bulk; therefore archaeological context would also be an important determinant rather than function of site (van der Veen & Jones, 2006; Valamoti, 2005).

In the Near East, it is not illogical to assume that regional settlement patterns and site hierarchy would have been indicative to the consumption/production patterns of crops. Certainly, a more non-food producing population may have inhabited larger sites at the top of the hierarchy. However, to identify this pattern in archaeobotany remains elusive as the site size which is the basic characteristic to identify the hierarchical position of any settlement, does not always corresponds to the function of the site. For instance, a 5-ha-site, the Bronze Age site of Tilmen Höyük in the Islahiye Valley (Gaziantep Province of Turkey) seems to be relatively small in comparison to other sites within the same region. However, the excavations revealed that the site contains sprawled palaces, gates, temples and administrative complexes (Duru, 2003). For this reason, more care is needed to define a site as consumer or producer site around the Near East.

It is noteworthy to mention that the agro-production in the past can be defined under four categories (Brookfield, 1972); 1) *for subsistence*: simply delineates the required agricultural output to sustain the household and the community needs, 2) *for "normal surplus"*: this refers to the agricultural produce reserved to minimize the various risks, 3) *for "social reproduction"* by which the agricultural surplus was devoted to rituals, religious celebrations and feastings. Morrison (1994) emphasized that this is the most variable and unpredictable form of production given its connection to the political economy; 4) *for trade*: cash crops, although anachronistic for a period without money, is the term that has been used to refer to those cultivars produced for trade exchange and gift-giving; those also contribute little to the subsistence while the significance resides to a high degree in convertibility with other commodities, income- and prestige-generating properties. The importance of cash-crops lays on the fact that they provide a basis for wealth accumulation and aggrandizing the status of elites in an agrarian state (Curet & Pestle, 2010; Sherratt, 1999, p. 21; see also several contributions in Dietler & Hayden, 2001). As shown in Fig. 12, Boivin and her colleagues

(2012, p. 462) rightly argue that these distinctions necessitate identifying the crop categories in their use-values:

> "… [S]ystematic comparison of these pathways [alternative trajectories of crop introductions – DK] necessitates classification of crop-use types and changes through time, and we propose one possible system in which such broad categories as 'cash-crops, 'spices/exotica', risk-buffering crops' and 'staple foods' are distinguished … We can draw upon these categories to abstract three spectra of interacting variables: the social value placed on a crop, from lesser to greater; the scale of production of a crop, from lower to higher intensity; and the distance from which a crop is obtained by direct trade for consumption, from local to more distant" (Boivin et al., 2012, p. 462).

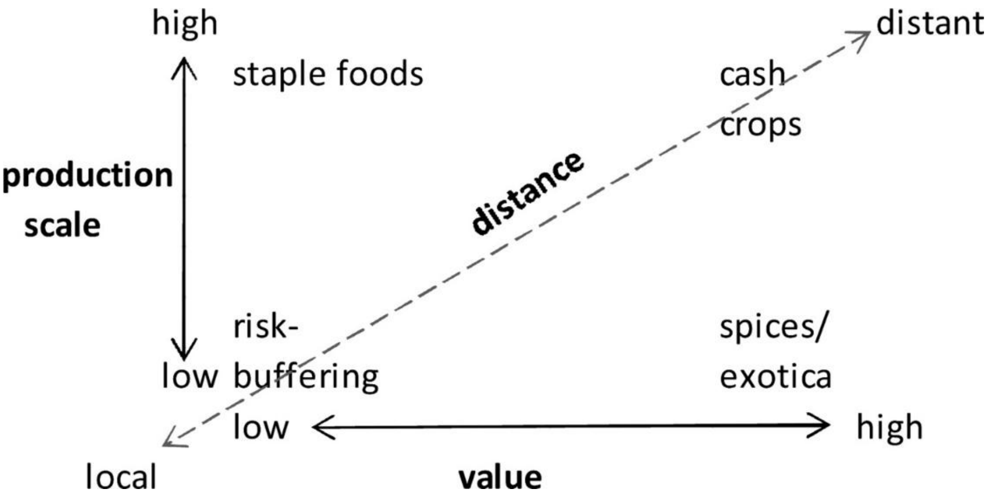
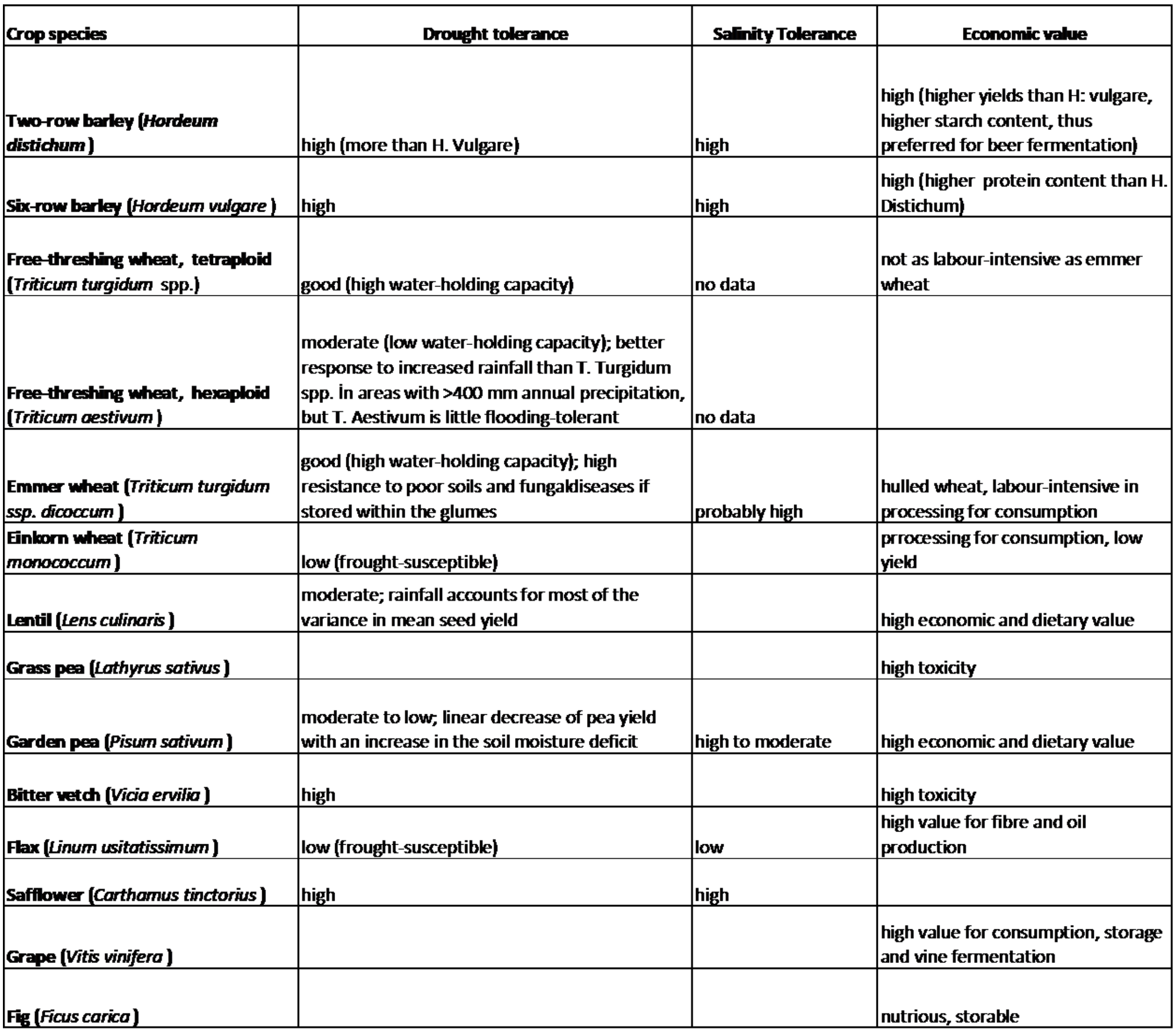


Figure 12 Schematic representation of several crop-use categories according to their social value,scale of cultivation, and distance from the region in which production occurs (afterBoivin et al. 2012, p. 462).

In this manner, Riehl describes that agricultural decision-making is "based on variable and complex relationships of environmental conditions and change, economic interests, political goals and cultural preferences, each of them with the potential to play a dominant role,



Crop species	**Drought tolerance**	**Salinity Tolerance**	**Economic value**
Two-row barley (*Hordeum distichum*)	high (more than H. Vulgare)	high	high (higher yields than H: vulgare, higher starch content, thus preferred for beer fermentation)
Six-row barley (*Hordeum vulgare*)	high	high	high (higher protein content than H. Distichum)
Free-threshing wheat, tetraploid (*Triticum turgidum* spp.)	good (high water-holding capacity)	no data	not as labour-intensive as emmer wheat
Free-threshing wheat, hexaploid (*Triticum aestivum*)	moderate (low water-holding capacity); better response to increased rainfall than T. Turgidum spp. İn areas with >400 mm annual precipitation, but T. Aestivum is little flooding-tolerant	no data	
Emmer wheat (*Triticum turgidum ssp. dicoccum*)	good (high water-holding capacity); high resistance to poor soils and fungaldiseases if stored within the glumes	probably high	hulled wheat, labour-intensive in processing for consumption
Einkorn wheat (*Triticum monococcum*)	low (frought-susceptible)		prrocessing for consumption, low yield
Lentil (*Lens culinaris*)	moderate; rainfall accounts for most of the variance in mean seed yield		high economic and dietary value
Grass pea (*Lathyrus sativus*)			high toxicity
Garden pea (*Pisum sativum*)	moderate to low; linear decrease of pea yield with an increase in the soil moisture deficit	high to moderate	high economic and dietary value
Bitter vetch (*Vicia ervilia*)	high		high toxicity
Flax (*Linum usitatissimum*)	low (frought-susceptible)	low	high value for fibre and oil production
Safflower (*Carthamus tinctorius*)	high	high	
Grape (*Vitis vinifera*)			high value for consumption, storage and vine fermentation
Fig (*Ficus carica*)			nutrious, storable

Table 4 Selected crop taxa and their ecological information (modified after Riehl 2010b).

depending on the society's concrete perception of world, state, group and environment. In consequence, it is assumed that e.g. in periods with increased environmental stress economic or political decisions are rather influenced by such stress factors, while during stable environmental conditions decision-making is based mainly on economic or political grounds" (2009a, p. 96).

On the other hand, the different metabolic requirements of crop plants are considered important indicators for comprehending the agricultural decision-making mechanisms (Riehl, 2009a, 2010b). Water availability was assumed to be the main stress factor in arid and semi-arid environments to influence the productivity of crop plants (Riehl 2009). In this manner, modern physiognomic studies of crop plants demonstrate that some plants are more drought-tolerant and others are not (Riehl, 2009a for a comprehensive research). Furthermore, Riehl (2009a) suggested that increased water stress due to environmental and climatic reasons should be observable in the disappearance of “drought susceptible” crop species rather than “drought-tolerant” species (see Riehl, 2009a, Table 4 for a detailed version of the agronomic data used in the present study).

4.2.5 Evaluation of crop growing conditions by the analysis of stable isotopes

Comprehensive studies on stable isotope research of modern cultivars demonstrates that the metabolic processes of plants are determined by biochemical fractionation of different isotopes, of each element, through which the analysis of the stable isotope values illustrate the intercellular ratio of the heavier isotopes, in comparison to lighter isotopes, when the plant tissues developed (Farquhar, Ehleringer, & Hubick, 1989). It is known that the mass differences between elements react differently in plant metabolism (Schoeninger, 1995). Therefore, the basic tenet of the stable isotope analysis depends on the fact that chemical bonds of “lighter” isotopes break down faster than the chemical bonds of “heavier” isotopes. The stable isotope values of carbon and nitrogen, $\delta^{13}C$ and $\delta^{15}N$ respectively, is a measure of the molar abundance ratio of the heavier to lighter isotopes (^{13}C:^{12}C and ^{15}N:^{14}N). The proportions in which the different isotopes of each element get assimilated into any organism’s tissues (such as animal muscles/bones, and crop grain/straw)were determined through the process of biochemical fractionation. In this case, organisms from various trophic levels have usually distinct isotopic signatures when any organism consumes the tissues of other organism, the stable isotope values of the consumer faithfully reflect the isotope signature of the food source in addition to an enrichment factor (Schoeninger, 1995, Vaiglova et al., 2014).

4.2.5.1 Stable carbon isotopes of charred plant remains

Atmospheric CO_2 serves as a source for all terrestrial plants. The two naturally occurring stable carbon isotopes (^{13}C and ^{12}C) exist in the atmosphere in a 1:98 ratio (Voltas et al. 2008). Plant $\delta^{13}C$ values are determined by two factors; the photosynthetic pathway and source carbon. There are three photosynthetic pathways commonly referred to as C_3, C_4 and the less frequent CAM (Crassulacean Acid Metabolism) with different rates of fractionation among each other. During photosynthesis, when the transfer of CO_2 from the atmosphere to the plant tissue occurs, a further depletion of ^{13}C through kinetic isotope fractionation occurs. Especially, the photosynthetic pathway of C_3 plants preferentially takes ^{12}C instead of ^{13}C. Therefore, the C_3 plants generally contain proportionally less ^{13}C than does the atmospheric CO_2. This is approximately a 1:99 ratio. There are two steps of carbon isotope discrimination during photosynthesis in C_3 plants; 1) during diffusion of CO_2 through stomata (+4.4‰), and 2) during carbon fixation by the enzyme RuBisCO which accounts for the major discrimination (+27‰). Modern biochemical studies demonstrated that when the water conditions are at optimal level, the stomata remain fully open to allow the flow of CO_2 inside the cellular space of the leaf without limitation. This leads to maximum discrimination (more negative $\delta^{13}C$ values) similar to that by RuBisCO. However, in a case when soil moisture levels are diminished, this situation usually leads to a common response in C_3 plants to simultaneously decrease in photosynthesis, transpiration, and leaf conductance. In doing so, the plants under stress lower the stomatal conductance to prevent further water loss thus restricting the flow of CO_2 (Farquar & Richards, 1984; Farquar et al., 1989). Limiting photosynthesis and increasing the strength of the discrimination during diffusion causes more ^{13}C molecules than those which have been used for carbon assimilation. In theory, from the analysis of stable carbon discrimination of grains it should be possible to infer the variations in water-use efficiency of the plants during their growth period (Farquar & Richards 1984; Araus et al. 1999).

Therefore, the measurement of carbon isotope discrimination provides “an integrated record of the ratio of intercellular to atmospheric partial pressure of CO_2” (Araus, 1997b, p. 730). $^{13}C/^{12}C$ molar ratio (R), therefore, is investigated by mass spectrometric analysis. The resulting values were normalized by the PeeDee Belemnite standard with delta notation ($\delta^{13}C$) (Voltas et al., 2008; Ferrio et al., 2003, 2005).

$$\delta^{13}C = [\ (R_{sample} - R_{reference}) / R_{reference}\ ] \text{ x } 1000 \qquad (1)$$

The $\delta^{13}C$ values of ancient plants are known to be approximately 1.0‰ higher than those of modern plants; for the reason that, our current atmosphere is enriched in ^{12}C prior to the 20th century. This atmospheric change in $\delta^{13}C$ values is related to the large-scale combustion of C_3 biomass (trees by wildfires) and fossil fuels by humans. While comparing large timeframes which comprise of thousands of years of stable isotope data points, the changes in the atmospheric CO_2 ($\delta^{13}C_{air}$) composition through time has to be taken into consideration.The principal reason for correcting the stable carbon isotope determinations is that the atmospheric CO_2 values changes over time (Ferrio et al., 2005); therefore the differences among CO_2 values can be significantly higher, especially when comparing the values from the 19thcentury onwards,due to the increasing amount of greenhouse gases released into the atmosphere (see Methods in *Chapter 5* and *6* for the same issue).

$$\Delta^{13}C\ (‰) = \delta^{13}C_{air} - \delta^{13}C_{plant} / (\ 1 + \delta^{13}C_{plant}/1000) \qquad (2)$$

Furthermore, Araus et al. (2014) have offered a methodology to estimate the water input of crop plants (precipitation or precipitation plus irrigation) from $\Delta^{13}C$ values of cereals. This estimation had been modeled through modern agronomic studies over years across a wide range of Mediterranean conditions. Ideally, this estimation reflects the water intake amount during the grain-filling period which covers roughly the second half of April to the end of May.

$$WI = 39.94 \times \Delta^{13}C - 560.36 \quad (3)$$

Past isotope research in archaeobotany, mainly focused on the stable carbon and much recently stable nitrogen analysis of crop plants, enabled to study particular problem-oriented research topics; for instance, the role of manuring in farming systems (Bogaard et al., 2013; Vaiglova et al., 2014; Fraser et al. 2011; Kanstrup et al., 2011), the climate patterns toward increasing aridity during Holocene (Riehl et al., 2008, 2014), crop provenancing (Fiorentino et al., 2012) or the periodical changes in water availability of ancient plants from a more site-focused approach (Masi et al., 2014; Fiorentino et al., 2012; Riehl, 2010, Riehl & Marinova, 2016).

The analysis of archaeobotanical remains pairing with the stable isotope analysis offers an important *methodological* tool to gather information both on the human cultivation strategies, i.e. agricultural management methods and the changing local palaeoclimatic conditions due to the increasing aridity. The application of stable isotope analysis to archaeological research questions, proved the usefulness of this research technique, to determine the crop growing conditions (e.g. water availability, manuring practices), particularly in arid and semi-arid environments under rain-fed farming regimes (see generally Bogaard & Outram, 2013; Fiorentino et al. 2015, Ferrio et al. 2003, 2005; Araus et al., 1997a, 1997b, 1999; Wallace, et al. 2013; Riehl et al., 2014). Riehl et al. (2014) found a high correlation between modeled moisture levels, at different sites in the Northern Mesopotamia, and the $\Delta^{13}C$ values from barley, indicating that stable carbon isotope values demonstrate natural soil moisture availability. This basic premise depends on the fact that barley was most probably not irrigated in ancient times due to its adaptive capacity to wide-ranging environments. Therefore, it is hypothesized that $\delta^{13}C$ values of barley can faithfully reflect the changing water uptake conditions (Fiorentino et al., 2008, 2015).

From the analysis of stable carbon isotope discrimination, it is possible to infer the water availability of the crop plants, especially in arid and semi-arid environments (Araus et al., 1997b, p. 730). Plants tend to react to decreasing amounts of water by closing their stomata (Ferrio et al., 2005). Although this was mainly studied from leaf material, but further experimental research also showed similar relationships for other plant tissues, such as seeds and wood in experimental conditions. This relationship indicates that plants show higher (less negative) $\delta^{13}C$ values when they grow under water stress (Ferrio et al., 2005). It is known that the grain filling period, of typical Near Eastern winter crops like barley and wheat, coincides 4-6 weeks in mid-April and May for barley and 5-6 weeks in May and early June for wheat. This is the period when the rainfall is decreasing, and evaporation rates are increasing in the entire Mediterranean basin. Both decreased water availability and increased evaporation tend to cause lower stable carbon isotope discrimination because of their effects on stomatal conductance and photosynthetic capacity of plants. Also, by investigating multiple crop taxa together, it is possible to establish the water availability conditions during a prolonged period from mid-April to early June (Araus et al., 1999, 2014).

4.2.5.2 Stable nitrogen isotopes of charred plant remains

In case of nitrogen, the major nitrogen reservoir is the atmosphere. However, the transfer of inorganic nitrogen (N_2) cannot be directly metabolized by the higher life forms such as animals and plants; therefore, the transfer of N_2 into the biological realm necessitates specialized microorganisms, such as the bacterial nodules at the roots of leguminous plants. For this reason, it is argued that the $\delta^{15}N$ of crop plants has close connections to the isotopic composition of their nitrogen source. The main problem in the nitrogen isotope analysis is identifying the correct source of nitrogen. For legumes, the nitrogen $\delta^{15}N$ of leguminous plants is close to that in the atmosphere at around 0.0‰. Other plants take up the nitrogen form of the soil that was made available by the decomposition of organic materials. This process tends to generate more positive $\delta^{15}N$ values (Schoeninger 1995; Fiorentino et al. 2015).

$$\delta^{15}N\ (‰) = \left([\delta^{15}N / \delta^{14}N] / [\delta^{15}N / \delta^{14}N_{atmosN_2}] - 1 \right) \times 10^3 \tag{4}$$

Soil is the medium for plant growth, however, until recently this aspect has not been widely taken into consideration from an archaeobotanical perspective. Nonetheless, the role of nitrogen intake of plants from manuring has been mentioned earlier by Miller and Gleason (1994), Halstead (1987) and Wilkinson (1994). The authors emphasize that fertilizing has an important impact, not only on enhancing soil nutrients, but also the ability of plants to use air, water and nutrients by changing soil structure and texture (Miller & Gleason, 1994, p. 27; Halstead, 1987, p. 82). It is argued that if available, fertilizing the arable fields with animal dung can increase productivity more than the bare fallowing/cereal cultivation system (Halstead, 1987, p. 82). Organic trash and settlement debris were thought to be the principal agent for fertilizing soils in ancient times (Wilkinson, 1994, Miller & Gleason, 1994). Nonetheless, the prevalence of bare fallowing in traditional societies would be indicative of the water availability, this was more important rather than the nutrient contents; since bare fallowing can help to restore the soil moisture in arable fields (Halstead, 1987, p. 82). In this manner, manure application, although more productive, has a potentially deleterious effect on soil moisture since it requires opening the field up before implementing. The reason that the bare fallowing was so pervasive over cereal/pulse rotation in the Mediterranean countries until recently can be explained by higher human labor cost of the latter. Regarding the scale of traditional farming, targeted decisions may have been taken to large-scale production of cereals with bare-fallowing in alternate years, but more labor-intensive pulses may have tended to be restricted to small-scale gardens often worked intensively (e.g. weeding out, manuring) (Halstead, 1987, p. 82).

The stable nitrogen analysis has been much more recently integrated in archaeobotanical studies to determine manuring intensity (Bogaard et al., 2013, 2016), other interacting variables like rainfall (Styring et al., 2016, 2017), and nutritional status of arable soils (Aguilera et al., 2008; Fiorentino et al., 2015). Aguilera et al. (2008) and Araus et al. (2014) demonstrated a progressive decrease in δ^{15}N throughout time in the western Mediterranean basin. According to these authors, such a decrease is related to the loss of soil fertility as the amounts of rainfall remain constant in their study area. Moreover, it is assumed that stable nitrogen isotope analysis can be used to investigate the provenance of different harvesting sites (e.g.different growth-site conditions like nutrient-rich vs. –poor arable fields) in combination to the grain size and δ^{13}C (Fiorentino et al., 2012).

4.3 QUANTITATIVE ANALYSIS

Archaeobotanists use quantitative methods for three reasons; to compare 1) samples of unequal size; 2) samples differing in circumstances of deposition or preservation, and 3) samples differing in quantities of the types of botanical contents (N. Miller, 1988, p. 72). Quantitative measurements are necessary methodological tools to search and describe the patterning in the data and to distinguish the patterning defined by the research questions from other sources of patterning. Different methods of quantification would perhaps treat the data with different degrees, specificity, require different conditions and provide different information (Popper, 1988; G. Jones, 1992; Riehl, 1999; Hubbard & Clapman, 1992).

It should also be noted that every following chapter includes information for the methodology and materials used in that particular chapter. Various quantification techniques used in the dissertation will be described within the respective chapters 5, 6, 7, and 8. Therefore, this section aims to only give a general overview of quantitative analysis in archaeobotany.The purpose of numerical description aims at delivering the inferences of past human behavior. In this manner, two analytical categories were proposed to single out human behavior; “unit of analysis” which is the archaeobotanical sample; and “behavioral episode” through which the activity described is the unit of analysis. If the data described is on the level of the site or phase, it usually results in the conflation of numerous behavioral episodes diminishing the purpose of description. Moreover, as the plant data is usually fragmented and the variable production of seeds between plants, to quantify the samples in a standardized manner, it is necessary to choose a ‘unit of observation” (G. Jones, 1992).

4.3.1 Descriptive methods

4.3.1.1 Presence analysis

The presence/absence analysis records the absence or presence of plant remains in cultural layers across samples. The occurrences are equated to 1 for presence and 0 for absence. Therefore, this analysis is not affected from the alternating counts among taxa. Riehl (1999, p. 20) and M. Jones (1991, p. 58) noted that since the presence/absence analysis does not consider total seed counts, thereby equating all species by a single score. It should be noted that the absence of data can be related to the inadequate reporting and presence of certain taxa would be related to larger size of the samples. The pre- and post-depositional admixture of sediments can become problematic for this type of analysis. The contamination must be considered through stratigraphic and spatial information before the analysis starts (G. Jones, 1984).

4.3.1.2 Ubiquity (frequency)

The ubiquity analysis is a similar descriptive method. The ubiquity as used in archaeobotany is a method to comprehend the percentage occurrences of certain taxon across the total number of samples within a particular timeframe (N. Miller, 1988). The ubiquity scores –as well as presence/absence analysis- are useful tools to delineate the long-term occurrences of plants across cultural layers in a site or regional patterning in spatial distribution of selected plant taxa, because the score of one taxon does not affect the other one (Popper, 1988). However, in case of multiple sampling of the same context and if there is a limited amount of samples, the results can vary substantially in both methods (G. Jones, 1992; Miller, 2011).

4.3.1.3 Percentages

The percentage occurrence (or otherwise called proportions) of crops and wild/weedy plants describe the relative and/or absolute proportions of plant taxa within the same morphological category (e.g. crops) or ecological (wetland taxa) within the dataset. This method provides a relative quantitative measure for the occurrences of plant taxa across different contextual units and/or archaeological phases. The percentage occurrences of crop taxa are widely applied in the present inquiry to record the overall changes within different periods and phases. However, if large storage contexts or a single crop dominates the assemblage, the percentage analysis becomes problematic and its descriptive potential diminishes (Riehl, 2009a).

4.3.1.4 Ratios

Another descriptive measure used is ratios. Ratio analysis aims to delineate the comparative differences between two sets of categories (e.g. barley to wheat grains) by standardizing their values through time (N. Miller, 1988, 2011; N. Marston & Miller, 2014). The relationship between these selected categories is largely the result of some logical inferences developed in archaeobotany over the years. For instance, barley is known to be tolerant to different environmental and climatic conditions while the free-threshing wheat varieties are more susceptible to soil and environmental conditions, as well as water intake. Therefore, comparing both crop plants can indicate the agricultural risk management over the long term (Marston, 2011, 2015).

4.3.1.5 Find density

Find density describes the quantity of botanical finds relative to the soil sediment processed (G. Jones, 1992). This is recorded as the number of objects divided by the volume of the sediment. The density of plant macro-remains is also helpful to reflect the rate of deposition by which, for certain well preserved deposits, especially for conflagrations, it would be possible to distinguish whether the plant materials were discarded all at once or piecemeal over a longer period and/or mixed stage (G. Jones, 1992). Using the volume rather than weight has been argued to be advantageous for certain reasons. Volume measurements are more easily done during on-site processing rather than weight, because it may not always be easy to find a balance at disposal during the excavations. Secondly, this provides a standardization of the amount of soil sediment processed across the site. That means, it can serve as a measure to calculate comparable amounts of samples across different contexts at the site. It has been argued that a standard weight or volume of soil should be determined to process different quantities of soil sediments from different contexts in order to obtain a representative dataset (Riehl, 1999).

4.3.2 Multivariate methods

Multivariate analysis helps pattern searching in large datasets which would otherwise be impossible to find with the semi-quantitative methods. There are two ways to approach the data in the statistical analysis of “pattern searching”, one in which the researcher has no preliminary research problem to handle, searching for clustering patterns of plants across the periods, archaeological features and the other a "problem-oriented analysis" in which a pre-defined research problem is investigated by statistical tools (G. Jones, 1992).

4.3.2.1 Ordination techniques

Principal Component Analysis (PCA) and Correspondence analysis (CA) are two unconstrained ordination techniques to cluster the variables according to their species composition to be shown as relative proximities (occurrences) to each other in the plot. Both techniques do not assume *a priori* knowledge of the potential variables which can affect the dataset (Smith, 2014). The principal difference between both ordination techniques are that PCA presents a linear model where the variables are formed after linear relationships of increase and decrease in comparison to each other. On the other hand, CA employs weighted averaging of data points. That means, data points (samples and taxa in this study) close to 0.0 coordinates show similarities among each other in their occurrences while distance from the 0.0 coordinates indicate the degree of divergence among data points from the frequent compositional attribute in the assemblage. Both ordination techniques arrange the variables, if samples are considered, along the axis based on their composition. The first axis, horizontal axis, aims to differentiate the greatest amount of variation within the dataset. The remaining axes are subsequently displaying decreasing variations along the data points (Smith, 2014). However, both PCA and CA suffered from distorted scaling of the sampling units so that units at the ends of the gradient are getting closer to each other than they should be located in their original position (e.g. arch effect and horseshoe effect) (Legendre & Legendre, 1998). Detrending is proposed to be the solution for this problem which breaks the first axis up into a number of segments to be further rescaled and the second axis according to these segments, so the average tends to become similar across all segments (Quinn & Keough, 2001).

CA is widely used in archaeobotanical studies due to certain advantages. Smith (2014, p. 188) notes that CA can be more functional for archaeobotanical purposes because “it can accommodate (1) a large number of species (10 – 500); (2) show the presence/absence of species data; (3) abundance data sets (i.e., counts of taxa within a sample) that include numerous zero values (given that many species may be present, but not in all samples); and (4) a nonlinear, unimodal relationship between species and quantitative environmental variables, whereby a species’ abundance peaks within a set range along environmental gradient”.

Redundancy Analysis (RDA) and Canonical Correspondence Analysis (CCA) are both constrained ordination methods. RDA is similar to a PCA extracts gradients of variation inresponse to variables, but their relationship is explained by independent variables (constrained). That is the benefit of using an RDA instead of a PCA, in that the major patterns in species composition can be described and related to time. CCA, in this case, is similar to CA in using weighted averaging of species or samples to extract the major explanatory gradients.

There are several applications which aim to disentangle the clustering patterns of the wild plants which usually account the largest number of taxa entries in the archaeobotanical datasets. The multivariate analysis helps to group the large amounts of wild taxa into coherent characteristics such as site, dating, and ecological groups if provided. The choice of correct ordination technique is related to the heterogeneity of the species composition. If the gradient length is short and homogeneous in species composition, it is advisable to use linear methods (PCA or RDA) but in the other way around for heterogeneous species composition, the weighted averaging method (CA or CCA) is more suitable (Leps & Smilauer, 2003).

4.3.2.2 Generating p-value

RDA and CCA are preferable techniques if the ordination is constrained by pre-defined variables such as time periods or context type. Both ordination methods are particularly useful to allow the statistical significance of null hypothesis tested via the Monte Carlo permutation test.

4.3.2.2 Software

CANOCO 5.0 for Windows has been used in this dissertation. The dependent (species and samples) and independent variables (so called environmental variables in the software as it is designed for ecological purposes), such as time, have been integrated into the software to comprehend the variations through age (e.g. phases) in the Amuq. “Time” has been used as the only independent variable because of the constraining reasons mentioned in section 4.4. The choice of ordination technique has been determined according to the gradient length given by CANOCO. For the graphs concerning the Amuq sites, the linear method has been selected because of the homogeneity of the dataset (<2 SD).

4.4 ARCHAEOBOTANY OF TELL TAYINAT

4.4.1 Sampling strategies

The systematic recovery of archaeobotanical samples in TAP have been conducted as soon as the resumed excavations started in 2004. A predefined on-site sampling strategy, which is basically “purposive and judgment sampling”, has been implemented to sample every possible archaeological exposure since then. This sampling strategy has flaws, as mentioned before, not to give each sample equal chance to be selected in contrast to probabilistic sampling in which an equal chance is given every potential sample. This flaw has been partially tackled with intensive sampling of every observational unit at the site by excavators. Considering sampling the contexts, at least one sample has been taken from every context identified. This systemic sampling approach can be defined as “at least one soil sample from every locus” providing a wide range of samples from diverse archaeological contexts.

The on-site recording system at Tayinat contains four levels of observations. From the biggest to the smallest, “field” is the largest excavation unit comprising “squares” which were conventionally 10x10 meter units designed according to the pre-defined excavation strategies. After “field” and “square”, the “locus” represents the basic observational unit at Tayinat. The loci are identified by the excavator at the site, representing all ranges of archaeological features recovered such as pits, floor surfaces, fills, ovens, hearts etc. As the size, shape, depth and contents of each archaeological context can be different from one observation to another (e.g. floor surface vs. pits), the excavators assign “pail” numbers to identify each archaeological deposit identified within that particular locus. Collected soil samples are given separate pail numbers when recording the exact provenance. In addition, all soil samples are assigned another sample number for documentation. Also, multiple samples coming from the same locus have been documented in separate sample numbers.

Overall, the excavators had identified a number of archaeological features at Tayinat. Pit features have been identified more often than any other archaeological feature at the site.The majority of the samples we selected at Tayinat were confined into a limited number of contexts and of archaeological exposures which make a spatial investigation of plant remains impossible in most cases. M. Jones’ (1991, p. 54) words help to reconcile this fact with the research objectives handled during this dissertation:

> “The most important theoretical shift this century in the way we understand and explain changing environments has been towards a contention that human action can actually deflect environmental trajectories, in different ways in different places, rather than simply proceed at varying rates along a single progressive axis of

> environmental improvement. The latter theoretical position places no requirements on spatial and contextual sampling, but merely requires a chronological sequence of findspots, from whichplant remains may be extracted and analysed. It is only when particular human actions are seen as of qualitative significance that spatial and contextual sampling assumes a central position".

Due to the complicated nature of stratigraphy in Field 1 (i.e, pits and foundation trenches intercutting the earlier layers), multiple sampling and limited horizontal exposures at Tayinat become particularly problematic when trying to comprehend the spatial scale of plant use at the site. For instance, the EBA building in FP8a of Field 1 demonstrates a surface layer from a collapse event but not conflagration. The deposits recovered from the floor surfaces show a very particular composition across several samples taken from different provenance of the same room. In contrast, spatial distribution of these deposits does not demonstrate any clear patterning across the rooms of this particular building. One possibility is that these deposits which are supposedly recovered from the surface can be, in fact, discarded debris, in secondary or tertiary contexts, deposited after the use phase of the building.

Although the field phases provide a fine-grained chronological precision, the sequence of plant data are coming from a single excavation unit. The best method would have been the comparison of plant identifications from two and more sequences to test the potential temporal and spatial variability within the time units or archaeological phases. In relation to the obvious difficulties to find comparable find contexts, this research focuses on the temporal aspects of food use at Tayinat. However, this potentially significant research objective was only achieved for *Chapter 8* which investigates the spatial and temporal variations of plant remains in and around the temple structure, Building XVI.

4.4.2 Sample selection and sample size

Thus far, the intensive sampling produced the recovery of over 1.000 archaeobotanical samples across the site. Archaeobotanical samples were selected from Field 1, 5 and 7 by the help of excavators to minimize the inclusion of mixed deposits with imprecise age and contents. The selection of archaeobotanical samples has been undertaken after the floated samples have been imported to the laboratory of the Eberhard Karls University of Tübingen in 2015. An advantageous methodological tool at Tayinat is that relevant archaeological data for every locus has been entered to the relational database of OCHRE by the excavators. This database provides an easy access of all archaeological information produced for a particular "locus", including both on-site and off-site archaeological observations.

Despite the fact that many samples were derived from the pit features in Field 1, having limited amounts of contexts was a particular problem in statistical terms and research objectives. In order to minimize the effects of this constraint, the amount of samples analyzed per every phase in Field 1 were kept at the level of the above 15 samples to reach a reliable breadth of taxa recurring over the sampled units. Before there are more archaeological exposures unearthed from different parts of the mound, it is difficult to test the effect of multiple sampling over the representativeness of the whole assemblage. At least, however, the samples coming from the same loci were merged to avoid the recordings of multiple samplings in quantitative analysis.

4.4.3 Processing of soil sediments

Most soil samples used in this dissertation were processed using an Ankara-type floatation machine as described by David French (1971, p. 59) from 2014 onwards by the author. The Ankara-type floatation machine has wide-spread use in the Near Eastern archaeological sites because of its simplicity, efficiency and comparatively unbiased recovery of plant macro-remains (Samuel, 1986, p. 84; Riehl, 1999, p. 17; Wagner, 1982). Previous team members in charge of floatation used "bucket floatation" in the first two seasons (2004 and 2005). This method, although simpler and less costly in terms of implements used, involves placing soil sediment into a bucket of water to sieve the floating remains by stirring and pouring the water out (Samuel, 1986, p. 84). After that, in the subsequent years, the Ankara machine has been implemented at the site to process the soil sediment samples.

The Tayinat device contains three large oil barrels with different heights in which the water is circulated by a water pump to regulate and minimize the waste of water. A 1 mm plastic mesh has been maneuvered on the first tank to pour the soil down. Buoyant plant materials have been collected into clothes with openings smaller than 0.2 mm which was small enough to retain the smallest materials less than 0.50 mm in height. In addition, since the third tank is crucial for the cleanliness of the circulating water among the tanks, another mesh with a 0.25 mm in size was used for the third tank to prevent modern environmental contamination from the locality.

It is known that the buoyancy of plant taxa differs amongst each other (Riehl, 1999). Therefore, in addition to the recovery of botanical remains by floatation (those sorted as light fraction), heavy residue that remains unfloated on the mesh is visually sorted in the field. This allows for any charred material that did not float to be collected (those sorted as heavy fraction) for further investigations. Riehl (1999, pp. 16-7) notes that the specific sediment characteristics, such as soil types and alluvial pebbles, are important factors affecting the buoyancy of plant remains recovered through hand-sorting the heavy fractions, but the sorting would not change the sample composition dramatically, yet it is still important to check because of the proportions of different plant taxa. At Tayinat, less buoyant categories recovered during hand-sorting were big-seeded grasses and pulses and hard-coated fruits such as olives and almonds while small-sized weeds are rarely found as Riehl (1999, p. 16) mentions.

Additionally, the contents of heavy residues were rich with other kinds of finds, such as microfaunal remains, diagnostic pottery sherds, shell, metal slags, and occasional small finds. These are also sorted and documented during this operation.

4.4.4 Data preparation

4.4.4.1 Identification

The identification of plant remains was carried out in the archaeobotanical laboratory in the Institute for Archaeological Sciences, University of Tübingen.The comparative collections in the Laboratory of Archaeobotany at the University of Tübingen and with reference to relevant archaeobotanical publications were used for the identifications of charred botanical remains (e.g., Anderberg, 1994; Berggren, 1969, 1981; van Zeist & Bakker-Heeres, 1984a, b, 1985; Nesbitt, 2006; Bojnanskỳ & Fargavsová, 2007).

The plant remains were identified using a Euromex brand binocular with 10-60x magnification. During the laboratory process, the samples were separated by dry sieving them into different fractions (2 mm, 1 mm, 0.63 mm and 0.090 mm) to capture as many plant remains as possible for efficient sorting. Typical remains of the 2 mm fraction are cereal grains, large seeded pulses and charcoal. The 1 mm fraction mostly contains small-seeded pulses and most of the other taxa/genera. Most of the small-seeded grasses were recovered from the smaller fractions. Other types of objects such as charcoals, increments, and carbonized straw segments are not directly relevant to the purpose of this research and have been omitted from the analysis.

Nomenclature proposed in Zohary and Hopf (2000, Table 3 & 5) was followed for naming the identified crop remains in this dissertation. In case of insecure identifications, the object was categorized under “type”. “Cf.” designations indicate unspecified taxa due to either interspecific similarities of seed morphology or the unknown effects of carbonization complicating the species-level identifications. Otherwise, the taxon is left in the "unidentified" group with the most probable family name. Some frequently appearing taxa had not been securely identified into any levels and classified with "TT-unidentified" label. They were also included in the quantitative analysis in order to document their distinct periodical occurrences. Otherwise, no efforts have been undertaken to identify sparsely occurring unidentified objects.

4.4.4.2 Off-site sampling

No sub-sampling of floated samples by a riffle-box splitter was conducted due to the low seed counts of samples.

4.4.4.3 Documentation

Each complete seed or fruit was counted as one. For counting the fragmented plant objects, the method was to combine the fragmented parts into a whole in the case of grasses and pulses. The grape pips and olive pits have been counted with the same method, if there were enough fragments to combine (e.g. Number of Minimum Specimen). If not, some specimens with only one fragment, but an obvious identification of the object was apparent, also counted as one. For the chaff remains, the spikelet bases were accepted as one unit, while two glume bases were equated as one spikelet base to better quantify both object types.

4.4.4.4 Data standardization

To ease pattern searching, some taxa from the same genera (e.g. cultivated *Hordeum*) were amalgamated. For example, morphological identification of cultivated *Hordeum* varieties is difficult from the seeds, but rachis segments were found more useful to distinguish the two-rowed and six-rowed varieties. In this study, the rachis segments of barley do not show the typical morphological characteristics of six-rowed barley, although many rachis objects were heavily corroded to make a secure identification. Due to such uncertainties, the crop finds of this taxon are comprised under the *Hordeum vulgare* category.

4.4.4.5 Data reduction

A certain problem with the CA and PCA is that the plots can be too much crowded with large amounts of rare taxa, with few counts or samples, since this method considered weighted averaging of data points. To reduce the data to a certain cut-off level was advisable (Riehl 1999, p. 22; G. Jones, 1992, p. 67); therefore it helps to increase the comprehensibility of the graphs. Lange (1990, as cited in Smith, 2014) suggests excluding the outliers from the dataset for multivariate methods. The samples with few species or samples with large counts of one taxon can be problematic in searching for the patterns in the dataset.

G. Jones rightly notes that the threshold for data reduction is difficult to decide (1992, p. 67). In case of Tayinat, a cut-off level of 20 seeds in each sample has been established to avoid the effect of samples with few taxa forming the large shares of the sample. For the species variables, the data was transformed in the original data sheet because CANOCO already provided the best fitting species option when selected. Therefore, whenever needed this option has been used to avoid visual crowding of the species data points, instead of omitting the species less than the cut-off level.

4.4.5 Preservation and depositional conditions

At Tayinat, the state of preservation of most finds was mostly carbonization while some mineralized objects had also been encountered. Another condition which might have possibly affected the depositional conditions of plant macro-remains would be the physical shape of the mound. It is difficult to assess the impact of physical shape of the mound on deposition of plant materials in general in archaeological sites. Some samples at Tayinat which were recovered from the sloping edge of the mound do not yield particularly good samples for the analysis. A certain level of weathering of occupational deposits at the periphery of the tell would be considered a factor that influence the preservability of the material.

4.4.6 Modern seed contamination

The mound is supposed to be protected by Antiquities Law but certain parts of the mound are still being used for agriculture due to conflicting and complicated land tenure rights and interests, these appeared before the initiation of the law in Turkey. Therefore, the excavation areas were subject to farming and pasturing activities until recently, before the start of the resumed excavations of TAP, while some other unexcavated portions of the mound are still being cultivated. The impact of animal grazing is also seen in the vegetation on the mound where the dominant element are spiny shrubs and succulents as have been observed by the author during the fieldwork. The natural vegetation on the mound is possibly incorporated into the archaeological sediments regularly, as reflected by some archaeobotanical samples analyzed. Keepax (1977, p. 225) suggests four sources of contamination in an archaeological site: 1) careless excavation and collection of samples 2) cross contamination in the collection apparatus, 3) aerial contamination of exposed surfaces and 4) post-depositional contamination.

The first and second aspects were not particularly a problem since the TAP team has a very precise recording system for every sample and all objects. The documentation of collected samples has been done first on-site, given by a particular sample number and again another number for floatation and heavy residues. Therefore, there is little room of possible errors originating from the excavator to mix the soil sediments. In case of the third potential source of contamination, however, some samples, especially those taken close to the topsoil, were –

sometimes heavily-contaminated with modern seeds (especially weeds and crops), and roots, stem fragments and beetles as a rule.

One intriguing case of such possible contamination was the appearance of Characeae oogonia in the plant assemblage. Characeae is an important group of freshwater green algae which resembles vascular plants because of their ability to fix lime in their tissues (Blondel et al., 2014, p. 130). These remains were not in a carbonized state and for each case there was an opening on the oogonia's external coat and they were totally empty (see Riehl, 1999 for a detailed description of carbonized *Chara* finds). This indicates that oogania reached full maturity in these specimens; thereby suggesting that they are most possibly components of current vegetation entered to the archaeobotanical deposits from the upper layers. Regarding the small size of these objects, it is not unthinkable that they moved down during wetting and drying cycles of the soil.

The abovementioned fourth type of contamination was the most problematic one. Stubble burning and wild fires seem to be other factors for contamination on the mound. Perhaps stubble burning is not being practiced anymore on the mound due to the lawful protection of the ancient mounds, but occasional wild fires would be still common due to dry climatic conditions in the summer season as also observed recently (Capper, 2012). Certain slightly carbonized plant remains have been found mixed with the soil sediments. These plant taxa reflect well the current vegetation on the mound. Therefore, the samples which contain these plant taxa were ignored in the analysis (see *Chapter 8* for the excluded samples). Even more problematic than this one was possible root activities of modern vegetation delving into the deeper soils which can have an impact on translocation of the carbonized seeds from later levels into earlier ones as Samuel mentioned (1986, p. 87).

4.5 REGIONAL SURVEY OF PLANT MACRO-REMAINS

A considerable amount of time –and energy- has been spent to analyze the plant recoveries from other archaeobotanical sources which were relevant to the research scope of this dissertation. The majority of plant data from the Near East has been already confined in *ademnes.de* website created by Simone Riehl over the years (Riehl & Kümmel 2005). This database provides valuable information for the occurrences of charred seed records across the Near East comprising roughly from the early Bronze Age to the Hellenistic period. This time span covers almost 3000 years of archaeobotanical data points presented together with the level of accuracy of identifications. Presence/absence, ubiquity and percentage scores were basically used for surveying the occurrences of regional plant data.

4.5.1 Data standardization

In case of crop plants many species had been amalgamated into the higher taxonomic rank to avoid reporting the data in fragmentary fashion. That means, *Triticum aestivum* (bread wheat) and *T. durum* (durum wheat) were merged for analytical purposes, because in many cases, it is difficult to identify the correct species if spikelet bases are absent in the assemblages. This is combined in *T. aestivum/durum* instead. The same was repeated for many other crops and wild species (e.g. *Hordeum vulgare* category for both two- and six-rowed barley varieties).

4.5.2 Limitations of regional approach

While handling the plant data in a regional scale, some interrelated factors in relation to sampling, complex stratigraphy of tell sites, chronological uncertainties and varying methods of data handling hamper the representativeness of a regional plant datasets. Riehl (2008, 2014) describes three factors affecting the overall comparability of archaeobotanical assemblages as follow;

> “1. Archaeobotanical publications are of variable quality concerning the sampling strategy, quantity, and representivity of the data. 2. Archaeological sites are very unevenly distributed throughout the various periods, and archaeobotanical research is still limited in many areas … There are more than twice as many archaeobotanically investigated sites for the Early Bronze Age than for the Middle Bronze Age, resulting in complex visibility of geographical patterns. 3. Any fine resolution of the periods into phases that would be necessary for tracing small-scale variability is extremely difficult to realize […]” (2008, p. 45).

4.5.2.1 Sampling

Tell sites frequently have –but not always- complex stratigraphy with several successive layers superimposed on each other. This aspect becomes more complicated when archaeological features such as a pit or building trenches intercut earlier layers or habitation phases. M. Jones (1991, p. 56) describes that “a particularly intransigent sampling problem of the regional approach is how to collect the samples such that different sites within a region may be adequately compared”. He favors the probabilistic approach to sampling for plant remains which can provide datasets that allow the broad relationships between sites for economic plants. Although his observation mainly concerns British sites, in which the scientific and commercial research projects have been undertaken for years and collecting soil sediments is well-integrated, it is hard to envisage that this sort of sampling consistency has (and will be) ever been achieved in the Near Eastern archaeology.

Two reasons can be argued for this reluctance. First, systematic recovery of archaeobotanical samples is still an exception rather than being an integrated part of archaeological projects. While many excavators express their wishes to collect the soil sediments from the site, based on on-site conditions, the time and financial constraints do not allow to fully establishing such a strategy. Secondly, despite the new methods of scanning the belowground features with remote sensing and magnetographic tools, it is still difficult to establish a sampling strategy that induces probabilistic distribution of samples across any given site due to the complex stratigraphy of tell sites. Therefore, in most cases, excavators have only a rough idea what kind of archaeological feature, phase or layer they are digging up at the start of the excavation. For these reasons, especially for tell sites, more communication between botanical specialists and archaeologists is needed to determine the correct strategy to collect the soil sediments, to determine provenance of deposits and to omit the "mixed deposits" out of analysis.

4.5.2.2 Chronology

As Riehl puts it for such synthetic study, "any fine resolution of the periods into phases, which would be necessary for tracing small-scale variability, is extremely difficult to realize" (2010b, p. 20). Generally, the plant data is reported according to very broad chronological groupings, without delivering any information where and how the plant data was collected. That basically hampers research to follow, phase-by-phase developments, in plant economy. This limitation affects the regional survey of plants with the difficulty to place the sites into a correct chronological framework. In many archaeobotanical reports, the local chronologies have been used (e.g. Archaic period, Middle Assyrian) in reference to ceramic chronology. The radiocarbon datings are hard to find in general in archaeobotany.

This chronological uncertainty has been partly eliminated by categorizing the sites into much larger groupings in this dissertation. A certain level of chronological control can be achieved in *Chapter 6* as an example. The sites from the Late Bronze Age demonstrate imprecise datings. Many of these sites were reported as the Late Bronze Age without any specifications. However, the chronological resolution in this chapter is better for the Iron Age sites. The plant data of many Iron Age sites are recovered from the Iron Age I, approximately covers the period from 1.200 to 900 BCE. In *Chapter 7*, finding a concrete chronological resolution was more difficult due to varying local chronologies in the Near East. For this reason, the sites were categorized into three large temporal periods during the 1st millennium BCE as 1200-

900 BCE, 900-500 BCE and 500-0 BCE (see Material and Methods in *Chapter 7* for more information).

4.5.2.3 Comparability of datasets

Another problem occurs to the varying approaches to identification of plant remains. The amount of identified plant remains changes from one report to another while some are concerned only with crops, others are concerned with both crops and weeds. Also, limited sampling (few samples, small sample volumes, low diversity of sampled contexts) causes a similar situation (Riehl, 2014). Storage contexts are the best examples for such low taxon diversity of sampled context. Although the investigation on storage units is potentially important, the predominance of single taxon in the storage would basically skew the analytical results. These aspects also perhaps limit to determine possible identification errors originating from researchers, as well as to reach scholarly consensus on the reliability of such identifications.

On the other hand, the identification levels in many reports from the southern Levant tend to be unexpectedly too precise, resulting in inconsistencies in comparison to other identifications with broader groupings under the genus level. This tradition mainly depends on matching the modern distribution range of wild plants with identified remains (e.g. E. Weiss & Kislev, 2004) given the fine-grained ecological studies in Israel over several generations. However, from an archaeobotanical point of view, it is hard to conduct a follow-up for the accuracy of these identifications. No disciplinary consensus in archaeobotany has been reported on the reliability of these proposed identifications (e.g. Frumin et al., 2015). For instance, a monotypic genus *Octhodium aegypticum* from the Brassicaceae family has been reported from the southern Levant; however, modern ecological assessments show that this species is endemic to the northern Levant comprising Cilicia, the Amuq and as far south as Lebanon but not in the southern Levant (modern Israel, Palestine, Jordan). The appearance of this species in the southern Levant in the Iron Age (Frumin et al., 2015) would have been significant to comprehend regional distribution of wild plant species. On the other hand, unfortunately, we have no means to compare the morphological characteristics of these particular specimens with other morphologically close-by species/genera such as *Bunias orientalis,* due to the lack of a proper way to disclose the visual and written descriptions in many studies from the Southern Levant. This approach and lack of disclosing the identifications become too problematic to single out and compare taxonomic connections of different plant species.

4.6 STABLE ISOTOPE ANALYSIS

TAP provided funding for a joint stable carbon and nitrogen analysis of the Tayinat plant material. For this analysis, barley (n=30) and free-threshing wheat (n=35) grains were selected from all phases of Field 1 to attain a diachronic representation of crop growing conditions. This diachronic analysis has been presented in Chapter 5. Moreover, in Chapter 6, the Iron Age averages of barley and free-threshing wheat values were integrated into the regional dataset of stable carbon isotope values from several different regions and sites which was previously published by Riehl et al. (2014). The stable isotope carbon and nitrogen ratios had been analyzed at the Institute of Geosciences of the University Tübingen, Germany on a NC 2500 connected to a Thermo Quest Delta + XL mass spectrometer. The carbon and nitrogen contents and ratios have been determined in two independent measurements from the same grain. To eliminate the sedimentary carbonate from the surface of the samples, the grains were subjected to 5% HCL before taking the measurements. $\delta^{13}C$ values of ancient grains were calculated based on the VPDB common standard (Vienna PeedeeBelemnite ‰) to acquire the intercellular ratio of $^{13}C/^{12}C$ in our samples. The analytical precision of measurements was about 0.1‰ for $\delta^{13}C$ and 0.2‰ for $\delta^{15}N$.

The discrimination in plant remains was calibrated through comparing them to standardized atmospheric CO_2 values acquired from Antarctic and Greenland ice-core projects. Following the working protocol in Ferrio et al. (2005, 2012), an AIRCO2-LOESS data calibrator is used to calculate this new value which is referenced as $\Delta^{13}C$. Furthermore, the water input of both cereals was calculated to compare the values with the present rainfall data gathered from the modern meteorological stations in the region.

Furthermore, experimental studies have shown that the charred grains of crop plants faithfully preserve the original $\delta^{15}N$ signal, no effect has reported because of carbonization (Aguilera et al., 2008) while Fraser et al. (2013) found out 1‰ offset on average accounting the effects of carbonization over $\delta^{15}N$ signals. On the other hand, Styring et al. (2016) proposed a correction factor to normalize the $\delta^{15}N$ values according to the altitudinal changes of rainfall amounts.

Also, see “Materials and Methods” in *Chapter 6* for the effects of carbonization in determining the stable isotope values (also informative Voltas et al., 2008, p. 24 for additional references on the same issue).

4.6.1 Limitations of stable isotope analysis

4.6.1.1 Factors affecting the stable carbon isotope discrimination

Variation has been reported in isotopic values at both interspecific and intraspecific levels among plants plus different environmental growth conditions (Farquar et al., 1989). It has been indicated that a number of other factors may influence the cellular isotopic ratio of plants in their natural environments and perhaps the heterogeneity of stable carbon isotope values. Other factors such as atmospheric humidity, potential evapotranspiration, light intensity, soil salinity and soil water-holding capacity are indicated to affect the heterogeneity of stable carbon isotope values.Variations in Δ values have been reported in relation to leaf size and thickness, stomatal density, branch length and canopy height (Tieszen, 1991; Farquar et al., 1989; Fiorentino et al., 2008; Dawson et al., 2002, p. 513 and references therein).

Furthermore, the models to assess water inputs for ancient plants have been developed using $\Delta^{13}C$ values of modern cultivars. The modern crop plants have been subject to plant breeding experiments in order to obtain increased crop performance through improvements in water use, water-use efficiency and harvest index under optimal agricultural conditions (Araus et al., 2003; Fiorentino et al., 2015). Studies show that the plant yield becomes highest when water-use efficiency is low, demonstrating selection strategies for high yield of crops in ample water availability (Tieszen, 1991). Also, the modern studies usually work on the isotope composition of leaf material rather than grain (Fiorentino et al., 2012). It is known that the distinct physiological features of plant tissues determine slight differences due to additional fractionation of carbon isotopes after photosynthesis (Fiorentino et al., 2012). For instance, as is relevant to archaeobotanical material, isotope composition of rachis internodes is found to be around 2‰ more than grains (Wallace et al., 2013).

The local precipitation, atmospheric humidity, and soil moisture are proposed to occupy the largest part of variation for stable carbon isotope values in arid and semi-arid environments (Fiorentino et al., 2008). Araus et al. (2003) and Merah et al. (2001) demonstrated that the water regime was the most important factor affecting the yield and Δ, which are both correlated to this factor, whilst the combined effect of nitrogen source and water regime has been found the significant effect on photosynthesis, plant growth and carbon isotope discrimination, at least for barley (Lopes et al., 2004).

However, caution must be taken when interpreting $\Delta^{13}C$ variation in plant macro-remains, because the results may also reflect the regional variability of growing conditions; e.g. due to inter-annual variations in precipitation levels and/or local variations in soil moisture conditions (de Gruchy, Deckers, & Riehl, 2016; Araus et al., 2003). Flohr, Müldner, & Jenkins (2011) and Flohr et al. (2019) recommend caution when interpreting the relationship between $\Delta^{13}C$ values and water availability in Levantine settings comprising large environmental and climatic variability within short distances. Heaton, et al. (2009), for instance, identified around 2‰ difference for sites 35 km apart while such differences reach up to 3.2‰ between sites several hundreds of kilometers apart. Therefore, it is advisable to expect a 2-3‰ range for different sites. Thus, the authors suggest that the consistent trends in stable carbon isotope values can be established by minima and maxima values, however, the Δ mean values fluctuate around ±1‰ SD and cannot be conclusive.

Furthermore, another limitation in interpreting the $\Delta^{13}C$ values, as a proxy for climate, is the difficulty to distinguish anthropogenic watering of plants or a high-water table from greater rainfalls. Water availability describes many different forms of water input, for instance, rainfall, ground-water flow, irrigation as well as water losses through evaporation and evapotranspiration which is influenced by several other factors, such as temperature, humidity and wind speed (Wallace et al., 2013). Araus et al. (1997b, p. 730) indicate that some crop management strategies such as irrigation or cultivation in naturally wet soils may erase the negative effects of reduced rainfall; thereby no stress would be recognizable. A possible way to distinguish the anthropogenic watering from natural pathways of water intake is to compare the carbon isotope signature of cultivated crops with the wild C_3 plants such as trees (Masi et al., 2014; Araus et al., 2005; Ferrio et al., 2003).

4.6.1.2 Identifying increasing water stress

Similarly, the question how to establish a threshold, to test the increasing water stress conditions from the differing stable carbon isotope values has been previously discussed in the literature (Araus et al., 1997b; Wallace et al., 2013). This uncertainty seems to largely affect the interpretation of the researchers. Through investigating a series of stable carbon isotope values of ancient wheat and barley grains from the Near Eastern sites, Wallace et al. (2015) argues that the mean values of stable isotope composition of barley remain mostly either under their accepted range of moderate water stress (between Δ17‰ to 18.5‰) or below that whilst the results of free-threshing wheat indicate more-stressed conditions to be between or above their accepted moderate water stress levels within the Δ16‰ - 17‰ range. Instead, Riehl et al (2014) uses a Δ16‰ to 17‰ range as reference line for moderate water stress regarding the fact that the shorter grain-filling period of modern barley would equal to a total water input below 50 mm as it is shown in Ferrio et al. (2003). The authors further normalize the total water input as 40 mm in the spring season for the coastal and hilly regions of their investigation areas to be equal to a value $\delta^{13}C$ of -23‰ that roughly corresponds to a $\Delta^{13}C$ of 16‰. They accept any values below this level as indicative for increasing water stress for barley.

Nonetheless, comparing these results to a larger stable carbon isotope dataset of ancient barley published by Riehl et al. (2014) indicates certain problems in the proposition of Wallace and his colleagues (2015). A thorough examination from different geographical locations of the Near East shows that the majority of mean $\Delta^{13}C$ values fluctuates within the range of 16-17‰ which coincides well with the primary assumption of Riehl and her colleagues (2014, Fig. 3). Therefore, Wallace et al.'s (2015) elevated borderline for increased water stress for barley may be an erroneous interpretation of modern agronomic data while trying to extrapolate the modern values into the past. In this manner, I assume that Riehl et al.'s assumption is more plausible since it explains the results we attained better in the context of the present study. For free-threshing wheat, we follow the proposition of Wallace et al. (2013) as regarding stable isotope discrimination of free-threshing wheat should be placed 1‰ lower than barley, this seems reasonable to assume since the grain-filling period of wheat crop species in general is longer than the barley cultivars, which was most probably within the diminishing period of rainfall at the end of May and the beginning of July. Therefore, in the respective graphs used in this dissertation, a broad range of “moderate water stress” level has been implemented between 15-17‰ for both plants.

4.6.1.3 Variability of stable nitrogen values

It has been reported that variability of $\delta^{15}N$ values can differ as much as 10‰ in co-occurring plant species in the same environment. Similarly, $\delta^{15}N$ values of different plant parts, organs and compounds can vary amongst each other. This rate is typically small, between 2 and 3‰, but can reach 7‰, especially in desert plants. For this reason, “the presence of multiple N-sources with distinct isotopic values, …, mycorrhizal associations, temporal and spatial variation in N availability, and changes in plant demand can all influence plant $\delta^{15}N$” in a plant-soil system (Dawson et al., 2002). Although the process behind nitrogen (N) input is much more complicated to discern due to the large number of contributing factors that influence plant-soil systems, it is hypothesized that 98% of the organic nitrogen pool is fixed by microorganisms through the decomposition of organic matter in soils (Fiorentino et al., 2015).

Aguilera et al. (2008) argued that ^{15}N signal in plant matter would be affected in most cases through either the ^{15}N of different nitrogen sources, “nitrogen excess” when the amount of nitrogen exceeds the plant demand, and the changing amount of nitrogen derived from the decomposition of organic matter or combination of all. In spite of the difficulty to distinguish all of these factors from each other, however, it is known that manuring can significantly alter the δN values of cultivated cereals up to 10% because of volatilization, which leads to the enrichment of heavier ^{15}N, since the lighter ^{14}N is preferentially lost in the atmosphere; taken up by plants in the form of nitrates (Fiorentino et al., 2015; Styring et al., 2016; Bogaard et al., 2016; Aguilera et al., 2008; Vaiglova et al., 2014; Fraser et al., 2011).

Several comprehensive research projects have recently demonstrated that the relationship between nitrogen intake of crop plants and ecological conditions in the arable fields are positively correlated (Bogaard et al., 2016; Styring et al., 2017). Environmental factors such as aridity have been found to increase the plants $\delta^{15}N$ values whilst rainfall, although the mechanisms behind this enrichment, still remains speculative (Styring et al., 2016; but cf. Fraser et al., 2011). It is proposed that decreasing soil moisture can be a factor to reduce the plant growth and microbial activity, thereby an excess of volatilized mineral-N occurs (Styring et al., 2016). On the other hand, the variation in $\delta^{15}N$ values of wild plants tend to correlate with rainfall (Hartman & Danin, 2010) although more factors such as mychorrhizal interactions, soil texture and plant type, denitrification in marshlands are argued to influence $\delta^{15}N$ values (Styring et al., 2016; Vaiglova et al., 2014).

Importantly, no differences of $\delta^{15}N$ values have been found between bread wheat and barley, growing under similar manuring treatment, however, rainfall, in fact, becomes an important factor for increasing $\delta^{15}N$ values of both crops significantly. Irrigation has no effect on $\delta^{15}N$ values of bread wheat (Fraser et al., 2011). A negative correlation was found between grain $\delta^{15}N$ and temperature, however, positive with rainfall according to the results of Aguilera et al. (2008).

CHAPTER 5. SUBSISTENCE IN TRANSITION FROM EARLY BRONZE AGE IVB to IRON AGE I (ca. 2200 – 1000 BCE)

5.1 INTRODUCTION

The emergence of complex political systems is often investigated as either an outcome of the control of production systems or the control of exchange systems (Hirth, 1996, p. 207). From the first perspective, the elite control of production systems, a previous theory focuses on redistribution[15] of commodities and services among different segments of the society. The accumulation of agricultural surplus[16], wages[17], services and commodities at the hands of a group of ruling elites required new administrative structures such as palaces and/or temple[18]

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[15] The definition of redistribution and mobilization is as follows according to D'Altroy and Earle; "… We suggest that *mobilization* more accurately describes the system of finance used to obtain goods from both subsistence producers and the local elites than does the more general term *redistribution* … Redistribution in complex societies combines aspects of centrally administered exchange … and economic integration … with the extraction of the goods needed to fund centrally controlled activities. As societies become more complex and a larger fraction of the collected goods is allocated to support a managerial sector, what appears structurally to be redistribution takes on the role of centralized finance (i.e., becomes mobilization) while maintaining the trappings of political and ritual integration. The key to this transition lies in the central authority's increasing capacity to enforce an extractive economic relationship with the subordinate populations, while reinvesting a smaller proportion of the goods collected in supporting unattached producers or political relations with the subordinate populations" (D'Altroy & Earle, 1985, p. 190). See also Halstead (2011), Nakassis (2010) and Nakassis et al. (2011) for characterization of redistributive economies.

[16] This is what is called "traditional view", mainly attested to Childe (1950) who proposed the Marxist view of surplus production as a precondition of the development of social complexity. But cf. Pearson (1957) and Halstead (1989) for a lenghty discussion on the topic.

[17] It should be noted that wages and rations represent different systems of payments. "… And the fact is that the only system dominating the picture of early Mesopotamian economic history is that a semi-free class of laborers receiving *še-ba* "rations", and it was not until the later stages of the Ur III period, but mainly from the Old Babylonian on, that the rise of free laborers, offering their services, as *lu-hun-ga,* 'hirelings', brought about a radical change in the economic and social system of the country, and with it the institution of *á*, 'wages'" (Gelb, 1965, p. 230).

[18] Stein notes significant differences between polities in Southern and Northern Mesopotamia as the ideological and economic role of temples during the developing social complexity; "Southern temples were important economic institutions capable of generating large surpluses, providing a source of finance, and creating a subsistence buffer. Their wealth derived mainly from enormous holdings of agricultural land and irrigation works in the surrounding countryside … Temples almost certainly played a different, and smaller, economic and ideological role in the third millenium B.C. North Mesopotamian cities … The temple structures are generally small … and are free-standing with no associated complex of storerooms, workshops, and priestly residences … Northern temples likely had a much smaller social role than their southern counterparts – they were not a ‚great institution'; instead, the palace appears to have been the primary social and economic sector in polities oft he dry-farming zone" (2004, pp. 45-7).

organizations (Liverani, 2014; Foster, 1987; Hirth, 1996). Specialized craft industries, the expansion of urban centers, the appearance of settlement hierarchies, of scribal traditions, and extensive trade networks were all derivatives of this emerging complexity at the onset of the Early Bronze Age (Stein, 2012; Yoffee, 1995).

Complex societies entail over-centralization and organizational rigidity (Flannery, 1972; Schwartz, 2006). The development of the complexity signifies the growth of finance systems to mobilize the needed resources from the local population to the central administrative and religious institutions (D'Altroy and Earle, 1985). Two forms of state finance (staple and wealth) were proposed to exist in pre-industrial state formations, either side-by-side and deeply intertwined[19] to each other, or one dominant type of finance (Halstead, 1992; Frangipane, 2018; Nakassis, 2010; D'Altroy & Earle, 1985; Brumfiel & Earle, 1987). The notion of staple and wealth finance characterizes the discussions on how the central authorities were mobilizing the commodities (Nakassis, 2010). Staple finance basically refers to the obligatory payments of basic goods including foodstuffs, livestock and simple-woven clothes which were common to all households under the governance of the palatial or temple authorities. The staple finance systems were categorized in the form of redistribution, mobilization and taxation. Equally important to notice is that bulk storage and transportation of staple items was disadvantageous due to its high managerial costs (D'Altroy & Earle, 1985). Wealth finance, instead, employs high-status goods which were manufactured in palatial and temple workshops by specialists for the international trade exchange, other

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[19] Based on the Linear B tablets found in the palatial centers of Mycenean Greece, Nakassis and his colleagues (2011) suggest a wider scale of interactions in comparison to earlier model of resource extraction. According to the authors, "staple finance" would have been an integrated aspect of the economic system rather than being a precursor of "wealth finance". In their theory as well, the local communities carry out the basic manual labor such as crop cultivating, animal husbandry and weaving of simple cloths. The palace authorities use the accumulated goods to provide rations for the specialists who were working in the textile workshops. The reprocessed textiles were traded internationally to acquire rare products or metals. In reciprocity to the local communities, palatial authorities periodically organized feasts to give some of the accumulated goods back. Summarizing, Nakassis et al. envisages a larger and more complicated scale of interactions among the economic actors.

reciprocal exchange systems like gifting or special use during religious ceremonies, festivities, or burials (Nakassis, 2010; see Schmandt-Besserat, 2010 for visual imagery).

While this characterization is largely heuristic, that financial base of complex socio-political structures involves a mixture of both (D'Altroy & Earle, 1985; Knapp, 1985; Halstead & O'Shea, 1989; Hirth, 1996; Brumfiel & Earle, 1987), it helps to differentiate the broad dissimilarities between the pre-Iron Age political structures from the classical Greek and Roman political economies (Halstead, 2011, p. 229). There were varying degrees of emphasis on the control of staples and control of high-status goods among the different world empires (D'Altroy & Earle, 1985). Nakassis (2010, p. 138) observes that most of the staples recorded in the Linear B tablets were not documenting direct forms of payments; however, the majority indicates that the staples were used to fund large feasting ceremonies. According to Nakassis, this allows the palatial authority to "transform the basic foodstuffs into symbolic capital"; while he proposes the same function for high-status wealth items to gain honor and prestige and to establish relationships of debt and dependency among social actors. That means, institutional systems of resource mobilization were confined to reciprocity and the exchange of symbolic capital, irrespective to the type of finances.

The impact of external trade is another subject of interest among scholars to explain the rise and maintenance of complex socio-political structures. This perspective concentrates on the role of non-perishable luxury items as crucial elements in developing, defining and expanding both regional and supraregional networks (Hirth, 1996; Brumfiel & Earle, 1987). The commercial developmental model is often thought to stimulate the social complexity, while the emphasis on the elite-intervention as organizing agents of the economy remain less stressed (Brumfiel & Earle 1987; see Knapp, 1985 for an overview). Sherratt and Sherratt (1991), on the other hand, postulated a consumption-oriented model incorporating the production of specialized commodities as the principal role of the palatial system. Accordingly, the Bronze Age economies developed out of the economic incentive to monopolize the production and exchange of the processed goods, with added-value (Renfrew, 1972), while palatial organizations, like those appearing in the Mycenean Greece were not only storage areas, but also the workshops for manufacturing goods surrounding the palaces. Sherratt and Sheratt's main argument is that "… civilisation is dependent both on international trade and on the labours of those who do not participate in the consumption of the products which are traded" (Sherratt & Sherratt, 1991, p. 360). Therefore, the authors envisage the palaces as exploitative rather than sharing the benefits of the central administration to the general populace. Sherratt and Sherratt (1993) and S. Sherratt (1998) applied this understanding to the Late Bronze-Iron Ages transition by contrasting the decline of monopolistic palatial systems of the Late Bronze Age and the rise of international long-distance trade at the hands of the so-called sub-elites. These sub-elites who were previously entrepreneurial middlemen in the Late Bronze Age world accumulated significant political power due to the Eastern Mediterranean trade during the course of the 1st millennium BCE. The decline and collapse of the palace economy gave way to the two characteristic developments of the 1st millennium BCE: the emergence of territorial empire and the mercantile city state (Sherratt & Sherratt, 1993).

Very recently, the study of the collapse of those early complex societies became a research focus (Schwartz & Nichols, 2006; Yoffee & Cowgill, 1988; McAnany & Yoffee, 2010; Tainter, 1988). The collapse of complex socio-political structures, in general terms, may be defined as an abrupt, significant loss of an established level of socio-political complexity (Tainter, 1988, p. 4) that entails "the fragmentation of states into smaller political entities; the partial abandonment or complete desertion of urban centers, along with the loss or depletion of their centralizing functions; the breakdown of regional economic systems; and the failure of civilizational ideologies" (Schwartz, 2006, pp. 5-6). Tainter (1999) and Eisenstadt (1988) outline a paradox in relation to the conceptualization of collapse. They argued that collapse encompasses the various types of social reorganization; however, the complete end of the civilizational framework was never the case (Eisenstadt, 1988). Namely, "a process that we regard as the worst fate that can befall a society may actually bring economic and administrative gains. What may be a catastrophe to elites and administrators need not be to most people" (Tainter, 1999, p. 1025).

Two factors were more-widely debated as the most probable reasons of societal collapse in the Near Eastern archaeology: climatic aridification and environmental overshoot (e.g. Diamond, 2005; Middleton, 2012).

Parallelism was established between climate change and the Near Eastern cultural evolution by numerous authors (e.g. Migowski et al., 2006, deMenocal, 2001; H. Weiss, 2000, 2014, 2015; Wiener, 2014). The adherents of the climatic hypothesis in regards to a collection of historical events were primarily triggered by long-term drought episodes (4.200 BP and 3.200 BP events) at the end of the 3rd and 2nd millennia BCE (H. Weiss et al., 1993; H. Weiss, 2000, 2014, 2015; Neumann & Parpola, 1987; Kaniewski, Guiot & Van Campo, 2015; Wiener, 2014; see deMenocal, 2001; Staubwasser & Weiss, 2006 for an overview). According to Weiss, the impact of climatic degradation was manifold and included regional abandonments, habitat-tracking to spring-fed riparian environments, and nomadization (subsistence transfer from agriculture to pastoral nomadism) (2014, p. 367, 2015, p. 44; see also Carpenter, 1966; Bunimovitz & Lederman, 2014). Opposing opinions on the magnitude of such climate impact have also been put into words (Marro & Kuzucuoglu, 2007); human adaptation and resilience to changing climatic conditions became the subjects of considerable attention in the past decades (Holling, 2002; Haldon & Rosen, 2018; Marshton, 2015, Riehl, 2017; Redman, 2005).

The current debate on the increasing anthropogenic impact over the environment is highlighted in terms such as “ecocide”, “maladaptation” and/or “environmental overshoot”. Environmental overshoot may pose a threat to sustainability of food resources, as well as to resilience towards environmental disturbances of past societies (Diamond, 2005). Past societies overshoot the carrying capacities of their environments which was seemingly detrimental to the ecological system and consequently to human societal organization. Specifically, the increasing population size, aggregation of population and the emergence of complex hierarchical sociopolitical organization create an increasing impetus to extract more resources from the surrounding landscape. This process determines the degradation of the landscape and resource base. Malthusian recognition of the relationship between finite resources and demographic growth contemplates the anthropogenic environmental damage as a negative factor for food sustainability (see Middleton, 2012, p. 270 and references therein). Boserup (1965) argues differently than Malthusian thinking that the population increase was limited to the agricultural productivity, suggesting that the demographic pressure was the reason, not limitation, for agrarian change towards more intensive forms of agricultural practices. Otherwise, the agrarian communities were unwilling to change their subsistence base in the lack of demographic growth, because their main objective was to invest the least amount of labor. Her argument on the intensification of agricultural production was based on cropping/fallowing frequencies in various subsistence-based societies along a continuum from extensive treatments to more intensive fallowing regimes (see Morrison, 1994, pp. 116-7 for a review of Boserupian approach; cf. Erickson, 2006, pp. 336)[20].

The anthropogenic impact on environmental conditions causing societal collapse has been investigated by numerous archaeologists (e.g. Jacobsen and Adams 1958).Most famously by Adams (1988) who related the progressive salinization of irrigated fields in southern Mesopotamia to the overexploitation of arable fields by complex institutions. This consequently caused to the breakdown of the Ur III dynasty in the late 3rd millennium BCE (cf. Powell, 1985). Similarly, Wilkinson (1994) established an environmental overshoot model to describe the changes in settlement dynamics and food sustainability during the late 3rd millennium BCE. This model describes the expansion in dry-farming settlements in Northern Mesopotamia towards marginally drier environments. These environments, the so-called “zones of uncertainty”, are below the 200 mm rainfall isohyet which is assumed as the lower limit for a successful rain-fed cultivation of barley. This expansion was aimed at supporting the emerging textile industry in the northern sites and eventually the long-distance textile trade. Thus, the maximization strategy in zones of uncertainty was vulnerable to increased drought conditions which eventually caused the termination of the dry-farming settlement system in Northern Mesopotamia during the end of the 3rdmillennium BCE (Wilkinson, 1994; Lawrence & Wilkinson, 2015).

Specifically, three interrelated questions will be investigated in this chapter;

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[20] In this manner, it would be useful to distinguish the intensification of production and of productivity. The intensification of production indicates the increase in labor and capital inputs to a fixed land (Erickson, 2006, p. 337). On the other hand, the intensification of productivity refers “to an increase in output per unit of labor as a result of innovation” (Porter et al., 2014, p. 133). The principle of “underproduction” indicates households try to minimize total work expenditures by targeting production at subsistence levels (Sahlins, 1972) while this incentive provides the political basis for the establishment of larger socio-economic institutions to gather more surpluses (Hirth, 1996). However, complexity is not a prerequisite for increasing productivity. That means for instance, locally organized irrigation systems historically more efficient and stable than centrally managed canals (Erickson, 2006, p. 340).

1) *What are the characteristics of crop repertory at Tell Tayinat? And are there any changes in the range of crops during the transitional periods under consideration?;* 2) *What are the changes in the composition of wild/weedy flora during the periods under consideration in the Amuq Plain and the north of Syria and if any were detected, how can these changes be interpreted in a palaeoenvironmental perspective?;* 3) *Can we trace any climatic signals for changes in water availability and/or soil nutrient content of crop plants during the late 3rd and 2nd millennia BCE at Tell Tayinat?*

5.2 MATERIALS and METHODS

5.2.1 Archaeobotanical data

I studied 117 archeobotanical samples –relating to 1304 liters of sediment volume- of which 63 samples were from the EBA IVB and 54 from the Iron Age phases, excavated in 2005-2013. 16083 objects were identified and classified into 164 analytical plant categories. These were further merged or discarded; resulting in 135 taxa/genera entering the descriptive analysis. A multivariate approach was employed to evaluate temporal variations in the composition of wild/weedy flora. I performed a Redundancy Analysis (RDA) with species composition (total counts) as response to variables categorized by archaeologically identified phases. Note that for simplicity in the multivariate analysis, all samples with less than 20 counts, and taxa with less than 10 % ubiquities in each period were excluded. This reduced the total number samples from 117 to 101 and the total number of taxa from 135 to 54 for Tell Tayinat.

The published archaeobotanical data from Tell Atchana (Alalakh) were further amalgamated with the present study, to facilitate analysis of diachronic changes in crop and wild plant assemblages in the Amuq. This dataset includes the archaeobotanical reports of Cizer (2006), Riehl (2010) and Stirn (2013). For the ubiquity scores, only the dataset of Stirn (2013) was taken into consideration, because of a better stratigraphic control of these samples rather than the former two. The total counts and the percentages include all studies of Tell Atchana because these analyses were less affected by a sampling bias. Another RDA plot was produced for both sites comprising the wild plants of both settlements. The multivariate analysis was performed using CANOCO 5 (ter Braak & Šmilauer, 2012).

5.2.2 Stable carbon and nitrogen isotope data

Barley (n=30) and free-threshing wheat (n=35) grains were selected for joint stable carbon and nitrogen isotopes analysis. When available, 6 grains of both barley and free-threshing wheat were analyzed from each of the field phases. Mature and less-damaged grains were used to ensure the extraction of $\delta^{13}C$ values. The Early Bronze Age samples contain numerically less free-threshing grains so that fewer grains, of this sort, were included from this period. The stable isotope carbon and nitrogen ratios were analyzed at the Institute of Geosciences of the University Tübingen, Germany witha NC 2500 connected to a Thermo Quest Delta+XL mass spectrometer. To eliminate the sedimentary carbonate from the surface of samples, the grains were subjected with 5% HCL before taking the measurements. $\delta^{13}C$ values of ancient grains were calculated to the VPDB common standard (Vienna Peedee belemnite ‰) to acquire the intercellular ratio of $^{13}C/^{12}C$ in our samples. The analytical precision of measurements was about 0.1‰ for $\delta^{13}C$ and 0.2‰ for $\delta^{15}N$.

The mean water input values were calculated with the equation of Araus et al. (2014; see Chapter 4 for more information) and were compared with the modern meteorological data in the Amuq by calculating the total amount of ½ April + May rainfalls. This long-run meteorological data has been gathered from Akman (1973). Akman’s classification of meteorological stations, as leeward and seaward, has been integrated in the figures. The former stations are located at the leeward side of the Amanos Mnts. and include Islahiye, Hassa and Kirikhan, while the latter, which are situated on the seaward side of Amanos and having a good amount of atmospheric moisture, include Iskenderun, Antakya and Samandag stations (see Table 3 for more information).

5.3 RESULTS

5.3.1 Archaeobotanical results

The overall composition of the assemblage includes typical archaeobotanical findings such as crops, chaff remains, and a large number of wild plants from across the field phases (see Table 5). The assemblage of Tell Tayinat is divided into three categories to describe the relative densities of these find categories. In general, the inclusion of all crop plants and crop by-products (stalk, chaff remains) represents 1/3 of all finds. Similarly, four wild taxa/genera occur with high ubiquity scores in every occupational layer. Only these four taxa/genera form at least 1/3 of all finds identified. The remaining taxa are confined to the other 1/3 of the assemblage (Fig. 13). The find density scores show that the FP9-8b contains the denser deposits with 20 objects per soil sediment while FP8a and FP7 include 14 and 13 objects per 1 liter of soil sediment. Similar figures were reached for the Iron I deposits (FP6 and FP4-3); however, the density scores of archaeobotanical objects in FP5 is comparatively too low, below 5 objects per 1 liter of soil sediment (Fig. 13). Looking at the relative percentages of crop finds, cereals comprise the majority of findings with over 40% in each field phase. This value becomes the highest in FP5 with 80%. The relative percentages of the other two categories, pulses and perennial trees, appear comparatively less often. These finds compose 55% at most, in the FP9-8b, but this figure becomes the lowest in the FP5 and FP4-3 (20% and 25% respectively) (Fig. 14).

Phases	FP9-8b	FP8a	FP7	FP6	FP5	FP4-3	
Period	EBA IVB			IRON I			TOTALS
Total number of samples analyzed	21	12	30	27	16	11	
Total sediment processed	151	108.25	378.75	364.75	219	100	1321.75
Objects per one liter of sediment	20.78	14.00	13.78	11.55	4.34	12.00	
Total counts	3138	1515	5219	4214	950	1200	16236
Cereals	171	103	369	502	267	179	1591
Pulses	100	49	233	131	30	23	566
Perennial trees	100	79	169	220	23	36	627
Chaffs	637	121	539	255	27	9	1588
Selected wild taxa	1129	672	2191	1477	343	602	6414

Table 5 The overall characteristics of the Tell Tayinat plant assemblage including information on the total number of samples analyzed, total volume of sediment processed, find density scores per phases, total counts per phase, the counts of cereals, pulses, perennial trees, chaff remains and four frequently-occuring wild taxa (ryegrass, canarygrass, clovers, stinking chamomile).

5.3.1.1 Cereals

Across all samples, most identified crops are cereals (Fig. 15).The three most common cereal species are two-rowed barley (*Hordeum vulgare*), emmer wheat (*Triticum dicoccum*) and free-threshing wheat (*Triticum aestivum/durum*). Some remains could not be successfully identified to any of the *Triticum* categories; therefore, classified as *Triticum* sp. Additionally, einkorn wheat (*Triticum monococcum*) was only encountered sporadically. In general, the glume wheat grains (emmer and einkorn) tend to occur at low counts in all phases investigated.

During the Early Bronze Age, barley proportionally outnumbers emmer and bread/durum wheat. The relative percentage of this crop is above 30% during the Early Bronze Age phases. However, when combined, the crops from *Triticum* genus compose 60-70% of the cereal assemblage. Bread/durum wheat accounts for around 10-30% of the cereals during the Early Bronze Age phases. A slight decrease in barley values happens during the FP8a and FP7 when the wheat categories are composed of almost 70% of the cereal assemblage (Fig.15).

During the Late Bronze Age and Iron Age I, a higher proportion of free-threshing wheat, than two-rowed barley or emmer wheat,was detected (Fig. 15). Nonetheless, there is a notable increase in ubiquity scores of *H. vulgare* during FP6 and FP5 in comparison to the LBA Tell Atchana and the FP3 of Tell Tayinat.The ubiquity scores of *T. dicoccum* are higher during all Iron I field phases at Tell Tayinat, than those observed at the LBA Tell Atchana (Table 7). During FP6, and FP4-3, the proportions of bread/durum wheat reach to 40%. This value is 25% in the FP5. However, there are proportionally more emmer finds during FP5. Einkorn wheat also appears with higher proportions in the same phase (Fig. 15).

The ratio of barley to bread/durum wheat also demonstrates this trend towards greater representation of bread/wheat throughout this time. Figure 16 shows that higher barley occurrences during the Early Bronze Age are getting lower in the Iron Age I, although a small increase in barley occurrences is discernible during the FP5. When comparing the ratio of barley to all wheat finds (Fig. 17), it becomes clear that greater values of barley finds were concentrated during the Early Bronze Age. The barley to wheat ratio is never over 1 which indicates that barley is always found less than wheat finds. This ratio is getting smaller to around 0,3-0,4 values in the Iron Age I which indicates increasing numbers of wheat during this period.

The chaff remains of barley, bread/durum wheat and emmer wheat are well represented in all deposits. During the Early Bronze Age, the ratio of grains to chaff remains demonstrates abundant chaff remains early in the sequence. FP9-8b is especially rich with chaff remains while FP8a shows an increase in grain finds of bread/durum wheat. The other two cereal categories contained more chaff than seeds. Nevertheless, the ratio shows that there is a steady decrease of chaff finds during the Iron Age I. This decrease seems to have concentrated in the FP5 and FP4-3 (Fig. 18).

5.3.1.2 Pulses

Lentils (*Lens culinaris*), bitter vetch and an aggregate category of vetches, including both bitter vetch and grass pea/red vetchling (*Vicia/Lathyrus*), are relatively more common than field bean (*Vicia faba*) and garden pea (*Pisum sativum*). The latter two are only occasionally present in a few samples both during the Early Bronze and Iron I Age. However, during the FP9-8b, there are more field bean finds, while garden pea appears mainly during the FP5. Lentils occur less often than the aggregates of *Vicia/Lathyrus* in each of the occupational phases and periods of Tell Tayinat. The specific identification of the aggregates of *Vicia/Lathyrus* into any of these genera was not reliable enough due to the state of preservation and fragmentation (Fig. 19).

While comparing the relative percentages of pulses between Tell Atchana and Tell Tayinat, *Vicia ervilia* and *Vicia/Lathyrus* categories appear proportionally more often at both sites during the Late Bronze and Iron Age transition. *Vicia ervilia* is proportionally the most common pulse species at Tell Atchana. During the Iron Age, this trend continues to be the dominant pattern; however, the identification of the objects is less secure during this period. Therefore, many objects were classified as *Vicia/Lathyrus*. Nevertheless, it was either *Vicia ervilia* or *Lathyrus sativus/cicera* these were the abundant pulse taxa in this period. The ubiquity scores demonstrate high occurrences of *Lens culinaris* and *Vicia ervilia* during the Late Bronze Age at Tell Atchana. Either *Vicia ervilia* or *Vicia/Lathyrus* are always higher scoring than lentils. This trend continues during the Iron Age. During the FP6, the lentil occurrences are notably high while it drops to lower values in the succeeding phases of Tell Tayinat. *Vicia faba* was recorded during the latest level of Tell Atchana (n=4) and the earliest phase of Tell Tayinat (n=1). Apart from these entries, it is missing during the Late Bronze and the Iron Age. *Pisum sativum,* on the other hand, demonstrates a more substantial appearance with the beginning of occupation at Tell Tayinat.

5.3.1.3 Flax

Flax (*Linum usitatissimum*) is a minor component of the crop repertoire and it appears sporadically during the Early Bronze and the Iron Age I in the assemblage with low counts. There are five securely identified flax objects during the Early Bronze Age with a 6,35% ubiquity score. The Late Bronze Age levels of Tell Atchana show the same trend with ubiquity scores between 9,7% and 7,1% respectively to Level 5-4 and Level 3-2.This trend continues during the Iron Age, demonstrating ubiquities with 10,3% and 4,5% during the FP6 and FP5. In total, the ubiquity scores are close to each other with 8,9% and 7,5% at Tell Atchana and Tell Tayinat respectively.

5.3.1.4 Possible horticultural crops

Caper *(Capparis* cf. *spinosa)* and fenugreek (*Trigonella foenicum-graceum)* appear only in the earliest phase of the Iron Age I, FP 6. Coriander (*Coriandrum sativum)* was recovered at the end of Iron Age I (FP 3).

5.3.1.5 Perennial trees

The remains of grape (*Vitis vinifera*), fig (*Ficus carica*) and olive (*Olea europaea*) are well represented in the Early Bronze Age and the Iron Age assemblages (Fig. 20). In addition to regular well developed grape pips, a large number of rudimentary/miniature pips occurs. These small-sized grape pips comprise one fourth of all *grape* finds recovered. On the other hand, the so-called “skeletonized” grape pips usually occur throughout the site history. No raisins were found in the Tell Tayinat assemblage.

The relative percentage shows higher values during the Early Bronze Age phases for grapes, while olive and fig finds are second and third most common categories, respectively. The absolute percentage of grape in the plant assemblage is around 2,20%. The same value of other tree crops is much lower (Table 5). Olive proportions are lower during the FP9-8 but were increasing in the following two phases of the Early Bronze Age. The same is also visible for fig proportions which are higher in the FP7 compared to the previous phases. The LBA proportions of all three perennial trees are low in the levels 5-4 of Tell Atchana; however, it rises rapidly to higher values in the next level. During the Iron Age, grape and fig show higher values while the olive proportions are getting lower until the rest of Iron Age I. During the Iron Age I, instead, the fig proportions are increasing during the FP6 and FP4-3 while the values of olive stones are lower than in the Early Bronze Age and the Late Bronze Age Level 3-2. (Fig. 20, Table 6, Table 7).

	EBA IV	IRON I	EBA IV	IRON I	EBA IV	IRON I	EBA IV	IRON I
	Absolute counts		Ubiquity scores		Proportions		Find density	
	Total counts of crops		Total number of samples				Total soil sediment	
CROPS	**2675**	**1733**	**63**	**54**			**638**	**683,75**
Hordeum vulgare (grs.)	225	238	85,71	68,52	2,27	3,74	0,35	0,35
Hordeum vulgare (rachis)	381	123	66,67	27,78	3,85	1,93	0,60	0,18
Triticum spp. (fr. thres/gl.)	205	250	71,43	70,37	2,07	3,93	0,32	0,37
Triticum aestivum/durum (grs.)	124	333	53,97	64,81	1,25	5,23	0,19	0,49
Triticum aestivum/durum (spi. bases)	116	94	38,10	31,48	1,17	1,48	0,18	0,14
Triticum dicoccum	84	118	53,97	37,04	0,85	1,85	0,13	0,17
Triticum dicoccum (spi. bases)	800	74	84,13	35,19	8,08	1,16	1,25	0,11
Triticum monococcum/boeticum	5	9	7,94	1,85	0,05	0,14	0,01	0,01
Vicia/Lathyrus	280	120	82,54	64,81	2,83	1,89	0,44	0,18
Vicia faba	4	1	6,35	1,85	0,04	0,02	0,01	0,00
Lens culinaris	93	54	52,38	35,19	0,94	0,85	0,15	0,08
Pisum sativum	5	9	7,94	3,70	0,05	0,14	0,01	0,01
Olea europaea	84	22	73,02	25,93	0,85	0,35	0,13	0,03
Vitis vinifera	229	140	74,60	64,81	2,31	2,20	0,36	0,20
Ficus carica	34	116	26,98	29,63	0,34	1,82	0,05	0,17
Linum sp.	5	10	6,35	5,56	0,05	0,14	0,01	0,01
Pistacia cf. lentiscus	1	1	1,59	1,85	0,01	0,02	0,00	0,00
Coriandrum sativum		4	0,00	3,70	0,00	0,06	0,00	0,01
Trigonella foenum-graecum		5	0,00	1,85	0,00	0,08	0,00	0,01
Capparis cf. spinosa		12	0,00	3,70	0,00	0,19	0,00	0,02

Table 6 The absolute counts, ubiquity scores, proportions and find density scores of all crop categories and horticultural plants identified at Tell Tayinat.

In case of ubiquity scores, grape and olive are fairly well-represented during the Early Bronze Age phases. The scores are between 60-80% for both tree crops. The higher scores are concentrated at

	ABSOLUTE COUNTS						
	ALA_L5-4	ALA_L3-2	TAY_P6	TAY_P5	TAY_P4-3	ALA_TOTAL	TAY-TOTAL
Sample amount	54	59	39	22	6	113	67
Hordeum vulgare	438	34	126	78	31	472	235
Triticum spp. (fr. thres/gl.)	307	30	129	69	52	337	250
Triticum aestivum/durum	1551	98	192	66	63	1649	321
Triticum dicoccum	30	16	56	45	15	46	116
Triticum monococcum				2			2
Hordeum vulgare (chaff)	101	1	113	8	2	102	123
Triticum aestivum/durum (chaff)	227	6	78	9	7	233	94
Triticum dicoccum (chaff)	44		66	10		44	76
Vicia/Lathyrus	8	7	63	5	11	15	79
Vicia ervilia	818	70	21	10	2	888	33
Lathyrus sativus/cicera	4		6	2	4	4	12
Vicia faba		4	1			4	1
Lens culinaris	94	33	44	5	5	127	54
Pisum sativum			1	8			9
Linum sp.	13	1	9	1		14	10
Vitis vinifera	26	61	91	15	6	87	112
Olea europaea L.	7	14	89	5	22	21	116
Ficus carica L.	20	57	21	1	1	77	23
	UBIQUITY SCORES						
	ALA_L5-4	ALA_L3-2	TAY_P6	TAY_P5	TAY_P4-3	ALA_TOTAL	TAY-TOTAL
Sample amount	31	14	39	22	6	45	67
Hordeum vulgare	74.2	21.4	82.1	40.9	83.3	57.8	68.7
Triticum spp. (fr. thres/gl.)	41.9	42.9	69.2	68.2	83.3	42.2	70.1
Triticum aestivum/durum	93.5	42.9	56.4	54.5	83.3	77.8	58.2
Triticum dicoccum	25.8	21.4	33.3	36.4	66.7	24.4	37.3
Triticum monococcum	0.0	0.0	0.0	4.5	0.0	0.0	1.5
Hordeum vulgare (chaff)	38.7	7.1	53.8	13.6	33.3	28.9	38.8
Triticum aestivum/durum (chaff)	29.0	0.0	38.5	27.3	33.3	15.6	34.3
Triticum dicoccum (chaff)	22.6	0.0	48.7	27.3	0.0	20.0	37.3
Vicia/Lathyrus	0.0	0.0	66.7	13.6	33.3	0.0	46.3
Vicia ervilia	74.2	57.1	23.1	31.8	33.3	68.9	26.9
Lathyrus sativus/cicera	0.0	0.0	10.3	9.1	50.0	0.0	13.4
Vicia faba	0.0	0.0	2.6	0.0	0.0	0.0	1.5
Lens culinaris	51.6	21.4	41.0	22.7	33.3	42.2	34.3
Pisum sativum	0.0	0.0	2.6	9.1	0.0	0.0	4.5
Linum sp.	9.7	7.1	10.3	4.5	0.0	8.9	7.5
Vitis vinifera	32.3	28.6	61.5	31.8	50.0	31.1	50.7
Olea europaea L.	19.4	35.7	48.7	4.5	16.7	24.4	31.3
Ficus carica L.	9.7	7.1	30.8	18.2	50.0	8.9	28.4
	PROPORTIONS						
	ALA_L5-4	ALA_L3-2	TAY_P6	TAY_P5	TAY_P4-3	ALA_TOTAL	TAY-TOTAL
Sample amount	54	59	39	22	6	113	67
Hordeum vulgare	11.9	7.9	11.4	23.0	14.0	11.5	13.9
Triticum spp. (fr. thres/gl.)	8.3	6.9	11.7	20.4	23.5	8.2	14.8
Triticum aestivum/durum	42.0	22.7	17.4	19.5	28.5	40.0	19.0
Triticum dicoccum	0.8	3.7	5.1	13.3	6.8	1.1	6.9
Triticum monococcum	0.0	0.0	0.0	0.6	0.0	0.0	0.1
Hordeum vulgare (chaff)	2.7	0.2	10.2	2.4	0.9	2.5	7.3
Triticum aestivum/durum (chaff)	6.2	1.4	7.1	2.7	3.2	5.7	5.6
Triticum dicoccum (chaff)	1.2	0.0	6.0	2.9	0.0	1.1	4.5
Vicia/Lathyrus	0.2	1.6	5.7	1.5	5.0	0.4	4.7
Vicia ervilia	22.2	16.2	1.9	2.9	0.9	21.5	2.0
Lathyrus sativus/cicera	0.1	0.0	0.5	0.6	1.8	0.1	0.7
Vicia faba	0.0	0.9	0.1	0.0	0.0	0.1	0.1
Lens culinaris	2.5	7.6	4.0	1.5	2.3	3.1	3.2
Pisum sativum	0.0	0.0	0.1	2.4	0.0	0.0	0.5
Linum sp.	0.4	0.2	0.8	0.3	0.0	0.3	0.6
Vitis vinifera	0.7	14.1	8.2	4.4	2.7	2.1	6.6
Olea europaea L.	0.5	13.2	1.9	0.3	0.5	1.9	1.4
Ficus carica L.	0.2	3.2	8.0	1.5	10.0	0.5	6.9

Table 7 The absolute counts, ubiquity scores, relative percentages of all crop categories identified at Level 5-4 (ALA_L5-4) and Level 3-2 (ALA_L3-2) of Tell Atchana and Iron Age I field phases of Tell Tayinat in succession from the earliest phase on (TAY_P6, _P5, _P4-3).

the end of the Early Bronze Age sequence. Fig ubiquities, however is much lower than the other two during this period. Olive pits are found in most occupational deposits with comparatively higher ubiquity scores in the Early Bronze Age than in the Iron Age samples. Fig finds, most of them carbonized and less mineralized, are also present throughout the whole sequence with slightly higher ubiquities in the Iron I samples (Fig. 21).

5.3.1.7 Wild plants

Four wild taxa, *Lolium* (ryegrass), *Phalaris* (canarygrass), *Melilotus/Trifolium* (clovers) and *Anthemis cotula* (stinking chamomile) occur frequently and consistently in each sample and phase (Fig. 23). The ubiquity scores of the first three taxa are over 90% and stinking chamomile is around 60% of ubiquity during the Early Bronze Age and the Iron Age I (Table 8). The absolute percentages of these four wild taxa also show high values. Ryegrass is prominent among the others if considering the percentages. This wild genus possibly includes several different species at Tell Tayinat. Its percentage score increased to over 35% during the end of the Iron I. The increasing trend of this genus continues during the Iron II and III (see *Chapter 7*). A decrease is discernible in find density scores on the other hand. There are 3,03 *Lolium* caryopses per sediment during the EBA while this score diminishes to 1,28 during the Iron Age I. Canarygrass also demonstrate a similar trend across the Tell Tayinat phases. This wild plant is so abundant during both periods with ubiquity scores of over 90%. The percentage of canarygrass, on the other hand, was about 6,63% during the EBA and is getting notably higher during the Iron I period, increasing to 14,16%. Its densities are also getting higher from 1,03 to 1,32 per 1 liter volume of sediment during the Iron Age I (Table 9). Clovers (also possibly including several small-seeded *Melilotus* and *Trifolium* species) demonstrate the same trend as *Lolium* with notably high ubiquity and percentage scores during the Early Bronze Age. Similar to the *Lolium* category, the percentage score of this plant decreases from 11,88 to 6,76 respectively during the Iron Age I. Such decrease is also visible in the find density scores (Table 9). Stinking chamomile has been added to this list, apart from other members of Asteraceae family, this species appears continuously in both periods. The ubiquity scores of this species slightly decreases from about 60% to 53% compared to both periods, but an increase is visible in percentage from 2,30 to 3,35%, whilst find density scores remain steady (0,36 and 0,31 per sediment volume respectively) (Table 9).

Apart from these four wild taxa, the remaining wild plants also demonstrate some dissimilarity between both periods. The EBA samples are composed of numerous wild leguminous plants other than *Melilotus/Trifolium,* including *Prosopis* cf. *farcta*, *Coronilla*, *Trigonella*, *Scorpiurus*, *Securigera securigeda* and *Medicago*. The ubiquity scores of wild leguminous plants vary from genera to genera during the Early Bronze Age. However, in comparison to the Iron Age I, the entire wild leguminous plant category shows higher ubiquity, percentage and find density scores during the Early Bronze Age (Table 9). When comparing the small-seeded clovers to the rest of the relatively bigger wild legumes, it shows the higher ratios achieved during the Early Bronze Age phases and lower ratios during the FP6 and FP5, but not in FP4-3 (Fig. 24). *Prosopis* cf. *farcta* is the most conspicuous among all wild legumes as it occurs with 68,25% ubiquity in the EBA, whilst this score falls down to 5% in the Iron Age I. Such a decrease also appears for other leguminous taxa such as *Securigera securigeda* and *Trigonella.* This decrease in ubiquity is less pronounced in consideration of *Scorpiurus* and *Coronilla;* however, percentage and find density scores are consistently low for all of these wild leguminous plants during the Iron Age I. This trend of decrease also includes *Medicago* in the case of ubiquity and density scores. Nonetheless, it is apparent that the percentage of this plant taxon remains steady between both periods (Table 9).

Similar to *Lolium* and wild-leguminous plants, medium-seeded wild grasses (*Hordeum spp.*, *Bromus spp.*, *Stipa/Stipagrostis*, *Festuca* type; *Avena* type) follow the same decreasing trend, except the wild *Hordeum spp.* which increased its values in all scores during the Iron Age I. The comparison of percentages of medium- and small-seeded wild grasses (incl. *Lolium* into medium category, *Phalaris* into small category) demonstrates a distinct pattern towards greater occurrences of small-seeded grasses in FP6 and FP5, but not in FP4-3 (Fig. 22). This diminishing trend is visible in *Bromus spp*., *Festuca*-type and *Stipa* type at best. Iron Age I is characterized by the relatively high abundance of small-seeded grasses (e.g. *Alopecurus*/*Poa*, *Phleum* cf. *phleoides*, *Agrostis canina* type, *Aeluropus* cf. *littoralis* and *Cynodon* cf. *dactylon*). These small-seeded graminoids were not new additions to the assemblage since they also occured in the Early Bronze Age in varying ubiquities. However, they become more visible in the Iron Age I assemblage with higher percentage and density scores. The same trend is also seen in the unidentified small-seeded graminoids as they account for a comparatively major part of wild grasses (Table 9).

A similar dissimilarity appears within the various plant taxa from different families. The taxa strongly associated to EBA levels are *Silene*, *Thymelaea*, *Lithospermum arvensis*, *Vaccaria* cf. *pyramidata*, *Ranunculus cf. arvense*, *Valerianella dentata*, and *Bupleurum*. Larger-seeded plant taxa from the Rubiaceae family also show a strong clustering pattern in the early Bronze Age phases. These taxa include *Galium aparine/spurium*, *Asperula* and *Sherardia arvensis*. *Galium* cf. *parisiense*, on the other hand, a small-seeded Rubiaceae plant, demonstrates the same ubiquity and find density scores between both periods and shows an increase in percentages during the Iron Age I. In general, unidentified small-seeded Rubiaceae finds show a notable increase in all scores during this period.

The remaining taxa are associated with the Iron I phases. These taxa appear in higher scores in all analyses. These are made up of several wild plantsfrom the families of Cyperaceae (*Scirpus maritimus*, *Eleocharis*, *Fimbrystris* cf. *annua*), of Asteraceae (incl. *Cichorium*, *Picris hieracoides*, *Centaurea* type; see also Fig. 14), as well as several other taxa such as *Chenopodium murale*, *Malva*, *Rumex*, *Torilis leptophylla*, cf. *Octhodium aegypticum*, *Ornithagalum/Muscari*,and *Verbascum/Scrophularia*. They all show a trend of increase during the Iron Age I (Table 9).

For all taxa which thrive in good soil moisture conditions, the analysis demonstrates that there is a steady increase in their representations during the Iron Age I (Fig. 25). During the FP4-3, these moisture-loving taxa reach the highest value with 8% of the entire assemblage. The majority of these findings are coming from *Rumex* and *Scirpus maritimus*. The ubiquity scores of *Rumex* are fairly high during the early Bronze Age; nonetheless this taxon slightly diminishes during the Iron Age I. A certain increase in ubiquity scores is visible for both *Rumex* and cyperious plants during the FP7 which is the final Early Bronze Age occupational layer. Also, during the Iron Age I, in combination with *Rumex*, the cyperious plants are getting more ubiquitous (Fig. 26).

The ordination diagram of the redundancy analysis revealed that time periods were clearly associated with the wild species community (Fig. 27). The variation in the wild species composition explained by time amounted to 7,8% with the first two partial RDA axes as well as each of the time periods independently having a significant effect in the composition of plant remains. Specifically, the wild species community was separated into three clusters, Early Bronze Age and the Iron IA (FP6), the first partial RDA axis with explained variation of 7,8% (pseudo-F =2.0, P=0.0245, n = 126, permutations n = 9999).

After breaking the dataset into phases of Field 1, the RDA demonstrates that the species composition is more different in FP6c, the earliest Iron Age sub-phase, from the rest of the assemblage. The contribution of this sub-phase to the total variation of this analysis is about 30% while this explanatory variable accounts for 4.3% of the variation in the whole dataset (pseudo-F = 5.6; P=0.0018, n = 126, permutations n = 9999). Two other clusters are discriminated in the plot. The Early Bronze Age phases show a close clustering pattern with each other. FP7 explains 2.2% of total variation. This phase accounts for 15.5% of variation in the present plot (pseudo-F = 2.2; *p*=0.0016, n = 126, permutations n = 9999). It is important to note that the *p*-value of FP8b is 0.043 and of FP8a is 0.071 respectively. The other cluster includes Iron Age field phases other than FP6c demonstrating a diminishing significance level and contributing much smaller variation than the rest of the phases Fig.28, Table 8). Among other Iron I phases, the FP3 explains for 1.8% variation of the entire assemblage. The contribution of this phase to the total variation of this analysis is 12.5% (pseudo-F=2.4; P=0.0535, n=126, permutations n = 9999).

Name	Explains %	Contribution %	pseudo-F	P
Field 1 Phases.6c	4.3	30.3	5.6	0.0018
Field 1 Phases.7	2.2	15.5	2.9	0.0016
Field 1 Phases.3	1.8	12.5	2.4	0.0535
Field 1 Phases.8b	1.6	11.4	2.2	0.0434
Field 1 Phases.8a	1.4	10.1	2	0.0711
Field 1 Phases.5b	1.3	9.4	1.8	0.1163
Field 1 Phases.6b	1.1	7.7	1.5	0.1175
Field 1 Phases.5a	0.3	1.8	0.4	0.9905
Field 1 Phases.6a	<0.1	0.1	<0.1	0.9998

Table 8 The table charts the explained variation (%) of the field phases to the overall variation in the assemblage, the contribution of the field phases to the variation in the current analysis together with pseudo-F and *p*-values.

When repeating the RDA technique of all available datasets from the Tell Tayinat and Tell Atchana[21], wild plant community tends to react to time variation with significance at all axes. Three time periods were clearly clustered separately. Time as an explanatory variable accounts for 45.8% variation of the analysis. The horizontal axis separates the Late Bronze Age from Early Bronze and Iron Ages that accounts for 27.41% of the total variation (pseudo-F=1.9; P=0.0032, n=60, permutations n=9999). The vertical axis, instead, show a separation of the Early Bronze Age from the other two succeeding phases. This axis explains 18% of the total variation. The Monte Carlo permutation test results, on all axes, demonstrates that time, as a variable, has a significant effect on the species composition (pseudo-F=2.1; p=0.0023, n=60, permutations n=9999) (Fig 29).

To test if there was a significant change in the species composition from the Late Bronze-to-Iron Age transition another RDA plot was designed. Looking closer to the sampled phases/levels, the ordination diagram of RDA separates the phases/levels of both sites into three clusters; the LBA levels of Tell Atchana, FP6 and the remaining Iron Age I levels. The pattern described in previous plots also appears in this one. The FP6 of Tell Tayinat show more similarities along the horizontal axis to the succeeding Iron Age phases, but also differs from them along the vertical axis. These two Iron Age phases of Tell Tayinat have more similarities with the Late Bronze Age Tell Atchana levels along the vertical axis (Fig. 30).

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[21] Note that the initial multivariate analysis of Tell Tayinat plant material included 126 plant taxa while this reduced to 60 in the the comparative analysis of Tell Atchana and Tell Tayinat to remove rare taxa.

	EBA IV	IRON I	EBA IV	IRON I	EBA IV	IRON I	EBA IV	IRON I
	Absolute counts		Ubiquity scores		Proportions		Find density	
	Total counts of wild plants		Total number of samples				Total soil sediment	
WILD PLANTS	6536	4222	63	54			638	683.75
Lolium sp.	1932	878	95.24	88.89	19.52	13.80	3.03	1.28
Phalaris sp.	656	901	90.48	90.74	6.63	14.16	1.03	1.32
Hordeum spp.	30	48	31.75	33.33	0.30	0.75	0.05	0.07
Festuca-type	25	8	19.05	3.70	0.25	0.13	0.04	0.01
Bromus spp.	39	15	41.27	11.11	0.39	0.24	0.06	0.02
Stipa type	17	2	22.22	3.70	0.17	0.03	0.03	0.00
Phleum cf. phleoides	24	96	20.63	24.07	0.24	1.51	0.04	0.14
Aeluropus cf. littoralis	24	29	12.70	24.07	0.24	0.46	0.04	0.04
Alopecurus/Poa	3	22	3.17	11.11	0.03	0.35	0.00	0.03
cf. Cynodon dactylon	13	13	19.05	12.96	0.13	0.20	0.02	0.02
Poaceae, indet. (large)	178	202	60.32	72.22	1.80	3.17	0.28	0.30
Poaceae, indet. (medium)	405	183	66.67	59.26	4.09	2.88	0.63	0.27
Poaceae, indet. (small)	26	30	17.46	25.93	0.26	0.47	0.04	0.04
Poaceae, embryo (indet.)	112	68	49.21	25.93	1.13	1.07	0.18	0.10
Poaceae, chaff (indet.)	15	26	11.11	14.81	0.15	0.41	0.02	0.04
Coronilla sp.	146	16	79.37	20.37	1.47	0.25	0.23	0.02
Scorpiurus sp.	54	10	49.21	18.52	0.55	0.16	0.08	0.01
Prosopis cf. farcta	101	3	68.25	5.56	1.02	0.05	0.16	0.00
Securigera securigeda	97	3	61.90	5.56	0.98	0.05	0.15	0.00
Medicago sp. (+pod frags)	14	10	14.29	7.41	0.14	0.16	0.02	0.01
Melilotus/Trifolium	1176	430	93.65	90.74	11.88	6.76	1.84	0.63
Trifolium cf. alexandrium	11	9	12.70	7.41	0.11	0.14	0.02	0.01
Trigonella sp.	19	1	20.63	1.85	0.19	0.02	0.03	0.00
Fabaceae, indet (medium)	26	13	23.81	12.96	0.26	0.20	0.04	0.02
Fabaceae, indet (large)	200	59	76.19	33.33	2.02	0.93	0.31	0.09
Bupleurum sp.	42	39	31.75	14.81	0.42	0.61	0.07	0.06
Apiaceae, indet. small-seeded	99	44	53.97	20.37	1.00	0.69	0.16	0.06
Centaurea type	25	130	22.22	25.93	0.25	2.04	0.04	0.19
Anthemis cotula	228	213	60.32	53.70	2.30	3.35	0.36	0.31
Cichorium sp.	6	30	6.35	12.96	0.06	0.47	0.01	0.04
Asteraceae, indet	26	10	23.81	12.96	0.26	0.16	0.04	0.01
Lithospermum arvense/tenuifolium	31	10	28.57	11.11	0.31	0.16	0.05	0.01
Ochthodium cf. aegyptiacum	1	12	1.59	11.11	0.01	0.19	0.00	0.02
Valerianella dentata	13	4	17.46	7.41	0.13	0.06	0.02	0.01
Vaccaria cf. pyramidata	10	19	12.70	1.85	0.10	0.30	0.02	0.03
Silene sp.	55	8	47.62	14.81	0.56	0.13	0.09	0.01
Caryophyllaceae, indet.	12		17.46	0.00	0.12	0.00	0.02	0.00
Scirpus maritimus	51	64	25.40	44.44	0.52	1.01	0.08	0.09
Rumex sp.	110	226	63.49	53.70	1.11	3.55	0.17	0.33
Eleocharis sp.	8	10	7.94	14.81	0.08	0.16	0.01	0.01
Fimbristylis cf. annua	2	16	3.17	11.11	0.02	0.25	0.00	0.02
Cyperaceae, indet.	6	17	6.35	11.11	0.06	0.27	0.01	0.02
Galium aparine/spurium	60	10	47.62	14.81	0.61	0.16	0.09	0.01
Galium cf. parisiense	20	27	12.70	12.96	0.20	0.42	0.03	0.04
Asperula sp.	93	23	47.62	11.11	0.94	0.36	0.15	0.03
Sherardia arvensis	14	4	19.05	1.85	0.14	0.06	0.02	0.01
Rubiaceae, indet. (frags)	67	22	49.21	14.81	0.68	0.35	0.11	0.03
Rubiaceae, indet. (small seeded)	5	18	7.94	12.96	0.05	0.28	0.01	0.03
Thymelaea sp.	140	22	60.32	24.07	1.41	0.35	0.22	0.03
Chenopodium murale	4	52	6.35	11.11	0.04	0.82	0.01	0.08
Ornithagalum/Muscari	6	8	7.94	11.11	0.06	0.13	0.01	0.01
Malva sp.	10	64	12.70	25.93	0.10	1.01	0.02	0.09
Anagallis sp.	8	7	11.11	9.26	0.08	0.11	0.01	0.01
Verbascum/Scrophularia	8	20	11.11	16.67	0.08	0.31	0.01	0.03
Ranunculus cf. arvense	7	1	11.11	1.85	0.07	0.02	0.01	0.00
Mouse droppings	26	17	28.57	9.26	0.26	0.27	0.04	0.02

Table 9 **The absolute counts, ubiquity scores, proportions and find density scores of wild plant categories with an ubiquity score higher than at least 10% in either Early Bronze Age or Iron Age at Tell Tayinat.**

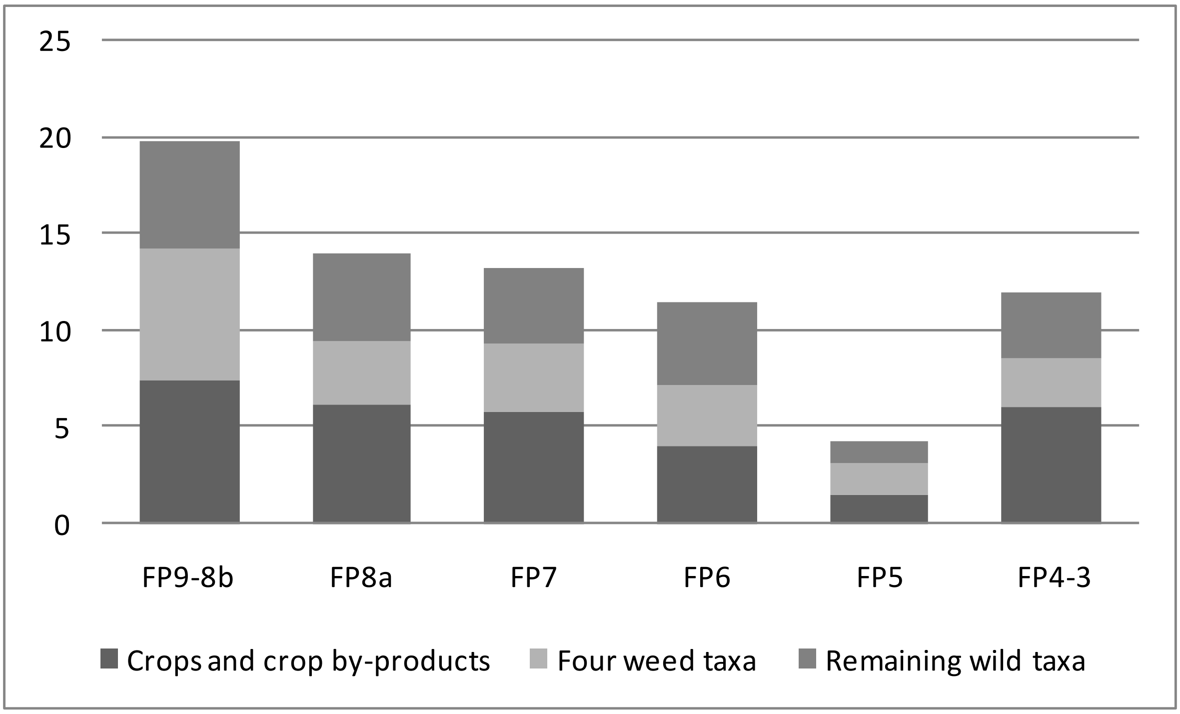

Figure 13 Find density scores of three categories including all crops and crop by-products, four wild and weedy taxa (ryegrass, canarygrass, aggregate clovers, stinking chamomile) and the rest of wild plants identified at Tell Tayinat.

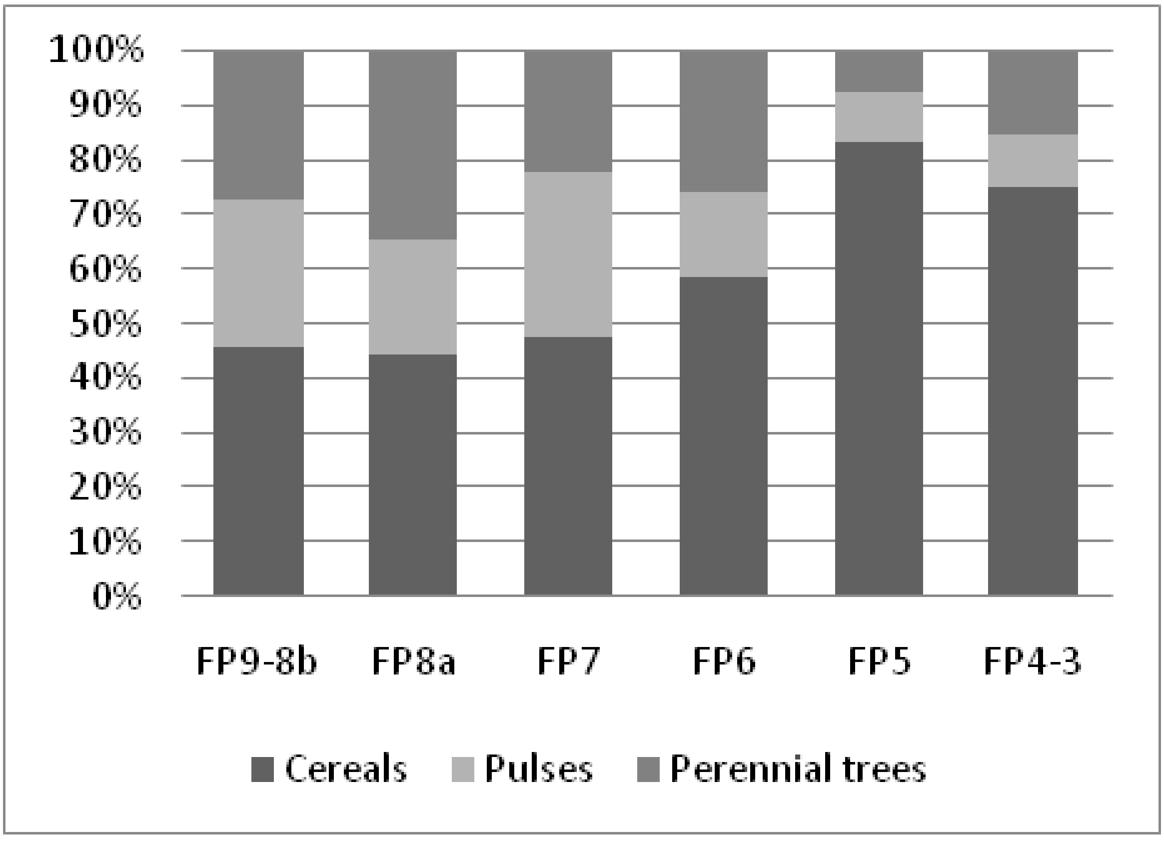

Figure 14 Relative percentages of crop categories across the Early Bronze Age IV phases (FP9-8b, 8a, and 7) and Iron Age I (FP6, 5, 4-3).

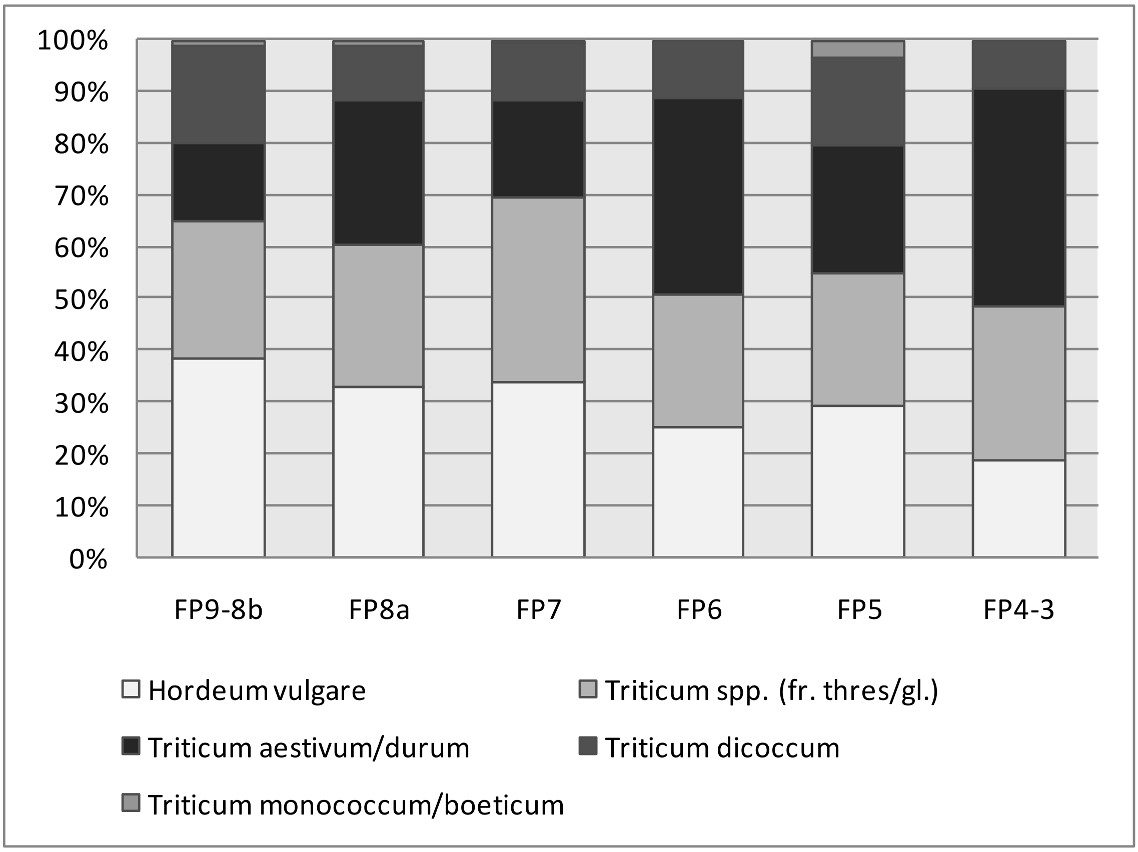

Figure 15 Relative percentages of various cereal crop categories.

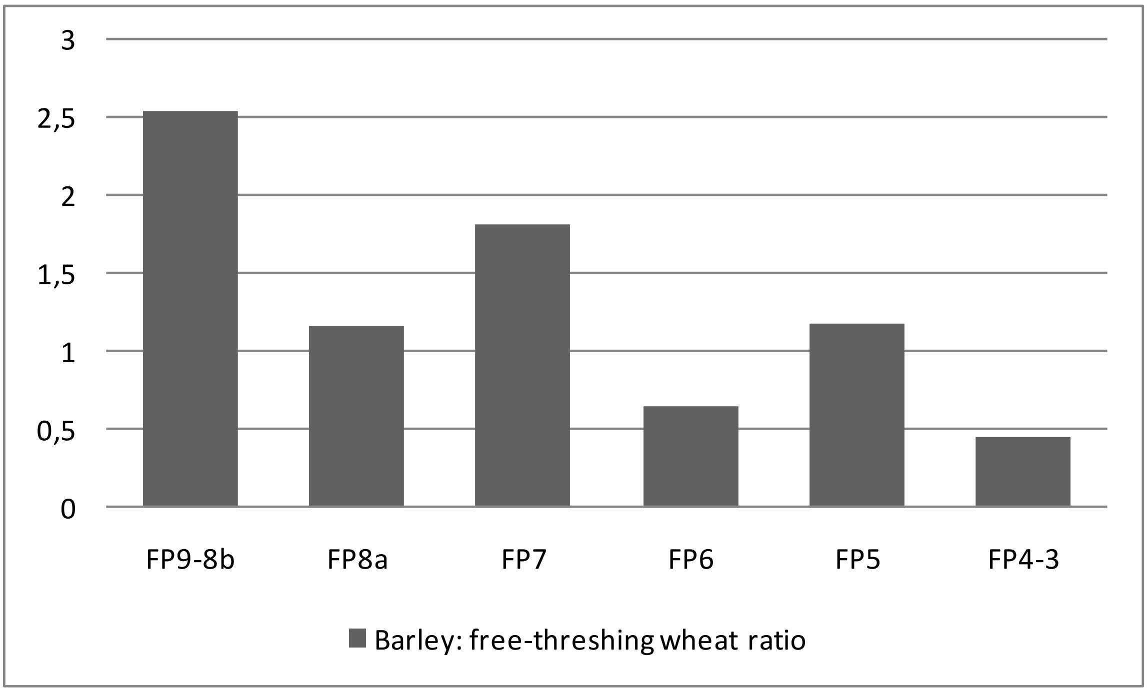

Figure 16 Ratio of barley to free-threshing finds across field phases.

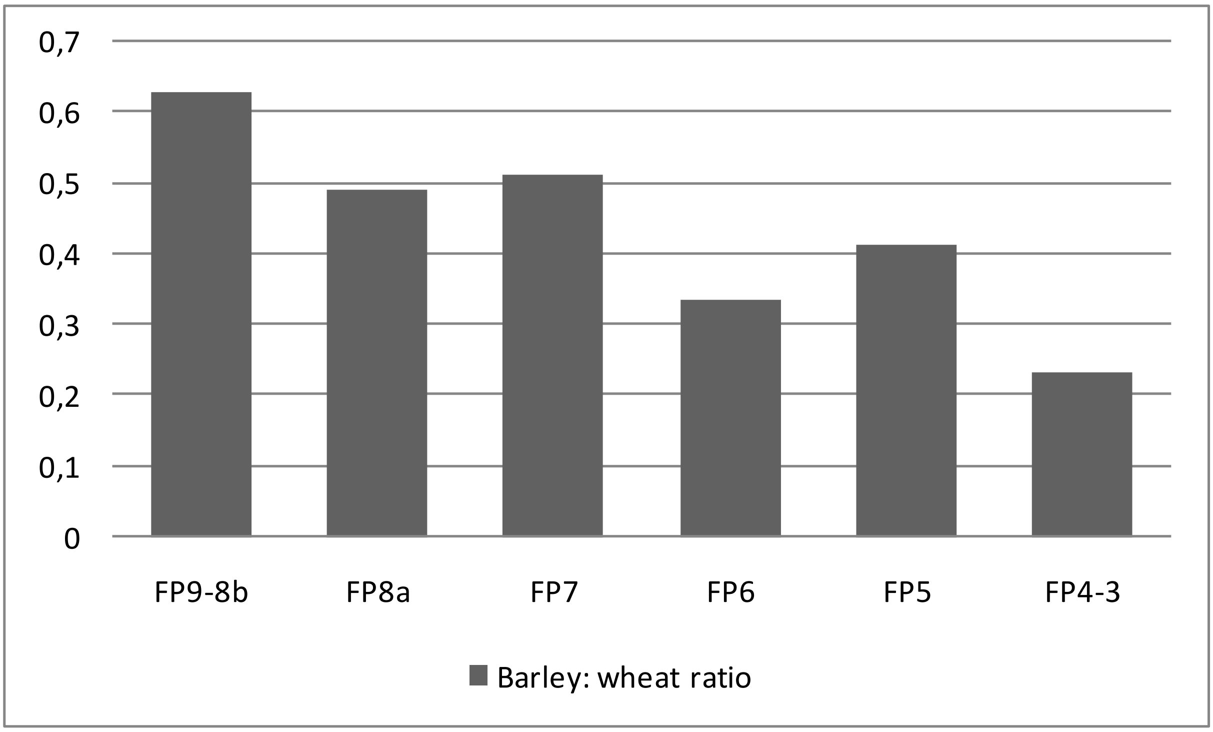

Figure 17 Ratio of barley finds to all wheat finds including durum/bread wheat, emmer wheat and ***Triticum*** **sp.**

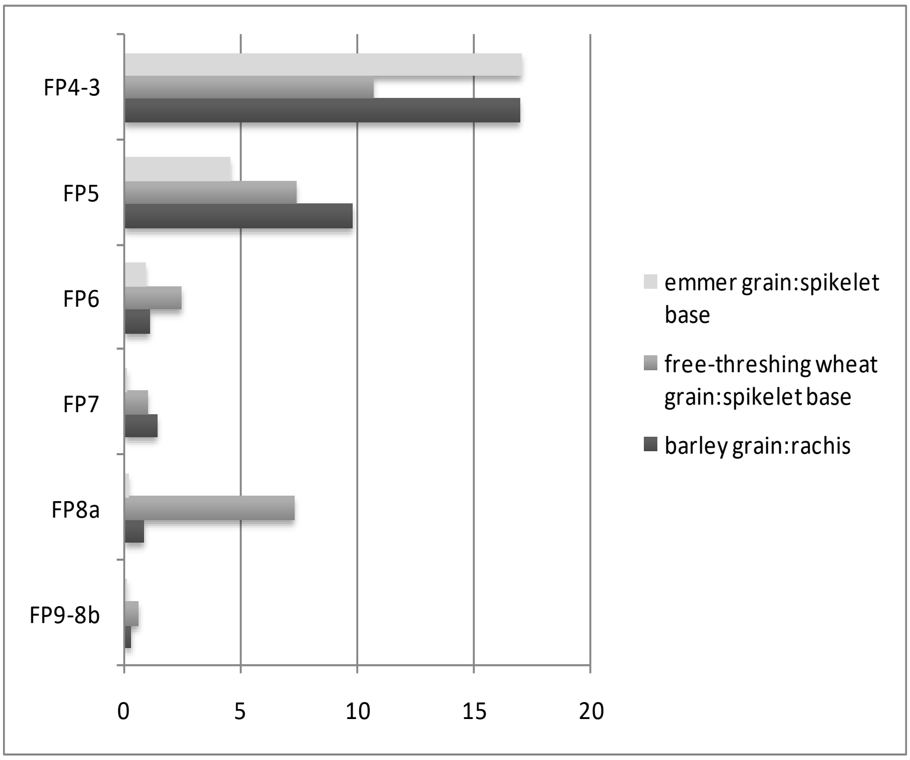

Figure 18 Ratio analysis of selected crop categories and associated chaff remains across field phases.

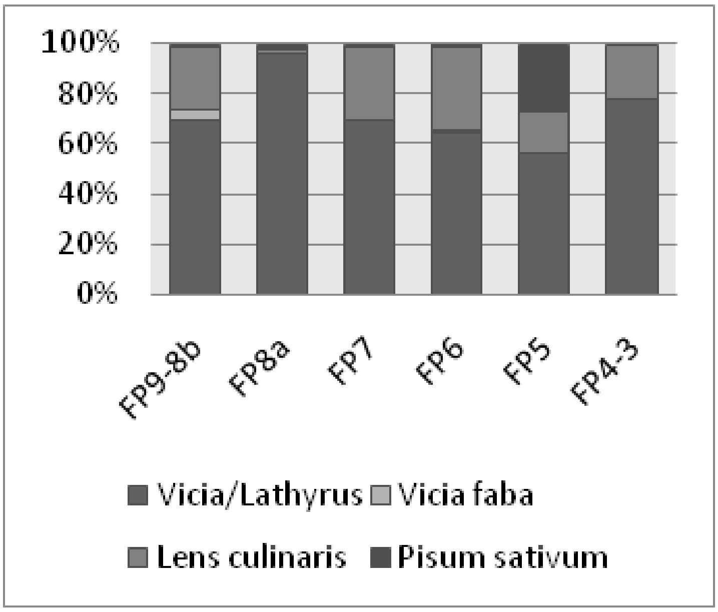

Figure 19 **Relative percentages of legume crops across field phases.**

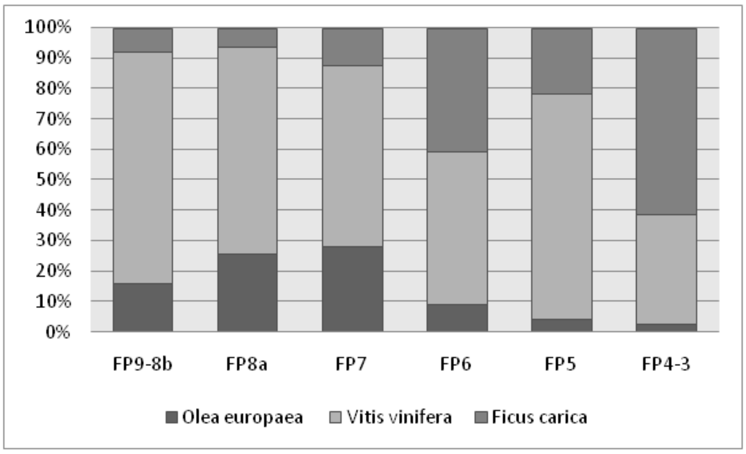

Figure 20 **Relative percentages of perennial trees across field phases.**

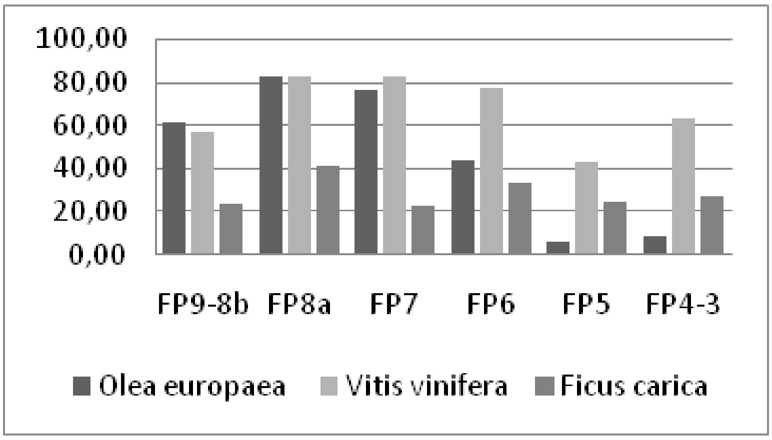

Figure 21 **Ubiquity scores of perennial trees.**

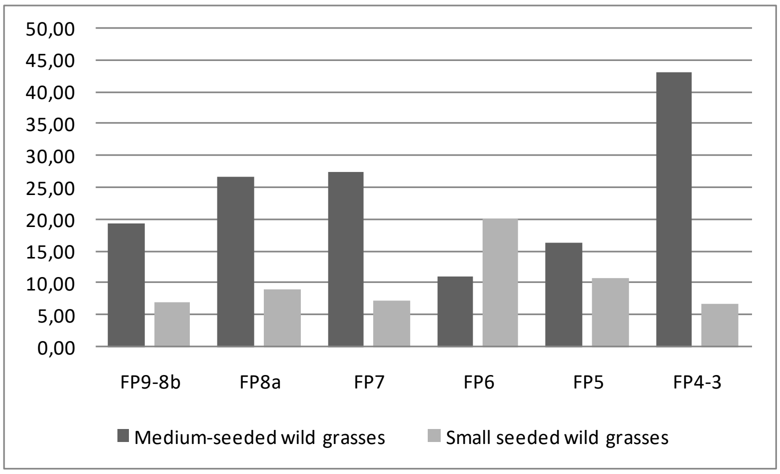

Figure 22 **Percentage scores of medium- and small-seeded wild grasses across the field phases.**

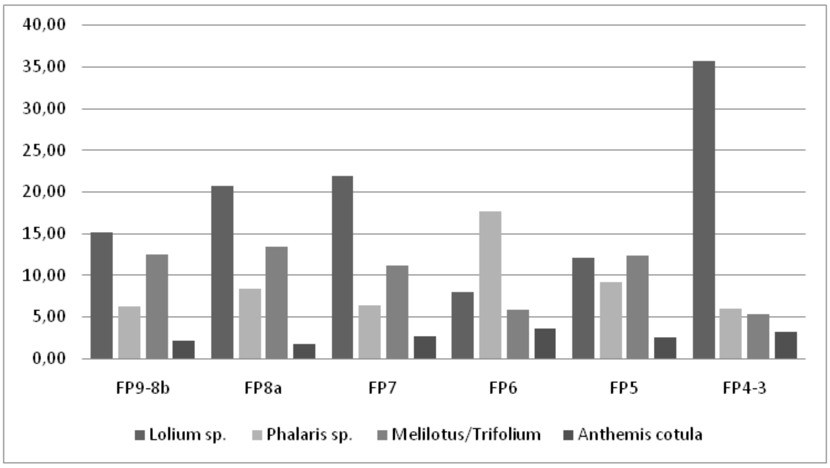

Figure 23 **Percentages of four wild taxa across the EBA IV and Iron I field phases.**

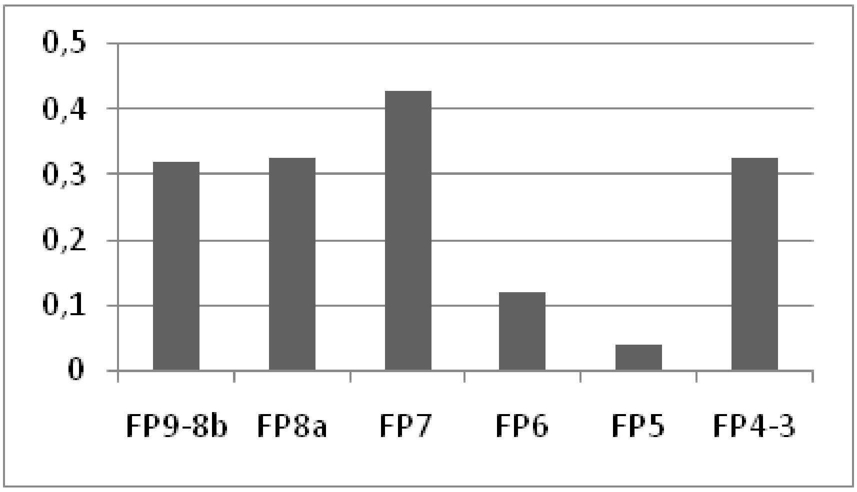

Figure 24 **Ratio of wild legumes to clovers.**

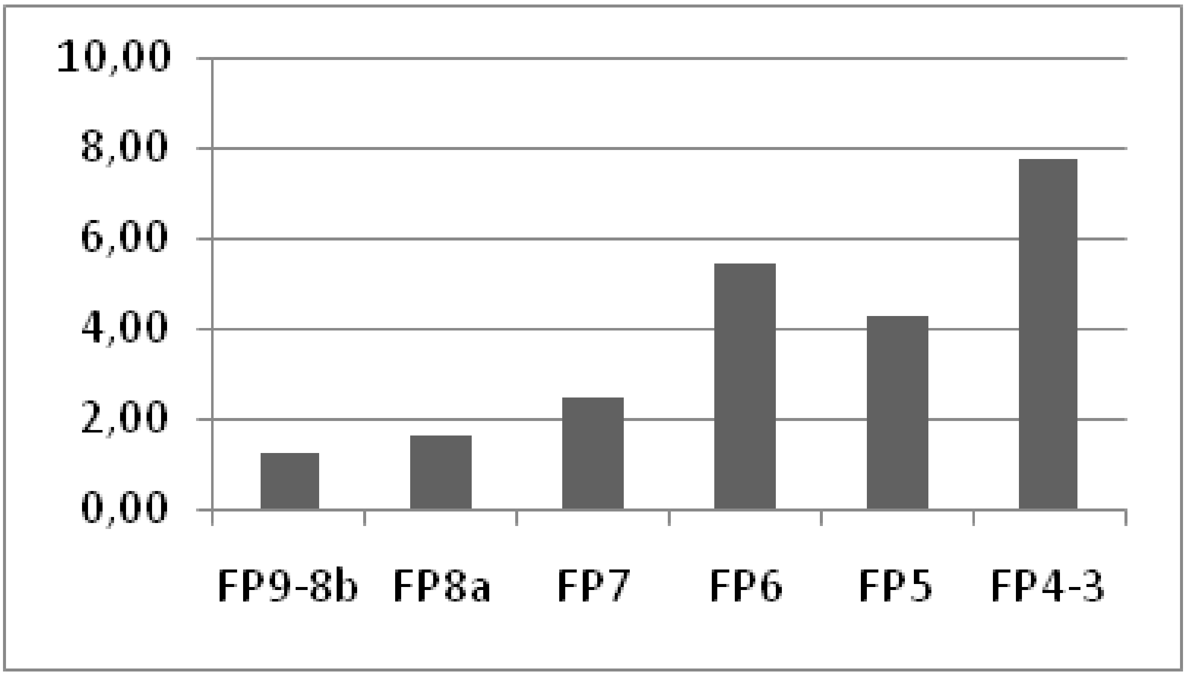

Figure 25 Percentages of water-loving taxa.

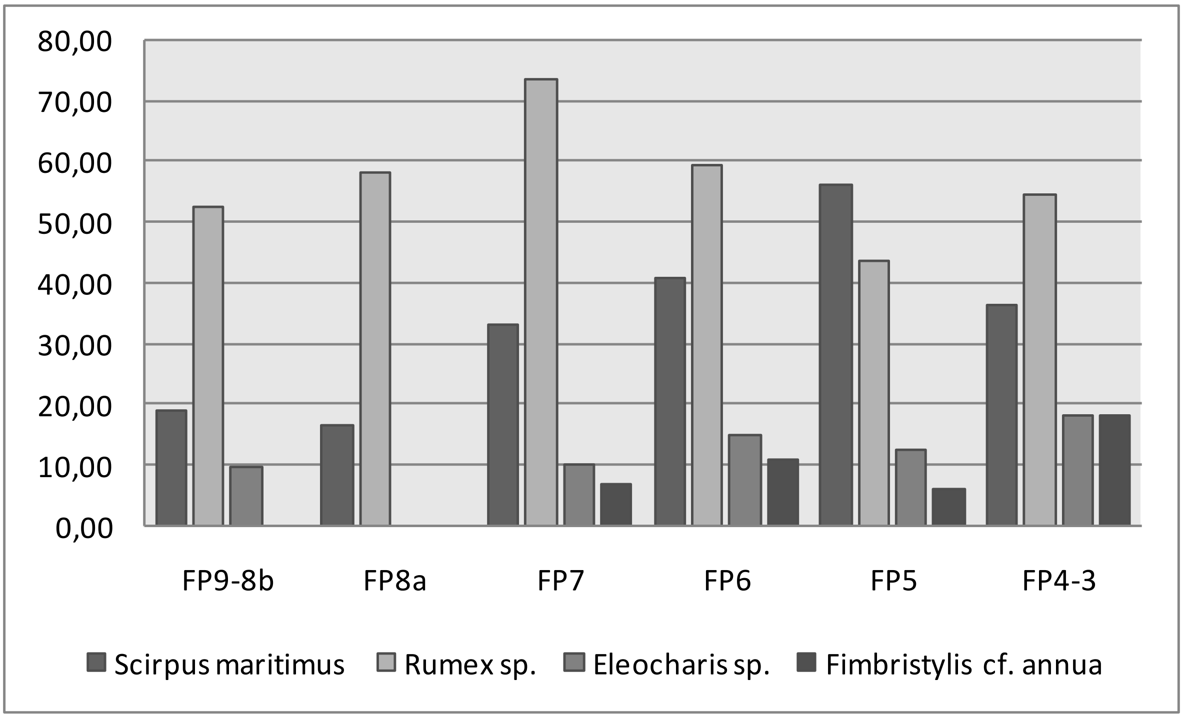

Figure 26 Ubiquity scores of selected water-loving taxa.

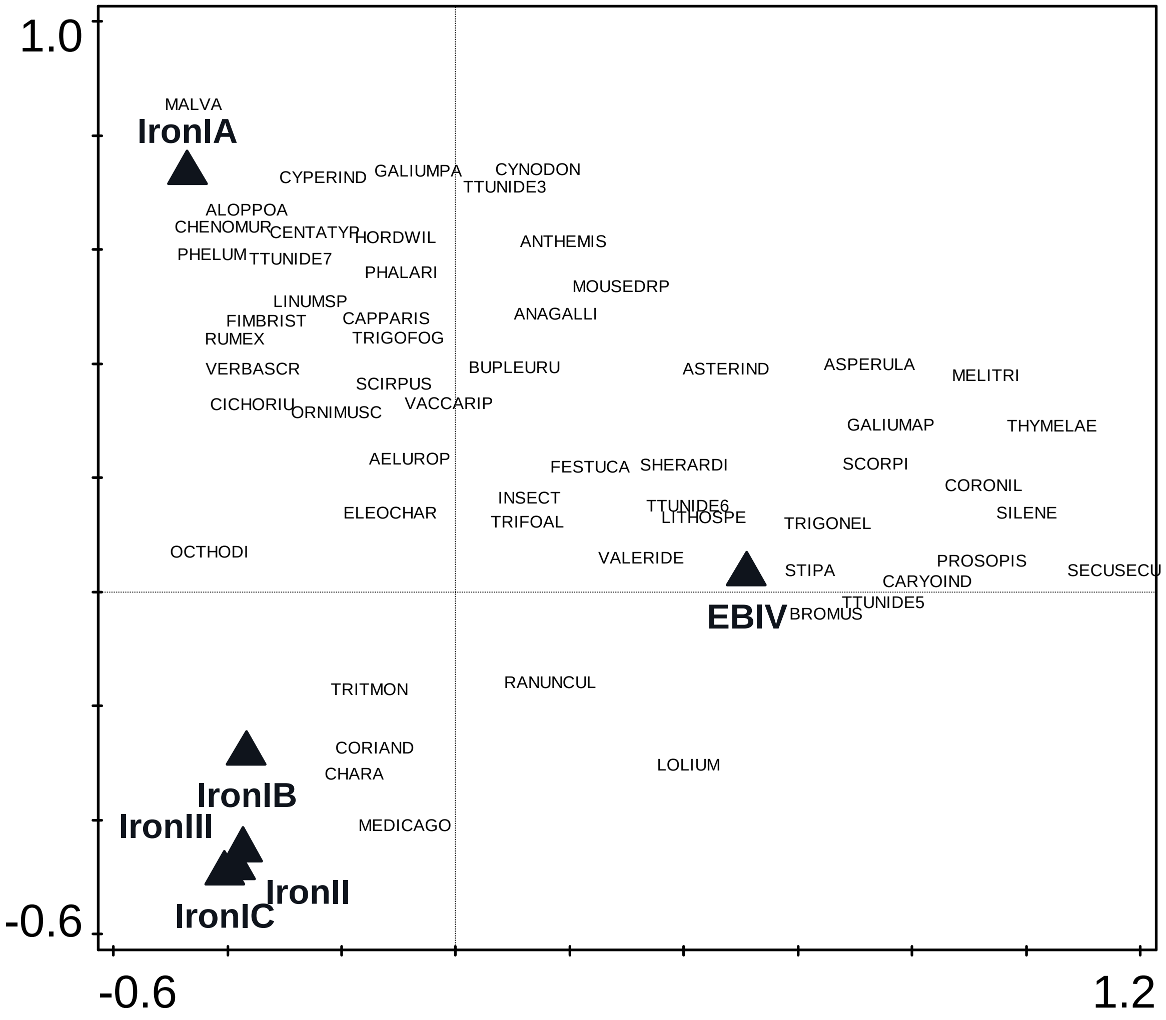

Figure 27 **Ordination diagram of the redundancy analysis for the wild species community across periods. Triangles indicate samples. Dots represent change in species position along the ordination axes.**

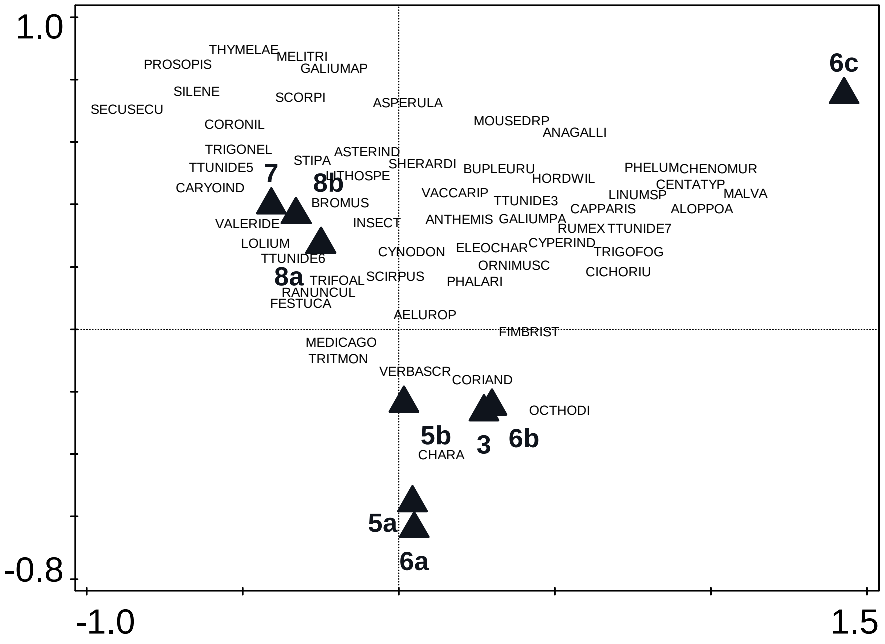

Figure 28 Ordination diagram of the redundancy analysis for the wild species community across sub/phases. Triangles indicate samples. Dots represent change in species position along the ordination axes.

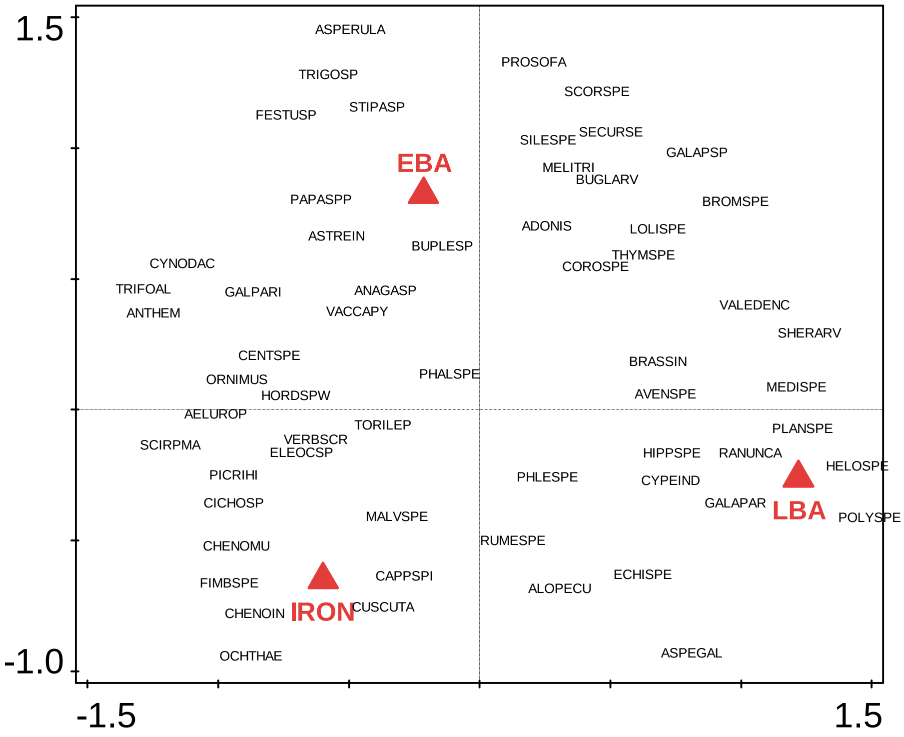

Figure 29 Ordination diagram of the redundancy analysis for the wild species community across occupational periods of Tell Atchana (LBA) and Tell Tayinat (EBA, IRON). Triangles indicate samples. Dots represent change in species position along the ordination axes.

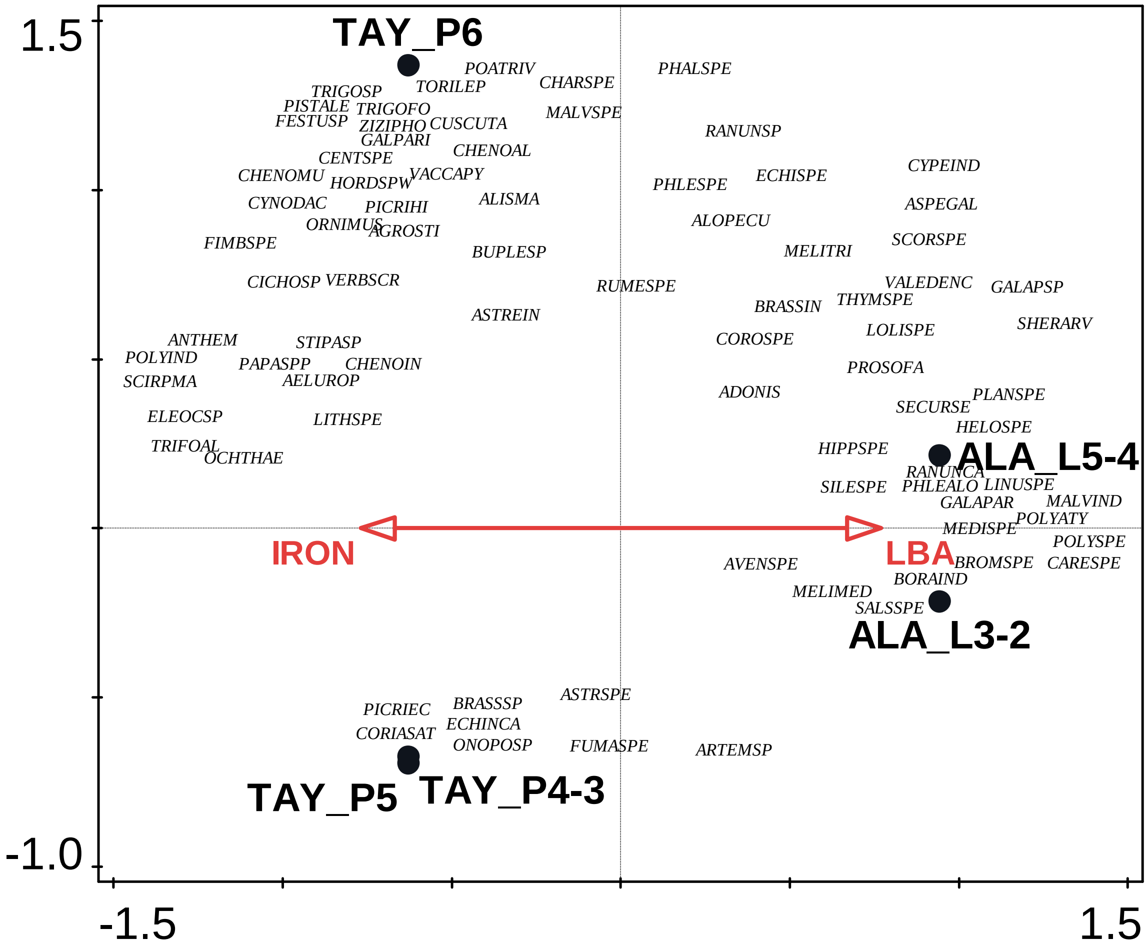

Figure 30 Ordination diagram of the redundancy analysis for the wild species community across phases/levels of Tell Atchana and Tell Tayinat. Circles indicate samples. Dots represent change in species position along the ordination axes.

5.3.2 Stable carbon and nitrogen isotope results

Both crop plants in the EBA show either favorable or moderate water stress but never under the expected thresholds of 16-17‰ for barley and 15-16‰ for free-threshing wheat (Fig. 31). The mean $\Delta^{13}C$ values during FP8 and FP 7 are over 17‰ for both plants. In FP8, the mean $\Delta^{13}C$ values is 17,51‰ ±0,50 for barley and 17,30‰ ±0,90 SD for free-threshing wheat. In the following occupation phase, during FP7, the mean values are 17,88‰ ±0,43‰ for barley and 17,27‰ ±0,75‰ for free-threshing wheat. The range of barley $\Delta^{13}C$ values are 1,4‰

during the FP9-8 and 0,6‰ during the FP7. The range of free-threshing wheat is 2,4‰ and 1,8‰ during the FP8 and FP7 respectively (Table 10).

The mean ^{15}N values during the EBA demonstrate the results with around 5,15‰ ±1,96 SD for barley and 5,45‰ for free-threshing wheat (Fig. 34). The mean nitrogen isotopic values by phases are between 5,63 ±1,63 for free-threshing wheat and 5,59‰ ±1,90 for barley during FP8. In the following FP7 phases the mean nitrogen value remain almost steady with 5,23‰ ±1,46, but for barley this value falls to 3,60‰ ±1,0. The range of stable nitrogen values is 5,8‰ for barley and 4,3‰ for free-threshing wheat during the EBA. Minima value of barley is 2,35‰, while the same value is 4,1‰ for free-threshing wheat. Maxima values for both plants are close to each other with 8,3‰ and 8,2‰ respectively for free-threshing wheat and barley (Fig. 35, Fig. 36, Fig. 37, Table 10).

The mean carbon isotope values of the Iron I period is 16,97‰ for barley and 16,47‰ for free-threshing wheat. The mean Δ^{13}C value in FP6 is 16,01‰ ±0,78 SD for free-threshing wheat. The mean Δ^{13}C value in the same phase is 16,89‰ ±0,83 SDfor barley. During FP5, the mean values are similar to the previous phase that are 15,77‰ ±0,77 SD and 16,71‰ ±0,64 SD for free-threshing wheat and barley respectively. During the FP3 instead, the mean values of both plants are getting higher. This value is 17,67‰ ±0,60 SD for free-threshing wheat and 17,43‰ ±0,98 SD for barley. The range of both plants fluctuates between 2,5‰ to 1,6‰ during the Iron I. This value is steadily getting smaller towards the end of the sequence. For both plants, the values is 2,5‰ in FP6; 2,2‰ and 1,7‰ for free-threshing wheat and barley respectively during FP5, whilst this value is much smaller in FP3 at around 1,6‰ for free-threshing wheat and 1,9‰ for barley (Fig. 32, Fig. 33, Fig. 36, Fig. 37, Table 10).

The mean ^{15}N values during the Iron I show that there is about 2‰ decrease compared to the EBA values (Fig. 34, Fig. 35). The mean Iron I stable nitrogen values are 3,58‰ ±1,64 for barley and 3,17‰ ±1,53 for free-threshing wheat. A phase-by-phase look at the stable nitrogen values demonstrates that the values are fluctuating between 2,22‰ and 4,29‰. The range of nitrogen values for both plants is 5,5‰ and 6,6‰ for barley and free-threshing wheat. While the minima value of wheat is 1,4‰, the maxima is 7,9‰ during this period. This is 6,7‰ (maxima) and 1,2‰ (minima) for barley (Fig. 36, Fig. 37, Table 10).

The mean water input amount demonstrates no stress conditions during the Early Bronze Age phases (FP9-8 and FP7). The amount of water input coincides well to the current rainfall amount derived from the Antakya meteorological station. During the Iron Age I, more specifically in FP6, the mean water input diminishes by about 40 mm, decreasing to 100 mm for barley and 80 mm for free-threshing wheat. This amount of water input coincides to the Iskenderun, Samandag and Islahiye meteorological stations. This trend continues during the FP5 whilst at the end of Iron Age I in FP3 it is marked with well water input conditions coincident to the modern values in the Antakya meteorological stations (Fig.38, Fig. 39).

When comparing to minima and maxima values of water input, the same trend towards greater water input appears in the Early Bronze Age. The minima values do not fall down under the values of Iskenderun and Samandag for both plants. The same is true for FP3 of the Iron Age I. For the FP6 and FP5 of Iron Age I, instead, the minima values diminish to the rainfall values of the leeward side of the Amanos. These values coincide to the modern rainfall amounts at Islahiye, Hassa and Kirikhan. On the other hand, the maxima values show well watered input conditions even for the FP6 and FP5 of over 150 mm. The lowest maxima values are measured for the FP5 which coincides with the modern values of the Iskenderun station at about 100 mm (Fig. 40, Fig. 41).

			Carbon			Nitrogen		
Period	**Phases**	**Crop**	**Mean Δ (‰)**	**Range (‰)**	**SD±**	**Mean 15N (‰)**	**Range (‰)**	**SD±**
EBA	**FP 8**	**WHEAT**	17,30	2,4	0,90	5,63	4	1,66
		BARLEY	17,51	1,4	0,50	5,59	6	1,90
	FP7	**WHEAT**	17,27	1,8	0,75	5,23	3	1,46
		BARLEY	17,88	0,6	0,43	3,60	2	1,09
IRON I	**FP6**	**WHEAT**	16,01	2,5	0,78	3,77	6	1,82
		BARLEY	16,89	2,5	0,83	4,04	5	1,69
	FP5	**WHEAT**	15,77	2,2	0,77	3,05	4	1,23
		BARLEY	16,71	1,7	0,64	2,22	2	0,90
	FP3	**WHEAT**	17,67	1,6	0,60	2,36	2	0,85
		BARLEY	17,43	1,9	0,98	4,29	3	1,44

Table 10 The mean carbon and nitrogen isotope values, range and standard deviation of barley and free-threshing wheat across field phases.

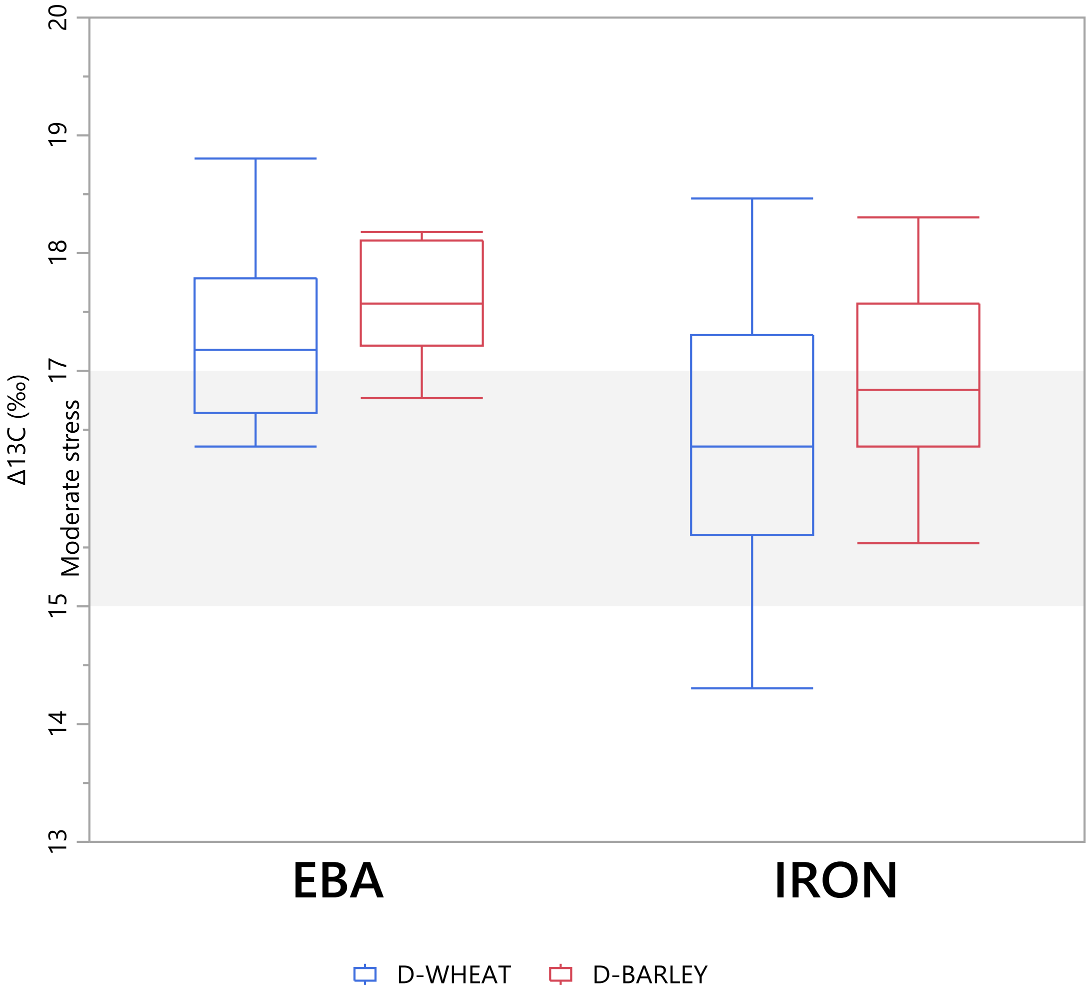

Figure 31 AccumulatedΔ values of barley and free-threshing wheat during the Early Bronze Age and Iron Age at Tell Tayinat. Highlighted area shows the threshold of moderate water stress conditions.

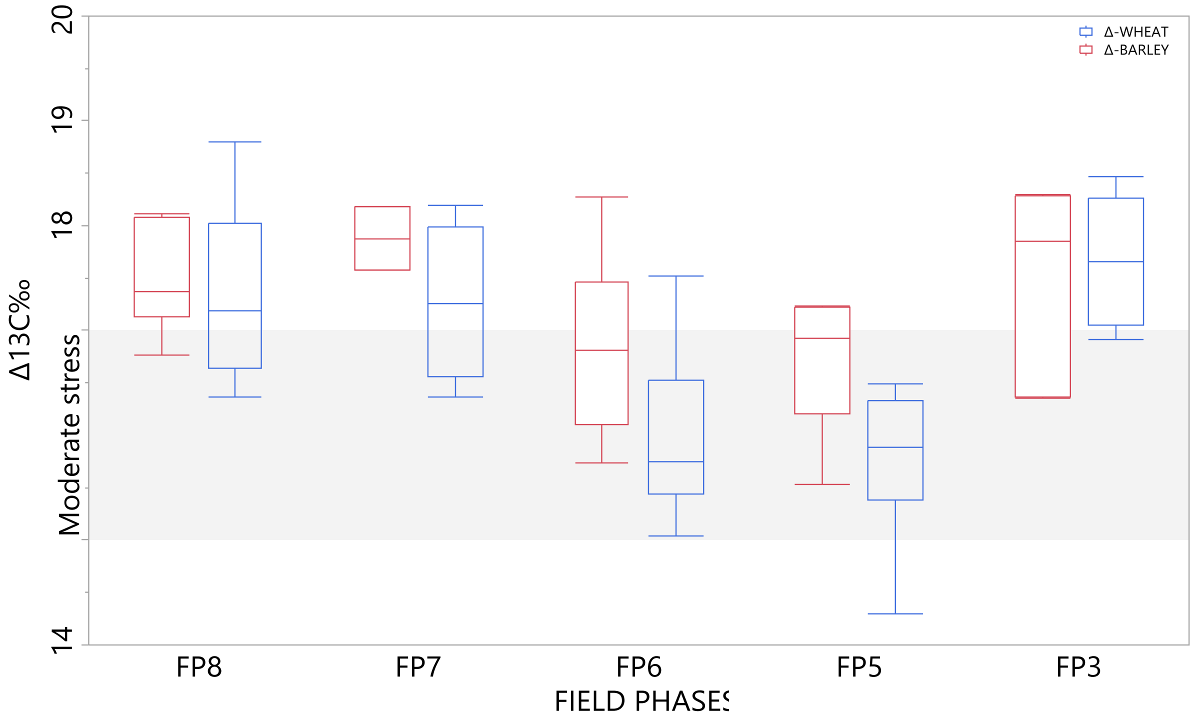

Figure 32 Stable carbon isotope values across field phases.

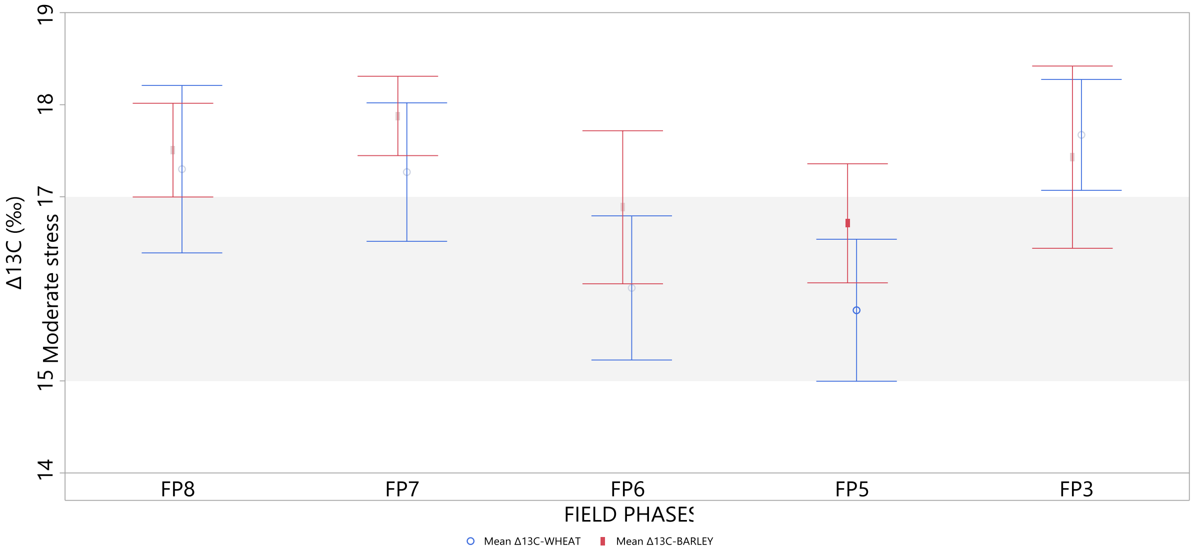

Figure 33 Mean $\Delta^{13}C$ values with standard deviation across the field phases. Blue bars is free-threshing wheat, red bars is for barley.

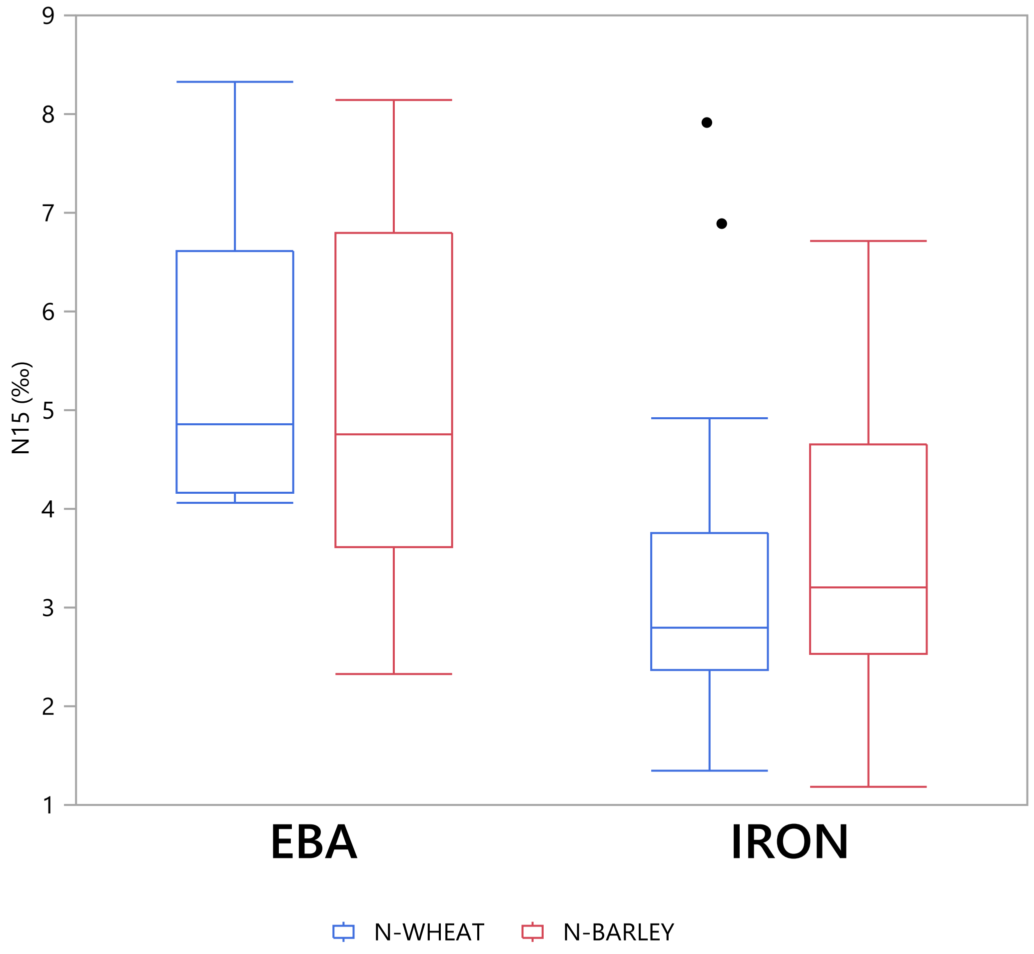

Figure 34 ^{15}N values across periods.

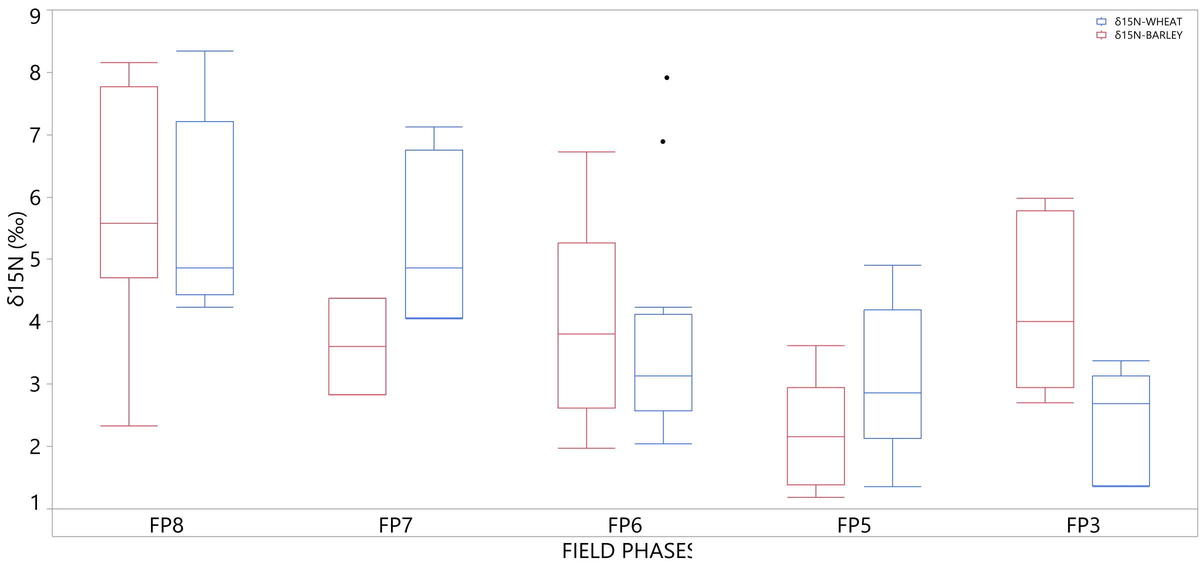

Figure 35 ^{15}N values across field phases.

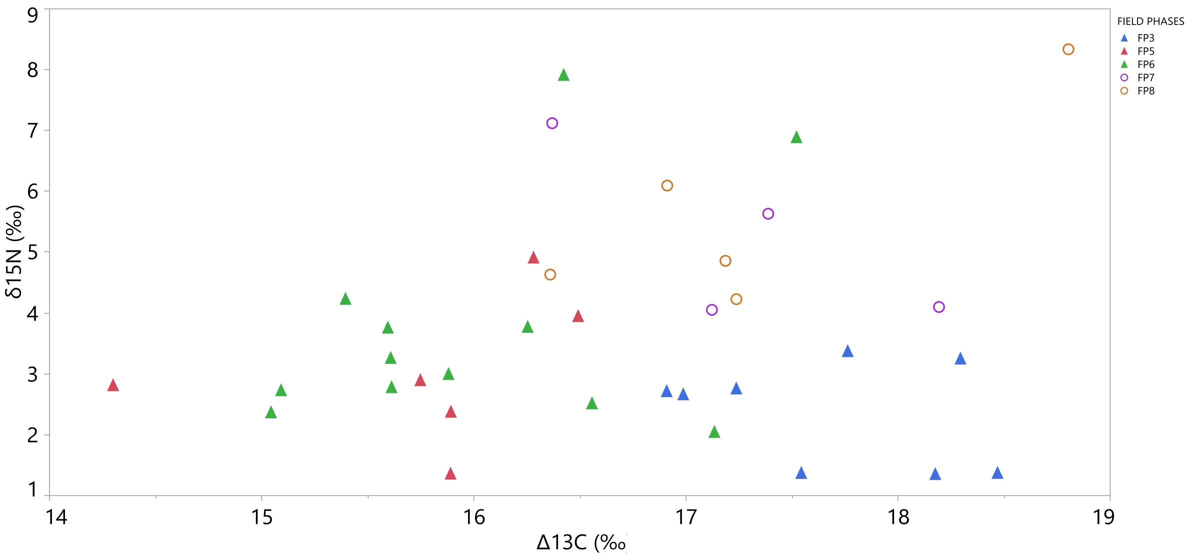

Figure 36 Stable carbon and nitrogen isotope values of free-threshing wheat across field phases. Triangles denote Iron Age phases (blue: FP3; red: FP5, green: FP6), circles are the Early Bronze Age phases (purple: FP7, orange: FP8).

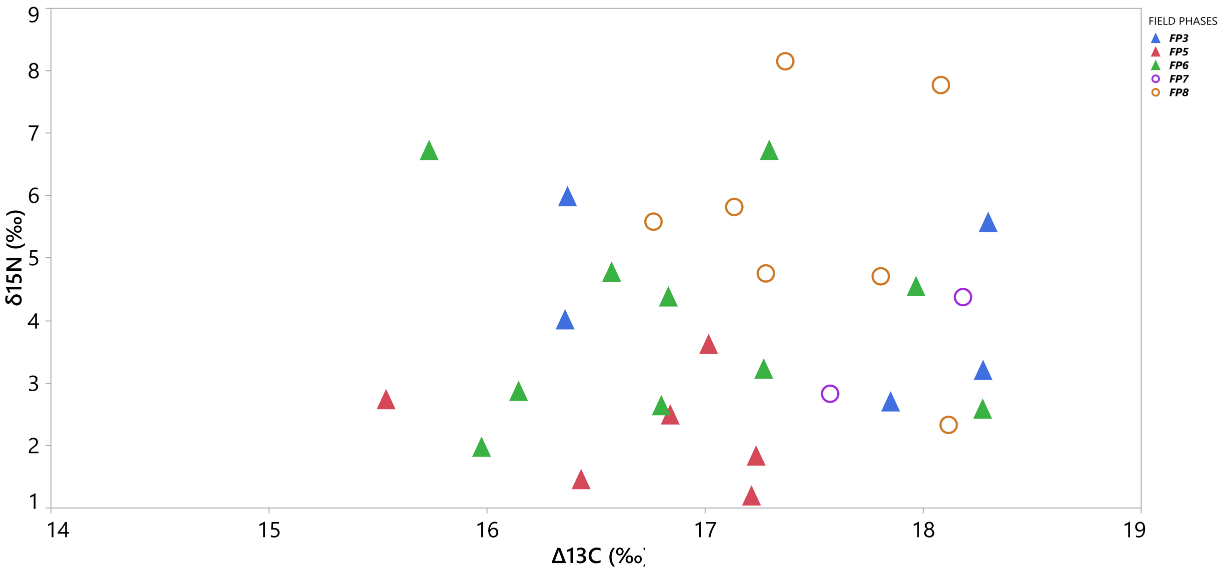

Figure 37 Stable carbon and nitrogen isotope values of barley across field phases. Triangles denote Iron Age phases (blue: FP3; red: FP5, green: FP6), circles represent the Early Bronze Age phases (purple: FP7, orange: FP8).

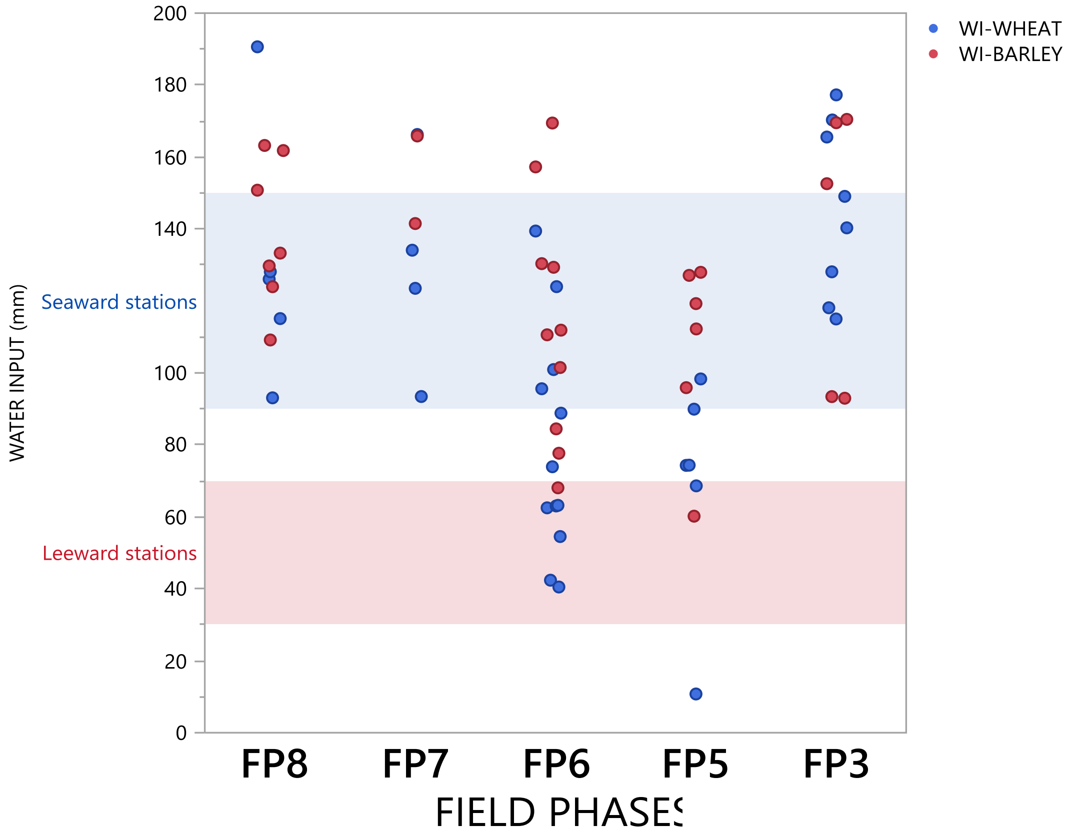

Figure 38 Water input values calculated from stable carbon isotope discrimination across field phases. Red and blue zones denote the upper and lower limits of leeward and seaward meteorological stations in the Amuq Plain.

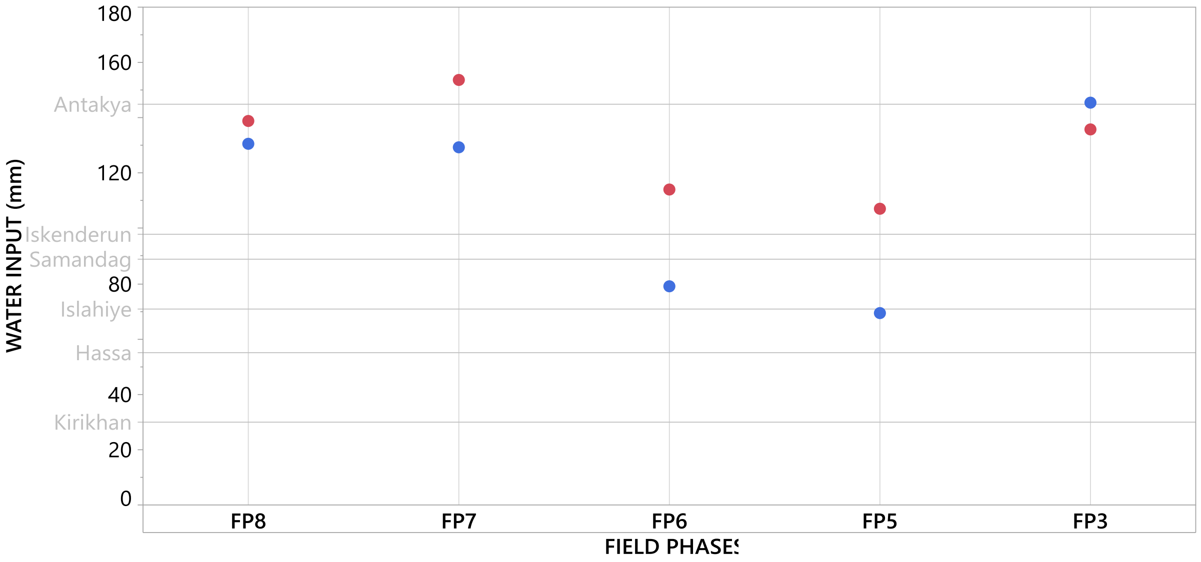

Figure 39 Mean water input values of barley (red) and free-threshing wheat (blue). Lines indicate the total rainfall amount during ½ April + May (meteorological data taken from Akman 1973).

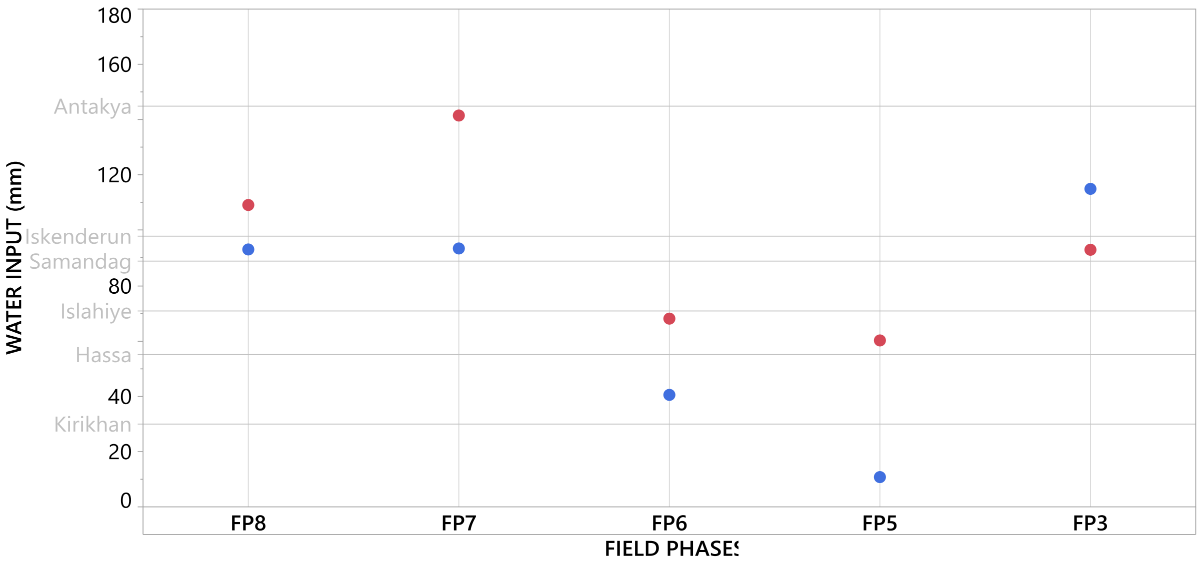

Figure 40 **Minima water input values of barley (red) and free-threshing wheat (blue). Lines indicate the total rainfall amount during ½ April + May (meteorological data taken from Akman 1973).**

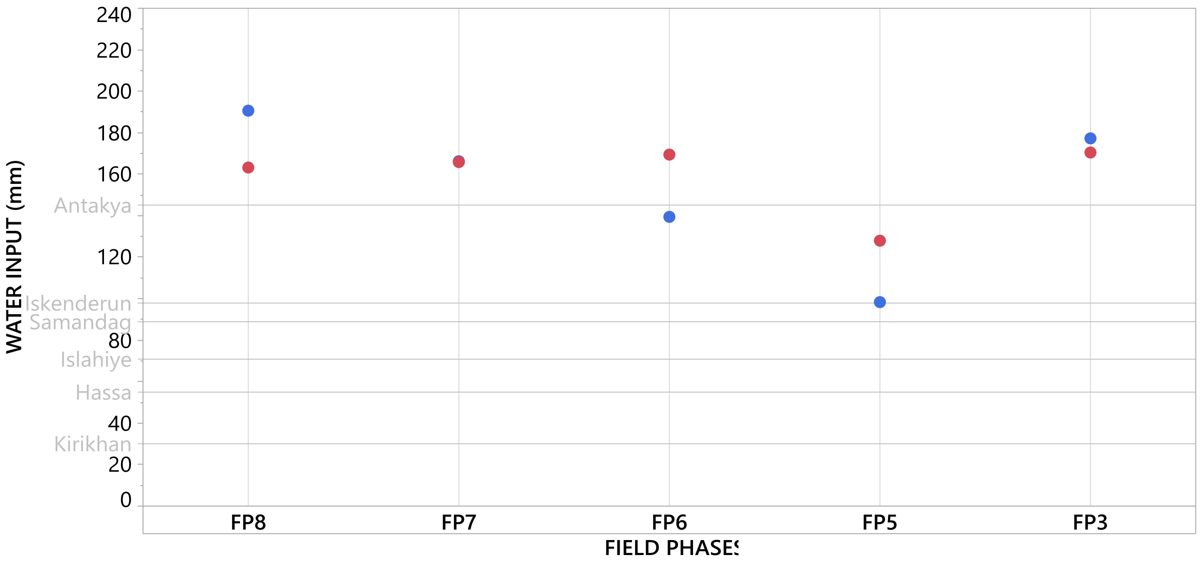

Figure 41 **Maxima water input values of barley (red) and free-threshing wheat (blue). Lines indicate the total rainfall amount during ½ April + May (meteorological data taken from Akman 1973).**

5.4 DISCUSSION

Maintaining the complexity is costly since more social groups are involved in the social networks like specialists and administrators who did not engage in food producing activities for their own sustenance (Tainter, 1999). The overcentralization of complex political systems was often marked by the institutional interference of palace and temples into agricultural production. Renfrew (1972) argues that the palatial system controls redistribution of specialized production over grain-oil-wine polyculture in the Aegean region. It is often assumed that "subsistence agriculture" represents a less-complex form of food-production system with a greater emphasis of self-sufficiency (e.g. Tainter, 1999). Subsistence agriculture is more associated with the commoners, who had no or less means to produce agricultural surplus, to have personal gains and eventually to record these into the clay tablets. On the other hand, "institutional agriculture" was conceived as an elite-oriented activity and propensity of the "complex" civilizations of the Bronze Ages, a productive system to fuel the needs of the non-producers (cf. Frangipane, 2018; van Koppen, 2001; also see Hirth, 1996 for various interpretations).

This understanding largely treats social structures as static, timeless categories, as well as some social actors as invisible and subordinate to others in *history-making*. What follows is a unilinear comprehension of cultural evolution in which subsistence agriculture eventually transforms into the more complex forms of productive and exchange systems, after the complex administrative and political entities emerged during the Late Chalcolithic in the Near East. Also, this distinction by no means implies *a priori* lacks of surplus for the subsistence agriculturalists (Halstead, 1989). Instead, more archaeologically-accurate interpretation would be to define the pathways of resource mobilization and risk-buffering strategies among both types of agricultural practice. Hirth (1996, p. 223) defines two types of resource accumulation in preindustrial societies targeted at different purposes; 1) individual-oriented: where the resources were accumulated at the level of household or lineage organization to successfully manage important rites of passage or rituals for the community; 2) context-oriented: where elites accumulate resources in special social contexts which were validated by social rank, status and cosmology. Schloen (2001) proposes that Bronze Age communities were structured through hierarchical kinship model (called the Patrimonial Household model). This model indicates that all agricultural lands were possessed by extended patrimonial households and organized by a steep hierarchy. The top of this hierarchical scheme is occupied by the king's household, while at the bottom there are small-landholders who owe some kind of corvee service to hold the rights to work on their lands. Nonetheless, this Weberian understanding of ancient society regards the social structure as modular; that means, may it be a king's or the ordinary farmer's household, they operate through similar organizational principles, but the scale of operations differs. Seen in this way, in a case of what is called institutional agriculture, more managerial information has to be transmitted and processed among the diverse social segments (in relation to class, professional, gender, etc.), in which the information has to be centralized and processed to reach the correct social actors (Tainter, 1988, p. 91-92), but this information transmission is not necessarily presupposing a higher level of technological significance in food production.

Traditional agricultural economy encompasses various risk buffering mechanisms against stress factors (Halstead & O'Shea, 1989). The three risk-buffering mechanisms of agro-production are crop diversification, intensification and specialization, aiming at reducing the variability of food supplies due to climate, pest infestation, environmental hazards or political instabilities (Marshton, 2011; Morrison, 1994). Other risk-buffering strategies were practiced by ancient farming communities, such as transferring the agricultural surplus into livestock, by feeding the animals, this was one of those strategies to cope with possible future bad years (Halstead, 1996, p. 23). Water management in the form of terrace-building to minimize the risk of crop failure is not a propensity of complex socio-political organizations, but also appeared in small-scale so-called subsistence agriculturalists of the early Iron Age when expansion of settlements in the topographically challenging landscape of the Central

Highlands in the Southern Levant took place (Hopkins, 1987, p. 184; cf. Wilkinson, 2003, p. 135).

Storage has been considered another mechanism to average out the resource variations over time (D'Altroy & Earle, 1985). One type of storage is called "social storage" which defines the buffering effects of lineage organizations over fluctuating resources (Halstead and O'Shea 1989). Survival in unpredictable environments, where the seasonality is a significant factor over agricultural production, necessitates creating larger social units among kin groups which can buffer the risks of crop failure through "social storage" (Halstead & O'Shea, 1989). The palatial economy in Mycenaean Greece is argued to constitute "social storage" for the inhabitants to buffer the various risks from unpredictable climatic and environmental fluctuations (Halstead 1996). In this line of thinking, Cooper (2006) notes that kin-based networks and affiliations could become risk-buffering social structures during the post-collapse period. On the other hand, physical storage of resources was a necessity where the marked fluctuations happen due to seasonality (D'Altroy & Earle, 1985). D'Altroy and Earle (1985) mention that; "… Where seasonality is an important feature of subsistence production in the political economy, however, the intensification of agriculture associated with the rise of early states exacerbates the risks involved in relying on such crops, because of a reduction in the complexity of the agricultural base (i.e. by increasing dependence on a limited crop mix)" (1985, p. 191).

According to Middleton (2012), the palatial organization in Mycenaean Greece was never fully encompassing every segment of society. Foxhall (1995, p. 243) and Halstead (1995, p. 232) suggest that the palatial control over food supplies was highly specialized. As Linear B tablets demonstrate, the palace did not hold control over the whole food supply, but only income-generating products were produced under the palatial administration. The crop range from the non-institutional sector tends to be more varied aiming at self-sufficiency (O'Shea & Halstead, 1989). For instance, the Linear B tablets do not record the leguminous crops which were generallyfound in the storage units in the LBA Mycenaean sites. Akin to Halstead's interpretation of the Linear B texts from the Aegean, Charles and Bogaard (2001) suggest that the lack of pulse crops at certain archaeological exposures, like public courtyards, during the Akkadian occupation at Tell Brak is considered as evidence of specialized agriculture, while the wider range of crop remains uncovered from a domestic contexts has been argued to be the so-called private–sector agriculture. Therefore, Halstead (1995) mentions that all pulses and some cereals might have been acquired for the palatial storerooms via exchange from local farming communities.

How was the agricultural system affected by the loss of complexity during the post-collapse period when the political instabilities occurred? Foxhall (1995) argues that although the framework (political economy) changed dramatically, that means "the way the various components of the agricultural system are integrated", the individual components of the political economy remained constant in the succeeding post-collapse period in respect to the fall of the Mycenaean civilization in Greece. The range of staple crops represents no change after the fall of the palatial economy in Greece while the principal changes were detected in relation to the proximities of communities to a major palatial center, the dependence and integration to the agrarian economies of the palace during the Late Bronze Age.Therefore, the post-collapse period was characterized with cultural continuity although changes in the settlement organization were detected in many cases (Middleton, 2012, p. 284). Thus, instead, post-collapse periods may be better interpreted as a period of social adaptation rather than a "tedious interlude between more interesting periods" (Tainter, 1999, p. 1030) or from a "catastrophism" perspective (see Middleton, 2012 for a review of approaches).

Moreover, the administrative records demonstrate a significant change in labour organization with the transition from the Early Bronze to the Middle Bronze Age, in relation to the transformation of the Mesopotamian society according to Gelb (1965, p. 243):

> "The semi-free class of the *gurus* workers and the ration system dominated the socio-economic life of early Mesopotamia all through the periods of Fara through pre-Sargonic and Sargonic to Ur III. Beginning with the Old Babylonian period, the term *guruš* for the semi-free class disappeared completely and was replaced by others. At the same time the ration system was slowly dying out in Babylonia proper, although it continued strongly in outlying regions, such as Mari and Chagar Bazar. After a brief period of revival in the Kassite period, the ration system seems to have died out in Mesopotamia by the end of the second millennium B.C."
>
> "These changes are the result of the radical evolution of the Mesopotamian socio-economic system, which began at the end of the Ur III period and reached a full form in Old Babylonian times. The growing urbanization of the country brought about a rise of industry and an increased number of artisans who were free to work for wages; and the redistribution of land as a result of Amorite invasions created a new class of small peasants who paid taxes and owed service to the palace. While in the older periods major productive forces were concentrated and controlled by the state (palace, king), temples, and large landholders, by the Old Babylonian period the major production seems to have been achieved by the small landholders and artisans".

Gelb's remarks are potentially important for understanding the historical development of agro-production in the Amuq. Although the archaeobotanical data from the Middle Bronze Age levels at Tell Atchana are to date non-existent, the textual evidence from Level VII shows the predominance of barley rationing for dependent workers of the palace (Zeeb, 2001). Despite the favorable micro-climatic conditions at the Amuq, the dependency of barley as principal crop taxon for rations would be related to diverse historical and economic reasons. Firstly, the conversion and equivalency factors made barley more suitable to be used for economic activities since the crop provides dependable yield structure. Hirth mentions that resource conversion is an important factor for the growth of the political economy to structure the form of exchange relations, to stimulate the flow of resources through exchange systems, to create imperishable "wealth" that can be converted to food or other resources as needs arise and to allow accumulation of wealth items in the hands of the political elite (1996, p. 226). These properties of barley possibly relate to the minimal fluctuations in yield and also the total weight of harvested crops would be equal from one year to another. This confidence level in yield structure possibly brings greater emphasis on the convertibility of barley into other goods and services (*sensu lato,* Nakassis, 2010) and even credits (e.g. Paulus, 2014). Secondly, the continuation of a ration system rather than wages could be indicative of the Mesopotamian impact on the development of socio-political complexity that continued even after the ration system was abandoned in Southern Mesopotamia.

5.4.1 Local and regional patterns of crop productionin the Amuq and northern Syria

5.4.1.1 Cereals

As common with archaeobotanical assemblages in the Near East, cereals comprise the majority of crop finds at Tell Tayinat. The EBA ubiquities and proportions of cereal crops in the Tell Tayinat assemblage temporally coincide well to the regional patterns of agricultural production. At Tell Tayinat, this is also recognized in other Bronze Age sites (Riehl, 2009; Riehl & Deckers, 2012), the prominence of barley cultivation remained unchanged throughout the Bronze Ages. Riehl identifies a continuous trend for the dominance of barley during the transition from the Early Bronze to the Middle Bronze Age at another settlement in the Orontes watershed, Qatna (Riehl, 2007). Similar observations have been made at Ebla (Watcher-Sarkady, 2013, p. 377).

The emmer wheat, on the other hand substitutes a marginal role in the food economy of Tell Tayinat with substantially lower densities and ubiquity scores. Another cereal crop, einkorn wheat, on the other hand is almost absent in the crop repertory of Tell Tayinat. According to Riehl and Deckers (2012) this crop plant has the lowest yield structure and high water requirements. The authors argue that this crop's susceptibility to drought conditions would be a factor for its virtual disappearance from the crop assemblages during the Middle Bronze Age.

At Tell Atchana, the ration lists from the Middle and Late Bronze Age also shows the distribution of barley (Wiseman, 1953). The archaeobotanical finds, on the other hand, from the Late Bronze Age levels of this settlement present an already-established use of free-threshing wheat as the preferred crop for human consumption; barley becomes the second most occurring cereal in these levels (Stirn, 2013; Riehl, 2010). However, it should also be noted that the intra-site variability of dietary practices within a settlement remains unknown to us at this site. Contextual information can further elucidate the prevalence of free-threshing wheat at this site. This means, the presence of free-threshing grains in these particular contexts may be related to the provisions allocated to the military personnel, who would be expected to be given more valuable free-threshing wheat rather than barley. Therefore, the deposition of crop remains onto the cultural layers of Tell Atchana would be more complicated to reconstruct due to its changing site function and depositional characteristics of crop plants.

In general, free-threshing wheat outnumbers other crop plants for all Iron I deposits of Tell Tayinat, although a slight increase in the proportions of barley is discernible in the present study. This trend appears at near-by sites along the Orontes Watershed. The patterns of agro-production at Tell Tweini demonstrate close similarities with the sites in the North Orontes Valley and Cilicia (Kinet Höyük and Kilise Tepe) with a significant focus on free-threshing wheat, barley and bitter vetch (Linseele et al., in press). At Tell Afis, a similar situation is recorded with a greater emphasis on free-threshing wheat in the assemblage, rather than barley use, which was consistently dominant during the Bronze Ages (Wachter-Sarkady, 1998).

Both periods show high amounts of chaff remains of all three cereals mentioned above. Hillman (1984, p. 126) suggests that the settlements in dry climates would generally process their products just after the harvest, completely to the clean grain stage, to be stored in the storage units. On the other hand, the inhabitants of wetter climates mostly processed to a semi-cleaned stage, to store their product as spikelets to be consumed daily. Nesbitt and Samuel inform that this was not the case in ancient Egypt where the grain was stored as spikelets at semi-cleaned stage although the climate was fairly dry (1995, p. 50). This practice was also identified in the Aegean, at Assiros Toumba during the Iron Age and at a Chalcolithic site Kuruçay in western Anatolia. Instead of hulled wheats, on the other hand, Hillman (1985, p. 10) observes that the free-threshing wheat is generally stored in a semi-clean stage. In regards to this recurrent evidence, it is not implausible to assume that the final stages of crop processing, after possibly coarse and fine sieving (see Hillman's model, 1984), were handled indoor at Tell Tayinat during both periods.

5.4.1.1.1 Barley

Barley, especially the two-rowed variety, provides certain advantages in its reproductive habits (e.g. shorter growing cycle, low water demand and high salinity tolerance) and its suitability to malting, foddering and/or human consumption (Riehl, 2009; Miller, 1997; Powell, 1985). Abbo, Gopher, and Lev-Yadun (2015, p. 350) also mentions that the differential adaptive profile of the Near Eastern grain crops could be a factor in the wider ecogeographic range of certain crop plants. Among others, wild barley has a wider range of ecogeographic adaptive capability which is reflected in the wider agronomic adaptation of domesticated barley into different environments (Abbo, Lev-Yadun, & Gopher, 2010). Barley ripens two to three weeks earlier than wheat species therefore early harvests make it resistant to rust. These selective advantages can also be seen for the yield structure of barley. The yield of this crop species out-produces emmer and free-threshing wheat over an average of numerous years, although single year yields can be comparatively higher to a certain extent

(Powell, 1985, p. 16). In some Ur III records, emmer wheat out-performs barley in volume but never in weight (Powell, 1985, p. 15).

Two-rowed varieties of barley are dominant in the Early Bronze Age repertoire of Tell Tayinat as identifiable barley rachis segments demonstrate. The selection of two-rowed barley, instead of the six-rowed one, is a general trend in the Near East, while in the Aegean the six-row variety was more common (Riehl, 2010, p. 22). In the case of Northern Mesopotamian sites, McCorriston and Weisberg (2002) as well as Hald and Charles (2008) define a temporal trend toward greater occurrences of barley caryopses and processing debris in the Khabur Basin in Northern Mesopotamia from Late Chalcolithic to the Early Bronze Age. The same trend towards greater occurrences of barley over other crop plants has also been identified at Tell Hammam Et-Turkman, in comparison to Ubaid on Bronze Age levels of this settlement (van Zeist, Waterbolk-van Rooijen, & Bottema, 1988, p. 710). Later early Bronze Age levels at two other sites, Selenkahiye and Tell al-Raqai, in the Middle Euphrates confluence demonstrate the same prominence of barley (van Zeist 1993, p. 500; Dönmez, 2006, p. 14). The sites in the Balikh basin show similar results (van Zeist, 1999, Figure 19.4). Furthermore, a clear north-south gradient coincident to rainfall amounts for crop choices in Middle Euphrates sites has also been identified and is indicating the increase of barley proportions, at southern sites, at the expense of wheat (Miller, 1997, p. 128). Nonetheless, even much further north, barley was recorded abundantly rather than wheat species (Sadori, Susanna, & Persiani, 2006, p. 210).

Although Powell (1985, p. 13) rightfully notes the difficulties of identifying the exact attestations of other crop plants than barley and emmer in cuneiform texts, it seems that several other crop plants have been used in rationing the palace-dependent workers (Gelb, 1965, p. 236), barley single-handedly dominates the majority of agricultural production in terms of sowing rates and rations or wages in the administrative records recovered from Mesopotamia and northwestern Syria (Liverani, 2014, pp. 101-102; A. Cohen, 2007, pp. 411-412; Ellison, 1981; Marchesi, 2013, p. 274; Archi, 2015, p. 321; Dornauer, 2017; van Koppen, 2001; Sallabergeer & Pruß, 2015; Gelb 1965). This trend in the confluence of the Euphrates and Northern Mesopotamia in general demonstrates a greater focus on barley mono-culture, rather than diversification of crop repertoire for a risk-buffering strategy and to minimize failure of the whole yield due to a single crop (Riehl, 2019; Marston, 2011; see Halstead, 2011, p. 230 for the same issue in the Aegean). Hald (2010) puts forward that the similarity in the range of agricultural goods and of crop processing debris among the households of newly developed outer town of the EBA Titriş Höyük may indicate the central role of the political authority in food redistribution. That being the case, in regards to the concentration of barley mono-culture in the Khabur basin, it being administered by palatial organization must have been in concert with the small-scale farming activities, to maximize the annual returns and to secure the subsistence base of households in times of environmental/climatic and political crises (Weiss et al. 1993).

It is also suggested that the dominant character of barley cultivation may also be related to the specialized pastoral production beeing destined as animal feed (McCorriston &Weisberg, 2002; Miller, 1997, p. 128; Sallaberger, 1996 for textual evidence from Tell Beydar).In respect to the large storage structures, such as those at Sweyhat, Hajji Ibrahim and Raqa’i, Miller (1997) points out that these should have been used for storing fodder. Environmental aridification was also proposed as a factor for the prevalence of barley as favorable crop to sustain the subsistence economy (Hald & Charles, 2008; Charles, Pessin, & Hald, 2010)[22].

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[22] Charles et al. (2010) repeats this argument of climatic aridification and the predominance of barley at Tell Brak from Late Chalcolithic onwards to climatic aridification brought by 5.200 BP event. However, the flax finds also become more common at the turnover of LC3 to 4. That indicates that it is also likely that the fields previously allocated to hulled wheat cultivation can be used this time for flax cultivation while barley became the principal crop for human consumption to have been practiced in poor soil.

Akin to Wilkinson's theory of zone of uncertainty, Van Zeist suggests that the population pressure can be a determining factor for the increasing presence of barley as the cultivable areas in Hammam et-Turkman were restricted to the river valley, but the comparatively unproductive plateau near the settlement was the only area with arable fields to cultivate crops (1999, p. 363).

5.4.1.1.2 Free-threshing wheat

The appearance of wheat taxa, in lower proportions in the EBA Tell Tayinat assemblage, also corroborates the plant evidence from the neighboring sites. The archaeobotanical analysis from the destruction layer of the Palace G at Ebla, which is roughly contemporary to Tell Tayinat in the second half of the third millennium BC (Welton, 2011) confirms the limited occurrence of wheat species (Wachter-Sarkady, 2013, p. 377). Tell Qarqur, another multi-period site along the Orontes, represents a similar pattern with a certain greater emphasis on barley use, however, as recorded at Tell Tayinat, the *Triticum* species become more common than barley when all *Triticum* taxa are considered together during the Early Bronze Age IV (Smith, 2005, Figure 6.3). Further south at Qatna, although barley was the dominant crop, a shift occurred in the crop assemblage including more free-threshing wheat rather than emmer wheat at the end of the 3rd millennium BCE (Riehl, 2007). Barley also continued to be dominant at the Middle Euphrates sites while ubiquities of free-threshing wheat remain high in this region.Moreover, Riehl and Deckers (2012) describe that the free-threshing wheat proportions are getting lower in the Euphrates settlements during the Middle Bronze Age in comparison to the Early Bronze Age values. The use of free-threshing wheat is discernible at much more easterly sites in the Khabur Basin (Riehl, 2009, 2010b; Smith, 2012; cf. McCorriston & Weisberg, 2002, p. 491) where the rainfall amount was getting higher than at southerner sites.

It is known that hexaploidy *Triticum aestivum* and tetraploid *T. durum* strains differ in their water-holding capacity, as the latter has the highest capacity level, compared to free-threshing and emmer wheat (Riehl 2009; 2010a; Samuel, 1986, p. 92). On ecological grounds, durum wheat would be a more likely candidate for Tell Tayinat free-threshing wheat grains since it is known that durum wheats are well-adapted to the bimodal conditions of a Mediterranean-type climate and tolerate drought stress comparatively better (Percival 1974). On the other hand, the *aestivum*-type is suggested to be more-adapted to continental conditions and to a sub-humid temperate climate (van Zeist, 1999, p. 360) which responds better to the increased rainfall (Riehl 2010) but is less tolerant to floods (Davies & Hillman, 1988).

5.4.1.1.3 Emmer wheat

Grains and spikelet bases of emmer wheat have relatively high occurrences during the EBA but never higher than barley. During this period, emmer wheat grain occurrences are half of those for barley. Modern agricultural experiments in long-run demonstrate that emmer was not reliable enough to average yield over long years. Powell (1985) notes the experimental studies of the US Department of Agriculture Experimental Station. According to their results in the long-run, "… in a total of 58 crop years, emmer yields averaged 4% more by weight than barley, whereas, in a total of 187 crop years, barley averaged 48% more than emmer" (Powell, 1985, p. 17). However, from the Alalakh tablets, it is known that emmer was allocated to the royal horses during the MBA (Wiseman, 1953). The occurrences of emmer wheat during the Iron Age show constantly diminishing values that progressively contain less and less finds in the course from Iron I to Iron III at Tell Tayinat (see also *Chapter 7* and *8* for emmer).

Emmer wheat apparently seems to obtain a much wider preference in the Southern Levant as a staple food during the Bronze Ages (Chernoff & Paley, 1998). The figure presented by

Riehl (2009, p. 109, Figure 13) shows a certain geographic differentiation among barley and emmer wheat. Barley is predominant in the settlements close to the coastal zones while emmer wheat occurs at inland sites. It is difficult to describe this patterning according to the bioclimatic properties, as both crop species comparatively tolerate drought conditions well. However, such a focus on emmer cultivation in this region would be related to the relationship to Pharaonic Egypt where studies show that emmer wheat was the prevalent crop for a long time up until the Roman period (Nesbitt & Samuel, 1996). Economic and social impacts of the Old Kingdom over the Southern Levant were known from textual sources (Nesbitt & Samuel, 1996). This could indicate that the organizational patterns of agro-production may have been another aspect of such interaction.

Regarding the overall evidence of crop production, the cultivation of the glume wheat species becomes less and less evident from the Early Bronze Age onwards and is largely replaced by free-threshing wheat in the course of the Iron Age (Riehl, 2009). This evidence coincides well with the evidence derived from Tell Tayinat. One explanation for this long-term trend would be that the processing cost of glume wheats is higher than of free-threshing wheat species, therefore, in operational terms, free-threshing wheat requires less labor input during post-harvest processing compared to glume wheats, like emmer and einkorn (Hillman, 1984). This economic explanation considers that the centralization of markets necessitates the reorganization of labor force towards crop plants that require lower labor input in the post-harvest operation like free-threshing wheat (Nesbitt & Samuel, 1996; van der Veen, 2007). van der Veen also points out that since free-threshing wheats are nowadays fully processed, immediately after the harvest, this agricultural change from glume wheats to free-threshing wheats requires a shift in greater labor allocations of the household during the harvest operations. She argues that this shift would have a significant impact to women’s labour (van der Veen, 2007). Instead of piecemeal processing the glume wheats in the household, cleaning the crop product on the field can liberate women from this laborious task (2007, p. 985) while women can allocate more time to manufacture textiles for income-generating (McCorriston, 1997). Therefore, this specific shift may indicate a labor-optimizing strategy for the developing textile industry.

Despite the fact that emmer wheat is becoming less ubiquitous over the Bronze Ages; taste, on the other hand, would still be a significant factor for its survival as a minor crop. Hillman (1984, p. 135) observes that emmer wheat was the only crop product which was preferred for *bulgur*-making by the farmers in the Asvan area of Turkey. The antiquity of this type of use is certainly unknown to us although the identification of bulgur-like plant objects was previously proposed in literature (Valamoti, 2002). As Hillman (1984, p. 135) reports, Pliny the Elder, mentioned the same particular situation of emmer preference during the Roman period, although the exact association of the Latin word *alica* for bulgur is not definitely proven on linguistic grounds.

5.4.1.2 Pulses

At Tell Tayinat, the pulse crops display a more prominent focus on two large vetches, bitter vetch (*Vicia ervilia*) and to a lesser extent on grass pea (*Lathyrus sativus/cicera*), rather than lentil (*Lens culinaris*), garden pea (*Pisum sativum*) and faba bean (*Vicia faba*). The latter pulse crops, as well as chick pea (*Cicer arietanum*), occur frequently in varying degrees in other regions (see the next chapter) while the characteristic emphasis on bitter vetch consumption is recognizable in the accumulated data along the Orontes (Riehl, 2009a, p. 110). This diversity, in contrast, doesn’t exist in the Khabur assemblages during the third millennium BCE. These sites show that the richness of crop legumes was diminished to lentils, grass pea and pea, while other taxa such as bitter vetch and chickpea, to a certain extent disappeared (McCorriston & Weisberg, 2002, p. 492).

5.4.1.2.1 Large vetches

Bitter vetch and grass pea/red vetchling can be classified under large vetches due to certain common physiological characteristics of both crop plants. These characteristics are their ability to fix nitrogen by symbiosis with bacteria (this trait is widespread in leguminous plants except for trees from this family); secondly, the toxicity of their seeds which are causing neurological malfunction if consumed in quantity for a prolonged period. Additionally, regional distribution of both plants shows that they were more common in the Northern Levant and Northern Mesopotamia except for singular occurrences in other regions (Riehl 2010b). This important regional patterning was adressed again in *Chapter 6.*

Bitter vetch is common in the Orontes Watershed in Bronze Age sites like Tell Qarqur (Smith, 2005, p. 184), Tell Tweini (Marinova et al., 2012a, p. 348) and Zincirli (D. Karakaya, unpublished data) which produced pure bitter vetch concentrations recovered *in situ*. Moreover, Alalakh tablets demonstrate evidence of “a type of vetch” (*kissanu*) which was allocated to ruminants (Wiseman, 1953; Zeeb, 2001). According to Stol (1985: 131-2) this crop plant in cuneiform texts can be attested to either common vetch (*Vicia sativa*) or bitter vetch while the evidence of common vetch is non-existent so far at Tell Tayinat as well as at Tell Atchana (Stirn, 2013; Riehl, 2010). The *kissanu* has been referred to several times in the Alalakh tablets as feed for the oxen, horses, donkeys and birds (Stol, 1985, p. 131). Regarding the frequent occurrences of these two crop plants in the Near East (Riehl, 2010a), it is plausible to assume that this *kissanu* can either belong to *Vicia* or *Lathyrus* genera.

Bitter vetch has a dense root network, requires less water to grow than cereals and has a high tolerance to drought and cold. It does well with shallow soils (Miller & Enneking, 2004). The plant is harvested by uprooting because of its compact growth habit. It contains high amounts of protein, about 25-27%, and is accepted as good fodder for cattle, sheep and camels.

However, Miller and Enneking mention that the ruminants should not have more than 25% of their diet due to its toxicity. Pliny the Elder notes that the seeds must be soaked for several days before feeding them to cattle (Miller & Enneking, 2014).

It is known that the seeds of bitter vetch as well as *Latyhrus sativus/cicera* are toxic to humans and animals (except ruminants); therefore its use as staple and fodder crop in antiquity has been discussed by several authors (Zohary et al., 2012; Miller & Enneking, 2014; Riehl, 1999, 2010a; see Valamoti, Moniaki, & Karathanou, 2011 for ethnographic and experimental evidence)[23]. Dung burning has been proposed as a possible taphonomic pathway for bitter vetch remains to be incorporated into the archaeobotanical assemblages (Miller & Enneking, 2014). On the other hand, although bitter vetch has been associated with fodder or famine food in recent texts, there is also ethnographic evidence for its consumption after the detoxification process (Pena-Chocarro & Zapata-Pena, 1999). Valamoti et al.(2011), suggesting that soaking in water and boiling can significantly reduce the toxicity of these two grain legumes, while the removal of testa by either soaking and boiling or mechanically by pounding or grinding can help todetoxification of these crops[24]. Ethnographic evidence from Spain shows that there are a variety ways of consumption of the *Lathyrus sativus/cicera*, including eating uncooked in the green state, cooked in a stew, milled into flour or as roasted seeds eaten as snacks. On the other hand, boiling the seeds and the lower ODAP content of the selective *Lathyrus* crops seems to reduce the number of neurolathyrism cases substantially (Pena-Chocarro & Zapata-Pena, 1999, p. 51).

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[23] *Latyhrus sativus* contain the neurotoxic non-protein amino-acid 3-N-oxalyl-L-2, 3 diaminopropanoic acid (B-ODAP). If consumed by humans or animals a disease caused lathyrism affects the patients with loss of muscular control, paralysisof lower limbs (Miller & Enneking, 2014, p. 255; Pena-Chocarro & Pena, 1999, p. 51; Kislev & Hopf, 1985, p. 143).

[24] Although there is no ethnographic parallel to my knowledge, it is also possible that as the toxic substance is largely concentrated in the seed testa, early harvesting of these crops before the testa is fully formed can be another way of reducing the toxicity. This treatment, if ever happened, can explain the conspicuously small sizes that we recognize in the archaeobotanical record of Tell Tayinat in comparison to modern specimens.

A climatic explanation for the preference of bitter vetch as a drought-tolerant crop remains rather elusive given the fact that the rainfall amount is more than sufficient to cultivate water-demanding crops in the Amuq. Furthermore, regarding the dichotomy between drought-susceptible and -tolerant crop plants, it should be noted that the moisture-demanding pulse crops, like chick pea, are totally absent in the assemblage, while similarly garden pea is only minimally represented in the whole sequence of Tell Tayinat.

5.4.1.2.2 Lentil

Lentil is one of the most valued grain legumes in the Near East. The high protein content (25%) makes it a valuable contribution to the diet (Riehl, 2010b). Riehl (2009, 2010b) notes that the crop has a moderate stress-tolerance while modern agronomic studies show that its yield reacts to rainfall more than to temperature. Although the persistent trend for bitter vetch findings at Tell Tayinat, at Ebla, lentil seems to have been the dominant legume crop (Watcher-Sarkady, 2013, p. 391).

From the Early Bronze to Middle Bronze Age, the proportions of lentils are reduced compared to bitter vetch in much of the Near East (Riehl, 2008). An interesting regional trend is that the lentil which was most widely appearing in the Southern Levant was superseded by the cultivation of bitter vetch after the end of the Early Bronze Age (Riehl, 2009). The dominance of bitter vetch over other crop legumes continued during the Bronze and Iron Ages. In northern Mesopotamia, the prevalence of bitter vetch over other pulses is also visible.

5.4.1.3 Flax/linseed

The general lack of flax/linseed finds in the Near Eastern sites is evident from the end of the EBA onwards (Riehl, 2009). Due to its high oil content (which is about 40% on a dry weight basis (Kislev et al., 2011, p. 580), the preservation condition is regarded as a contributing factor for the virtual absence of flax/linseed objects. Moreover, more concrete evidence of flax finds at Tell Tayinat, excluding its sporadic occurrences in EBA, is concentrated in the later Iron Age at symbolically charged urban spaces like the temple (Building XVI), and the so-called "Gate Complex" in the upper town of Tell Tayinat (see *Chapter 7 and 8*).

Also, most probably, this crop had limited culinary use but was largely allocated for textile fibers and/or oil extraction. This type of use may explain its conspicuous absence at Tell Tayinat and elsewhere. Flax cultivation depletes the soil nutrients dramatically. Therefore Kislev et al. (2011, p. 580) informs that a flax farmer has to wait at least 5-6 years to replant the crop on the same field.

5.4.1.4 Other economically useful plants

Caper remains appear only sporadically in the assemblage. These remains are only recorded in the Iron I deposits at Tell Tayinat while its presence has been recorded at several sites in chronologically disparate sites. The remains of this plant species have been reported from the EBA Tell es-Sa'idiyeh (Cartwright, 2002) in Jordan, the EBA Tell es-Sweyhat (Miller, 1997) in Northern Mesopotamia and at the LBA Uluburun shipwreck (Ward, 2003) as concentrated bud finds in jars. This indicates that the plant has been in use for a long period in the Near East. Caper seeds are rich in protein, oil and fiber. Also its medicinal use has been recorded by Dioscorides (Megaloudi, 2005a).

Coriander and fenugreek are addressed in *Chapter 7*.

5.4.1.3 Tree crops

It is long known that the area of cultivation of the typical perennial trees does not usually exceed the latitudinal range of their wild progenitors in the Near East (Zohary & Spiegel-Roy, 1975). Moreover, spontaneous hybridization events are common among wild forms and cultivated forms of these perennial trees (Zohary & Spiegel-Roy, 1975). Occasional hybridization is reflected in the genetically interconnected wild forms, escapees, and weeds; this makes it almost impossible to identify whether the origin of genuine genetic material was from wild or weedy forms of these trees. Nonetheless, another important aspect is to note that the cross-pollination syndrome and high heterozygosity of individual clones are important to yield phenotypically diverse progenies from hybridization events (Abbo et al., 2015, p. 350).

The available evidence thus far indicates that the domestication of perennial fruit trees was a step-wise process as also seen in the domestication of grain crops (Fuller, 2018). The typical Near Eastern fruit trees cultivated with vegetative propagation which requires a detailed knowledge of various methods (e.g. stem cuttings and rooting of twigs for vine, stem cuttings for fig and pomegranate; basal knobs for olive, offshoots for date palm, and seeds for almond). On the other hand, these perennial trees require constant care and labor investment in the long-term. McCorriston (2009) and van der Veen (2014) defined the continuity of arboricultural cultivation as indicators of stability of communities and land rights. On the other hand, Hamilakis suggests that the drinking of wine (and using perfumed oil) became an exclusive elite activity at the height of the Minoan civilizations in the neopalatial period, while the palatial authorities controlled the knowledge of production for factional differences among different palatial centers in Crete (Hamilakis, 1999, p. 49).

5.4.1.3.1 Grape

Grape is one of the “first wave of tree domesticates” in the Near East together with olive, fig, date and pomegranate (Zohary, Hopf and Weiss, 2013, p. 115; Weiss, 2015; Zohary & Spiegel-Roy, 1975). Grape thrives in moist habitats, grows well in the Mediterranean Basin with the requirement of 500-1200 mm rainfall during the growing season, between February and July (Riehl, 2009), while submerged conditions and salinity are negative factors for its cultivation (Powell, 1995, p. 104). The main distribution range of wild *Vitis* in the Eastern Mediterranean basin comprises cooler mesic habitats in the sclerophyll vegetation belt as its primary habitats (Zohary & Spiegel-Roy, 1975). The Amuq is within the distribution range of wild *Vitis*. In general, the sizeable amount of rainfall in the Amuq basically provides good local climatic conditions for the cultivation of arboricultural products. In regard to the biodiversity of the forested landscape of the Amanos, apart from wild *Vitis sylvestris* and cultivated *Vitis vinifera*, another species is *Ampelopsis*, a member of Vitaceae thrives in the mesic forests of the Euxinian-Hycarnian belt and is present in the region (Wagenitz, 1962).

The appearance of grape pips during the Early Bronze Age VIB at Tell Tayinat is somewhat a late date regarding the domestication of grape and the dissemination of viticulture across the Near East. The earliest evidence for wine production has been found at Georgian and Armenian sites during the Neolithic and Chalcolithic periods (McGovern et al., 2017). By analyzing a jar through organic residue analysis, McGovern et al. (1996) offers a Neolithic date for the earliest evidence of viticulture, contained in a jar from Hajji Firuz Tepe in the Zagros Mountains in Iran. In the Aegean, the early indications of wine production were proposed at Dikili Tash (Valamoti et al., 2007). Wine imports from the Levant to Egypt appear as early as the Early Bronze Age I as indicated by the organic residue analysis (Batiuk, 2013, p. 458). At the EBA I at Ras an-Numayra in Jordan, pressed grape fruits were unearthed coincident to the late 4th millennium BCE and the early 3rd millennium BCE. Archaeobotanical record also demonstrates an early 3rd millennium date for the proliferation of grape finds in the southern Levant (Miller, 2008, D. Zohary 1995).

The grape pip finds at Tell Tayinat do not provide reliable information for distinguishing wild and domesticated types due to the effects of carbonization and overlapping morphologies

(Smith & Jones, 1990; Mangafa & Kostakis, 1996; Jacquat & Martinoli, 1999; Zohary, 1995; E. Weiss, 2015; cf. Terral et al. 2009 for a new methodology). Kroll (1999) however, rightly argues that the miniature-type grape pips (which have been found in quantity in the present study) may be indicative for the presence of domesticated varieties, since wild grapes (*Vitis sylvestris*) tend to produce even-sized four to six pips and their shape is somewhat more robust. The presence of rudimentary seeds is a biological process known as parthenocarpy and stenospermocarpy in modern literature. Both indicate the natural or artificially induced production of fruit without fertilization of ovules or the abortion of embryo development in a very early stage (Stout, 1936, pp. 15-7). For that reason, these two biological processes govern what we know today as seedlessness, the break of the wild-type bisexuality and the shift to hermaphroditic flowers (D. Zohary, 1995, p. 24; E. Weiss, 2015).

Apart from the miniature pips several other objects, like unfertilized fruits, stalks and skin fragments were identified in the assemblage. A frequent member of this *Vitis* assemblage at Tell Tayinat are the so-called "skeletonized" grape pips, as Fairbairn et al., (2018) referred to them. Energy Dispersive X-Ray Spectrometer analysis revealed that these objects are actually mineralized seeds in regards to high calcium carbonate and calcium phosphate content, while the carbon content differs from specimen to specimen (Fairbairn et al., 2018). Therefore, the authors concluded that these are derived "from mineralization after they had been partially burnt" (2018).

The grape remains in their entirety resemble the findings of the experimental study undertaken by Margaritis and Jones (2006). The authors identify these objects as the sieving by-products of wine production (must) when pouring down the liquid from where the grapes are crushed (the treading pit) into the vat. They propose that insufficient filtering of the by-products may be a factor for the incorporation of these objects in the plant assemblages.

Furthermore, Powell (1995) describes the role of grapes and raisins in S. Mesopotamia as sweetening agent in foods which may also explain why this crop plant is so ubiquitous in our assemblage.

Although there were no wine presses unearthed at Tell Tayinat thus far, the settlement might have been an important regional wine supplier regarding its favorable local climate and its strategic position in the trade networks connecting the Eastern Mediterranean Basin to Mesopotamia and Central Anatolia (Welton, 2011; Batiuk, 2013, p. 471)[25]. Recent assessment of ceramic evidence demonstrates that the pottery assemblage contains some distinct forms of ceramics for liquid consumption. In relation to that, Batiuk (2013) and Welton (2011, p. 20) report the appearance of ceramics characteristic to Early Transcaucasian Culture (ETC) during the Amuq Phase J. ETC is thought to have originated from Eastern Anatolia and the Caucasus. Possibly this cultural sphere was influential as far south as Palestine during the course of the 3rd millennium in regard to ceramic occurrences. Also significant for the appearance of extra-regional contacts in the Near East, Batiuk suggests that the prevalence of certain pottery types in the Tell Tayinat assemblage and their region-wide distribution (e.g. jugs and goblets) hints at connections between viticulture and the ETC phenomenon (2013). According to the author, these pottery types were designed specifically for consumption of liquids, presumably wine. Therefore, he links the movements of population or ceramic types to the development of viticulture in the north of Syria.

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[25] Given the fact that Tell Tayinat sits at the hinterland of the forested landscape of Amanos Mnts., the rich floristic diversity of the region might have provided large variety of herbal additives and ingredients to be mixed during wine production analogous to the organic residue analysis results derived from the Middle Bronze Age Tel Kabri in Southern Levant (Koh, Yasur-Landau, & Cline, 2014). For example, many ingredients listed by Koh and his colleagues can be more easily procured elsewhere in the Levantine region, however, the resin of the storax tree (*Liquidambar orientalis*) can only be found either in Southwestern Turkey or in the Amanos Mnts. in the whole Near East in regard to the modern distribution of this tree (see Hepper, 1996, p. 8 for modern distribution).

5.4.1.3.2 Olive

Olive is a prominent tree in the present Mediterranean vegetation. The present-day natural distribution of wild olive (*Olea europaea* L. var. *sylvestris* (Miller) Lehr.) has been confined to the coastal areas of the Mediterranean Sea. Its distribution largely coincides with the bioclimatic level of thermo-mediterranean (Carrion, Ntinou, & Badal, 2010). The olive tree requires 400-450 mm of rain for commercial harvest today (Zohary et al., 2013). A. Singer (1996, p. 31) reports that olive trees react well to higher precipitation as the harvest can reach up to 350 kg per hectare. The tree can also survive on 200-300 mm of rainfall amount and it can provide a suitable harvest every three or four years.

Olive is an important crop plant in the Levant from the Chalcolithic onwards as archaeobotanical studies show (Riehl 2010a; Kaniewski et al. 2012). Riehl (2010a) stresses that there is a contrast between the economic importance of this crop and the low amount of olive finds at archaeological sites inland, this may suggest that this crop plant was not a major cultivated crop outside of its natural distribution zone. The textual records demonstrate that olive as oil, wood or fruit was an important traded good in the Near East for various purposes (Knapp, 1993; Kaniewski et al., 2012). The evidence of olive pits appears from the earliest deposits at Tell Tayinat, which would be expected, as this tree was domesticated long before the establishment of occupation at the site (Zohary et al., 2013). Alalakh, Ugaritic, and Eblaite texts demonstrate that olive orchards (as well as vineyards) were part of the agricultural landscapes of this terrain reflecting the significance of olive cultivation and olive oil production in the Northern Levant (Klengel, 1979, p. 450; Archi, 2015, p. 333). At Ebla, administrative records documented the orchards directly controlled by the palace (Archi, 2015, p. 342). The continuation of olive occurrences is uninterrupted from the Late Bronze Age to the Iron Age; this indicates the importance of olive production during the early Iron Age at Tell Tayinat. However, the ubiquity scores of olive finds are getting lower during this period in concurrent with the general decrease in other north Syrian and Northern Mesopotamian sites (see *Chapter 6*).

In the Southern Levant, Langgut, Adams, & Finkelstein (2016) observed that the olive pollen values in the Sea of Galilee records become abundant from the start of the Early Bronze Age IB (3500 – 3000 BCE according to the southern Levantine chronology) possibly indicating the Eygptian demand for olive oil according to the authors. Although olive pits and wood in bioarchaeological records are encountered at several sites, Genz (2003) notes that the olive pressing installations become common in the domestic and public contexts during the Early Bronze Age III.

5.4.1.3.3 Fig

Fig was most probably regarded as a valuable and nutritious dietary element which could be used year-long if stored dried (Zohary and Hopf 2010). Wild figs are floristic elements of the Mediterranean maquis and garrigue formations. Although their primary habitats are rock crevices, gorges and stream sides, the feral forms are usually occupying man-made habitats such as terrace walls, wells, collapsed cisterns and cave entrances etc. (Zohary & Hopf, 2000, p. 160). Zohary and Spiegel-Roy (1975) regard this second type of figs as derived from seed produced by locally cultivated clones which were pollinated by neighboring wild figs.

Fig was continuously present during Bronze and Iron Ages at Tell Tayinat. The finds of pips are getting higher during the Iron I, however, this evidence cannot be used to generalize an increase in fig use, due to its small size and the abundance of pips within the fruit (syconium). The ubiquity scores seem to remain steady across all phases investigated. In general, the archaeobotanical data in *Chapter 6* on the regional fig finds demonstrate the continuing contribution of this tree to human diet.

5.4.2 Ecological evaluation of the Tell Tayinat wild plant assemblage

Among the wild plant taxa recorded at Tell Tayinat, only four taxa dominate the assemblage, these could be securely identified as common weeds of arable lands. These four wild taxa most probably entered into the plant assemblage after crop-processing stages. These ubiquitously appearing wild plants in the Tell Tayinat assemblage comprise those commonly recorded taxa in the Northern Levant and Northern Mesopotamia (see Riehl, 2010b for an overview of evidence). Riehl notes that when proportionally speaking *Lolium* appears more prominently in the Mediterranean zone and the northeastern part of Syria then at the Euphrates sites (2010b, p. 44).

Lolium is by far the most common wild taxon in the present study. The typical natural habitats of this genus are barley fields and open meadows on basalt and phrygana (Riehl, 2010b). *Lolium* species are somewhat called as one of the “professional weeds” (van der Veen, 2014, p. 801), the others are including wild oat, brome grass and false flax due their ability to survive in arable fields through mimicking the crop cycle, seed shape and size (Riehl, 2010a; Harlan, 1992). Such adaptive features cause difficulties in sorting them out during crop cleaning, removing them only at the final stage by hand-picking, prior to food preparations. This is necessary since some species of *Lolium* (e.g. *Lolium temulentum*) are noxious for human consumption (Riehl, 2010a), if not a serious pest.

Similarly, *Phalaris* and *Melilotus/Trifolium* and *Anthemis cotula* are all frequently occurring taxa across the Near East. These three taxa are normally only slightly lower in their ubiquities. However, for certain episodes, *Phalaris*, interestingly reported more ubiquitous than *Lolium*. Riehl (2010a) notes that *Phalaris* becomes more ubiquitous in the 13th century at Tell Atchana. This trend continued in FP6 at Tell Tayinat. Riehl (2010a) reports that some species of the genus thrives in moist habitats (*P. aquatic*a, *P. arundinacea*). It is rather unknown if this trend can be indicative to the cultivation of moister soils during this transitional phase from the Late Bronze Age to the Iron Age.

Other than the abovementioned wild taxa, the EBA charred seed record is largely characterized by wild leguminous and graminoid plants such as *Securigera securidaca, Coronilla, Scorpiurus, Melilotus/Trifolium, Trigonella* and *Prosopis* cf. *farcta.* Crawford records that at the Early Iron Age ‘Ain Dara, to the east of Tell Tayinat, at the confluence of the Afrin River, also describes the same range of wild leguminous plants at Tell Tayinat (1999, p. 118). Nevertheless, due to the small number of samples, temporal trends are not discernible at this site. Rightfully, she mentions that the high incidence of such occurrences would have provided good forage for stock animals, similar to our observations at Tell Tayinat. Miller (1997) also reaches the same conclusion that these wild herbaceous plants would have been favored as forage species by the farmers. Many medium-seeded graminoids such as *Bromus, Avena,* wild *Hordeum, Stipa*/*Stipagrostis* and *Festuca* are also abundant during the Early Bronze Age indicating the species richness of agricultural habitats within these two abovementioned categories.

Some other frequent taxa, however, like *Prosopis* cf. *farcta*, *Phleum*, *Thymelaea*, *Verbena*, *Verbascum/Scrophularia*, *Plantago* are not typical weeds infesting the agricultural fields (see Riehl, 2010b for more information). For example, a possible entryway for *Prosopis* cf. *farcta* would be dung burning since it flowers later in June after the harvest of winter crops (Charles, 1998). The modern ethnographic accounts show that the pods of another *Prosopis* species are eaten fresh or boiled into a kind of syrup in Mexico (Flannery, 1972). This rhizomatous plant is a perennial segetal that occasionally occupies the cultivated fields and it usually forms one of the richest plant associations, occupying fertile, fine-grained alluvial soils, as leading species (Zohary, 1973, p. 638).

Iron I levels, more specifically the assemblage of FP6, demonstrate an episode strikingly different to the preceding and succeeding periods with diversified and rather contrasting ecological conditions among the recorded taxa. A multitude of taxa which are indicative of moisture-laden habitats in regards to the current ecological information (Riehl, 1999, 2010b) including grasses (*Aeluropus* cf. *littoralis, Phleum, Cynodon dactylon*), cyperious plants (*Scirpus maritimus, Eleocharis, Cyperus cf. michelianus, Fimbristylis annua*) as well as herbs *(Geranium, Alisma, Rumex)* and riverine trees like *Salix*. For instance, *Cynodon dactylon* (bermuda grass) is a perennial grass that reproduces vegetatively, spreading by means of stolon and rhizomes, where the water is abundant (Kislev & Melamed, 2000, p. 210). Hillman (1991) has mentioned that *Scirpus maritimus* (clubrush) can grow in arable fields as weeds on poorly-drained patches while Charles and Bogaard note that this wild plant produces fruits later than the traditional harvest period, therefore another explanation is needed for their incorporation into the plant assemblage (2001, p. 309). Riehl (2010b, p. 51) informs that this wild plant is a typical weed in irrigated soils. The cyperious plant can tolerate the changing water levels and saline soils. Equally important to recognize is that several *Rumex* species have their fruiting time between June and September (Riehl, 2010b). Charles and Bogaard also mention that *Rumex conglomeratus* was hardly incorporated into the assemblage via crop processing (2001, p. 309). Therefore, the increased amount of *Rumex* finds in the Iron I assemblage of Tell Tayinat would be indicative of dung burning. Previously, Riehl (2019) hypothesized that the central management of animal herds was most probably absent in the Early Bronze Age I at Tell el'Abd due to the presence of large amounts of wild plants from moist habitats (*Rumex/Polygonum*) in the ruminant coprolithes at this site. Animals have a better convertibility, therefore feeding the animal stocks with the surplus crop grain, aimed to fatten the animals for sacrificial or storage purposes and were largely practiced by ancient communities, as extant textual records demonstrate (Halstead, 1987). The increasing appearance of overgrazed plant taxa at Tell Tayinat would be indicative of the lack of feeding the animals with surplus grain and therefore the grazing of animals in open habitats would be a taphonomic factor in the formation of archaeobotanical assemblage during Iron I. This indicates that possibly dung burning became a viable taphonomic factor in this period.

These results coincide well with the findings of Riehl (2010a) from Tell Atchana, including the increasing number of moisture-indicating wild plants. The author furthermore, interprets the finds of saltwort seeds (*Salsola*) as an indicator for increased salinity, but notes that most probably this is not an indication for irrigation systems, but this can have happened due to periodically high-level evaporation. Therefore, Riehl concludes that these plant taxa would have originated from moisture laden habitats in the Amuq which Wilkinson (1999) also identified through several geomorphological indicators for temporary marshes in the Amuq. The high occurrences of hydrophytic (water-loving) plants in the Iron Age I would be related to the hydrological history of the Orontes. Regarding the highly dynamic hydrology of the Orontes (Wilkinson, 1999), the agricultural lands at the vicinity of Tell Tayinat were likely affected by the Orontes' flooding episodes or its changing course. The plant communities might have been steadily expanding and contracting their range of distribution in response to abiotic, climatic and anthropogenic factors. The immediate landscape of Tell Atchana had also changed as the geophysical surveys and sediment borings have determined. According to Ryter (as cited in Yener et al., 2012), the Orontes River once covered three-sides of the settlement of Tell Atchana, possibly during the Middle Bronze Age. That being the case, the hydrogeological characteristics of the Amuq would determine the changing land-use patterns; thereby reducing the importance of rainfall, by shifting farming localities towards more moisture-laden habitats.

Some other plants occurring in the Iron I assemblage can provide more information on past vegetation. The exploitation of moist habitats is accompanied by another group of plants which thrives in open vegetation such as *Chenopodium murale*, *Cichorium*, *Hordeum* spp., *Centaurea* type, *Malva* (Riehl, 2010b). *Chenopodium* species are considered as steppic indicators which are well-adapted to arid and saline conditions (Roberts et al., 2011b). *Artemisia* and *Astragalus* finds are usually referred to as indicators for the open steppe vegetation and imply a certain degree of vegetation degradation and overgrazing. *Verbascum* can be added to this list of degraded landscapes since Riehl (2010b) reports that *Verbascum* is also very common in heavily overgrazed landscapes because the herd animals tend to avoid eating the plants of this genus. *Ornithogalum* and *Muscari* are two other indicator genera in which the ubiquities and proportions are getting higher during the Iron I. Both genera are avoided by grazing animals.

5.4.3 Crop growing conditions at Tell Tayinat

5.4.3.1 The Early Bronze Age IVB

In general, overall climatic and stable carbon isotope data indicate increasing aridity over the Near East (see Riehl, 2008, 2009 for an overview). The proxy indicators for the climatic changes, roughly at about 2.200 BCE, are various in the Near East and elsewhere in the world (Kaniewski et al., 2018 for the most recent assessment). This climatic event is largely visible in two geographically-discrete and well-dated proxy records from Lake Van (Wick et al., 2003) in southeastern Turkey and the Soreq Cave in Israel (Bar-Matthews et al., 1999). Both indicate increasingly arid conditions after roughly 4300 BP, following a broad regional pattern of this climatic event (Riehl, 2008). A high-resolution Soreq Cave record demonstrates about 30 to 40% percent reduction of annual rainfall during this time period (Bar-Matthews et al., 1999). This is basically a considerable amount of rainfall loss in the

Near East, with this data becoming the backbone of the climatic aridification hypothesis (H. Weiss, 2015 for the most recent evaluations).

The recent analysis of a varve-dated pollen sequence from the Dead Sea Lake (Finkelstein & Langgut, 2014) suggests a different picture. The authors locate the drought episode at the beginning of the Middle Bronze Age between 2000 – 1800 BCE in the southern Levant. Another palynological study in the Sea of Galilee by the same authors describes a period of increasing olive pollen between ca. 2250 and 1950 BC in the southern Levant, in contrast to the results recovered from the Soreq Cave (Langgut et al., 2015). The 4.200 BP event is visible in the Dead Sea sediment cores in which sea levels decreased because of dry conditions marked by the deposition of gypsum. Migowski et al. (2006) defines this evidence, abrupt reversal, to drier conditions within a sequence of increasing sea levels of the Dead Sea during the mid-Holocene, indicating an interlude within a humid phase until cal. 3.500 BP.

There is a scholarly agreement on the general trend towards increasing aridity after the mid-Holocene (Roberts et al., 2004). However, it should also be mentioned that the human impact becomes more apparent for the periods after 5000 BC. Therefore, the difficulty is to distinguish the climatic impact from increasing human interference to ancient vegetation (Roberts et al., 2004). Marro and Kuzucuoğlu suggest that drying trends ending in arid peaks "are actually part of a cyclic pattern of the climate". This indicates that rather than expecting a sudden degradation of the climate, starting from the second half of the third millennium BCE it should be understood as interrupted by short but high magnitude drought phases within a rainfall depletion trend; again interrupted by short-term humid phases. Therefore, the climatic crisis in 4.200 B.P. according to these authors can be justified in climatic trends only, since other periods with severe changes in precipitation do not demonstrate settlement changes appearing in the Khabur region (2007, p. 587). It should also be noted that while the traditional temporal frameworks in the Near East relied on the relative chronologies of ceramic occurrences, recent radiocarbon studies refined this chronology. Radiocarbon evidence in the case of the southern Levant revised the traditional chronology so that the site abandonment period is now dated at the end of EBA III around 2.500 BCE, i.e. several centuries earlier than previously anticipated (Höflmayer 2014a, b). According to the traditional chronology, this abandonment period covered the period between 2.200 to 1.900 BCE in reference to the Egyptian "First Intermediate Period" which was a time of regionalization and the disintegration of the Old Kingdom Egypt (Höflmayer 2014a, b). Currently, the dates for the Intermediate Bronze Age in the southern Levant were elevated between 2.500 BCE to 1.900 BCE.

In relation to the increasing aridity, Riehl et al. (2014) provided evidence that there is "a decrease in carbon isotopic fractionation in crops at the point of transition from the Early to Middle Bronze Age in the Near East, respectively in Upper Mesopotamia". The rapid change to low carbon isotopic values in some sites remained unchanged until the end of the MBA, implying a long-lasting water stress for rain-fed cultivated crops, at least in some regions. A notable increase in stable isotope values was also identified through isotope evidence at a number of sites in Northern Mesopotamia, while a north-south distinction in water availability is also visible in this isotope record (de Gruchy, Deckers, & Riehl, 2016). Riehl and her colleagues (2014) recognized this local climatic variability as a determining factor for alternation of stable carbon isotope values in their regional dataset. The impact of Holocene fluctuations in their accumulated $\Delta^{13}C$ dataset tends to be less-recognizable in coastal sites, illustrated through lower intra-sample variations of $\Delta^{13}C$ values, which indicate better water uptake conditions than the inland sites with greater aridity. Kaniewski et al. (2018, p. 1533) also reached the same conclusion regarding the palynological results from two pollen sites (Tell Tweini and Tell Sukas) in the Northern Levant.

During the late 3rd millennium BC, the stable carbon isotope results of Tell Tayinat show no clear stress conditions. This may be either due to the small sample size of our EBA samples, or perhaps the samples are not chronologically corresponding, to faithfully record the *magnitude* of the 4.200 BP event. The absence of any pronounced stress conditions was also evident in the estimated values of the modeled available moisture in the Amuq Valley. Riehl et al. (2008) extrapolate a series of modern climatic variables through using the Macrophysical Climate Model (MCM) to estimate the changing levels of available net moisture (the modeled evaporation (E) minus the modeled precipitation (P)) from Tell Atchana. According to their prediction, the modeled available moisture shows a conspicuous increase until a peak is reached at the end of EBA –roughly coinciding with 2.200 BCE- and a constant decrease of P-E towards negative values until the end of the Middle Bronze Age when the figure reaches a plateau within a longer timeframe during the LBA.

Although preliminary, as the age-depth model depends on two radiocarbon determinations, the most recent sedimentological assessment demonstrates alternations in the physical course of the Orontes as well as its sedimentation rate (Avsar et al., 2019). More specifically, the authors of this study consider the Ca/Ti ratio as an indicator for measuring the increasing aridity in the Amuq. They show that the 4200 BP event in their age-depth model does not show clear evidence of a Ca/Ti increase, therefore no climatic aridity. On the other hand, the aridification event in 3200 BP shows a sudden peak in the ratio of Ca/Ti. Additional evidence from micro-charcoals demonstrates an increase with the start of roughly 1750-1800 BCE during the Middle Bronze Age occupation in the valley. The trend became continuous during the 2nd and 1st millennia BCE.

Comparing the stable carbon isotope results of Tell Tayinat to three Northern Syrian and the Khabur sites of Ebla, Qatna and Tell Mozan, where the amount of annual rainfall is lower than at Tell Tayinat, between 500 and 300 mm, it is recognizable that all these three sites show a certain degree of water stress during the period of roughly between 2.200 – 2.000 (Fiorentino et al. 2008; Riehl 2007). It is known that the geographical limit for a successful rainfed cultivation of barley was 200 mm rainfall isohyet, but this is a critical threshold for dependence of long-term rainfed cultivation, due to unpredictable precipitation patterns (Riehl 2009a). Therefore, as Riehl (2009a, p. 94) puts it,

> "… The mean precipitation in a series of drought years is 100-200 mm less than the long-term mean annual precipitation (e.g. the 250 mm isohyet in drought years may be equivalent to the 400 mm isohyet of the long-term mean), causing continuous sequences of crop failures in areas with long-term mean annual precipitation below the critical 400 mm, as was the case in Syria between 1957 and 1961."

This indicates that all three sites locate in regions comparatively more sensitive to any decrease of precipitation. Combined with the well-studied chronological sequence, these three sites demonstrate potentially significant information for the impact of the 4.200 BP event at a local level. Stable carbon isotope results from Qatna in both studies display the decreasing stable carbon isotope values during the end of the 3rd millennium BCE. The results attained from barley and free-threshing wheat according to Riehl (2007) demonstrate that Qatna, which is located in the South Orontes Valley, experienced water stress conditions only around 2000 BCE, but such water stress is not visible for emmer wheat. Fiorentino and his colleagues (2008) also demonstrated that $\delta^{13}C$ of AMS-dated barley samples reach less negative values between 2.200 BCE and 2.000 BCE at Ebla[26]. Tell Mozan, on the other hand, shows the same trend in three investigated crop plants during the same time interval, but the stress conditions are more prominent at about 2100 BCE, which was one hundred years earlier than at Qatna

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[26] Although the results towards degrading conditions have to be considered important, caution has to be taken when interpreting the radiocarbon results of this particular study. Roberts (2015, p. 31) specifically notes that the precision of any individual date "almost always" rises to more than 50 years following calibration of ^{14}C dates. Fiorentino et al. accept "uncal BP" dates to describe their data points. However, the authors ignore the fact that when calibrated (also given in the same study), the radiocarbon dates provide a larger temporal range (possibly with 95% probability range but no information given). In some measurements, the dates span almost 400 years which makes the interpretation of stable carbon isotope determinations towards increasing aridity questionable.

(Riehl, 2007). A fourth settlement, Tell Brak which is situated in the Khabur Basin, close to Tell Mozan, also demonstrates similar $\Delta^{13}C$ results. An increase is discernible in the better water uptake conditions through the Early Jezireh III to post-Akkadian periods, possibly indicating the impact of climatic aridification was evened out by anthropogenic water management or changing land-use towards naturally moist soils around the River Jaghjagh (Bogaard et al., 2016; Styring et al., 2017).

Apart from such regional variability of water stress signals in timing and magnitude, in all studies, the mean values of all determinations do not fall below the respected threshold for moderate water stress for any cereals investigated. However, what is interesting to note is that settlement size appears to be an important factor for determining the cultivation intensity. Stable nitrogen isotope results show decreasing contribution of manuring in relation to the increasing size of settlements leading to agricultural extensification (low labor input per unit of land) rather than intensification strategy (Strying et al., 2017). Agro-production at Tell Mozan, in this respect has an interesting pattern. The end of the 3rd millennium is characterized by the urban retreat to the upper town and the abandonment of the lower town to a large extent (Pfalzner, 2010). However, the archaeobotanical and stable isotope data demonstrate that roughly during the Early Jezireh 5 (ca. 2.100 BCE), when the climate proxies show increased aridity, the crop assemblage is dominated by free-threshing wheat (drought-sensitive) rather than barley (drought-resistant) (Riehl, 2010b). In fact, such relationships had been established from the combined assessment of stable nitrogen isotope and archaeobotanical (FIBS) results from several sites in Mesopotamia, indicating that the relatively small settlements like Tell Sabi Abyad and Tell Zeidan (1 and 12 ha respectively) demonstrated high intensity manuring compared to the larger settlements which were characterized for agricultural extensification in spite of the general opinion that the complex socio-political units tended to intensify the agricultural production with more targeted investments (Styring et al., 2017: 8). Although there are some discrepancies, to directly compare nitrogen isotopic data from different periods, separated by thousands of years (e.g. Tell Sabi Abyad and Tell Brak in Strying et al., 2017), since there can be an overall decrease in soil nitrogen reservoir through the Holocene (Araus et al., 2014), nonetheless, this evidence could indicate that settlement size (perhaps also structure) would be an important factor for differential treatment of arable soils, according to labor, water and fertilizer inputs.

At Tell Tayinat, the stable nitrogen isotope values are remarkably high for both barley and free-threshing wheat during the EBA. One factor for high nitrogen values would be related to the presence of wild leguminous plants as described in the previous section. Several leguminous plants are in a symbiotic relationship with a certain type of bacteria which produces nitrogen. Therefore, leguminous plants, wild and cultivated, except trees, do not deplete the nitrogen contents of arable soils. This is an important factor which has not been discussed in the archaeobotanical literature before. Without the need of additional manuring, in fact, the communities would have been aware of the nitrogen contribution of these wild leguminous plants, thereby favoring them in their arable fields to enhance soil fertility.

Furthermore, both the stable carbon and nitrogen isotope values during the late 3rd millennium BCE at Tell Tayinat do not demonstrate a clear indication that the crops were treated differently, as for example previously reported in Wallace et al. (2015) for Northern Mesopotamian sites. The mean of $\Delta^{13}C$ values for free-threshing wheat, in their study, tends to indicate less-stressed conditions in contrast to mean values of barley in Northern Mesopotamian sites. Since barley tolerates the salinity and drought conditions better, therefore it was most probably cultivated in comparatively poor and saline soils rather than free-threshing wheat which might have been specially treated in fertile soils (Riehl et al., 2008; Riehl et al., 2014). In the same line of argumentation, Fiorentino et al. (2012b) stated that the notable variation of stable carbon and nitrogen values for the barley samples from a silo context at MBA Ebla may indicate that the agricultural produce arrived to the site from different fields of the Eblaite countryside. However, at Tell Tayinat, the only obvious difference in $\Delta^{13}C$ values of both plants can be transcribed to seasonality of the growing cycles of the two crop plants under consideration, since barley reaches maturity earlier than the wheat species, before the temperature rapidly escalates in early June in the Mediterranean Basin.

5.4.3.2 The Iron Age I

The carbon isotope sequence shows a slight decrease in $\Delta^{13}C$ values to moderately watered conditions just from FP 6 to FP 3. FP6 has more positive values compared to the FP5 values. This trend ends in FP3 when the values are over the 17‰. The decrease in D13C values presented for Tell Tayinat temporally fits well with the previous claims on climate change during the Iron I. A certain difficulty to assess significance to such a decrease is that the natural variation in the field can be as high as 3-4‰ (Tiezsen, 1991). Therefore, relating the 1‰ decrease in Tell Tayinat data to global climate change explanations remains circumstantial for now.

Another decrease in nitrogen values was detected in our data indicating the nitrogen accessibility was restricted during the Iron I compared to the Early Bronze Age. The probable reasons of such decrease in nitrogen values will be discussed down below. However, as Tiezsen (1991) notes, the nutrient-impoverished fields can signal less negative effect on the carbon discrimination rates, thereby, neutralizing the impact of water stress in other direction. This being the case, the discrimination rates due to water stress would be much more pronounced than shown in the stable carbon isotope signatures that we attained in our study.

Concurrently, Riehl et al. (2008) demonstrated that MCM also records a slight reduction in projected moisture levels at the locality of Tell Atchana with the start of the Iron Age roughly until Iron Age II. Neumann and Parpola (1987) and B. Weiss (1982) reached similar conclusions after investigating the Middle Assyrian textual records[27]combined to the interpolated modern climatic data. Interpolated climate data derived from modern weather stations showed evidence of increasing water stress conditions in Northern Mesopotamia (Neumann & Parpola, 1987) and the rest of the Near East (B. Weiss, 1982[28]). The authors locate the climatic degradation roughly between the 12th - 10th centuries BCE when the Assyrian Empire retreated to its Northern Mesopotamian heartland near the town of Assur. Neumann and Parpola estimate that “a mere 1°C rise in mean temperatures may reduce the annual rainfall in the area by as much as 30 mm” which is critical for the regions having less than 200 mm rainfall per year. B. Weiss, on the other hand, notes two aspects which need further attention before reaching a climate-centered conclusion. First, the calculations made from modern climate data are not particularly consistent with the observed historical developments, like the population movements from the Aegean towards the Levant. That means, when extrapolating modern climate data, the Levant demonstrates higher stress conditions; therefore, the migrational pattern has to be *reversed*. Second, perhaps more importantly, he mentions that the timing of precipitation would be another important factor. Referring to Coffing’s USDA study on the wheat yields in Turkish sites (1973, as cited in B. Weiss, 1982, p. 194), B. Weiss notes that the autumn and spring precipitation would affect the

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[27] However, it should be noted that the reliance of Middle Assyrian records to propose the climatic shift is hampered by the fact that the chronological and geographical distribution of the documentation may not be even among diverse regions. More importantly, the Assyrian interest to the same environments may have shifted in relation to the altered ideological framework from conquest to empire-building phases (e.g. Liverani, 2014). The power relationships between the Assyrian kings and the governing officers can also affect the influx and type of the information processed as asserted by Radner (2017).

[28] See B. Weiss, 1982, p. 194 for inconsistencies in reconciling the modern climatic data to past climatic conditions. Also his remarks are informative on the choice of statistical analysis (pp. 194-5).

crop growing conditions more than the precipitation in winter months; however, temperature becomes a more significant variable than precipitation during the winter.

The climate records demonstrate regional variability for aridity signals (Riehl et al., 2008). A global cooling event has been proposed by Bond et al. (2001) between 3200 and 2700 cal. BP which coincides to the period between the end of the Late Bronze Age and the beginning of the Iron Age II. The Soreq Cave record displays a slight increase in precipitation during the earlier phase of the Iron Age; in contrast, the Lake Van record demonstrates a peak of increased aridity roughly at the same time (Wick et al., 2003). Mayewski et al. (2004) and Rohling et al. (2009) define the climatic anomalies during 3.500-2.500 BP (roughly coincides to 1.500-500 BCE) as Rapid Climate Change event[29]. In the Levant, several recently published palynological records coincide well with this evidence. The studies from the former territory of the LBA Ugaritic kingdom in the Northern Levant and from Cyprus also suggest a period of climatic stress, either during the earlier Iron Age (Tell Tweini: Kaniewski et al. 2008, 2010, 2013, 2015; Hala Sultan Tekke: Kaniewski et al. 2019; see Knapp & Manning, 2016 on methodological problems in age-depth modelling of sediments) or during the closing centuries of the LBA (Tell Sukas: Sorrel & Mathis, 2016). In the Southern Levant, the most recent evidence corroborates these results in the North (Langgut, Finkelstein & Litt, 2013).

Stable carbon isotope results from Tell Atchana indicate differential treatment of free-threshing wheat as some individual measurements of free-threshing wheat are higher than the mean values of barley measurements (Riehl, 2010a). Riehl also interprets the large variance of olive stable carbon isotope values withthe same explanation (2010a). Importantly, a selective treatment of crop plants is also visible in stable nitrogen values of the Iron I. The rather homogenous values of ^{15}N values of both free-threshing wheat and barley in the EBA

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[29] Riehl and Marinova were skeptical to classify such short amplitudinal fluctuations in the proxy records as "events" but rather "trends" would be a more plausible term; "particularly when applied to socio-cultural systems" (2016, p. 321).

changed to vary noticeably in Iron I, thereby indicating a greater emphasis on differential treatment of crop plants during this period. Araus et al. (2014) found a general decrease in cereal ^{15}N values through time in the Near East that was interpreted as decrease in soil fertility caused by diverse reasons, such as overexploitation of arable lands or reduced manuring. Moreover, Styring et al. (2017) suggested that the increasing site size of dry-farming states of Northern Mesopotamia can be a significant factor towards reduced manuring input as the catchment area of the towns expanded. In relation to the discussion of manuring levels, it shall be argued that stable nitrogen values derived from Tell Tayinat bring an important aspect of soil fertility conditions; specifically, the nitrogen pool of the soil and the contributions of wild leguminous plants into this pool. The decrease at Tell Tayinat may be related to the changes identified in the wild plant assemblages. The conspicuous absence of nitrogen-fixing wild leguminous plants may be a direct reason why the nitrogen values decreased in the Iron I. Therefore, most probably more competitive wild species, especially abundant small-seeded grasses, might have depleted the soil nutrient contents of arable fields during this period.

5.5 CONCLUDING REMARKS

The study of the charred seed record of Tell Tayinat demonstrates that the patterns of local crop production temporally coincide well with the regional trends. While barley is the prominent crop plant at Tell Tayinat and in much of the Near East during the Early Bronze Age, free-threshing wheat varieties became important in the Late Bronze Age record of Tell Atchana and continued to be principal crop plants during the Iron Ages, despite a small increase in the proportions of barley which is visible in our comparative study. Similar conclusions can be derived for crop legumes such as bitter vetch, lentil and garden pea. Despite the comparatively sizeable rainfall in the Amuq Plain, the characteristic focus on a limited range of crop plants, especially drought-tolerant barley and bitter vetch, surpasses the significance of climatic explanations for human crop preferences. The fine-grained trajectory of the Tell Tayinat crop assemblage suggests that the disintegration of the Hittite occupation at the beginning of the 12th century caused the diversification of crops, which included a large variety of crop plants largely underrepresented during the LBA, as well as possibly horticultural crops such as fenugreek, caper and coriander. The Iron Age I history of the wild/weedy flora represented in the archaeobotanical assemblage of Tell Tayinat diverges starkly from preceding and succeeding periods. It is highly likely that the vegetation in the immediate vicinity of Tell Tayinat might have been disturbed due to environmental and/or climatic reasons.

CHAPTER 6. SUBSISTENCE IN POST-COLLAPSE SOCIETIES: PATTERNS OF AGROPRODUCTION FROM THE LATE BRONZE AGE TO THE IRON AGE IN THE NORTHERN LEVANT AND BEYOND

6.1 INTRODUCTION

Notwithstanding the fact that the causal explanations of the socio-political transformations during late second millennium BC are manifold and have been debated for years (see Cline, 2014 for an overview) the question as to whether climatic degradation contributed to this process has recently received much more substantial attention, possibly stimulated by contemporary concerns of global climate change and the sustainability of food resources (see Finné et al., 2011; Roberts et al., 2011a; Staubwasser & Weiss, 2006; Wanner et al., 2008 for an overview of past climatic evidence). The discussion of the role of climate in the demise of Late Bronze Age territorial states is not new, at least since the seminal work of Carpenter (1966). However, numerous climatic archives from the eastern Mediterranean basin have increasingly provided evidence for prolonged drought conditions at the transition from the Late Bronze Age to the Iron Age (e.g. Drake, 2012; Finné et al., 2011; Frumkin & Elitzur 2002; Kaniewski et al., 2008, 2010, 2013; Langgut et al., 2013, 2015; Neumann et al., 2010; Sorrel & Mathis, 2016). According to the climatic scenario suggested by Kaniewski and his colleagues (2015), the settlement system of their study site Tell Tweini, which was located in the hinterland of Late Bronze Age Ugarit, collapsed at about 1200 BC without any sign of regeneration or political stability for the next 300 years. The reason may have been the combined impact of seaborne invaders and increased aridity that may have affected crop yields. The authors suggest "[…] this climate shift caused crop failures, dearth and famine, which precipitated or hastened socio-economic crises and forced regional human migrations at the end of the LBA in the Eastern Mediterranean and southwest Asia" (Kaniewski et al., 2013, p. 9; cf. Langgut et al., 2015). Notably, some textual records during the Late Bronze Age mention famine, harsh weather conditions, nomadic incursions, and dislocated sea-faring groups, as well as frequent grain shipments from Egypt and Ugarit to the Hittite heartland, “to keep the land of Hatti alive” as declared by the Pharaoh, also proposed to be the consequences of shifting climatic conditions by some authors (Cline, 2014; Kaniewski et al., 2015; Neumann & Parpola, 1987).

Despite such compelling palaeoclimatic evidence from recent years and several textual records, the climate narrative is hampered by several limitations. The exact timing and magnitude of this particular climatic event is still a matter of discussion due to the conflicting chronological frameworks of the proxy records. It has been indicated that the chronological resolution of climatic archives is often too imprecise to securely attribute certain cultural developments to climatic degradation (see Knapp & Manning 2016 for a critical overview). Furthermore, spatial variation of climatic archives is another inherent problem since it is rather uncertain how to synchronize geographicallydistant proxy indicators to global climate events (see in general Finné et al., 2011, Marro & Kuzucuoğlu, 2007; Riehl 2009a; Roberts et al., 2011a).

Moreover, there are other obstructions to placing the Late-Bronze-to-Iron Age transition within a single deterministic framework. The causal link between climate and social change remains hardly straightforward as human societies respond to any particular environmental stressor in varying ways (Haldon et al., 2018; Izdebski et al., 2016; Riehl, 2009a; see Middleton, 2012; McAnany & Yoffee, 2010a; Tainter, 2006 for an overview of discussions). The degree and in which social context ancient human communities perceive climate as a stress agent still remains poorly understood (Riehl, 2017). Regarding subsistence in times of climatic stress, reduced crop yields and widespread famine are recurrent themes in the climatic decline hypothesis. However, Slavin (2016) rightly warns about the categorical uncertainties between references to famine and food shortage in the literature. He argues that food shortages were common in Medieval Europe due to climatic anomalies (i.e. Little Ice Age) but whether these shortages transformed into famine was determined by the social inequities, demographic pressure and/or dietary structure of the population under stress. This being the case, envisioning “post-collapse societies” at the edge of extinction, subsistence crisis, or exhaustion of resources is usually not determined by analyses of skeletal remains for nutrient deficiencies, but rather remains a sub-narrative to reinforce the overall catastrophic tone of the climate hypothesis. McAnany and Yoffee reframe this “conflation of profound societal change with the notion of biological extinction” (2010b, p. 977) as a persistent error in the literature, while Adams asserts “[…] societies are not organisms but collectivities that can fragment and recombine on new principles” (1988, p. 22), thus emphasizing the aspect of resilience.

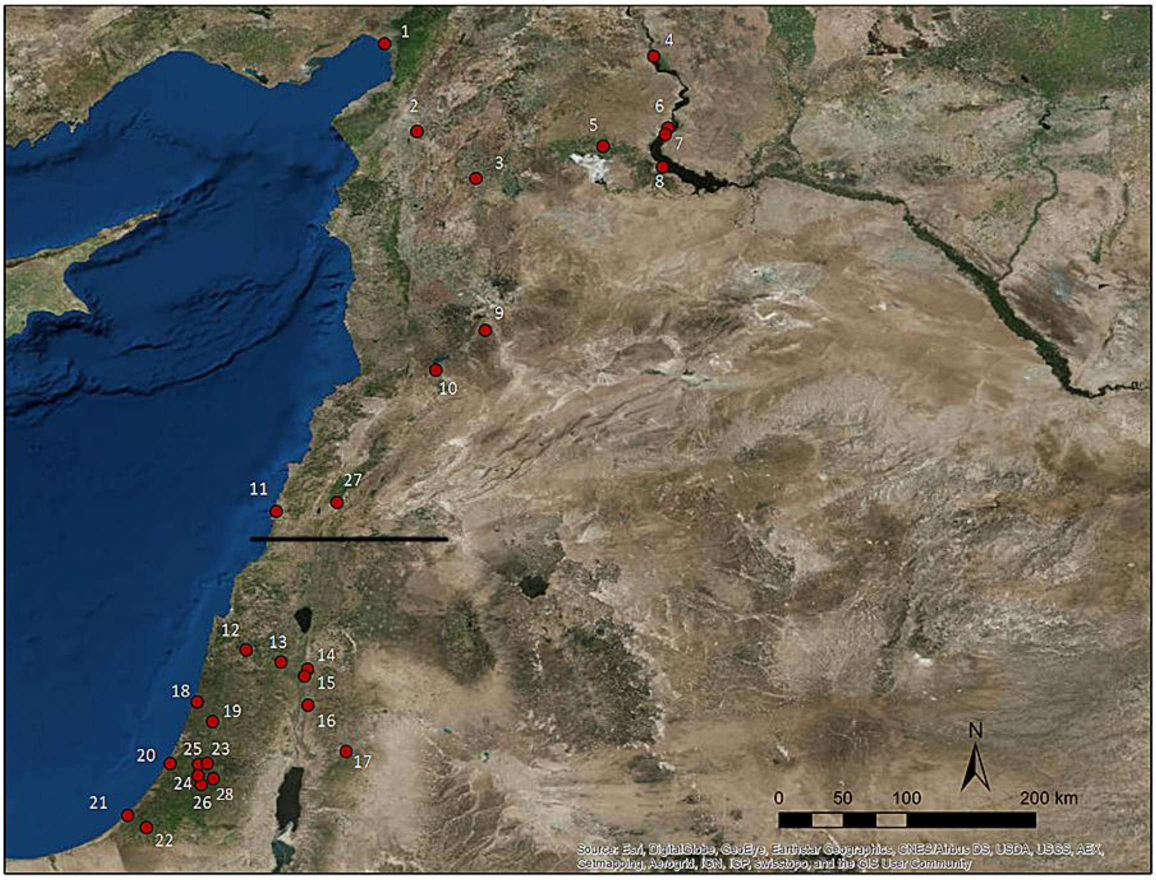
Where does archaeobotany stand in these heated discussions of the sustainability of food resources during “post-collapse” periods? Archaeobotany, when coupled with stable carbon isotope analysis, has tremendous potential to fill the empirical gap concerning subsistence in times of political instability and/or climatic decline by delivering information on economic interests, cultural traditions, and environmental limitations to crop production. Despite the fact that available archaeobotanical data from Late Bronze and early Iron Age sites in the Levant are scarce to date, archaeobotanical studies have already contributed substantially to our understanding of subsistence economies during the Bronze and Iron Ages. In general, Riehl (2009b) studied the long-term changes in agricultural management strategies in the Near East, indicating the prominence of regional diversity in human crop selection. Riehl puts forward that after the 4200 BP climatic event, drought-tolerant crop taxa (e.g. barley, emmer, bitter vetch) became more common in the plant assemblages, while many drought-susceptible crops (e.g. flax, einkorn) disappeared or their abundance was reduced (2009b). In particular, Riehl and Nesbitt (2003) surveyed the crop plants from published datasets of the Late Bronze and Iron Ages. Their analysis, based on a limited number of archaeobotanically investigated sites, suggests continuity of crop cultivation in the Near East and the Aegean during this transitional period. In addition, the later Iron Age is characterized by the gradual introduction of new crop plants (e.g. millets, sesame) with their growing cycle comprised of summer months when rainfall is negligible and traditionally household labour is allocated for harvesting of arboricultural products (grape, olive, fig) in the Levant (e.g., Gezer calendar, Hopkins, 1987). Regionally, irrigation input may have been a necessity to cultivate these field crops and thereby indicates a change in labour organization and timing.

Other archaeobotanical studies have introduced different perspectives on the transition from the Late Bronze Age to the Iron Age. While Smith and Munro (2009) point out the prevalence of local environmental conditions in the composition of archaeobotanical assemblages among various sub-regions of the Northern Levant and northern Mesopotamia, Olsvig-Whittaker et al. (2015) suggest a progressive change towards greater occurrences of wild xeric taxa during the course of the Late Bronze Age-Iron Age transition in the southern Levant. According to Mahler-Slasky and Kislev (2010), the emergence of a ceramic horizon foreign to the Southern Levant (attributed to the Biblical Philistines) coincides with the widespread use of grass pea/red vetchling (*Lathyrus sativus/cicera*) as a substitute for another species, Spanish vetchling (*Lathyrus clymenum),* which mainly has an Aegean distribution (Sarpaki & G. Jones, 1990). They consider this pattern as a material manifestation of a certain food-centred nostalgia invoked through gustatory memory of newcomers for their far-flung homeland. Furthermore, Frumin and her colleagues argued for the degree of compositional change in wild plant assemblages of Philistine and Canaanite sites as evidence of a vegetational fingerprint of the same dislocation of population (Frumin et al., 2015). The appearance of some introduced species (e.g. opium poppy, coriander, cumin, bay tree) is also connected to the Philistine phenomenon in the southern Levant, according to the same authors.

In recent years, stable carbon isotope analysis has developed into an established methodological tool to gather information on the availability of water during the grain-filling period of crop plants and to assess local growing conditions (Araus et al., 1999; Fiorentino et al., 2008, 2012; Masi et al., 2014; Riehl et al., 2008, 2014; Wallace et al., 2015; see generally Araus et al., 2014; Bogaard & Outram, 2013; Fiorentino et al., 2015). Comprehensive studies on modern cultivars show that stable carbon isotope analysis reflects the assimilation rate of atmospheric carbondioxide into the photosynthetic metabolism of plants (Farquhar et al., 1989 for an overview). In particular, C_3 plants (which include the majority of cultivated cereals and pulses in the Old World) tend to restrict their stomatal conductance under reduced water availability to prevent excessive water loss, which leads to an increased involvement of the heavier ^{13}C due to limitation of the continuous availability of the lighter ^{12}C molecules (Araus et al., 1999; Ferrio et al., 2003, 2005; Wallace et al., 2013).

Even though synthetical studies are still in their early stages (see also Wallace et al., 2015), the currently available data suggests two important aspects of water stress levels in the Near East: the recognition of major Holocene fluctuations (e.g. 5200 BP, 4200 BP and 3200 BP events) in stable carbon isotope data and the significance of local environmental variability in stress signals (Riehl et al, 2014). According to Riehl and her colleagues (2014), the latter finding is particularly important, as it differentiates the stable isotope values found from areas of higher aridity inland compared to coastal sites, which are characterized by lower intra-sample variation in carbon isotope discrimination and indicate better water uptake conditions.

The aim of the present study is to provide a more intrinsic view of the subsistence economy and crop growing conditions during the transition from the Late Bronze Age to the Iron Age in the wider Levantine region from an archaeobotanical perspective (Figs. 42 and 43). Archaeobotanically investigated sites form only a small portion of the total number of known archaeological sites for the periods under consideration (see Porter 2016 for the most recent assessment). Nevertheless, apart from certain sub-regions (e.g. the Central Highlands in the Southern Levant), comparable plant evidence on crops is available to allow cross-regional comparisons on a temporal basis (see Materials and Methods for details). Therefore, following Riehl (2009a), the basic assumption of this paper is that the archaeobotanical record can demonstrate changes in agro-production patterns towards cultivation of drought-tolerant crops rather than drought-susceptible crops, which would have allowed ancient farmers to cope with the reduced rainfall amount. In doing so, we have assembled the available crop data (which is readily available on the online platform *ademnes.de*) and stable carbon isotope evidence from the published literature, as well as new evidence that has been compiled from Tell Tayinat (D. Karakaya, unpublished data), Jaffa (Andrea Orendi, personal communication) and Tel Burna (Orendi et al, 2017). Specifically, we test: *Were there any temporal changes in the crop repertoire and in their growing conditions regarding the wider region of the Levant during the transition from the Late Bronze Age to the Iron Age?*



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 42 Map of the Late Bronze Age sites with archaeobotanical records. Black line indicates the relative border between the Southern and Northern Levant, as defined in this study. (1) Kinet Höyük, (2) Tell Atchana/Alalakh, (3) Tell Afis, (4) Shuyukh el-Fawqani, (5) Umm el-Marra, (6) Tell Hadidi, (7) Tell Munbaqa/Ekalte, (8) Emar, (9) Tell Mishrifeh/Qatna, (10) Tell Nebi Mend/Qadesh, (11) Sidon, (12) Megiddo, (13) Beth Shean, (14) Pella, (15) Tell Abu al-Kharaz, (16) Deir ʻAlla, (17) Tall al-Umayri, (18) Tell el-Ifshar, (19) Tel Aphek, (20) Ashdod, (21) Deir el-Balah, (22) Qubur al-Walaydah, (23) Timnah, (24) Tell es-Safi, (25) Tel Miqne/Ekron, (26) Lachish, (27) Kamed el-Lōz/Kumidi, (28) Tel Burna. (Graphic Courtesy: Tuna Kalayci).

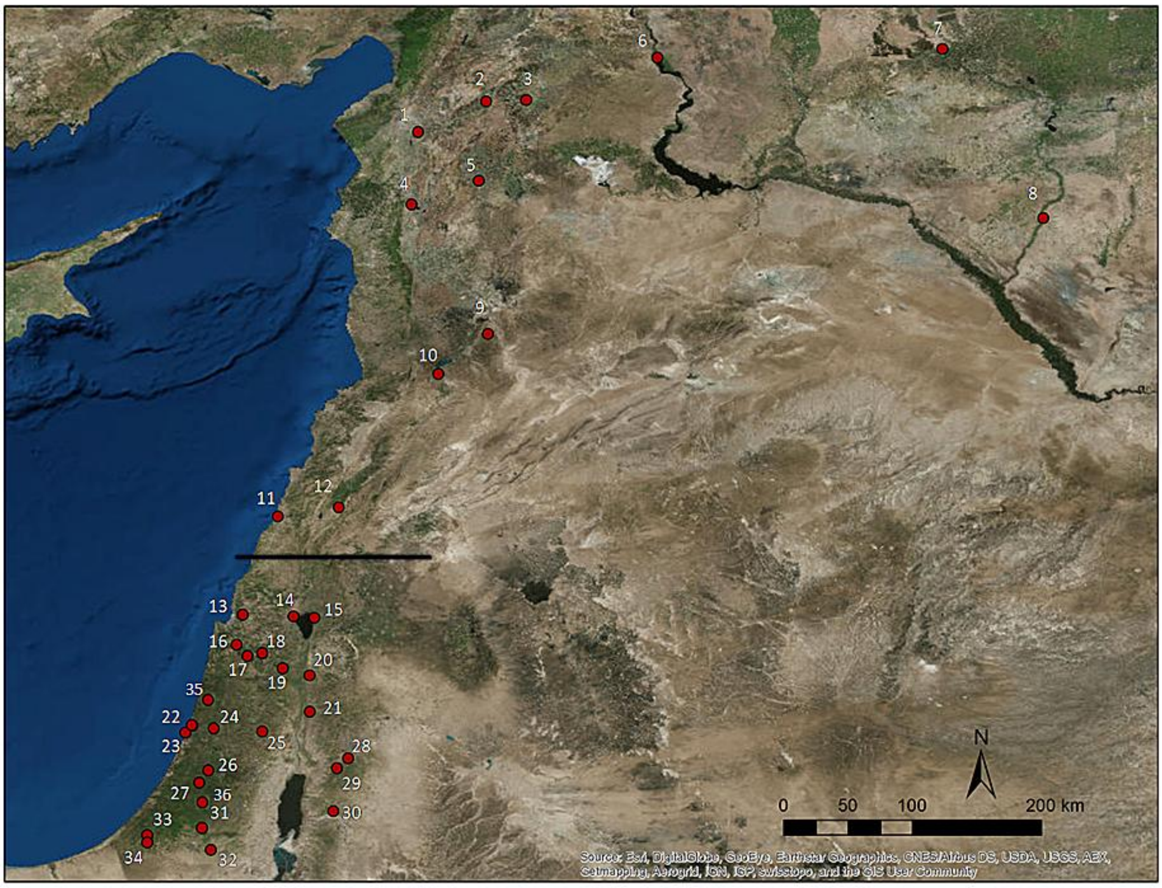


Figure 43 Map of the Iron Age sites with archaeobotanical records.Black line indicates the relative border between the southern and northern Levant as defined in this study. (1) Tell Tayinat/Kunulua, (2) ‘Ain Dara, (3) Tell Rifaat, (4) Tell Qarqur/Qarqar, (5) Tell Afis, (6) Shuyukh el-Fawqani, (7) Tell Ḥalaf, (8) Tell Sheikh Hamad/Dur Katlimmu, (9) Tell Mishrifeh/Qatna, (10) Tell Nebi Mend/Qadesh, (11) Sidon, (12) Kamed el-Loz/Kumidi, (13) Tell Keisan, (14) Tell Hadar, (15) Kinneret, (16) Yokneam, (17) Megiddo, (18) Afula, (19) Beth Shean, (20) Pella, (21) Deir ‘Alla, (22) Tell Qasile, (23) Jaffa, (24) Tel Aphek, (25) Shiloh, (26) Timnah, (27) Tell es-Safi, (28) Tall al-Umayri, (29) Heschbon, (30) Ḏibon, (31) Tell el-Ḫuwelfe, (32) Tel Masos, (33) Qubur al-Walaydah, (34) Tell el-Farʿah (S), (35) Tell el-Ifshar, (36) Lachish. (Graphic Courtesy: Tuna Kalayci).

6.2 MATERIALS and METHODS

6.2.1 Archaeobotanical data

The dataset includes 28 sites from the Late Bronze Age and 36 sites from the Iron Age. In total, the dataset covers 1,362,498 objects from 1747 samples. There are 17 sites that show continuity of occupation, enabling chronological comparison at the local level. The samples (total counts of plant objects from each individual site) entered the dataset as absolute counts (if counts were provided in the original publication) and were further transformed into both ubiquity scores and percentages. The ubiquity scores in this study are the percentage expression of how frequently a certain crop plant appears among the total number of sites of each period. For some cases, the crop remains were only reported as either present or absent, preventing a fully quantitative approach. Therefore, for analysing presence or absence of a particular crop, all sites have been included; however, for the percentage analysis, we discarded the sites containing exclusively presence data. This reduced the total number of sites to 26 in the Late Bronze Age and 27 in the Iron Age. More methodological limitations derive from inadequate reporting, sampling strategies, and data recovery methods. Some investigations are based on one particular storage context, often only including a single sample dominated by a single crop plant. On the other hand, some crop categories were amalgamated for consistency in nomenclature (e.g. *Hordeum vulgare* designates both 2-rowed and 6-rowed forms) or discarded to avoid ambiguity (e.g. indeterminate chaff remains). After data cleaning, 17 crop taxa remained for the final analysis.

Geographical subdivision of the Levant is at best arbitrary and largely depends upon researchers' approach and interest in the studied subject (Killebrew & Steiner, 2014). The Levant is characterized by large environmental diversity of a landscape with rugged topography and proximity of the Mediterranean Sea (Suriano, 2014). In this study, we roughly divide the Levant into two parts, south and north, basically setting 33° northern latitude as the boundary between the two regions. We further extended the northern assemblages by including the published datasets of sites in north-eastern Mesopotamia to enhance the comparability of two climatically opposing regions (Levant vs. Mesopotamia).

A major limitation is the periodization of sites, as comparable radiocarbon dates are unavailable in many cases. Therefore, the only reliable source of periodization remains relative chronology, and regional chronologies usually have different temporal frameworks for the Late Bronze Age and the Iron Age in relation to the archaeological tradition dominant in each country (Sharon, 2014). Therefore, the temporal resolution of our archaeobotanical samples is coarse, preventing the study of the plant evidence phase-by-phase. It should also be mentioned that our plant dataset is composed mostly of sites inhabited during the later Late Bronze Age (LB II) and sites from the earlier Iron Age (Iron I). A few sites in our dataset are reported in general terms, as Late Bronze Age or Iron Age respectively.

6.2.2 Stable carbon isotope data

New stable carbon isotope evidence has been gathered from Iron Age I levels of Tell Tayinat, roughly covering the mid-12th to 10th centuries BC. In all, 21 barley and 26 free-threshing wheat grains have been analysed from this site. All grains from this site are recovered from pit fills, thereby representing secondary depositions. It was aimed to analyse six individual grains from each sample to cover the full range of variability within particular samples (Fiorentino et al., 2015).

$\delta^{13}C$ values of ancient grains were calculated according to the VPDB common standard (Vienna Peedee belemnite ‰) to acquire the intercellular ratio of $^{13}C/^{12}C$ in the grains of our samples. The analysis of stable isotope carbon ratios was conducted at the Institute of Geosciences of the University Tübingen, Germany on a NC 2500 connected to a Thermo Quest Delta+XL mass spectrometer. To eliminate sedimentary carbonate from the surface of the grains, they were treated with 5% HCl before taking the measurements. The analytical precision of measurements was about 0.1‰ for $\delta^{13}C$.

Additionally, changes in atmospheric CO_2 ($\delta^{13}C_{air}$) composition through time were taken into account in the comparison of samples from different periods. Therefore, the discrimination in plant remains was calibrated by comparing them to standardized atmospheric CO_2 values acquired from the Antarctic and Greenland ice-core projects. AIRCO2-LOESS data calibrator (Ferrio et al. 2012; Ferrio et al. 2005) is used to calculate this new value, which is referenced as Δ^{13}C.

$$\Delta^{13}C = \delta^{13}C_{air}-\delta^{13}C_{plant}/(1+\delta^{13}C_{plant}/1{,}000)$$

The effect of charring on stable carbon isotope values has been found to induce no significant change under various experimental settings (Araus et al. 1997b; Ferrio et al. 2007; Fraser et al. 2013; also see references in Fiorentino 2015 for other conclusions). Therefore, no correction factors were applied. In this study, we follow the proposition of Riehl et al. (2014) in accepting a reference line of Δ^{13}C between 16‰ to 17‰ for moderate water stress for barley measurements (cf. Wallace et al., 2013; see further Fiorentino et al., 2015 and Riehl et al., 2014 for a summary of interpretations on the variability of stable carbon isotope values).

6.3 RESULTS

6.3.1 Archaeobotanical results

6.3.1.1 Cereals

The ubiquity scores of selected crop taxa in fig. 3 show that the most prominent cereals were free-threshing wheat and barley, and to a lesser extent emmer wheat, in each period in the Northern Levant and northern Mesopotamia. Both free-threshing wheat and barley demonstrate similar ubiquities in the Late Bronze Age and the Iron Age, while a decrease in emmer wheat values is evident in the same regions. Einkorn wheat, which is a minor component of the crop repertoire, displays much lower ubiquity scores in the Late Bronze Age but its values significantly increase in the following period. Regarding the proportions of these cereals in figs. 4 and 6, there is a geographical division between the northern Levantine and Mesopotamian sites, as the latter demonstrate a focus on the barley cultivation in both periods, while the northern Levantine sites are locally more variable in barley and free-threshing wheat percentages. It can be recognized that the sites within the higher rainfall zone, such as Tell Atchana, Tell Tayinat, Kinet Höyük, etc., located in the north Orontes Valley and Cilicia, tend to include more free-threshing wheat. Mesopotamia and inland Syria differ from these westward sites in their heavier dependence on barley. Free-threshing wheat appears to be a minor dietary component in this region. Interestingly, the central Levantine sites on the Lebanese coast (Sidon), the Bekaa Valley (Kamed el-Loz) and in the south Orontes basin (Qatna, Qadesh) show a similar focus on barley to sites in Mesopotamia. It should be noted that the plant data is somewhat patchy from this region, questioning its representativity.

The most ubiquitous cereals in the southern Levantine Late Bronze Age sites are free-threshing wheat and barley, like in the Northern Levant, whereas emmer ubiquities are comparatively low. Free-threshing wheat shows higher proportions than barley in some Late Bronze Age sites such as Beth Shean, Tell el-Ifshar, Tel Aphek, Timnah (Figs. 44 and 45). Otherwise, the majority of sites are characterized by the predominance of barley during this period. Although it is as ubiquitous as ever before during the Iron Age, this trend of heavier dependence on barley does not continue into the Iron Age in many southern Levantine sites when considering percentages (Figs. 44 and 46). Free-threshing wheat instead becomes proportionally dominant in a large number of sites, while many sites in arid and semi-arid inland zones still display the prominence of barley. The proportions of emmer wheat are generally low. This taxon appears in large proportions only at Megiddo.

6.3.1.2 Pulses

The most ubiquitous pulse taxa are lentil (*Lens culinaris*) and bitter vetch (*Vicia ervilia*) in both regions. Also, the ubiquity scores of both plants increase from the Late Bronze Age to the Iron Age (fig. 3). In terms of proportions of these pulses, the Late Bronze Age pattern in the Northern Levant and Mesopotamia is diverse, as no distinct geographical distribution patterns are recognizable. During the Late Bronze Age, the majority of sites contain bitter vetch, grass pea/red vetchling and/or aggregate vetches (*Vicia/Lathyrus*), while lentil is abundant in a few sites such as Kinet Höyük, Sidon, and Umm el-Marra. During the Iron Age, however, lentil reached a wider appearance in the Northern Levant (Figs. 47 and 48).

The Late Bronze Age southern assemblages also show mixed production strategies among sites, with varying types of leguminous crops with a strong reliance on bitter vetch and grass pea/red vetchling in the majority of sites. During the Iron Age, bitter vetch becomes proportionally higher particularly in the northern valleys of the Southern Levant (Jezreel and Beth-Shean valleys) and the Galilee. In contrast, the majority of inland sites are predominated by greater proportions of lentil (Figs. 47 and 48).

Grass pea/red vetchling, which appears to be less ubiquitous than lentil and bitter vetch, is more widely present in the Northern Levant and Mesopotamia than the Southern Levant. During the Late Bronze Age, this crop plant appears in high quantities at three geographically distant sites, Tell Afis, Shuyukh el-Fawqani and Qadesh. In the Southern Levant, this crop taxon is also recorded more often during the Late Bronze Age (e.g. Timnah, Ekron, Tel Burna), but not during the Iron Age, when it appears to be strongly reduced in the Southern Levant. Legume crops other than lentil, bitter vetch, and grass pea/red vetchling appear less frequently with regard to ubiquity and percentage scores. There are significant amounts of broad bean (*Vicia faba*) at Tell Afis and garden pea (*Pisum sativum*) at Tell Hadidi. Chick pea (*Cicer arietanum*) is another legume crop that appears only in Lebanese sites in significant proportions (LBA: Sidon, IA: Kamed el-Loz).

6.3.1.3 Flax/linseed

Another field crop that is valued for its oil and fibre is flax (*Linum usitatissimum*), showing consistently higher ubiquity scores in Iron Age sites compared to Bronze Age sites in the Levant (Fig. 44). The ubiquity and proportions of flax are generally low compared to other crops, except at Beth Shean and Tell el-Qasile, which show conspicuously high percentages.

6.3.1.4 Tree crops

During the Late Bronze Age, the ubiquity scores of tree crops, including olive (*Olea europaea*), fig (*Ficus carica*), and grape (*Vitis vinifera*) but excluding pomegranate (*Punica granatum*) are fairly high in both regions. During the Iron Age, olive ubiquities only document a decrease in northern Levantine sites. The ubiquity scores of this tree crop decrease from 66% to 35% when all northern sites are considered. In contrast, the ubiquity scores for olive in the Iron Age Southern Levant increase. Grape pips appear frequently in northern Mesopotamia (LBA: Tell Hadidi, Umm el-Marra, and Emar; IA: Tell Halaf, Shuyukh el-Fawqani and Tell Sheikh Hamad), as well as in most of the northern and southern Levantine sites, without interruption during the transition and even with slightly greater ubiquities in the Iron Age in the northern sites. Fig follows a similar trend as olive in its ubiquities, with a decrease in northern sites but an increase in southern sites, but site-by-site differences also exist, as there are higher percentages of fig finds at Iron Age Tell Tayinat in comparison to Late Bronze Age Tell Atchana from the same region. Lastly, another tree crop, pomegranate, appears only with one entry in both periods in the Northern Levant (LBA: Tell Atchana; IA: ‘Ain Dara). In the Southern Levant, this tree taxon appears at Timnah in the Late Bronze Age and at Jaffa, Deir ‘Alla, Pella, and Tel Aphek in the Iron Age (Fig. 44).

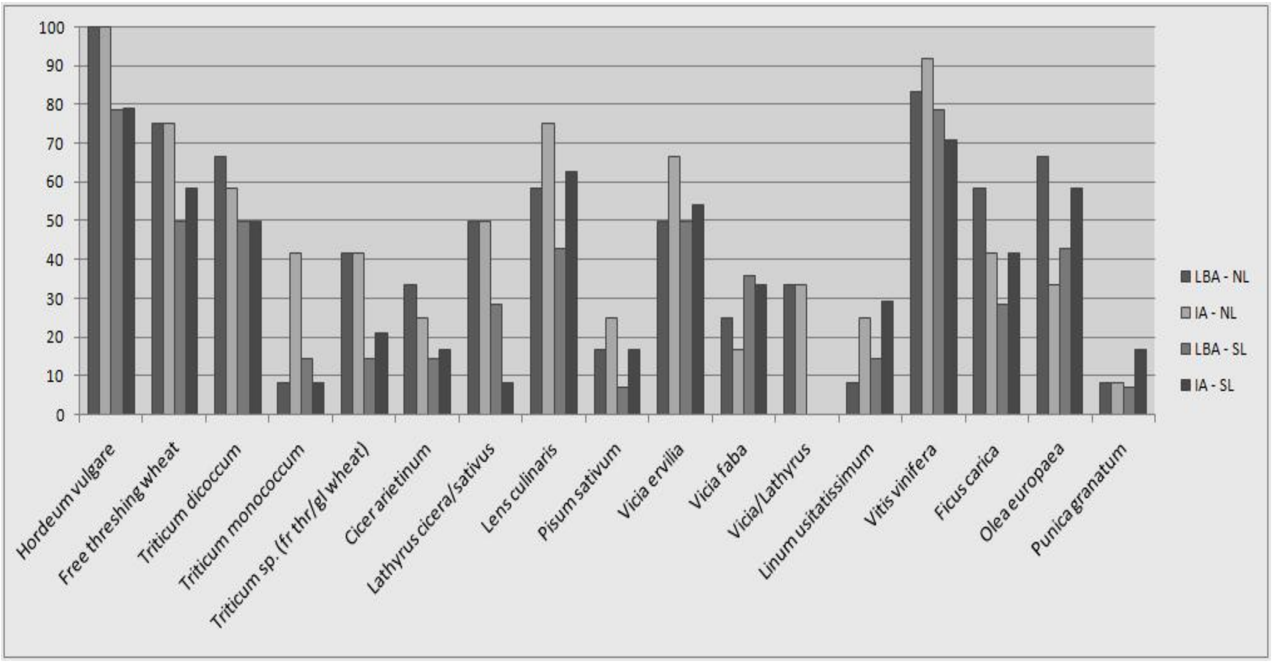


Figure 44 The ubiquity scores of several crop taxa in the Late Bronze Age (LBA) and the Iron Age (IA) in the Southern Levant (denoted as SL) and the Northern Levant and the northern Mesopotamia (denoted as NL).

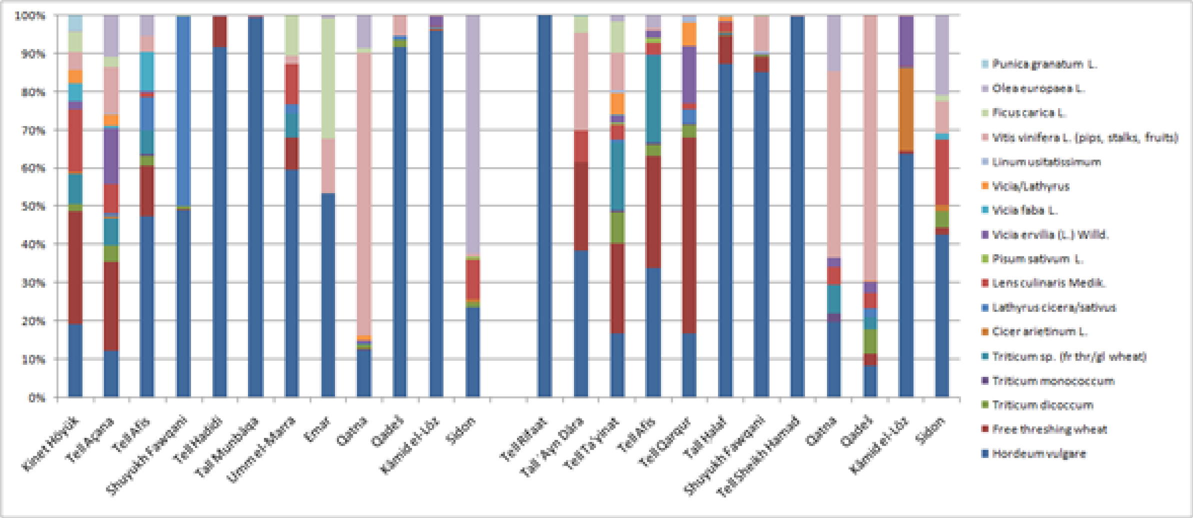


Figure 45 The proportions of crop taxa during the Late Bronze and Iron Age in the Northern Levant and northern Mesopotamia.

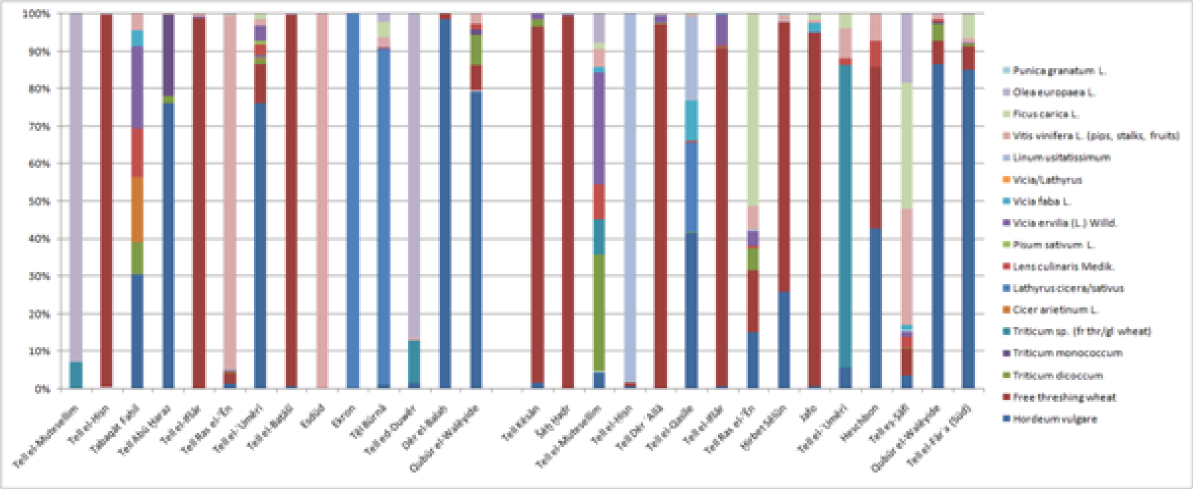
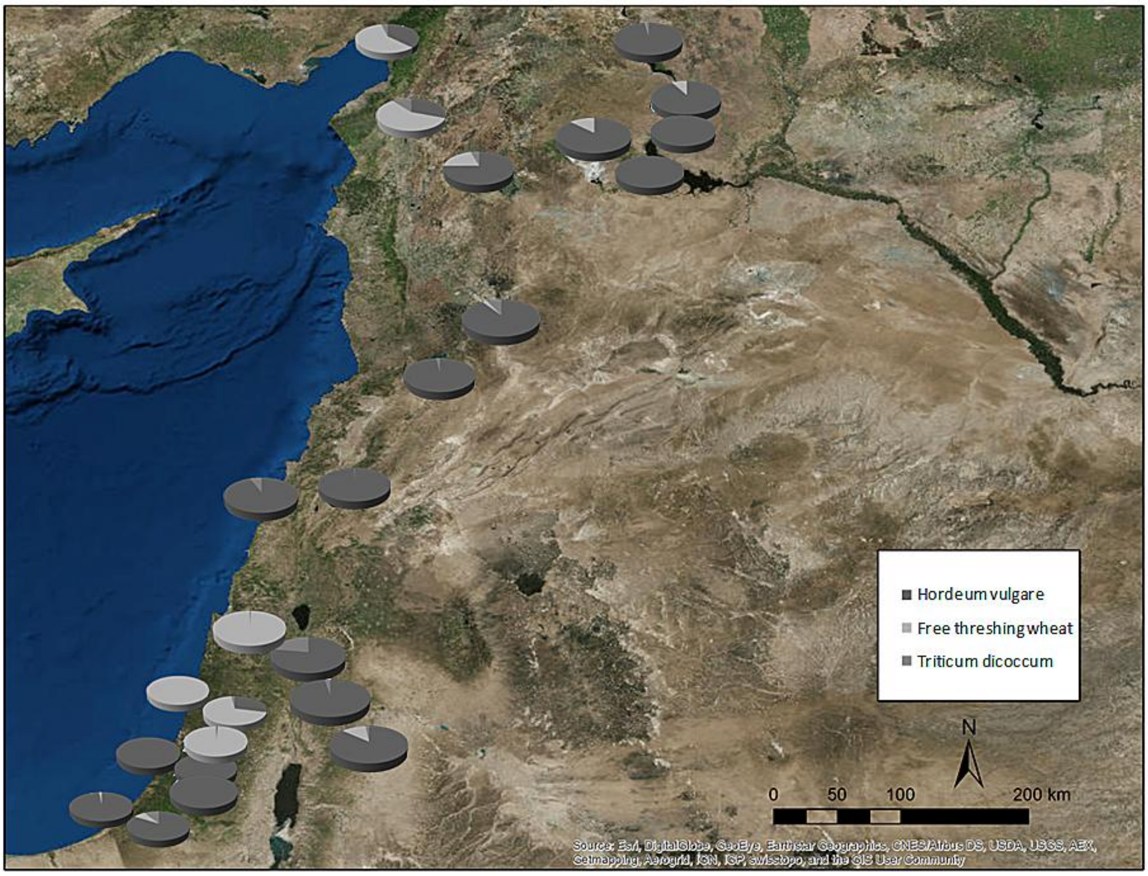


Figure 46 The proportions of crop taxa during the Late Bronze and Iron Age in the Southern Levant.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 47 The relative proportions of selected cereal crops during the Late Bronze Age in the Levant and northern Mesopotamia.

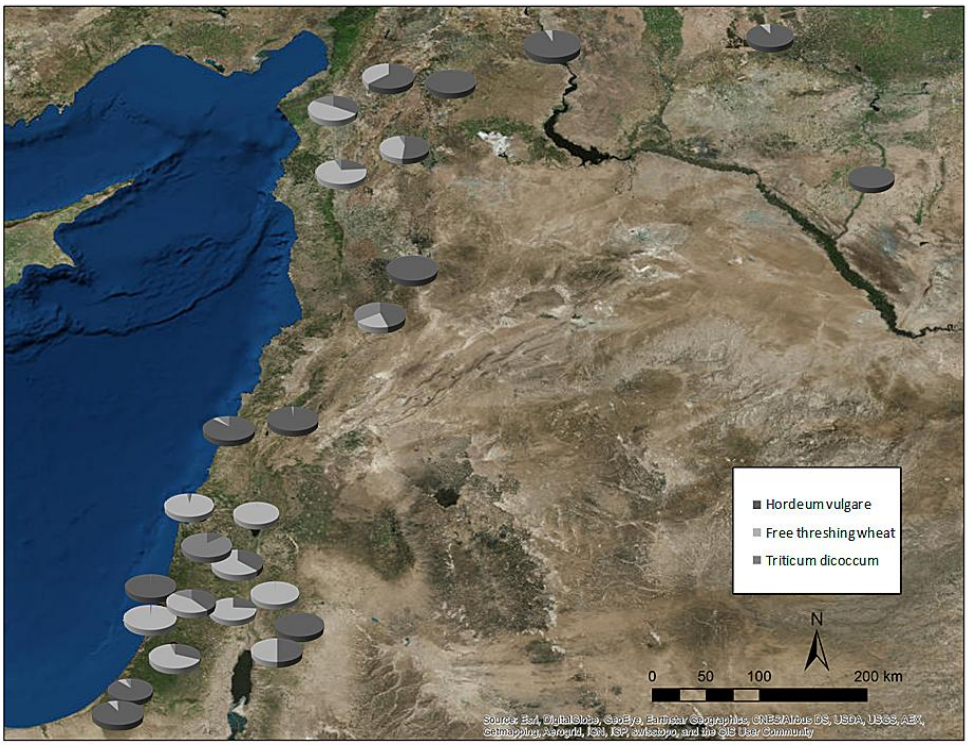


Figure 48 The relative proportions of selected cereal crops during the Iron Age in the Levant and northern Mesopotamia.

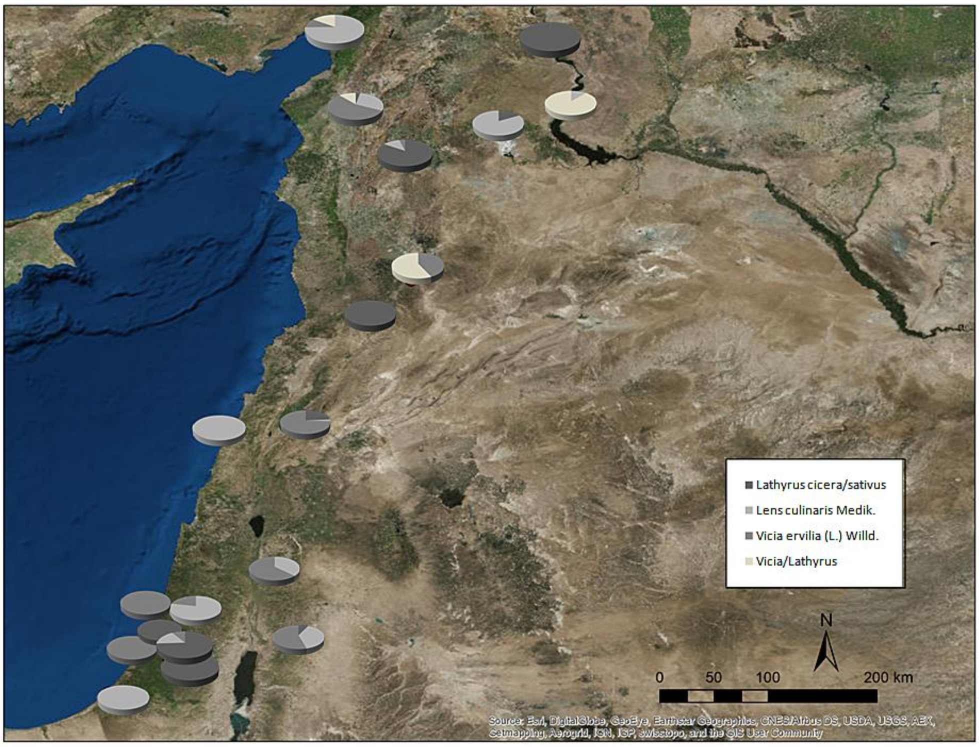
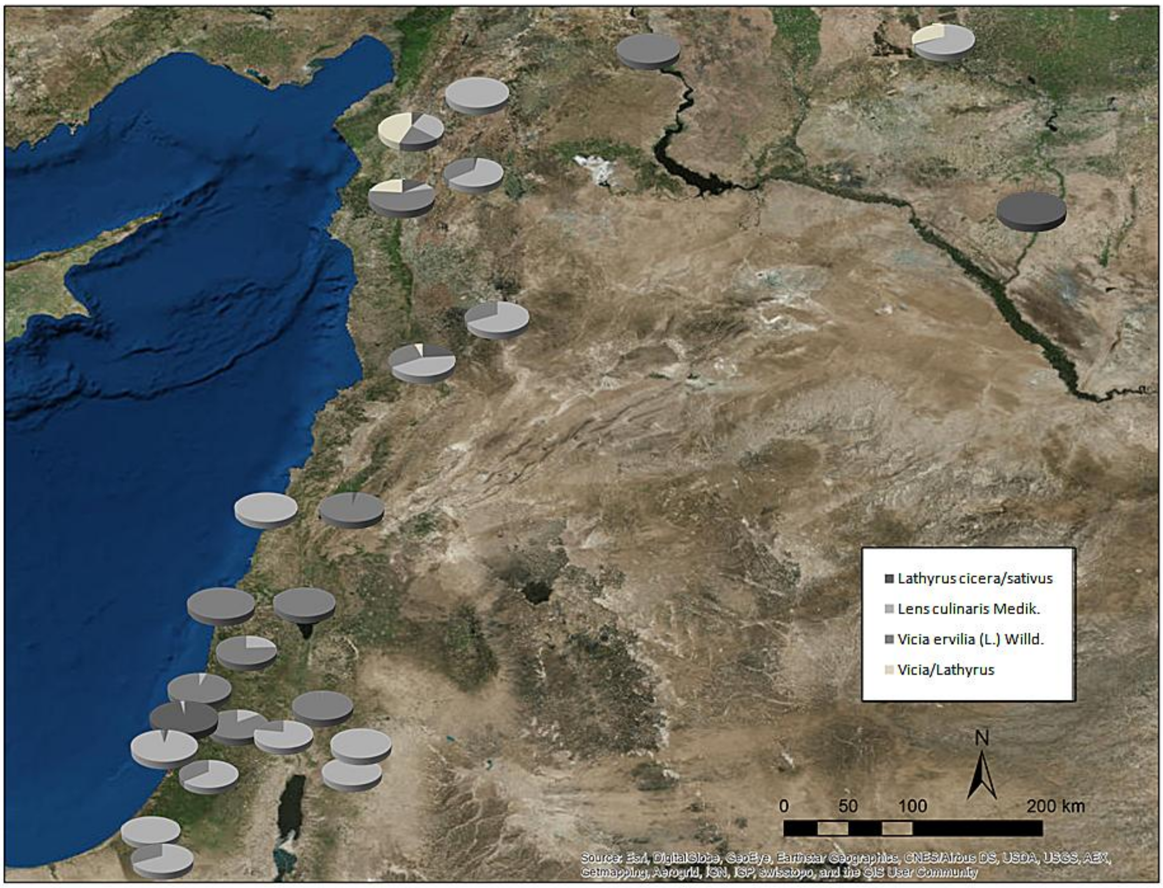


Figure 49 The relative proportions of selected legume crops during the Late Bronze Age in the Levant and northern Mesopotamia.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 50 **The relative proportions of selected legume crops during the Iron Age in the Levant and northern Mesopotamia.**

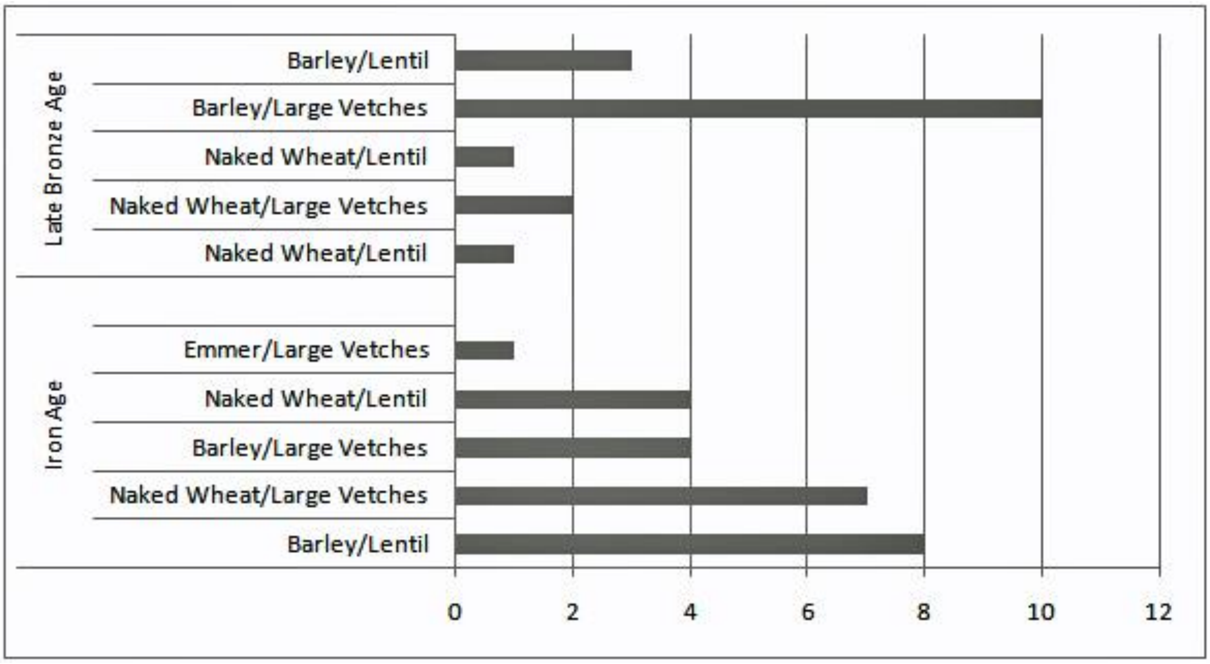


Figure 51 **The number of sites with dominant cereal and pulse taxa according to the proportions of the individual sites during the Late Bronze and Iron Ages.**

6.3.2 Stable carbon isotope results

The Δ^{13}C values of barley at Tayinat differ from those of free-threshing wheat in that they cover a considerably smaller range of values and aside from single measurements show virtually no drought stress signal. In contrast, most of the values for free-threshing wheat appear to indicate drought stress, if the boundaries of 17‰ and 16‰, considered to indicate no or moderate stress in barley, are also applied to wheat (Fig.52). However, due to different agronomic properties and a longer vegetation cycle for wheat, we may expect a generally higher risk of negative effects under arid conditions. Trends toward stronger drought-stress signals for free-threshing wheat under similar conditions have also been documented in experimental studies, suggesting that drought-stress in free-threshing wheat would occur at an interval 1-2‰ lower than in barley (e.g., Aguilera et al., 2008, Wallace et al., 2013). Transferring these results to the data from Tell Tayinat, the difference in Δ^{13}C between barley and wheat thus may well indicate the different physiological properties of the two species under equal conditions of agro-production. Overall, the available data from Tayinat suggests that drought stress was not a major problem in barley cultivation, and may have only affected free-threshing wheat to some degree. Whether selective irrigation practice may have contributed to the broad range of values in free-threshing wheat remains unclear due to a lack of syntheses of modern comparative data for free-threshing wheat.

Comparing the Tayinat Δ^{13}C record for barley to other sites (Fig. 53), it fits well with the chronological trend observed at other sites in geographic regions with coastal environments, which are assumed to have not been affected by drought periods as strongly as inland regions, such as the northern Mesopotamian river valleys.

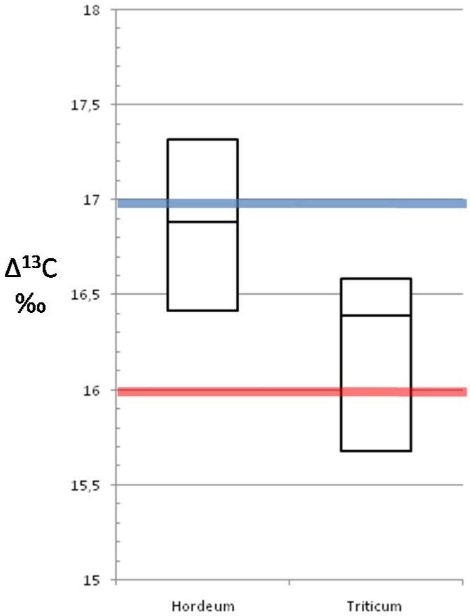


Figure 52 Boxplot of Δ^{13}C values in barley (*Hordeum vulgare*) and free-threshing wheat (*Triticum aestivum/durum*) from Tayinat, showing the range of measurements, 1st and 3rd quartiles and median. Note that the values between blue and red lines indicate hypothetical borderline for moderate water stress for barley. For free-threshing wheat consult the text for more information.

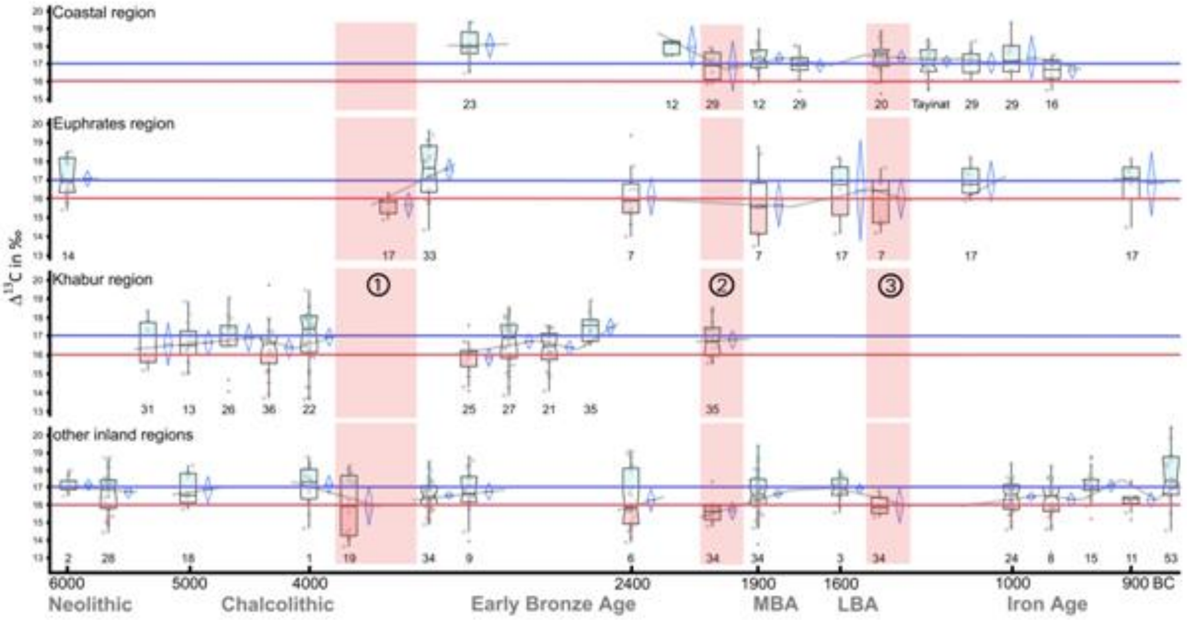


Figure 53 Δ^{13}C record for barley grains from 33 archaeological sites (for key to site numbers, see below); blue diamonds represent means; red line: reference line for drought stress at 16‰ and below; blue line: reference line for favourable conditions at 17‰ and above; red bars: global climatic fluctuations at roughly 5200 (①), 4200 (②) and 3200 BP (③); MBA: Middle Bronze Age; LBA: Late Bronze Age; sampling locations: (1) Abu Hamid, (2) Ain Rahub, (3) Boğazköy, (6) DilkayaHöyük, (7) Emar, (8) Gordion, (9) Hirbet ez-Zeraqon, (11) Kamed el-Loz, (12) Kinet Höyük, (13) Mashnaqa, (15) Nerik (16) Qubur al-Walayida, (17) Shuyukh el-Fawqani, (18) Shir, (19) Tell esh-Shuna, (20) Tell Atchana, (21) Tell Atij, (22) Tell Beydar III, (23) Tell Fadous-Kfarabida, (24) Tell Halaf, (25) Tell Kerma, (26) Tell Kuran, (27) Tell Raqa'i, (28) Tell Tawila, (29) Tell Tweini, (31) Umm Qseir, (33) Tell 'el Abd, (34) Qatna, (35) Tell Mozan, (36) Ziyade, (53) Tel Burna.

6.4 DISCUSSION

It becomes increasingly clear that the collapse of Late Bronze Age territorial states and subsequent developments were complex and varied substantially across sites. Divergent trajectories of settlements, with different rates of recovery from the “collapse” in the late second millennium BC, are evident in much of the Near East (Dever, 1992; Porter, 2016), while more nuanced archaeological approaches assign an important role to cultural continuity superseding the paradigm of a catastrophic break of urban life and literacy during the earlier Iron Age (Mazzoni, 2000b; Harrison, 2010). This being the case, the patterns of agro-production in the Levant during this significant transitional period present an intriguing case-study to comprehend pathways of human adaptation to the altered socio-political settings resulting from the demise of palace-centred economic structures, rather than the probable impact of climate degradation.

Bronze Age administrative records make clear that palatial control over agricultural production focused on a limited number of crop plants; foremost among these was barley, which seems to be the most-circulated agricultural good in the redistributive scheme and single-handedly dominates the majority of agricultural production in the administrative records (see Dornauer 2017 for an extensive treatment of documentary records). In concert with the textual evidence, a prominent feature of Late Bronze Age archaeobotanical assemblages is the prevalence of barley over other cereal crops. The role of barley as a common currency in economic transactions –together with silver– (Liverani, 2014) most probably relates to the fact that this crop taxon provides a stable yield structure under various ecological conditions with its low water demand and tolerance to saline soils (Riehl, 2009a). Similarly, the large-seeded vetches, bitter vetch and grass pea/red vetchling, proportionally appear more often in the Late Bronze Age than lentil or any other leguminous crops, although some exceptions occur. Similar to barley, both bitter vetch and grass pea/red vetchling are well-adapted to poor soil conditions and low water expense, with short growing cycles less prone to crop failure caused by erratic periodicity of rainfall (Riehl, 2009a). Because their seeds are toxic, requiring soaking in water before consumption (Miller & Enneking, 2014), some scholars have regarded these crops as inferior for human use compared to lentil and other pulse crops, but better suited for animal feed (Zohary et al., 2012; Miller & Enneking, 2014). Nonetheless, the widespread appearance of crop plants adapted to low water expense indicates risk management to prevent crop failures and to stabilize crop yields during the Late Bronze Age.

During the Iron Age, the regional plant data show continuity regarding the range of crops cultivated, confirming the earlier findings of Riehl and Nesbitt (2003). On the other hand, the cultivation of drought-susceptible, water-demanding field crops like free-threshing wheat, lentil, flax, and einkorn, as well as arboricultural crops such as olive, grape, and fig, becomes increasingly apparent in their comparatively greater ubiquity scores during the Iron Age. Such focus on the cultivation of drought-susceptible crops is in contrast to the scenarios proposing degrading climatic conditions. Stable carbon isotope measurements on cereal grains from Tell Tweini (site 29 in Fig.42) also do not reflect cereal production that was massively affected by climatic change at the Late Bronze Age-Iron Age transition, as argued by Kaniewski et al. (2003). Rather, our mean Δ^{13}C values suggest only moderate drought stress. There is, however, some variation in Δ^{13}C between different crop species. Particularly during the Late Bronze Age at Tell Atchana (Riehl, 2010a), individual Δ^{13}C determinations of some free-threshing wheat grains tend to be considerably higher than the mean values of barley. This could indicate different crop production technologies, such as irrigation of free-threshing wheat. It is likely that irrigation and/or cultivation on naturally wet soils may have also been practiced by Iron Age farmers.

The distribution of the preferred cereal and pulse taxa reveals an interesting pattern regarding the ecological requirements of crop plants. During the Iron Age, the majority of sites that are proportionally enriched with free-threshing wheat also contain large vetches as the dominant legume crop, while those enriched with barley demonstrate the prominence of lentil. Hopkins describes labour-optimizing goals in the development of agricultural production in early Israelite settlements as being part of a risk management strategy, i.e. “for moving beyond mere coping with risk to risk-reduction through terracing and other special treatments” (Hopkins, 1987, p. 189). Labour optimization may be realized by investing in less laborious crops like free-threshing wheat (see Hillman, 1984 and 1985 for a comparison of crop processing stages of naked and hulled wheats). Risk-spreading is, for example, observable in the increased appearance of bitter vetch. Such a particular pattern, i.e. the combination of stress-tolerant species and low-labour-investment crops, including the maintenance of soil fertility, may be interpreted as a strategy of finding a balance between water and labour input that was probably pursued by Iron Age farmers, rather than relying on the cultivation of drought-tolerant barley and large vetches as their Late Bronze Age predecessors had done (Fig. 51).

There are also local preferences visible among diverse regions in the Levant and beyond. Broad bean, chick pea, and pea are only minor constituents of the crop repertoire, presumably used as an additional nutritional supplement for protein intake. Broad bean has an entirely Levantine distribution, excluding all Mesopotamian sites studied, while chick pea and garden pea appear only sporadically in a few northern Mesopotamian sites (e.g. chick pea at Tell Halaf, garden pea at Tell Sheikh Hamad and Tell Hadidi), and their distribution can be conceived as virtually Levantine. With regard to food preference, Mahler-Slasky and Kislev conceive that “*L. sativus/cicera* was probably an imported choice of food that may be said to be associated with the Philistines, thus making it an “ethnic food”, a component of the

Philistines diet in their Aegean homeland, which they did not give up when they immigrated to the Southern Levant" (2010, p. 2483). Nevertheless, there is not enough evidence in our dataset to assume that the appearance of grass pea/red vetchling in the Southern Levant represents a nostalgic dietary substitute for the Biblical Philistines. The taxon appears relatively frequently in the Late Bronze Age, but on the other hand, none of our records demonstrate its appearance in Philistine sites. In fact, fig. 3 in Mahler-Slasky and Kislev (2010, p. 2483) shows that grass pea/red vetchling was present in just three sites in the whole Southern Levant from Iron II onwards, but not before and never more frequently than bitter vetch.

The prominent focus on high water input during the Iron Age becomes plausible through the cultivation of various taxa, such as olive, grape, fig, pomegranate, and flax that require long-term strategies for soil fertility maintenance and substantial labour input to cultivate. The role of this group of tree crops surpasses pure subsistence, since they are not only economically important, income generating products with respect to long-distance trade (Faust & Weiss, 2005; Faust, 2011; Genz, 2003; Knapp, 1991; Sherratt, 1999), but are also significant in cultural traditions such as anointment ceremonies, feasts, and religious practices (Dothan &Ben-Shlomo, 2007; Güterbock, 1968; Hamilakis, 1999; Hoffner, 1995; Kaniewski et al., 2012; Stager & Wolff, 1981). Olive and fig ubiquities follow the same pattern during the Iron Age, with a decrease in the north and an increase in the south. Wild olive (*Olea europaea* subsp. *oleaster*) is a sclerophyllous species which thrives in dense coastal woodlands, well adapted to the variability and periodicity of rainfall in the Mediterranean basin (Blondel et al., 2014), and its natural distribution widely covers the coastal regions of the Mediterranean (Zohary & Spiegel-Roy, 1975). It is known that water input can significantly increase its yields (Riehl, 2009a). Our data shows that it is present in Late Bronze Age northern Mesopotamian sites but largely absent during the Iron Age in the same region. Fig has been long-valued for its sugar-providing fruits and for timber, and has a wide natural distribution range in the Near East, including northern Mesopotamia and the eastern Fertile Crescent and Caucasus (Zohary et al., 2012). Its general decrease in the northern assemblages is most probably related to poor documentation of the small-sized fig seeds, rather than to widespread abandonment of this crop. The present-day distribution of wild grape (*Vitis vinifera* var. *sylvestris*) also covers a wider range than the typical Mediterranean climatic zone but penetrates into riparian habitats, including northern Mesopotamia (N. Miller, 2008, p. 937). This taxon basically develops well in the Mediterranean Basin, enjoying the sizeable amount of rainfall here, with 500-1200 mm per year (Riehl, 2009a), while it does not tolerate submerged growing conditions and salinity (Powell, 1995, p. 104). The presence of grape pips in our records represents the continuing importance of viticulture in the whole region, which most probably had been practiced without interruption after the Late Bronze Age collapse.

Apart from these three widely occurring arboricultural products, pomegranate appears to have been a minor element of horticulture (Zohary et al., 2012), because archaeobotanical finds are rare in Near Eastern sites, although this crop is part of the visual iconography as early as the Uruk period in southern Mesopotamia (Ward, 2003), as well as in different kinds of symbolic pottery and metal objects in the Iron Age Southern Levant. During the Iron Age, archaeobotanical finds of pomegranate are still rare, but with an increasing number of occurrences in the Southern Levant. Assessing the significance of this increase in the Southern Levant is difficult, but considering the appearance of cultic objects in the form of pomegranates in some Philistine sites (Dothan & Ben-Shlomo, 2007), as well as the material evidence from the Late Bronze Age Uluburun shipwreck (Ward, 2003) and from Tiryns on the Aegean peninsula (Papadimitriou et al., 2015), such an increase may indicate links to groups with a possible westward origin, like the Philistines during the Iron Age.

The regional data on flax/linseed is consistent with earlier observations by Riehl (2009a, p. 106; also see Orendi *in press* for a detailed analysis). Due to its high oil content, the preservation of flax seeds is usually low in archaeological deposits. This may well be a contributing factor to its virtual absence after the end of the Early Bronze Age (Riehl, 2009a). However, the Iron Age in this case is a period of exception, when this crop taxon resurfaces in the Levant in general. The large deposit of flax remains at Iron Age Beth-Shean is rather conclusive, since annual rainfall in the Beth-Shean Valley is too low to support cultivation of flax. This crop taxon requires a substantial amount of water input and depletes soil nutrients during the growing season (Kislev et al., 2011). Interestingly, Beth-Shean is not the only site with evidence of flax located in an unfavourable local climate. Deir 'Alla in the Jordan Valley is another example, indicating that low annual rainfall (200 – 300 mm) was almost certainly supplemented with irrigation to cultivate flax (van Zeist & Heeres, 1973), if it was not an import.

6.5 CONCLUSION

Although the plant evidence presented here has to be considered cautiously, since it lacks phase-by-phase resolution in general, the emerging picture as concerns plant subsistence is that there is no clear evidence that the Late Bronze Age and the Iron Age were periods of dearth and widespread famine, as some climate models have presupposed. On the contrary, the cultivation of drought-susceptible crop plants becomes progressively more widespread during the Iron Age, as shown in our synthetic study. In this manner, the earlier Iron Age can be seen as a period characterized by better accessibility of various crop plants in relation to the breakdown of the old palatial regime and of economic incentives embedded into the Late Bronze Age social structure. That is, the decline of palatial administration at the end of the Late Bronze Age might have opened up a new period of emancipation from former economic ties and obligations between local farming communities and their governing bodies (e.g. taxation, wages, corvée labour, tribute, services). This is akin to the assumption of Tainter (1999, p. 1025), as the collapse might differently affect various social segments in a given society. In place of their reliance upon the broader economic framework of the Late Bronze Age, in which the production of agricultural surplus was critical in maintaining local and regional networks of palatial centres, the earlier Iron Age farming communities, now liberated from either the external domination of the distant Pharaoh and Great-King or of local political leaders, were most possibly able to develop their own versatile subsistence strategies to mitigate diverse risk factors over agricultural production on a more localized level. Further archaeobotanical research will definitely add more to this emerging picture of plant subsistence and agricultural economy, and sharpen our understanding of the impact of diverse environmental, climatic, and social factors on Near Eastern societies.

CHAPTER 7. AGRARIAN ECONOMY AT THE PERIPHERY OF THE NEO-ASSYRIAN EMPIRE

This chapter discusses three interrelated subjects on the cultivation of field crops and perennial trees during the Late Assyrian period (8th and 7th centuries BCE): 1) the organizing role of the Neo-Assyrian provincial administration for agro-production in peripheral regions; 2) the political discourse of abundance and plenty, the resettlement policy and its impact on the subsistence base of the local communities in subjugated regions; 3) the translocation of crop and tree species across the imperial territories and the probable role of Northern Syrian environments in such transference of biological specimens. These three aspects of the agrarian economy have been presented to disentangle the site-specific and regional developments during the 1st millennium BCE.

7.1 INTRODUCTION

Empires are defined as geographically expansive political structures encompassing diverse local communities with different cultural traits (Sinopoli, 1994, p. 159). A significant outcome of imperial expansion depends on the acquisition of regularized revenues through the collection of tax and tributes (Sinopoli, 1994, p. 165). In general, Sinopoli argues that the intensity of imperial involvement in productive processes varies because of several factors in relation to, "… administrative structure, distance to accumulation points (the imperial capital or centers), the distribution of centralized institutions (centers, garrisons, or outposts), and the economic and symbolic significance of specific products" (1994, p. 165). The control over the labor force affected the control of materials, thus direct regulation of agricultural resources could become possible. In this manner, the incorporation into the imperial economic system has significant impact on the local economies, either through "top-down processes" with tribute payments, tax and labor demands or “bottom-up processes” that signify the local and individual responses to the expanding political, economic, and prestige networks (Sinopoli 1994: 171).

The Neo-Assyrian Empire was furnished with a provincial administrative apparatus operating effectively across the different geographies of the Near East (Liverani 1979: 306). During the 8th and 7th centuries when the Neo-Assyrian expansion reached its full zenith, the upper citadels became “landscapes of power” which was marked by substantial building activities in the provincial centers (e.g. Tayinat/Kunulua, Harrison, 2014a, p. 92). The political authority consolidated its legitimacy through a suit of monuments; e.g. palaces, temples, administrative complexes in every provincial center (Harrison, 2014a, p. 92; Liverani, 2012, p. 181). Other administrative measures undertaken by the Neo-Assyrians were the provisions of ploughs, the storage of grains and straws for men, animals or brickmaking and lastly, the acquisition of draught-horses for military and messenger purposes (Postgate, 1974b, p. 237; see also Parker, 2003, p. 541). Moreover, during this period, the standardization of the administration across the empire was undertaken through the yearly issuing of cuneiform texts by eponyms, the monthly calendar, fixed standards to weights and measures during the 7th century (Parpola, 2003; Fales, 2012).

The state-sponsored projects of mass deportations (Oded, 1979) and massive irrigation canals (e.g. Bagg, 2000; Wilkinson & Rayne, 2010) aimed to boost agricultural productivity. Both policies manifested in a significant increase in small rural settlements in the countryside as recorded in many archaeological surveys in the Syrian Jezireh (Wilkinson & Barbanes, 2000; Wilkinson et al., 2005, pp. 37-8) and also the Upper Tigris region (Parker, 2003) during the 8th and 7th century BCE. Two pathways of settlement growth have been described during the Late Assyrian period. One was a natural type of development of the settlement system, covering regions with higher rainfall such as the Upper Khabur, Balikh and Euphrates Valleys. This type of settlement growth was imposed by the direct exploitation of agricultural potential of these regions, without the implementation of large-scale irrigation systems. On the other side, the Lower Khabur Valley represents the artificial type of settlement growth, where the Assyrians built massive irrigation systems and forcefully resettled the population from other regions. The outcome of this interference was the significant increase in the agricultural capacity of the region and possibly even neighboring regions (Morandi Bonacassi, 2000, pp. 382-3).

The administration was centered in the capital city of every province. The most basic role of provincial administration was to carry out the collection of commodities for the central government in Assyria (Postgate, 1974a). The Neo-Assyrians distinguished their territories directly administered within the "Land of Assur", from the rest of the subjugated territories, such as the vassal/client kingdoms to the west of the Euphrates River (Postgate, 1992, p. 251). For example, the provinces within the "Land of Assur" were obligated to provide cultic offerings to the Assur temple, Assur was the national god of the Assyrians, situated in the town of Assur (Postgate, 1974a). On the contrary, client/vassal kingdoms were subjected to annual tribute payments of valuables (e.g. precious metals, linen garments, livestock). Specifically, these contributions were held by the king and high officials but not temples. Assyrian administration, in its entirety, was embedded in agricultural production to perform its duties,

> "State-owned land given as maintenance land, called *ma'uttu,* to the holder of an office as a provincial governor was the primary means to sustain the administration. Maintenance lands are also attested for such institutions as the royal tombs in Assur. While a fixed share of these estates' yield had to be handed over the state to support the central administration the remaining share was to sustain the holder's office …"
> "By using its crops as temple offerings and as provisions for the temple staff, land was the important means to support temples. It was king's responsibility to see to it that temples had sufficient land at their disposal. He did so by donating land to the temples, but also by bestowing land onto people who were supposed to use part of their fields' yields as provisions for the temples … " (Radner 2000: 243).

Provincial governors were expected to store grains and straw in case of a military campaign passing through their territories. The “village-inspectors” were responsible for the administrative issues of the countryside under the direct control of a governor (Postgate, 1974a, 1992, p. 256). For instance, the Assyrian Doomsday Book (or alternatively known as Harran Census) is a unique example of such recording of agricultural assets and labor. This is a group of tablets which were recovered at Nineveh, possibly either tax imposition or tax exemption records, describing small holdings in the Harran region (Şanlıurfa Province of modern Turkey) according to the size and use of land, presence of buildings, stock of animals, the quantity of attached personnel listed by sex and age (Postgate, 1974b; Lipinski, 1998 for an Aramean perspective on the same textual evidence).

Another important subject of investigation is the question how the political discourses shaped agricultural production across the Neo-Assyrian territories. A recurrent rhetorical theme in the Assyrian royal annals is the role of the king bringing prosperity and abundance to the desolate countryside (Grayson, 1991; Radner, 2000; see Rosenzweig, 2016, 2018 for an archaeobotanical approach; Winter, 2003 for iconographic examples)[30]. One of several epithets of the Assyrian king was “cultivator” (Radner, 2000) echoed in the recurrent emphasis of abundance and plenty of resources in their words such as “establish[ed] plenty, prosperity and abundance in his land”, “heap[ed] on abundance and plenty”, “provide[d] abundance and prosperity in the fields of Assyria” (Winter, 2003; Collins, 2006). The iconographic representations of “abundance” of flowers, trees and agricultural produce appeared on artistic mediums such as jewelry, wall reliefs, and carvings (Winter, 2003). Winter argues that the symbolic systems and representational strategies aimed to “create a

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[30] Such narrative, in fact, has a lengthy history in the Near East (Winter, 2007 for an overview and the references therein; Miller, 2013 same subject for the Royal Cemetery of Ur) and found in other contemporary Luwian and Aramaic inscriptions from the Syro-Anatolian geography (Hawkins, 2000) including Tell Tayinat (Harrison, 2014, see below *Chapter 8* for the context of the Tell Tayinat Inscription 2).

receptive social environment in which authority structures needed for a requisite surplus could be reinforced" (2007, p. 118).

Moreover, Assyrian domination in the Near East also presents an intriguing case for the translocation of biological specimens towards the Assyrian coreland (e.g. Reade, 2004). Bagg (2000, p. 315) considers this within the framework of agrarian politics. The physical transference of biological organisms represented another propagandistic means to impose the political control over an imperial domain. During this period, the royal annals and correspondences involve rigorous recordings of the number of trees and shrubs with their original provenance and the reason for what they were used (Postgate, 1992, Chart 1; Radner 2000, p. 239). This practice is known since the time of Tiglath-pileser I (1174 – 1076 BCE) (Bagg, 2000) while more recordings appear during the Late Assyrian period (Postgate, 1992b). The ideological cosmos of the empire has been remodeled in the royal gardens and game parks in the Assyrian heartland (e.g. Foster, 1998; Radner, 2000; Reade, 2004). More interestingly, Radner suggests that the rhetorical language of "the king's role as horticulturalist" or "gardener" in royal annals resembles the language of imperial resettlement strategy, "… which likens the deportees to precious tree that are uprooted and replanted in the best possible circumstances" (2017, p. 210).

As the Neo-Assyrian empire incorporates much of the Near East under a new political and administrative rubric, the crucial question to ask would be whether or not programmatic agrarian politics were executed in similar managerial principles throughout the Empire (e.g. technology of ploughs or hydraulic systems). For instance, did Neo-Assyrians introduce novel agricultural implements for milling and grinding to produce flour more effectively? Or did they ever transfer the "seeder's plough" -which was used in Southern Mesopotamia since time immemorial (Postgate 1992c)- to the peripheral regions like the Levant? It is also rather unknown how much of the repeated discourses of abundance/plenty is rhetorical and how much of these discourses involve actual political intervention of the Assyrians over agricultural and arboricultural production (see Radner, 2000 for an extensive treatment of the issue from the textual evidence; Rosenzweig, 2018 for an archaeobotanical approach). Similarly, as mentioned before in *Chapter 6,* previous archaeobotanical studies demonstrate that the beginning of the Iron Age marks a gradual introduction of new crop types such as millet, sesame, rice-and perhaps cotton if the Assyrian reference to a "woolly plant" is taken into consideration (Riehl & Nesbitt, 2003). However, whether or not the Assyrians designed crop packages or intentionally introduced novel crops to be cultivated by their imperial subjects was hardly ever investigated from an archaeobotanical perspective.

Investigating the Tayinat plant assemblage in combination with the regional occurrences of the novel crops, of which we know their use from late 1st millennium BCE textual resources, can be beneficial to answer some of these questions. Specifically, Tell Tayinat/Kunulua as the capital town of an Assyrian province (Patina/Unqi) can demonstrate many aspects of the Assyrian interference in agricultural life. In this chapter, there will be three research questions under investigation: 1) *Were there any discernible changes in the crop assemblage of Tell Tayinat indicating the organization and management of agricultural practices in the Neo-Hittite and Late Assyrian periods?;* 2) *How were the economically-important field and tree crops distributed during the 1st millennium BCE?; 3) What were the process(es) for the transference of crop products across various regions of the Near East during the 1st millennium BCE?*

7.2 MATERIALS and METHODS

7.2.1 Archaeobotanical data

Iron II samples were recovered from Field 7. In total, 19 samples were analyzed which correspond to ca. 230 liters of sediment. The samples yielded 717 seeds and fruits. For the Iron III, 25 soil samples were analyzed from Field 5 which corresponds to 315 liters of sediment. These samples yielded 956 seeds and fruits. Percentage, find density and ubiquity analyses were applied to the dataset. For clarity, some plant categories have been amalgamated to single taxa as in previous chapters.

7.2.2 Regional plant data

Surveying regional plant data has been done from the online database *ademnes.de*. The data on the typical Near Eastern crops has been recorded as presence/absence from the beginning of Iron Age (ca. 1200 BCE) to the end of 1st millennium BCE. This data has been analyzed with ubiquity scores.

Additionally, some rare field crops, perennial trees and condiments/spices were added into the dataset as presence/absence for the same period. These field and tree crops include summer crops (broomcorn and foxtail millet, sesame, and rice), perennial trees (almond, apple/pear, walnut, hazelnut, carob, pistachio, apricot, and peach) and condiments/spices (coriander, cumin, and fenugreek). The information on these selected crop species were analyzed for their distribution across the Near East.

The datasets have been divided into three broad periods, namely 1200-900, 900-500, and 500-0 BCE. In general, this periodization does not coincide with any local chronological sequence found in the Near Eastern archaeology. Although this periodization seems to be simplistic at first glance, the basic difficulty to place the archaeological settlements into the correct chronological framework was the large number of archaeobotanical studies that only reported according to local chronologies; thereby the lack of 14C dates. For this reason, this chronological division has to be conceived as preliminary in this study.

The 1200 – 900 BCE interval largely coincides to the Iron Age I developments in the Near East. This is basically a northern Levantine chronological scheme (Mazzoni 2000b). The end of the Late Bronze Age in the Southern Levant conventionally ascribed to the retreat of the Egyptian Empire during the 20th dynasty ca. 1130 BCE (LB III). In this case, the LB III sites in the Southern Levant were also amalgamated with the Iron I sites of the Northern Levant within the interval of 1200-900 BCE. This interval also covers the Middle Assyrian sites in Northern Mesopotamia. This sequence covers from the 13th to the 10th centuries. Since the larger portion of this timeframe coincides with the Northern Levantine Iron Age I, this local sequence was also added into the 1200 – 900 BCE timeframe. On the other hand, the 900 – 500 BCE timeframe saw the imperial expansion and increasing trade networks in the Near East. This makes an enrichment of local chronologies like the Neo-Hittite, Neo-Assyrian (Late Assyrian), the Urartian, the Phyrgian, the Greek Protogeometric andthe Greek Archaic period. All of these periods were studied together. The final episode, 500 – 0 BCE basically covers the developments of the Achaemenid, Hellenistic, Parthian and Roman periods.

7.3 RESULTS

7.3.1 Overall characteristics of plant assemblage in the Iron II and III periods at Tell Tayinat

The overall results gathered from Field 7 and 5 indicate that there was no change in the crop spectrum from the Iron II to the Iron III. The crop spectrum includes typical plants from preceding periods. The only important additions were almond and pistachio during these periods (Table 11). The most common preservation condition is carbonization in both fields.

Also, there are several mineralized specimens recovered from Field 5. Apart from some objects with obvious morphological characters easy to identify,many of these objects are left unidentified.

7.3.1.1 Cereals

Cereal crops are limited to free-threshing wheat, barley and to a much lesser extent emmer wheat. Einkorn wheat is completely absent in the crop assemblage. Free-threshing wheat and barley are by far the best-represented cereal taxa. During the Iron II, the ubiquity scores of free-threshing wheat and barley indicate that barley was more frequently represented in the analyzed samples. Free-threshing wheat tends to have always greater proportions than barley in the Iron II since the free-threshing wheat appears concentrated in certain deposits. In the subsequent period, the Iron III, the ubiquity scores of free-threshing wheat become higher than barley reaching up to ca. 65% and decreasing to ca. 46% for barley. The proportions of free-threshing wheat remain steady from the Iron II value in the Iron III (Table 11).

The chaff remains of all cereals are almost absent in both periods. Only few cereal chaff remains were recovered from these samples. Free-threshing spikelet bases appear more frequently than the chaff remains of barley and emmer wheat. The morphological characteristics of the free-threshing spikelet bases resemble closely *Triticum durum,* but it should be noted that many of these objects were severely corroded. For this reason, these objects were classified under the category of *T. durum/aestivum* spikelet base.There is only one barley rachis object that was found in the Iron II deposits, while none was found in the Iron III. The ubiquity scores of emmer and free-threshing wheat chaff remains are about 15%.

7.3.1.2 Pulses

The same trend recorded in previous periods has also been identified during both periods under investigation. The amalgamated category of *Vicia/Lathyrus* is the most prominent leguminous crop taxon; followed by lentil in lower proportions and prevalence than the *Vicia/Lathyrus* category. Other pulse crops (faba bean, pea, chick pea) are consistently absent during both periods (Table 11).

7.3.1.3 Flax/linseed

The flax objects appear in two samples of the Iron II assemblage. Many objects (n=8) were concentrated in one particular sample (SA 9477). On the other hand, no flax object have been found in the Iron III deposits, except in and around Building XVI (see *Chapter 8*for more details).

7.3.1.4 Wild plants

The larger part of wild plant assemblage is composed of three categories; *Lolium* (ryegrass), *Phalaris* (canarygrass) and *Melilotus/Trifolium* (clovers). Only these tree taxa composed about 60 % of the entire Iron II assemblage and 50% of the Iron III assemblage. Among the wild/weedy plants recorded for both phases, the wild leguminous plants (e.g. *Prosopis* cf. *farcta*, *Trigonella*, *Securigera securigeda*) appear within a range of 5% - 15% in the Iron II. During the Iron III, however, the ubiquity scores of all wild leguminous plants increased to over 10%. Equally interesting is the absence of *Anthemis cotula*. This wild taxon was so ubiquitous, in the EBA and the Iron I in its entirety, but the subsequent two periods show only insignificant occurrences. The remaining taxa occur only infrequently in the assemblage. Similarly, the genera of the Rubiaceae family were also comparably ubiquitous, during the EBA and the Iron I, becoming less pronounced during the subsequent periods (Table 11).

There are no new plant taxa in the wild plant assemblage which were not recorded in other periods. However, the botanical contents of SA 9477 are an exception. This sample contains a comparably good amount of flax finds (n=8) as mentioned before, as well as some floristic elements, belonging to the Brassicaceae (mustard) family, some unidentified plant objects which have never been recorded in other Tell Tayinat deposits before (Table 11).

7.3.1.5 Tree crops

The typical tree crops, olive, grape and fig appear in the assemblage alongside to almond and pistachio (n=1) finds. The ubiquity scores of olive pits are 31% and 34% respectively in Iron II and Iron III. A similarly steady increase was also recorded in the percentage of this taxon from about 0.80% to over 1% of the assemblage during the Iron II and III subsequently. In regards to the ubiquity scores of grape pips, 40% scores follow by an increase in the Iron III to 60%. Also, the percentage of grape finds is getting higher during the Iron III. Another tree crop, fig, has a somewhat different pattern. The ubiquity scores indicate much lower values for the Iron II (10%) and then increase to 26% during the Iron III. Despite the fact that the Iron II is a period of decreasing percentage for this crop taxon compared to Iron I, the Iron III also shows an increased percentage to about 1% in line with the other two abovementioned tree crops (Table 11).

The two other tree fruits, almond and pistachio, appear less frequently and in low counts. There was only one pistachio object which had been recovered from the Iron III. Almond shells appear with only one count in the Iron II. During the Iron III, however, six objects were recovered. The ubiquity scores reached about 25% during this period. The percentage of almond remains was also comparatively higher in the Iron III than the previous period.

PERIOD	IRON II	IRON III	IRON II	IRON III	IRON II	IRON III	IRON II	IRON III
	Counts		Ubiquity		Proportions		Find density	
	Total no of counts		Total no of samples				Total soil sediment	
TOTAL	687	920	19	26			230,50	315,00
Crops								
Hordeum vulgare	17	58	63,16	46,15	2,37	6,07	0,07	0,18
Hordeum vulgare (rachis)	1		5,26	0,00	0,14	0,00	0,00	0,00
Triticum spp. (fr. thres/gl.)	10	27	21,05	46,15	1,39	2,82	0,04	0,09
Triticum aestivum/durum	65	86	47,37	65,38	9,07	9,00	0,28	0,27
free-threshing wheat (spikelet bases)	1	5	5,26	15,38	0,14	0,52	0,00	0,02
Triticum dicoccum	5		15,79	0,00	0,70	0,00	0,02	0,00
Triticum dicoccum (spikelet bases)	2	5	10,53	19,23	0,28	0,52	0,01	0,02
Vicia/Lathyrus	16	31	52,63	46,15	2,23	3,24	0,07	0,10
Lens culinaris	3	12	15,79	26,92	0,42	1,26	0,01	0,04
Olea europaea	6	11	31,58	34,62	0,84	1,15	0,03	0,03
Vitis vinifera (all objects)	19	30	42,11	61,54	2,65	3,14	0,08	0,10
Ficus carica (carbon. + mineralized)	4	11	10,53	26,92	0,56	1,15	0,02	0,03
Linum usitatissimum	9		10,53	0,00	1,26	0,00	0,04	0,00
Amygdalus sp.	1	6	5,26	23,08	0,14	0,63	0,00	0,02
Pistacia cf. lentiscus		1	0,00	3,85	0,00	0,10	0,00	0,00
Coriandrum sativum		1	0,00	3,85	0,00	0,10	0,00	0,00
Wild Plants (>10%)								
Lolium sp.	338	380	73,68	96,15	47,14	39,75	1,47	1,21
Phalaris sp.	36	45	63,16	69,23	5,02	4,71	0,16	0,14
Hordeum spp. (wild and frags, NISP, >4mm)	3	5	15,79	15,38	0,42	0,52	0,01	0,02
Phleum cf. phleoides		4	0,00	11,54	0,00	0,42	0,00	0,01
Poaceae, indet. (large)	2	17	10,53	19,23	0,28	1,78	0,01	0,05
Poaceae, indet. (medium)	34	32	47,37	30,77	4,74	3,35	0,15	0,10
Poaceae, embryo (indet.)	4	7	10,53	19,23	0,56	0,73	0,02	0,02
Coronilla sp.	5	5	10,53	19,23	0,70	0,52	0,02	0,02
Scorpiurus sp.	1	7	5,26	23,08	0,14	0,73	0,00	0,02
Prosopis cf. farcta	4	1	15,79	3,85	0,56	0,10	0,02	0,00
Securigera securigeda	2	4	10,53	15,38	0,28	0,42	0,01	0,01
Medicago sp. (+pod frags)	5	3	10,53	11,54	0,70	0,31	0,02	0,01
Melilotus/Trifolium	53	54	57,89	65,38	7,39	5,65	0,23	0,17
Fabaceae, indet (large)	4	7	10,53	19,23	0,56	0,73	0,02	0,02
Bupleurum sp.	2	8	10,53	11,54	0,28	0,84	0,01	0,03
Apiaceae, indet. small-seeded	5	2	10,53	3,85	0,70	0,21	0,02	0,01
Centaurea type	3	1	10,53	3,85	0,42	0,10	0,01	0,00
Scirpus maritimus	1	5	5,26	19,23	0,14	0,52	0,00	0,02
Rumex sp.	17	17	31,58	34,62	2,37	1,78	0,07	0,05
Thymelaea sp.		3	0,00	11,54	0,00	0,31	0,00	0,01
Ornithagalum/Muscari	3		10,53	0,00	0,42	0,00	0,01	0,00
Malva sp.	6	6	10,53	19,23	0,84	0,63	0,03	0,02
Characeae (modern?)		23	0,00	19,23	0,00	2,41	0,00	0,07

Table 11 Crops, crop by-products and wild plant taxa (over 10% ubiquities) during the Iron II and III at Tayinat.

7.3.2 Regional distributions of selected crops and condiments/spices

The ubiquity scores of field and tree crops indicate little change during the course of the 1st millennium BCE. The dominant feature in the dataset is the prevalence of two cereal crops; barley and free-threshing wheat. Barley becomes more common in later 1st millennium BCE in comparison to the time interval between 1200-900 BCE. Free threshing wheat shows steady scores in all three investigated time intervals. Emmer wheat is less frequent than these two cereals. Emmer wheat also shows the same steady trends in the region-wide occurrences (Fig. 54).

The ubiquity scores of pulses demonstrate a clear patterning. Bitter vetch finds decrease from about 70% in the timeframe 1200 – 900 BCE to 40% during the rest of the 1st millennium BCE. Similarly, grass pea/red vetchling shows a similar trend of decrease during the same periods. 30% scores fall down to 20% during 900-500 BCE and about 10% during the 500-0 BCE time intervals. Lentil values increased about 5% from 1200-900 to 900-500 BCE following a decrease during the second half of the 1st millennium BCE. An increase is visible for the rest of the leguminous crops. Other pulses, chickpea and pea, demonstrate a consistent increase in the second half of the 1st millennium BCE. Faba bean values remain steady over the course of the 1st millennium BCE (Fig. 54).

The flax finds diminish steadily to lower values, from about 30% to 10% occurrences, during the course of the investigated time intervals.

The four tree crops investigated here show varying degrees of occurrences. Grape is by far the most widely occurring tree crop, showing higher scores of ca. 60% until the second half of the 1st millennium BCE, then a decrease of ca. 30% is recorded in our study. Theubiquity values of fig and olives vary during the three timeframes investigated. The scores of both tree crops change within a range of 10% between different time intervals. Otherwise, their scores remain more or less steady. The lower values of olive are recorded at 39% in the 500-0 BCE interval whilst the highest with 49% is from 1200 – 900 BCE. The fig finds become more common in the 900 – 500 BCE and 500-0 BCE time intervals. However, the degree of increase is only ca. 5%. Pistachio (*Pistacia atlantica/palestina*) remains appear less frequently than others (<10%). However, a slight increase happens during the second half of the 1st millennium BCE (Fig. 54).

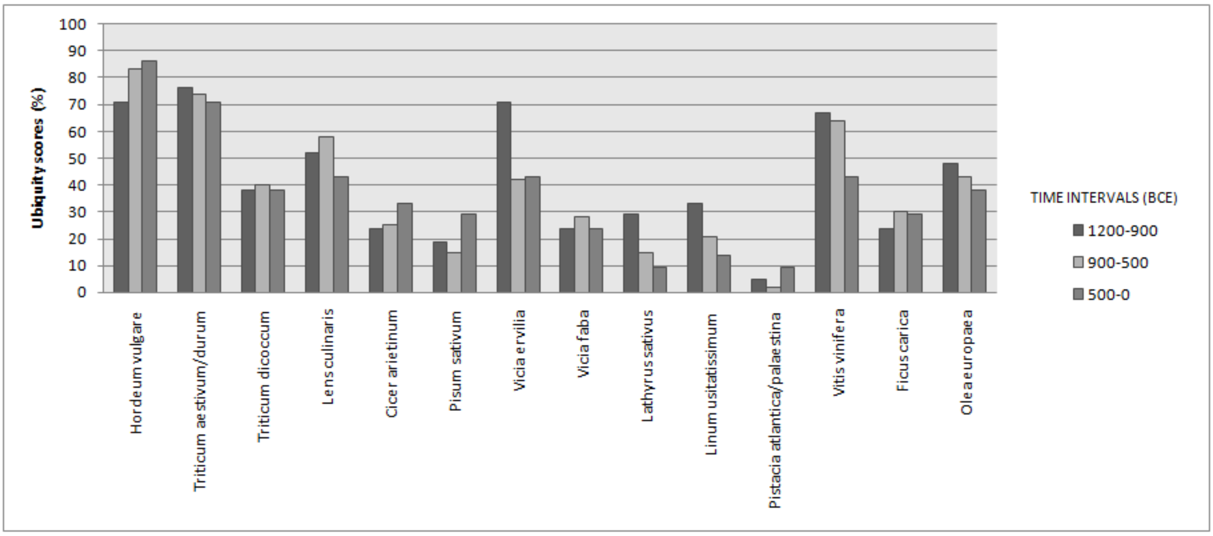

Figure 54 The ubiquity scores of field and tree crops from the beginning of Iron I to the end of the1st millennium BCE.

The Tayinat plant assemblage doesn’t contain any summer crops, such as foxtail and broomcorn millet, sesame or rice. Foxtail millet was somewhat less ubiquitous around the Near East. It is apparent in our survey that broomcorn millet achieved wider usage. Despite its absence at Tayinat[31], broomcorn millet is readily available in the Cilician Plain at Kinet Höyük in the Iron Age. The evidence for this crop plant is further found on the Eastern Anatolian Plateau or at Northern Mesopotamian sites like Nimrud, Tell Sheikh Hamad (Fig. 2). Sesame appears less often in a few sites only. Rice is only recorded in one settlement in the 500 – 0 BCE time interval (Fig. 55).

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[31] Also note that sesame appears at LBA Tell Atchana reported by Cizer 2016 while the remaining plant taxa is absent in this site.

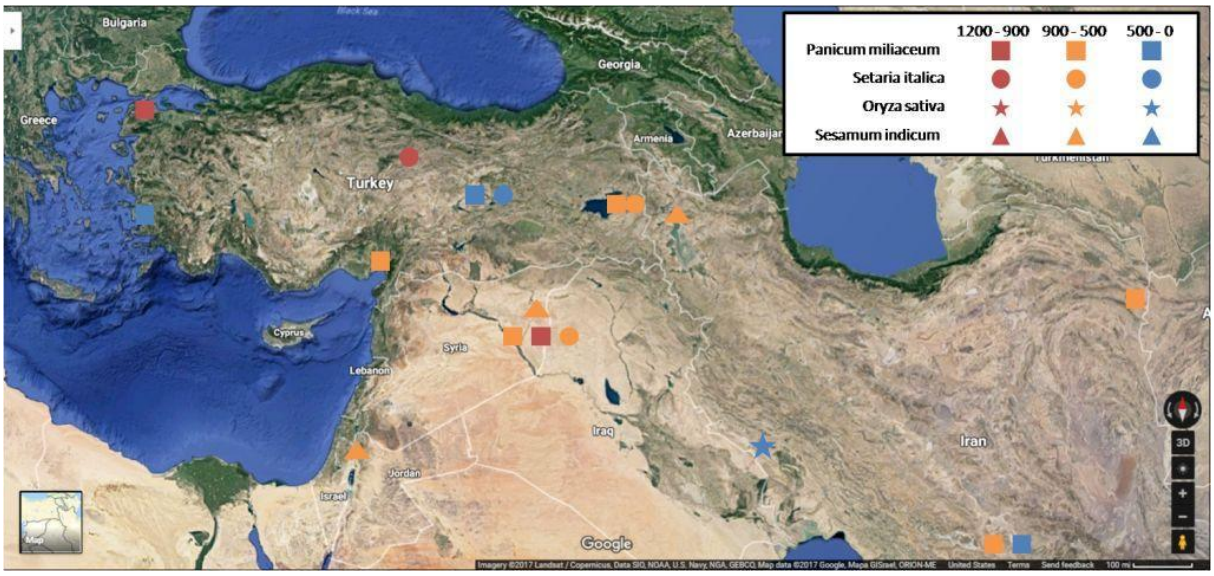

Figure 55 Regional distributions of *Panicum miliaceum* (broomcorn millet), *Setaris italica* (foxtail millet), *Oryza sativa* (rice), and *Sesamum indicum* (sesame).

The finds of almond shells at Tayinat were recovered from the Iron II and III. Accordingly, the regional almond records increased during the 900 – 500 BCE timeframe. The remains of other fruit-bearing trees such as hazel, walnut, pomegranate are totally absent in the Tayinat assemblage. They become more widespread during the 900 – 500 and 500 – 0 BCE timeframes, *albeit* still in low occurrences. Hazel only appears with one record at Nimrud in the 900 – 500 BCE interval from the Late Assyrian period (Fig. 56).

Another group of tree fruits, apple/pear, apricot, peach, and carob, has been reported more sporadically across the Near East in many cases. Regional distribution of these tree taxa indicate a mid-1st millennium date for their appearance. None of these tree taxa appears at the Tayinat assemblage. Apple/pear, on the other hand, appears in northern Syria at Zincirli and further west at Troy. Peach and apricot remains occur in geographically distant regions like Eastern Anatolia and the southern Levant. Two occurrences of carob have been reported from the southern Levant during the 900 – 500 and 500 – 0 BCE time intervals (Fig 57).

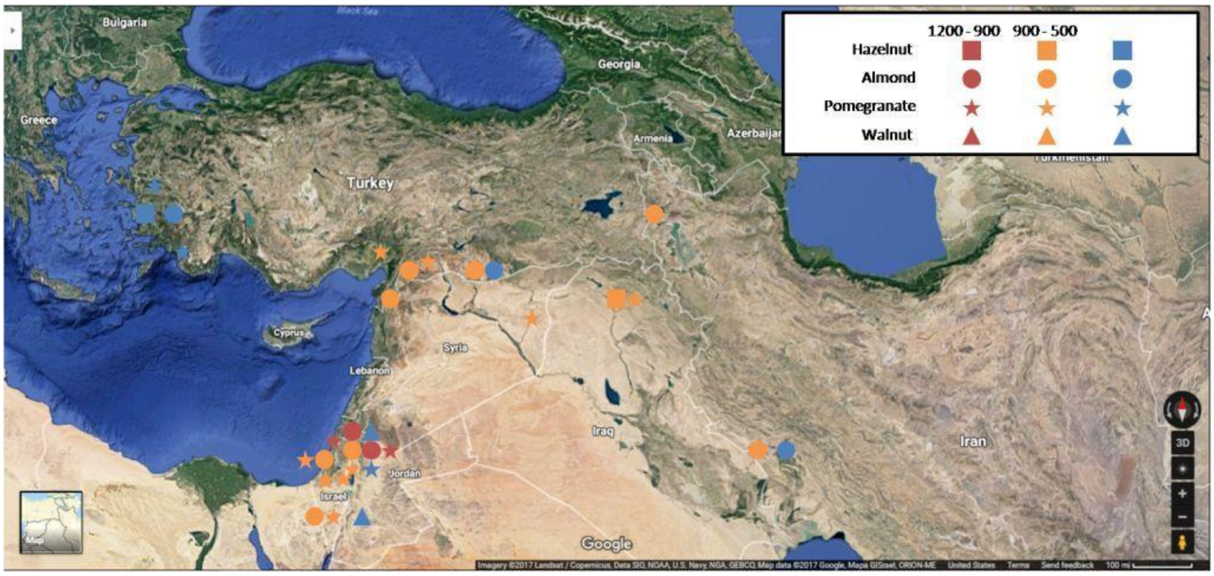

Figure 56 Regional distributions of *Corylus avellena* (hazelnut), *Amygdalus* sp. (almond), *Punicum granatum* (pomegranate), and *Juglans regia* (walnut).

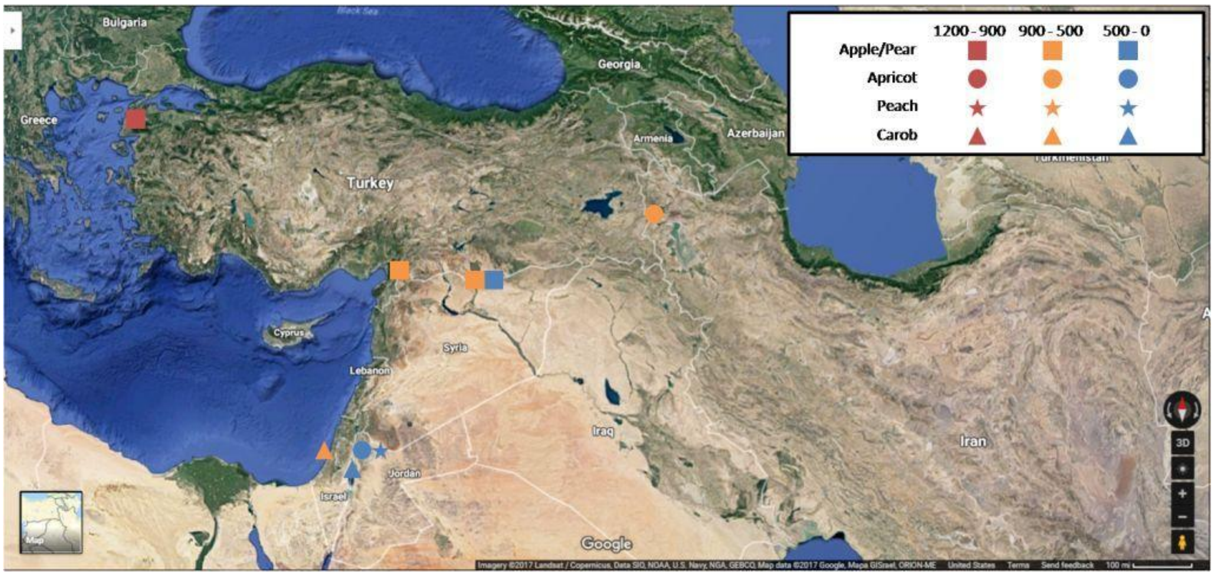

Figure 57 Regional distributions of Malus/Pyrus (apple/pear), *Prunus armeniaca* (apricot), *Persica vulgaris* (peach), and *Ceratonia siliqua* (carob).

In the case of some other economic plants like condiments and spices, the three taxa analyzed in this study, fenugreek, coriander and cumin, demonstrate a strong Levantine concentration, although some have been recorded in Mesopotamia and Eastern Anatolia. The Tayinat assemblage includes two of these taxa, fenugreek and coriander, from the beginning of the Iron Age onwards. Coriander has been recorded somewhat more often at Tayinat and around the Near East (Fig 58). Cumin, on the other hand, is reported in two cases.

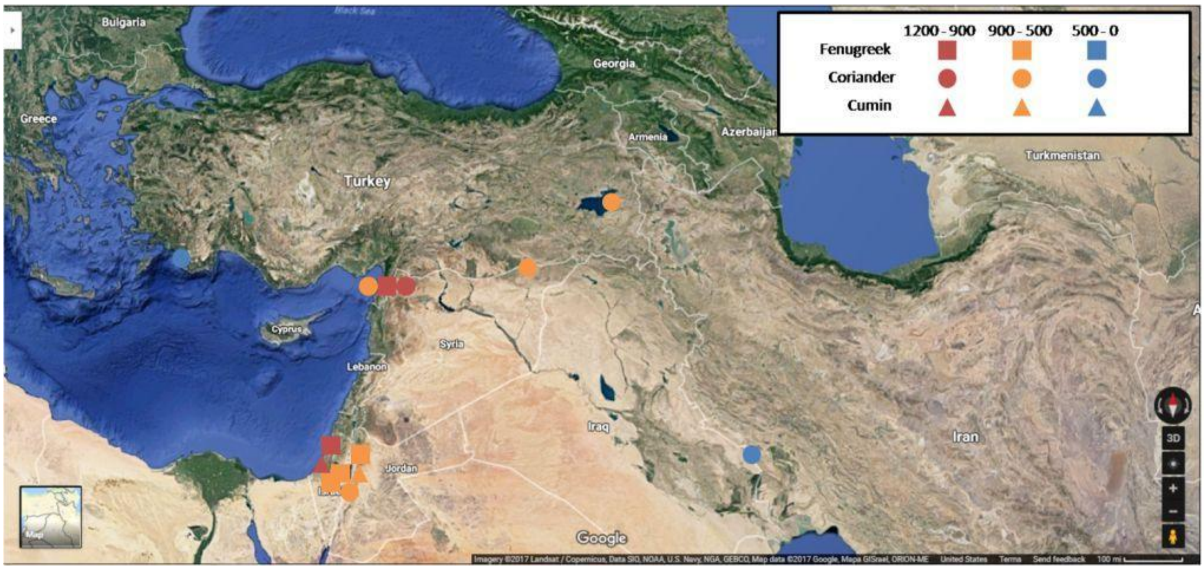

Figure 58 Regional distributions of *Trigonella foenicum-greacum* (fenugreek), *Coriandrum sativum* (coriander), *Cuminum cyminum* (cumin).

7.4 DISCUSSION

The general characteristics of the crop repertoire at Tayinat illustrate that the range of crops remained smaller in comparison to the earlier periods. The crop assemblage doesn’t include some crop plant like chickpea, pea, faba bean, einkorn wheat. Emmer wheat should be considered in this group because it appears in very low counts. However, this figure could be related to inhomogeneous sampling rather than representing the actual situation in the settlement. The Iron II and III exposures at Tayinat were recovered from a limited expanse of the excavated area within the confinement of the upper citadel of Tayinat. For this reason, it was not possible to evaluate the archaeobotanical remains for their spatial distributions across the urban layout of Tayinat (e.g. comparison of upper citadel and lower town). Potentially significant results were achieved at Ziyaret Tepe/Tushan (Rosenzweig, 2018 and previous contributions of this author) by comparing plant assemblages in the palatial and temple monuments in the upper citadel and residential buildings in the lower town. Rosenzweig notes that the plant assemblage from the lower town did consistently include a wider range of crop plants and other edibles from wild plants (2018). This is significant to understand food practices amongst different segments of the ancient inhabitants. Because of the lack of such clarity, an accurate conclusion on the food economy at Tayinat from the archaeobotanical finds remains elusive. This sort of investigations awaits more archaeological excavations on the site (see below). For that reason, current results should be conceived preliminary at best.

The plant deposition in the “Gate Complex” in Field 7 can have some ritual significance comparable to the depositional characteristics to Building XVI (see *Chapter 8*). Field 7 is situated to the south of Building XVI. Several large statues were unearthed over the years from the so-called “Gate Complex”. Ussishkin reports in such special contexts the burials of monuments in several Neo-Hittite towns (1975). A similar situation may have happened in this excavation unit. Therefore, it should be kept in mind that the burial of these large statues may have been accompanied by religious ceremonies and perhaps food offerings. We have analyzed sediments that were mostly recovered from several ashy lenses from around these large statues.

The Field 5 contains the archaeological remains of an administrative complex during the Late Assyrian period. The plant remains collected from these deposits show a very high amount of charcoals. This means dung burning was not particularly important in the formation of plant assemblage. Another significant aspect is the high number of mineralized objects in Field 5. Usually such concentrations of mineralized seeds and fruits are interpreted as the presence of a cesspit or general rubbish dump if the mineralization is not related to the local chemical conditions of soils in the excavation area (Fairbairn et al., 2018).

7.4.1 Agriculture and economy during the Iron II and III at Tell Tayinat

The agricultural economy of the Neo-Hittite states is understudied because the contemporary documentary sources are silent on this subject matter. The surviving texts largely deal with the data on warfare, kingly achievements and ritual practices. Only a small fraction of these texts are of some economic importance and usually are suffering from metrological uncertainties (e.g. KULULU LEAD STRIPs and FRAGMENTs deal with barley/grain and stock animals as well as listing private houses by sex and number of oxen, see Giusfredi, 2010 for the evaluation of these texts). However, their historical and social contexts are unclear. On the other hand, logic dictates, that regarding their geographical position, the Neo-Hittite kingdoms must have had close economic relationships with their more powerful neighbors like the Urartians, the Phyrgians and the Assyrians (Giusfredi, 2010, pp. 171-5, pp. 208-66) and/or with Phoenician and Greek merchants through Mediterranean maritime trade (Watson-Treumann, 2000/2001).

Basically, our knowledge on the Neo-Hittite economy has been deduced from external Assyrian sources like tribute payments imposed by several Assyrian kings during their military campaigns spanning centuries. These tribute lists contain precious commodities such as silver, gold and other metals, various types of herd animals and linen garments paid by Neo-Hittite states (Giusfredi, 2010). Radner mentions that the silver acquired from Carchemish especially became a turning point for the prevalence of silver standard in transactions in the Assyrian coreland rather than copper standard (2017, p. 215). Moreover, textual records show that this town was a major trade hub connecting Anatolia, Levant to Mesopotamia. The wine prices were lower in Carchemish in the Middle Bronze Age since the town served to fillings the jar for purchase (Powell, 1995, p. 108).

Due to the lack of economic texts matching the evidence of the Ur III (Ellison, 1981) or Neo-Babylonian (Jursa, 2014) periods, archaeobotanical remains can hint at some clues on the subsistence base of the Northern Levant during the Iron II and Iron III. At Tayinat, cereal crops were confined to barley and free-threshing wheat, whilst the absence of emmer wheat is typical for the Iron II and III periods. The ubiquity scores of barley demonstrate a decrease from the Iron II to the Iron III. This decrease could be indicative of the storage of this crop for administrative purposes (e.g. paying wages to the workers or for upcoming military campaigns). Free-threshing wheat, instead, demonstrates an increase in ubiquities which can be related to its increased prominence for the culinary use of this crop. Emmer wheat grains were somewhat totally absent in the Iron III. The diminishing role of emmer wheat in subsistence after the end of the Early Bronze Age has been previously mentioned (Riehl, 2009).

The lack of cereal chaff remains is consistently observed in both periods. As mentioned before in Chapter 5, it has previously been argued that the appearance of chaff remains in quantity may indicate storing the cereals in its hulled stage and their piecemeal processing on a day-by-day basis (Hillman, 1981). This type of crop storage had been identified at several sites before and argued to be beneficial for preventing insect infestation in the storage unit. Therefore, this practice aimed to reduce the crop loss through external factors (G. Jones, 1987; Nesbitt & Samuel, 1996, pp. 50-1). The lack of chaff remains at Tell Tayinat may indicate that the crop-processing stages were handled somewhere off site and only the prime grain had been transported to the site for consumption.

This is also evidenced in the composition of the wild plant assemblage. Three wild/weedy plants (ryegrass, canarygrass and clovers) were previously common constituents of Tayinat plant assemblage and became more frequent during the periods under consideration. This should be attributed to the same evidence of the lack of chaff remains. These three contaminants were particularly difficult to sort out during the field operations, as they mimic the growing habit of the crop plants. Hand-sorting before food preparation is necessary to prevent these contaminants getting mixed into the food products. Therefore, it is highly probable that the crop products were brought into the site as clean as possible, away from chaff and wild plants.

It is rather interesting to see that the wild leguminous plants were well-represented in contrast to FP6 assemblage of Iron Age I. The occurrences of this group of plants are most reminiscent to the sample composition of the Early Bronze Age levels of Tayinat and Level 5-4 of Tell Atchana. Another significant aspect is the absence of small-seeded grasses in both periods, unlike FP6 of the Iron I, when this group of taxa was abundant in the assemblage. The resemblance of the Iron II and III wild assemblages compared to the earlier periods, except FP6, demonstrate the fact that there is a continuous trend for floral elements in the agricultural habitats around Tell Tayinat.

Among others, the near-absence of *Anthemis cotula* (stinking chamomile) is interesting because this species is generally very abundant in the Early Bronze Age and the Iron I assemblages of Tell Tayinat. The species can stay dormant in the soil for up to 25 years which makes it difficult to effectively remove it from the arable fields (M. Jones, 2009, p. 61). M. Jones relates the dormancy shift to the deeper ploughing of soils. The proliferation of *Anthemis cotula* in England from the mid-1st millennium BCE, therefore, is related to the introduction of a mouldboard plough with tilling the soil deeper in contrast to ard-cultivated cultivation in the previous period. The reason of such absence is difficult to assess with the current plant evidence due to inhomogeneous sampling on the site. However, from modern textile studies, it is known that the capitulum of this particular plant provides yellow color as well as having medicinal uses (Öztürk et al., 2013). Also, wall reliefs furnishing the Assyrian palaces contain visual imagery of stylistic flowers from the Asteraceae family. It is tempting to assume that the plant species from the Asteraceae family would become important in bodily representations or perhaps accessories. Because of these reasons, the absence of stinking chamomile would be related to the early harvest of this plant for various uses.

Bitter vetch continued to be the principal pulse crop used at Tell Tayinat. Lentil has never succeeded to become the principal pulse crop over bitter vetch during both periods. This trend is also consistent with the earlier Iron I. However, a small decrease in bitter vetch/grass pea values and subsequently an increase in lentil values are visible in our dataset from the Iron II to the Iron III. The regional records of both plants also demonstrated this trend. As it is known that the water requirement of lentil is higher than bitter vetch, Rosenzweig links this trend to the increasing implementation of irrigation networks during the Neo-Assyrian period (2016b, p. 54). However, it is difficult to award significance to these local and regional trends before having more plant evidence. Bitter vetch continued to be the principal pulse crop at Tayinat and the Levantine region. The Northern Mesopotamian sites, on the other hand, contain lentil more widely during the periods under consideration.

The range of tree crops remained surprisingly narrow during the Bronze Ages in the Near East and Tell Tayinat. Grape, olive, pomegranate, fig and date were the main fruit-giving trees in the Near East for millennia. All of these fruits bear economically important products, usually traded as processed goods, like wine or oil, as discussed before in *Chapter 5*. The symbolic importance of pomegranate had been mentioned in *Chapter 6*. The appearance of the same range of crops at Tell Tayinat demonstrates that the cultivation of these labor-intensive perennial trees continued without interruption (note that there is no plant evidence of pomegranate in any studied periods). The two additions were almond and pistachio. These tree crops are discussed below in sub-sections *7.4.3.3.1* and *7.4.3.3.3* respectively.

7.4.2 Evaluation of regional distributions of field crops, fruit trees, condiments and spices

Agriculture was the backbone of the Assyrian economy to realize the administrative, military and religious goals of the Empire (Postgate, 1974a). However, the Assyrian interest on economy of the ruled territories is suggested to have been simplistic in the sense that extracting as much resources as possible to supply the central government (Grayson, 1991, pp. 216-17; Schloen, 2001, p. 146; Bagg, 2013, p. 131). The most relevant information for the reconstruction of agrarian conditions is generally derived from the secondary attestations. In case of ration lists, the available documentary sources are fragmentary (Fales, 1990). Much evidence on the agrarian conditions was derived from the state correspondences in the provinces (Radner, 2000, 2017, p. 251), on land sale records (Postgate 1974b), tributes, loans and allocation of grains and animals (Parker, 2003, p. 541; see Grayson, 1991 in general). It should also be noted that these administrative records mainly inform on the agrarian conditions of the "Land of Assur", but hardly peripheral regions (Postgate, 1979). It is also not certain from the documentary sources whether or not stocked agricultural produce (most importantly grain and straw) were sent back to the Assyrian coreland (Postgate, 1974b, pp. 231-2).

Barley was the prominent crop plant in the documentary sources from the Assyrian heartland. Even though some letters talk about the comparative prices of barley in different provinces, there were no attempts at price control by central government. On the other hand, the available textual evidence demonstrates that the daily ration of deportees was about 1 liter of barley in addition to 0.17 liter of "sesame" oil (Fales, 1990). Although Fales underlines his reservations on the metrological standards, according to his estimations, this amount of barley more or less coincides to 600-650 grams of bread. This daily grain ration could be considered at minimum stake for survival in relation to the modern physiological studies (Fales, 1990). Postgate (1974a, p. 206) suggests that in terms of taxes on agricultural produces, barley was the principal crop species to have been taxed, although it is apparent from documentary sources that other agricultural products could also be taxed. Cereals such as emmer and "wheat" were potentially cultivated for special purposes (Postgate, 1974a). An increase in barley can be also discerned in our regional study between 1200 – 900 BCE to the rest of the 1st millennium BCE. It is highly probable that barley became more widely cultivated for supplementing the empire's need for fodder and food rations.

Two processes of agricultural intensification have been previously proposed in literature. The archaeological evidence of wine and olive presses demonstrates the intensification of cash-crop production across the Near East during the Late Assyrian period. It is suggested that the intensification of wine and olive oil production in the Southern Levant were linked to the development of long-distance trade networks in the Mediterranean basin in later Iron Ages (Faust & Weiss, 2005). Hundreds of olive oil presses and wineries have been unearthed from the 7th century layers of Tel Mediggo and Ashkelon respectively (Faust & Weiss, 2005). This is interpreted as an economic incentive for intensification of cash-crop production due to international maritime trade. Some other researchers, on the other hand, see a much closer connection with the Assyrian demands over subjugated regions through the imposition of taxes and tribute payments for the same intensification (Hopkins, 1997, p. 29). Ur (2005, p. 343) links the construction of irrigation channels with the increased agricultural productivity of once desolate regions in the Assyrian coreland. The mass-deportation policy primarily aimed to allow an intensive agricultural production of grain crops by reducing the necessity of biennial fallow (Ur, 2005). According to Hopkins, the increased demand for tribute payments has manifested in archaeological records with the intensification of olive and wine production in ancient Palestine in the form of rock-cut presses and terrace building activities across the region (1997, p. 29):

> “The luxury goods demanded as tribute payments held more consequences for agricultural economics than short-term impoverishment; they incited the search for high value materials. These commodities had to be procured on the international trade network. To enter this network demanded intensive investments in exportable agricultural products. Thus Assyrian power pushed dependent polities to produce more and pulled them towards specific products. These influences were joined by increasing population densities, urbanization, and political centralization in spurring agricultural industrialization and commercialization”.

The reality resides quite possibly in between these two propositions which are not completely mutually exclusive in the end. The process of intensification of the so-called cash crops or manufactured goods, such as wine and oil, would have been manifold. The Levant as a whole must have been in a geographical position to become involved in both the increasing international trade networks with the Greek and Phoenician merchants across the Mediterranean basin (and also across the Arabian Desert reaching as far as to modern Bahrain) and the Neo-Assyrian demands for tributes and taxes. Weiss and Kislev (2004) argue that the weedy plant taxa that were usually part of the flora of the Central Highlands (Judah and Israel) started to appear in the coastal regions of Philistines. The authors suggest that the staple crops were translocated among the ecological zones of the Southern Levant to supplement the production of cash-crops in the coastal sites like Tel Megiddo and Ashkelon (2004). Faust and Weiss (2005, p. 82) argue that ancient Israel was mainly the cereal-growing zone for the wine oil-producing zone at the Philistine coast. The same aspect is also suggested to be referenced in the biblical accounts for Judah as the primary grain supplier of the Phoenician town Tyre. A cuneiform tablet from Nineveh also mentions the grain from Judah which may also indicate the involvement of this region in long-distance trade of staple crops (Faust & Weiss, 2005).

Similarly, the Assyrian demands for tribute payments and taxes could be another source for the intensification of crop production. The Assyrian administrative apparatus needed to perpetuate the flow of agricultural resources to perform diverse functions. Not only the regular administrative tasks like the payments of officials and workers for the construction of palaces and administrative complexes in the provinces, but also supplementing empire-wide projects like mass-deportations, as well as laborforce for constructing irrigation canals. The deportees, for instance, were supplemented with daily rations of barley and sesame oil, as well as sackclothes, leather bags, and sandals if the reference of Tiglath-pileser is taken into consideration (Radner, 2017, p. 210; Fales, 1990). If this figure would be extrapolated to the total sum of estimated one and a half million of deportees (according to Oded, 1979 but Radner 2017 thinks this is even a conservative estimation) during the two centuries of resettlement activity across the Near East, vast amount of staple crops, oil products and other supplements would be required to be manufactured to only perform this particular Assyrian policy. Even only this example can shed light on the immensity of such imperial operations.

The intensification of crop productivity and its connections to the introduction of novel crops represents an important avenue of discussion among archaeobotanists (Riehl & Nesbitt, 2003, M. Jones et al., 2011; Boivin et al., 2012; van der Veen & Morales, 2015). M. Jones et al. ask an important question in this regard: “why move starchy plants?” (2011). Their reason to ask this, is that there were counterparts of starchy crop plants everywhere among diverse global regions, like rice in Southeast Asia, wheat in Southwest Asia and maize in the Americas. The authors mainly suggest an agro-ecological perspective for the introduced crop plants, such as the advantages of fast-maturing crops, risk-minimization and multi-cropping. M. Jones et al. (2011) favors an explanation of an intensive multi-cropping system that was already established in the 2nd millennium BCE as evidenced from documentary sources in the Southern Mesopotamia (see sesame sub-section below). Boivin et al. (2012) retake this question and suggest that in every case of ancient crop introductions, there was often a temporal delay, sometimes several millennia, for the wide-spread cultivation and large-scale consumption of the novel crops in the introduced regions (see also Fuller, 2018 for perennial trees). Nonetheless, the authors argue that other reasons such as medicinal, symbolic and prestige reasons would be significant for the historical introduction of novel crops rather than M. Jones et al.'s perspective of ecological opportunism. It should be mentioned that these two explanations are not mutually exclusive and both find support from our regional survey.

7.4.2.1 Summer crops

The organization of agricultural activities and scheduling of household or institutional labor are complex. Such changes in timing, duration and intensity of agricultural activities require reorganization of other productive activities (Morrison, 1994, p. 131). The introduction of warm-season crops to agriculture requires an alteration of the rhythm of the agricultural operations (Watson, 1983; see Sinopoli 1994 for a general discussion and the references therein). In traditional agricultural practice, the harvest of winter crops happens during the months of May and June while the rest of the summer season is allocated to the caring and harvesting of perennial trees such as grape, olive, fig, date and pomegranate (Hopkins, 1987). Therefore, the addition of the summer season into the agricultural calendar requires more labor to be allocated to cultivate, irrigate and harvest these summer crops.

It is rather difficult to pinpoint the exact timing of the introductions of these summer crops as archaeological and textual records are silent in providing such precise information until the Hellenistic and Roman periods. Also, Riehl and Nesbitt (2003, p. 306) rightly argue that the scale and intensity of cultivation was unknown to us in archaeobotany; therefore the actual impact of adding the summer season remains unclear in terms of the intensification of agro-production from an archaeobotanical perspective (cf. Styring et al., 2016; also see Bogaard et al., 2018). Miller et al. (2016), on the other hand approach the introduction and prevalence of millet cultivation differently. The authors see a nomadic component for its widespread use. They suggest that the introduction of broomcorn millet would be related to its suitability to the pastoral nomadic lifecycle in regard to the shorter growing cycles and undemanding soil and water conditions. This explanation will not be discussed below due to the lack of clear textual or archaeological evidence for such an association (cf. Valamoti, 2016).

The following sub-sections evaluate the regional plant data to comprehend the reasons for the appearance of warm-season crops more often in the 1st millennium BCE. The regional distribution shows a certain bioclimatic distribution for the appearance of broomcorn millet and sesame. A second factor seems to be related to the goals of imperial statecraft; namely, the need to supplement empire-wide projects and institutions like resettlement policy and army.

7.4.2.1.1 Millets

Both Mann (1946) and Zohary et al. (2012) note that the broomcorn millet is well adapted to droughts, poor soils and intense heat conditions. Therefore it can be grown under various environmental conditions where none of the other summer crops could be cultivated. Foxtail millet is somewhat less ubiquitous around the Near Eastern sites than the broomcorn millet. The reason of this absence is hard to explain from an archaeobotanical perspective. Therefore, more research is needed to comprehend this absence. The millet identification in archaeobotanical records should be approached with care in general. Both millets are morphologically similar to each other. For that reason, it is not unlikely that the species identification may become hampered after charring in many of the reported cases.

Nevertheless, a bioclimatic dimension can be discernible in regional records of the 1st millennium BCE for broomcorn millet. The regional distribution of this crop plant in the Northern Levant show that although the Tell Tayinat plant assemblage does not show any evidence of millets (nor other summer crops) in this study, broomcorn millet is reported from the Cilican Plain to the west of the Amanos (Kinet Höyük: Hydn, 1997; Kilise Tepe: Colledge, 2001). It is highly probable that the absence of broomcorn millet at Tell Tayinat and its appearance in the Cilician Plain would be related to the microclimatic conditions between these two plains. That being the case, the relative humidity levels are markedly different in the Cilician Plain which receives a substantial amount of air moisture during the summer season, while the level of relative humidity becomes lower in the Amuq Plain due to the rainshadow of the Amanos Mountains (Atalay, 2012; Atalay et al., 2014). Therefore, due to climatic reasons, the cultivation of summer crops in the Amuq requires more labor and water inputs than the Cilician plain. This is in accordance with the proposition of M. Jones et al.'s ecological opportunism of newly introduced crop plants (2011).

Furthermore, the regional records of this crop plant are concentrated in the Eastern Anatolian Plateau at Ayanis Castle[32] (Solmaz & Sönmez, 2013) and at Tille Höyük (Nesbitt & Summers, 1988) and in the Mesopotamia at Nimrud (Helbaek, 1966) during the same time interval.

The summer season in Eastern Anatolia is milder and shorter than in the Mesopotamian lowlands (Atalay, 2012). The two-month summer season is suited well for a crop plant like broomcorn millet which needs a shorter growing cycle (60-90 days) to reach maturity (Mann, 1946; Murphy, 2016). The annual average temperature is about 14 ^{o}C in the Van region in Eastern Anatolia where large quantities of broomcorn millet deposits had been uncovered at Ayanis Castle, located at the coast of the moisture-bearing Lake Van. On the other hand, in Mesopotamia, it is known that many sites were under or just above to the 200-mm isohyets of rainfall, thereby requiring irrigation agriculture as a necessity to cultivate this warm-season crop.

However, the particular division between highlands and lowland zones in our record is also instructive for other reasons. The spatial distribution of broomcorn millet coincides well with

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[32] This crop plant is absent at a close-by inland site, at Yoncatepe (Oybak Dönmez & Belli, 2007) which is situated not at the coast of the Lake Van like Ayanis.

the two dominant political entities in the first half of the 1st millennium BCE; these are the Urartians who were located in Eastern Anatolia and the Neo-Assyrians occupying mainly the Mesopotamian lowlands. Valamoti (2016) and N. Miller, Spengler, & Frachetti (2016) suggest that this crop taxon is largely associated with mobile pastoralists as fodder[33] for the horses and other animals or also less frequently as human food. Several references in the Neo-Assyrian sources deal with supplementing the armies and storing straw for horse foddering (Postgate, 1974a, p. 18) reflecting this type of use for this crop. This possibility, in fact, finds some concrete support considering the plant findings in the temple of Haldi at Urartian Ayanis. Çilingiroğlu reports (2004, p. 257) a cauldron full of millet grains which was unearthed from the destruction debris inside the temple of Haldi. The same evidence also recovered from a hearth feature, again inside the temple. Several artefacts were reported to be filled with this crop plant (e.g. quiver, a lion-headed shield, a bone object). In relation to this, there are also some textual Urartian records which associate the god Haldi with warfare (Çilingiroğlu, 2004; Batmaz, 2013). In this way, the cultivation of broomcorn millet was possibly related to providing the imperial armies with a high-calorie, starchy grain for the lean season when the pasturage was unavailable due to extreme weather conditions[34].

7.4.2.1.2 Sesame

Sesame (*Sesamum indicum*) is an interesting crop plant for various reasons. This crop plant is also not native to the Near East. Since wild *Sesamum* plants are completely absent in the Near

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[33] According to Miller and Enneking, bitter vetch can also have such role (2014, p. 261) during the 2nd millennium BCE in relation to chariotry.

[34] It is important to note that the "lean season" for pasturage differed between these two imperial zones in relation to the environmental and climatic reasons. The Eastern Anatolian highlands are covered with snow for most of the winter season; therefore this is the season when the need of fodder was at maximum in this region. Summer is mild and the region contains vast natural pasturelands with good regenerative capacity (Atalay, 2012). On the other hand, the winters are mild in the Mesopotamian lowlands, when the rainfall becomes abundant between December and April. For that reason, the season with the maximum requirement for foddering would have been summer in case of the Neo-Assyrians.

East and the Mediterranean basin, the evidence from living plants supports the argument that the Indian subcontinent was the most likely location for its domestication (Bedigian & Harlan, 1984; Zohary et al., 2013). Sesame is a warm-season crop. The main growing period covers the months between June and September (Bedigian & Harlan, 1984).

Several cuneiformists argue that sesame was under production as early as the second half of the 3rd millennium BCE, although the archaeobotanical record of this crop is always scant until the 1st millennium BCE (Powell, 2003; cf. Helbaek, 1966). Linguistic reasoning shows that several texts mention an oil plant which was sown during the summer season just after the barley harvest (Bedigian & Harlan, 1984; Postgate, 1985). Since flax and several other oil plants from the Brassicaceae (mustard) family are winter crops that require a chilling period during the winter, sesame was the only other potential oil plant which could have been cultivated in relation to these linguistic grounds (Powell, 2003, p. 15). Moreover, some Mesopotamian sources describe this crop plant as white-seeded. This was proposed as another argument, because flax has no white-seeded varieties (Bedigian & Harlan, 1984). It should be mentioned that several excavations in Southern Mesopotamia were conducted long before certain plant recovery techniques such as floatation were used. Therefore, the plant evidence from this region is only preliminary. It would suffice to note that this discrepancy has time to be solved with renewed excavations in Southern Mesopotamia.

The Mesopotamian texts from the 3rd millennium BCE include the most common oil used was “lard” from the Fara to the Sargonic periods but “sesame” for the Ur III period. Textual evidence for the cultivation of sesame was more-widely found in the Hellenistic and Roman periods. Regarding our regional records, as previously mentioned for broomcorn millet, a similar bioclimatic differentiation exists in the regional distribution of sesame finds between the Northern Mesopotamian lowlands and the Eastern Anatolian/Zagrosian highlands. The occurrences during the periods under investigation are concentrated into two sites in Eastern Anatolia and Caucasia roughly in the same period, at Bastam and Karmir-Blur (Zohary et al., 2013). Karmir-Blur (ancient Teishebaini) is an Urartian site in modern Armenia. Concentrated deposits of sesame finds were reported from this settlement, even some pressed sesame cakes (Bedigian & Harlan, 1984, p. 147). Other evidence appears at Tell Sheikh Hamad in Northern Mesopotamia within the irrigation agriculture zone. Another occurrence recently reported from Ziyaret Tepe in the so-called “temple-treasury” where several *pithoi*, tokens and tablets had been unearthed (Rosenzweig, 2018). This occurrence is important because this settlement is somewhat sandwiched between two imperial powers described above. On the other hand, the only sesame occurrence outside of these imperial territories has been reported from Deir Alla with some 200 seeds alongside other water-demanding crops such as flax, millet, free-threshing wheat (Neef, 1989). It is significant that all these sesame occurrences are somewhat related to the sites with irrigation infrastructure as evidenced in archaeological and textual records.

7.4.2.1.3 Rice

Rice, on the other hand, is still highly infrequent in the archaeobotanical record during the periods under investigation. This crop plant has been reported from only one site for the entire 1st millennium BCE within the 500-0 BCE time interval. This evidence coincides well to M. Jones et al.’s study which reports that this crop plant only reached the Near East in the 1stmillennium AD. Boivin et al. (2012) mention that the Roman sources stated in particular the medicinal use of rice rather than as a food. Therefore, it is likely that this crop plant became part of the ancient diet much later than our period of investigation.

7.4.2.2 Condiments and spices

Condiments and spices are valued contributions to the diet and important for the manufacturing of scented oil in the ancient Near East. The information on their dietary use before Hellenistic and Roman periods is fragmentary. Similarly, much less is known about their dissemination across various regions of the Near East and Eastern Mediterranean basin. Frumin et al. (2015) recently postulated a theory for the dissemination of certain economically important plants into the Southern Levant by sea-faring groups (e.g. Sea Peoples) during the Late Bronze to Iron Age transition. The authors argue that some plants such cumin, sycamore fig, and opium poppy, were new crop introductions to the Southern Levant. Some others like coriander and bay tree are thought to be preferred by the new-comers, although they were not new additions to the plant assemblages.

Even though this migrationist approach is plausible to provide an exploratory framework for the introduction of new plants and dietary change in the Levant, there is not enough evidence to support Frumin et al.'s (2015, Fig. 4) claim[35] in general. The archaeobotanical data is too fragmentary to propose that these particular plant occurrences have been related to ethnicity[36].

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[35] The causal relationship remains empirically weak. It may have been the biblical Philistines or any other intrusive culture, it is methodologically uncertain how to relate a new set of wild plants to an alien ethnic group (plants equates peoples?); at least prior to showing in what ways (e.g. productive means, technology, food preparation techniques, etc.) a foreign population may entail a distinctly new ecological signature. For another approach see Kislev, Artzy, & Marcus (1993), to recognize the foreign ethnic elements in archaeobotany as the appearance of an endemic crop plant from the Aegean, *Lathyrus clymenum,* in the Middle Bronze Age at Tel Nami in the southern Levant.

[36] Opium poppy is possibly the only species supporting what Frumin and her colleagues want to claim. A particular uncertainty of Frumin et al.'s claim, however, is the difficulty to identify cultivated poppy from its seeds. The seed size and distinctive reticulate structure of the seed surface of some wild species overlap with the cultivated opium poppy. Therefore, seed size alone is not reliable enough to conclude the correct identification whilst the authors do not provide any visual or written descriptions for this taxon in their study. More secure identifications appear to be reported from the Greek sites during the Bronze Ages (*ademnes.com*, [Access date: 09.04.2019]). Wild poppy (*Papaver somniferum* subsp. *setigerum*) is not native to Greece or the Near East but it has a western distribution covering the coastal Mediterranean plains (Zohary et al., 2013; Day, 2013, p. 5810). Kroll (1991) identifies the opium poppy from several sites in the Bronze Age Greece, Bulgaria and former Yugoslavia. Bunimovitz and Lederman (2016) stress that the textual references to the opium trade are missing in the LBA context and additionally no references can be found until the late 1st millennium BCE. This may be related to the actual use of opium poppy seeds for oil production, not the liquid drug derived from the fruit capsule.This plant taxon also appears in a sanctuary at Kalapodi in Greece during the Protogeometric period

In fact, several vegetables and condiments appear in the Near East before the alleged intrusions of these groups (e.g. coriander, fenugreek and *Cucumis melo* at Tell Tweini, Linselee et al. in press) indicating greater antiquity in the use of these plants (see Ellison 1984, p. 91 for the use of spices in sweet confections). The Uluburun shipwreck also showed evidence of condiment/spices such as coriander, nigella (black cumin), and sumac seeds (Haldane, 1993). If the excavators' assumption for a Levantine origin of the Uluburun ship is considered true (Pulak, 1998), it is possible to assume that these were neither introduced nor ethnically preferred species.

Coriander is the most widespread condiment/spice type among all others. In the Aegean, earlier occurrences were reported from the Franchiti Cave (Neolithic), Sitagroi (the EBA) and Akrotiri (BA) (Sarpaki, 1992). Coriander has been reported previously from the Middle Bronze Age deposits at Tell ed-Der and Hammam-et-Turkman (N. Miller in Schwartz et al, 2000). Similarly cumin has been reported from Egyptian sites in a burial context during the Late Bronze Age (Zohary et al., 2013)[37].

The geographic disposition of coriander during the Iron Age is not limited to the southern Levant but also covers the Northern Levant as visible at Tell Tayinat, Tell Tweini (Marinova

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(Kroll, 1993). At Tell Tayinat, at least one mineralized object looks like opium poppy seed in the Iron III samples. However, it is difficult to assess the morphological attributes of *somniferum*-type cultivars for this specimen. The remaining *Papaver* finds belong possibly to either *P. dubium* or *P. syriacum,* which are the only two poppy elements appearing in the current vegetation of the Province of Hatay (*tübives.com* [Access date: 09.04.2019]).

[37] It should be noted that many cultural attributes of Philistines (pottery forms and decorations, special vessel types, hearths, loomweights etc.) were changed at the end of Iron I, although this change seems to have been different in the symbolic realm (Bunimovitz & Lederman, 2014, p. 256; Mazzoni, 2000, p. 35). Mazzoni (2000: p. 35) reached the same conclusion for cremation burials, that appeared much earlier in the Eastern Mediterrenean basin than the alleged Sea People connection: "Whatever date can be assumed for the initial use of the Hama cemeteries, the documentation argues for an introduction of this practice in the course of the Late Bronze II, at least at Ugarit, Alalakh, Tell Sukas and Hama, an increased diffusion in the 10th century at Yunus, Hama, Tell Sukas, Akhziv, Hazor and its definitive spread in the 9th-8th century at Yunus, Deve Hüyük, Tell Halaf, Hama, Ras el Bassit, Tell Arqa, Khalde, Tell el Ajjul. The pre-crisis emergence of the practice would exclude its association with Sea People in the same way as its later increase and spread on the coast preclude a connection with Late Hittite elements. The adoption of a well-characterized social and economic structure already present in the Late Bronze Age, once again emphasizes continuity as a specific trait of this area and this earlier period of the Iron Age".

et al., 2012a) and Tell Qarqur (Smith, 2005) and at Tell el-Burak on the Lebanese coast during the later Iron Age (Orendi & Deckers, 2018). In general, Deir Alla in Jordan, far from being a Philistine site, represents the best evidence reported so far in the Iron Age for the probable production of these taxa. Archaeobotanists reported the remains of cumin, fenugreek and coriander in a storage context in a comparatively large amount (Neef, 1989, Table 2).

Irrespective to this problem of ethnic food preferences, the more significant fact is the prevalence of the Levant for cultivation and/or procurement of these condiments/spices. The distribution pattern of the three condiment/spice taxa analyzed in this study demonstrate some important implications about what Sargon II said to describe his royal garden "in which all the aromatic herbs of Hatti and fruit trees of the mountains" (Radner, 2000). It is basically not too speculative to argue that the Levantine regions would have been the primary supplier of these "aromatics". The Neo-Assyrians possibly appreciated these condiments/spices of the Levantine region as food seasonings, medicinal plants, and herbal aromatics for perfumery and religious ceremonies, while the Levantine provinces might have been the primary providers of these taxa exported to the Assyrian coreland.

Therefore, their increasing visibility in the charred seed records should be understood in relation to, the developing oil industry for land and maritime trade, or possibly tribute payments highlighting the potency of these plants in rituals (funeral rites, offerings), in perfumery, and in medicinal remedies. These condiments and aromatics would have been used for enhancing the oil produced to be used in international trade. It is known that coriander has been mentioned in Linear B tablets in Mycenean Pylos for the perfume production (Sarpaki, 1992, p. 225, footnote 17; Megaloudi, 2005a, p. 75). This, in fact fits better to the overall picture of trading aromatic oils across the Eastern Mediterranean basin during the LBA as previously studied by Knapp (1991); Amarna letters demonstrate that the king of Alashiya sent a jar of aromatic oil as a gift to the Pharaoh, waiting reciprocity from his counterpart to be also sent aromatic oils in return. That indicates a certain regional specialization in the production of scented oils (Bunimovitz & Lederman, 2016, p. 1558). Their role in the manufacturing of oil products with added-value would have been a more significant factor for their proliferation during the Iron Age in the Levant in connection to Sherratt's consumption-oriented model of social complexity.

7.4.2.3 Perennial trees

Many perennial fruit trees we surveyed in this study, including pistachio, carob, walnut, hazelnut, apple, pear, apricot and peach (except almond and pomegranate), do not show clear evidence in favor of their widespread use during the time intervals of 1200-900 and 900-500 BCE. More records of these tree species appear between the 500-0 BCE time interval coinciding with the textual records from the classical times. Archaeobotanical records show that in late 1st millennium BCE and early 1st millennium AD, especially during the Roman Period, the cultivation of this new set of tree crops was already well-established in the Mediterranean basin (Livarda, 2011, see also van der Veen, Livarda, & Hill, 2007 for the introduced plants in a provincial region like that of Roman England).

It is known that these perennial fruits are all nowadays cultivated with scion grafting (Zohary et al., 2013). The late 1st millennium BCE and early 1st millennium AD show the first definitive textual evidence for the implementation of this technique in the description of Pliny the Elder in the Roman Period[38] and later Jewish sources (i.e., Mishna, ca. 200 AD) while any reference to this technique in the Old Testament is absent (Zohary et al., 2012). The available archaeological evidence is too scarce to make generalizations on the use of grafting before the Roman period (Zohary et al., 2012).

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[38] Note an earlier but unclear reference from the Mari texts on grafting during the Middle Bronze Age (Zohary et al., 2012).

Scion grafting represents another technique of cultivation. It is still unknown when and where this novel cultivation technique had been discovered (although E. Weiss notes a Far East connection but did not give details). Ethnographic observations (e.g. Abbo, Gopher, & Lev-Yadun, 2015 in Georgia and Armenia) demonstrate a significant practice in the Mediterranean basin and beyond that farmers intentionally grow fruit trees with less attractive fruit traits (shape, size, color and/or taste) in their gardens. These modern orchards contain each of the various tree species characteristics to the Mediterranean basin. With this practice, the farmers aim to select other traits than those targeted by modern breeding programs (e.g. selection of sweet apricot kernels for consumption as Abbo et al. 2015 mention). Abbo et al. (2015), on the other hand, propose that this particular practice to select diverse type of fruit traits would have been important to maintain the genetic diversity of perennial fruit trees. The authors suggest that these *bustan*-type mixed tree orchards in the modern Near East would have been loci to maintain the genetic diversity of various tree species.

While it is not easy to evaluate when and how these *bustan*-type mixed cultivations have become part of the Mediterranean agro-ecosystems, Watson suggested that gardens in the early medieval Islamic world have served the purpose as loci of acclimatization for introduced plants, brought first as botanical “oddities”, exotic pleasures from afar, while only later becoming prized in commercial scale (1983, p. 117; see also Boivin et al., 2012, p. 456). An early prototype of this kind of mixed orchards could be the Neo-Assyrian royal gardens. This opinion regards that the dissemination of tree fruits had a much closer connection with the appearance of institutionalized forms of gardening. Watson’s remarks on the gardens of the early Islamic period demonstrate the fact that the physical establishment of royal or elite gardens follows an enrichment of interest in plant biology and experimentation by royal elites and contemporary scientists (1983, p. 119).

In the case of the Assyrian royal gardens, the textual records show interesting hints to a contemporary knowledge of horticulture. Notwithstanding the fact that there are inherent problems in identification of Akkadian words with particular plant species, Postgate states that the majority of the timber/tree procurement records were derived from the Amanos, Lebanon, Mt. Hermon and Anti-Lebanon Mountains during the military expedition of the Assyrian kings to the Levant (1992b, p. 178). On the other hand, the Neo-Assyrian kings made several statements in their royal inscriptions precisely referring to the royal gardens that have been modeled after the Amanos Mountains. More specifically, Sargon defines his royal garden "in which all the aromatic herbs of Hatti[39] and fruit trees of the mountains were planted" (Thomason, 2001, p. 80; Radner, 2000, p. 239; see also Wiseman, 1983 and Glassner, 1991 in general for royal gardens and surviving references on these gardens). The mentioning of the Amanos by Sargon II and other Neo-Assyrian kings, this is by no means a coincidence, but should possibly be linked to the recognition of exceptional biodiversity of the Amanos Mountains by the ancient observers.

In this connection, it is also noteworthy to point out that the Northern Syrian landscapes became subjected in wall reliefs furnishing the Assyrian palaces. Thomason (2001, p. 92) describes that five different pictorial topoi were prevalent in this visual imagery; 1) "the depiction of numerous species of plants"; 2) "the receipt of diverse species of tame animals as tribute"; 3) "the witnessing and control of the chaos of the North Syrian faunal landscape"; 4) "the representation of the *ex situ* re-creation of the abundant North Syrian landscape"; 5) "to invoke a sense of fertility, leisure, and triumphant celebration associated with the king" in relation to the essential implications for collecting biological specimens from northern Syria. Thomason (2001, p. 92) informs that;

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[39] Neo-Assyrians referred to the Syro-Anatolian kingdom of Carchemish as Hatti in general but this toponym became to represent whole other Syro-Anatolian realm in later centuries (Liverani, 2014). See also Postgate (1979, p. 199) for Sargon's reference in relation to metal acquisition from the mountains of Hatti.

> “ … Thus the mountainous region to the west of Assyria was a consistent source of mystical intrigue and pleasure in Mesopotamian history, a diverse and tantalizing place worthy of emulation in the heartland. Later the symbolic representation of Babylonia emerges as an equally important aspect of Assyrian garden construction in the heartland. However, until texts from the reign of Sennacherib mention the concomitant re-creation of the Babylonian marshes, north Syria’s landscape alone seems to embody the bounty and diversity deemed worthy of emulation in gardens at the center of the empire”.

From an agronomic point of view, Sargon’s imperial claim relating to Syro-Anatolian geography and to the diversity of plant species, basically indicates that several species with different ecological requirements had become part of the royal gardens in the dry climate of Northern Mesopotamia. Therefore, maintaining the royal gardens must have required an already well-developed knowledge on the plant biology and ecology of different species. Furthermore, contemporary textual records show that maintaining gardens or orchards were not only for the king’s privilege but promoted for the general populace. It appears that Sennacherib divided his royal lands purposefully to distribute the land to people of Nineveh so that they could also have their own gardens (Radner, 2000, p. 240). A similar reference with the same intention was mentioned from a recently unearthed cuneiform inscription at Carchemish (Carchemish Cylinder Inscription). This inscription specifically mentions the deeds of Sargon II at Carchemish. The Assyrian king mentions that the lands around the town were allocated as gardens and orchards after the annexation of the town (Marchesi, 2019). Therefore, what the Neo-Assyrians’ imperial propaganda achieved would have been to start a process of institutionalization of horticulture, manifested within royal gardens, to acquire and acclimatize these botanical specimens in Mesopotamia.

7.4.2.3.1 Almond

Almond (*Amygdalus communis*) represents an intriguing case study for the crop dissemination across the Near East during the first half of the 1st millennium BCE. Almond is a late-comer to Tell Tayinat although the modern distribution of several almond species is fairly widespread across the Near East. Many species are well-adapted to the diverse habitats and climatic conditions from southeastern Europe to the central Mediterranean basin to south of Mongolia (Zohary et al., 2013; see Browicz & Zohary, 1996 for its distribution range). Several species have an Irano-Turanian distribution, mostly thriving in arid and semi-arid environments, but there are also species adapted to more-humid Mediterranean conditions (Browicz & Zohary, 1996, p. 230; Abbo et al., 2015, p. 342). Wild forms of the *A. communis* type have been identified in the Levant and this tree is a common constituent of maquis formations on the rocky slopes between 50-1200 m.

It is important to note that the domestication of almond is a “perplexing” issue in literature. This tree is considered as one of the earliest domesticated trees in the Near East, usually accepted within the typical Near eastern fruit trees category (incl. grape, olive, date, pomegranate and fig) according to Zohary et al. (2013). Many almond species do not respond well to vegetative propagation methods unlike the abovementioned perennial fruit trees. However, modern breeding programs show that almond trees can be propagated by seeds to attain desired traits (Zohary et al., 2013; Abbo et al., 2015). Despite this factor, modern cultivation today depends on grafting (Zohary et al., 2013). Two issues need to be taken into consideration if the seed propagation is considered a viable way of almond domestication. Abbo et al. noted that “it is difficult to explain how the early almond domesticators managed to identify individual almond trees with sweet kernels, because testing by tasting a few dozens of bitter kernels within a short time interval could be lethal”. Secondly, “a more puzzling question is why the early would-be almond growers embarked on such a hazardous endeavor without a prior knowledge on the existence of the sweet kernel trait and/or earlier encounter of such trees?” (2015, p. 356).

The bitterness of the almond seeds is related to the presence of the glycoside amygdalin, which produces cyanide, also known as prussic acid (Ladizinsky, 1999). It is also known that if the progeny populations of a tree, bearing sweet kernels are propagated from the (non-toxic) kernels, the offspring do not produce bitter kernels (toxic) (Abboet al., 2015, p. 344). Despite such difficulty to pinpoint the timing and pace of these selective traits, evolutionary history of the almond demonstrates that most almond lineages differentiate during the Holocene, possibly a result of human-driven migration (Delplancke et al., 2013, p. 1101); a conclusion that Browicz and Zohary also observed (1996, p. 246). According to these authors, the spread of almond cultivation over the Mediterranean basin, southwest Asia and middle Asia provided genetic contact between previously geographically separated almond species since many almond species are self-incompatible (Abbo et al. 2015). Abbo et al. (2015) considered such genetic contact between wild populations; enhancement of the standing genetic variation would be a factor to the appearance of sweet-kernel phenotypes. Genetic evidence from wild and cultivated almond populations also demonstrated this wide genetic variability (Delplancke et al., 2013).

Previous archaeological evidence shows that almond was continuously collected in the Neolithic and Chalcolithic sites, possibly from the wild (Nesbitt & Postgate, 2001). However, in case of the Bronze Ages, the appearance of almond remains was scarce; the most famous occurrence among others is in the tomb of Tutankhamun (Zohary et al., 2013). Following the information for other sites, almond remains seem to proliferate in the Levant regionally during the 900-500 BCE time interval. Additional evidence, although scarcer, was recovered from Northern Mesopotamian, Caucasian and Iranian sites. Although almond wood is documented in the LBA Tell Atchana (Deckers, 2010), fruit shells of this tree have not been reported in the charred seed records in the Amuq during the Bronze Ages (Stirn, 2013; Riehl, 2010; Çizer, 2006). A similar trend is visible at Zincirli where almond shells start to appear during Iron II but not found before until now (D. Karakaya unpublished data). More frequent occurrences of this tree genus are only recorded for the classical times (Zohary et al., 2013: 147).

In regard to almond finds like those at Tell Tayinat and Zincirli, there is no possibility to determine if these specimens were collected from the wild or domesticated (Nesbitt & Postgate, 2001). Such clarity in determining the domesticated status from remains of almond shells is hampered by the fact that the size of the fruits and productivity of trees are variable, even within the domesticated populations today, because of self-incompability of the almond species (Abbo et al., 2015). On the other hand, it is not unlikely to assume that almond cultivation and/or collecting from the wild might have focused on the bitter kernels to extract the almond oil for medicinal purposes (Albala, 2009).

Almond seeds, bitter or sweet, are amenable to long-term storage with their tight shells and contain high oil content (Albala, 2009). The use of bitter almond oil was mentioned in several references to the medical and culinary use of almond seeds and oil, starting the 3rd millennium BCE (Nesbitt & Postgate, 2001, p. 633). The medical texts distinguish the sweet and bitter almond, having different therapeutic qualities for the human metabolism (see Albala, 2009 and, Salas-Salvado, Casa-Agustench, & Sala-Huetos, 2011 for classical and medieval references; see also Nesbitt & Postgate, 2001, p. 634 for an uncertain reference mentioning the two types of almond in pre-classical times). For example, the textual records from Nineveh also show that almond oil has been used for therapeutic reasons to cure head injuries (Thompson, 1924). Therefore, selective pressure on the sweet kernel-type cultivars may have been absent in the first place before the introduction of grafting techniques. This argument explains better the discussion of Abbo et al. (2015) on how the sweet almond cultivars may have been selected, since eating a few of bitter seeds can be fatal for the taster.

7.4.2.3.2 Walnut, hazelnut, and pomegranate

The information about other fruit trees such as hazel and walnut is more scant. These tree crops also rarely appear in the charred fruit records of Bronze Age sites. Walnut (*Juglans regia*) is especially valued for its hard timber. The timber of this tree has been identified from the Neo-Assyrian capital Nimrud, where it was used as wooden diptych as well as two artifacts from the Neo-Babylonian times (Warnock & Pendleton, 1991). The seeds are large and edible, also rich in oil. This tree thrives in mesic, temperate forests of the Balkans and as far as western China. The fruit shells of this tree species are recovered from the second half of the 1st millennium BCE (500-0 BCE interval).

Hazels (*Corylus avellana, Corylus maxima*) are common constituents of broad-leaved deciduous forests of temperate Europe, Caucasia, north Turkey and south of the Caspian Sea (Zohary et al., 2012). *Corylus* can also be propagated from seed like almond, but nowadays the cultivation is undertaken with grafting superior clones. Archaeological evidence of hazelnut occurs somewhat earlier from the Middle Bronze Age Kültepe/Kanesh (Fairbairn et al., 2014), although more widespread occurrences were reported from the European sites during the Bronze Ages (Zohary et al. 2013). On the other hand, our study only records one appearance in the Near East at Nimrud in an uncarbonized state (Helbaek, 1966). Other occurrences uncharted in this study for the Iron Age cover the settlements at Gordion in Central Anatolia (N. Miller, 2010), Deir ‘Alla in Jordan and Archaic Miletus in Western Anatolia (Nesbitt & Postgate, 2001). All of these records date roughly from the 8th to 5th centuries.

Pomegranate, as discussed before in the *Chapter 6*, has more material culture occurrences with greater antiquity than the former two. The Iron Age occurrences of this perennial tree were concentrated in the Levant, although it is absent at Tell Tayinat.

7.4.2.3.3 Carob and pistachio

Two subsequent trees which are nowadays common constituents of maquis vegetation in the Near East are missing in the archaeobotanical record. Carob (*Ceratonia siliqua*) is a leguminous tree and a wide-spread constituent of maquis formation together with pistachio (Zohary et al., 2013; Abbo et al., 2015). However, it is reported for only a few cases in the charred seed records of the Near East. The sugar-bearing fruit pods of this species are valued in the Mediterranean basin (Zohary et al., 2013). This tree is not easily amenable to vegetative propagation; therefore, grafting is the main method of cultivation today (Abbo et al., 2015). For this reason, Zohary and Spiegel-Roy (1975) considered the domestication of this tree as a later phenomenon. Our study also records this tree's remains as only appearing in the Southern Levant in two sites.

Pistachio (several species *Pistacia vera*, *P. atlantica*, *P. palaestina*, *P. lentiscus*), is recorded much fewer than expected. *P. atlantica* and *P. palaestina* are also genuine elements in maquis formations in the Mediterranean Levant (Zohary, 1973). Today, *Pistacia vera* dominates the commercial production. This is a dioecious, wind-pollinated species cultivated by grafting (Zohary et al., 2012).

The pre-Iron Age occurrences of pistachio were concentrated from Pre-Pottery Neolithic to Chalcolithic, but fewer finds appear in the archaeobotanical records during the Bronze Ages (Nesbitt & Postgate, 2001, p. 634). Zohary et al. (2012) noted that the singular finds from the Bronze Age period of the Near East and the Aegean would be questionable as modern intrusions into earlier layers. More precise determination has been reported from the Bronze Age site Tepe Yahya and Djarkutan in Turkmenistan (Zohary et al., 2012). These occurrences are plausible regarding the main distribution range of wild *Pistacia vera* in Central Asia. Stol (1979) locates the wide-spread cultivation of *Pistacia vera* to the Hellenistic period. The maritime trade of pistachio nuts has been identified in about the fourth century BCE from amphora's recovered on the Greek island of Chios (Hannson & Foley, 2008). An interesting aspect of our regional record is the increase of pistachio remains during the 500 – 0 BCE timeframe. However, this figure would also be related to the differential sampling of the sites rather than the introduction of widespread cultivation of pistachio. Also, Zohary et al. (2012) mentioned that it is hard to assess from these remains, whether these were collected from wild or cultivated. In our regional survey, the remains are recorded within three different taxa: *Pistacia* sp., *Pistacia atlantica/palaestina*, and *Pistacia palaestina*. It is also difficult to demonstrate whether the Tell Tayinat specimen was cultivated or collected from the wild.

The resin of pistachio trees, however, has been identified more often through organic residue analysis. The Uluburun shipwreck has also carried large amounts of pistachio resin in the ceramic vessels (Haldane, 1993, p. 352; Mills & White, 1989). The resin components were also identified in an organic residue analysis from the Late Bronze Age Royal Tombs of Qatna in ceramic vessels, probably used to embalm the deceased to prepare for the netherworld as Lange suggested (2014, p. 93). Stern et al. (2008) and McGovern et al. (1996, p. 481) noted that the addition of *Pistacia atlantica* resin has served to inhibit the growth of a certain bacteria that converts wine to vinegar. The requirement of resin, in general, to embalm the bodies or to impregnate the carriage vessels would indicate that use of resin would be more widespread than the use of its fruits.

7.4.2.3.4 Apple and pear

The remaining fruit trees studied in this dissertation all belong to the Rosaceae family. Apple (*Malus domestica* [syn. *Pyrus malus* L., *Malus pumila* Mill.]) and pear (*Pyrus communis*) seem to have been much later additions into the Near Eastern plant assemblages. Zohary et al. (2012) suggested the classical age for the widespread cultivation of these two tree species.

The archaeobotanical records are fragmentary for both species. They are mostly reported within the category of *Pyrus/Malus* in *ademnes.de*. Therefore, it was not possible to differentiate the spatial distributions of both species. The modern distribution range of wild forms of both species covers largely the colder and temperate zones of Europe, Turkey, northern Iran, Caucasus and Central Asia. Sufficient winter chilling is required to ensure normal flowering and fruit setting for both perennial trees (Zohary et al., 2012).

Archaeological evidence for apple and pear shows that these fruit trees were not a major crop during the Bronze Ages in the Near East. More occurrences were reported in Europe for pear. The widespread cultivation has been suggested to be linked to the introduction of grafting during the classical times (Zohary et al., 2012). The earliest occurrences in our study are from Troy which is understandable since this site is within the natural distribution range of both trees. Other records are from Zincirli (D. Karakaya unpublished data) and Tell Sheikh Hamad.

7.4.2.3.5 Apricot and peach

Zohary et al. (2012) categorize apricot (*Armeniaca vulgaris* Lam. [syn. *Prunus armeniaca*]) and peach (*Persica vulgaris* Miller [syn. *Amygdalus persica*]) as late-comers appearing during the Classical period. Apricots grow wild in Central Asia and were possibly cultivated with much greater antiquity in China (Delplancke et al., 2013; Zohary et al., 2013). The history of peach is similar to apricot; a connection with Central Asia and archaeological remains are suggesting early cultivation in China (Zohary et al., 2012). In our study, plant records appear in the 900-500 BCE time interval. However, these two appearances are recorded as *Prunus* sp. from Aşvan Kale and Tell Qasile. These records could also belong to other *Prunus* species such as cherry, plum, almond and/or apricot.

7.5 CONCLUDING REMARKS

The taxa diversity of the crop repertoire remained smaller during the Iron Age II and III without changes in the major crop plant categories. Free-threshing wheat and barley were the principal crops cultivated at Tell Tayinat. Arboricultural produce like almond and pistachio started to appear in the assemblage together with other tree fruits which had a longer cultivation history, such as grape, olive and fig. This diversification in perennial trees indicates a long-term investment in arboricultural production. Stable political settings under the Neo-Assyrian rule had most likely provided suitable conditions for long-term investment in perennial trees during the Iron III.

The increase of almond remains in the Near East, specifically in the Levant, would be related to the use of almond oil in supplying oil demand of international trade and the imperial goals of the Assyrians during the first half of 1st millennium BCE. The warm-season crops become more visible in the archaeobotanical records during the same period. This is hardly a coincidence but demonstrates the need for intensification of agricultural production to supplement the empire-wide projects like mass-deportations and military campaigns. The extreme climatic conditions in the Urartian and the Assyrian realms coincide with the implementation of irrigation agriculture. This is an interesting result of this study which needs further consideration after more archaeobotanical research is conducted in these two regions.

More prominently, the widespread introduction of several perennial trees would be the result of two long term processes started during the 1st millennium BCE; 1) increasing connectedness of trade networks through which the knowledge of new methods on the cultivation of new species became prevalent across the Mediterranean basin and the Near East; 2) the establishment of royal gardens that institutionalized the introduction of new species in the Near East. This second process also resulted in the acclimatization of alien species from climatically distinct zones into the Near East.

CHAPTER 8. COMMENSAL POLITICS AT TELL TAYINAT

This chapter investigates the role of commensal politics in imperial statecraft during the Neo-Assyrian period. The crop plants have had a great significance to supplement empire-wide projects (e.g. mass deportations) as previously mentioned in *Chapter 7*. This chapter instead focuses on a certain cultic context of Building XVI, at Tell Tayinat. The section below introduces first an overview of the feasting and commensality in the Near Eastern archaeology. The importance of food offerings in religious rituals is also described. This follows a description of the studied context, at Building XVI, which was conflagrated after a severe fire event and resulted in the discovery of a thick deposit of material culture inside the monument.

8.1 INTRODUCTION

The notions of commensality and feasting refer to communal food consumption events that differ in some way from everyday food consumption practices (Bray 2003). A useful term to study commensality and feasting is “commensal politics” which refers to occasions when “the shared consumption of food and drink is marshaled in the negotiation of power” (Dietler, 2003, p. 272; 2011, p. 183; Tierney & Ohnuki-Tierney, 2012). Feasts were prominent forms of commensal politics in the Near East that could serve to increase group solidarity, promote prestige, find allies, exchange valuables, maintain social control, communicate with deities or honor the deceased ancestors (Hayden, 2001; Dietler, 2011). Pollock (2003, pp. 17-18) highlights two intentions of feasts: First, to form allies with people who have common affiliations and/or interests that could potentially conflict or confirm those of state leaders and administrators; and second, to create and maintain a hierarchical social order in which groups are distinguished by their relative access to privilege and prestige.

Sacrificial offerings and communal food consumption were an integral part of these commensal events (Recht, 2015; Lange, 2014; Sallaberger, 2012; Nowicki, 2014; Struble & Herrmann, 2009; see Beal, 1995 offerings after military victories). Several religious celebrations were occasions for ancient communities to secure and perpetuate fertility and abundance of agricultural crops. Through these religious celebrations people asked for divine blessings and beneficiaries (M. Cohen, 1993 in general on the Near East; Hazenbos, 2003 and Singer, 1983 for the Hittites; see Sarpaki, 2009 for ethnographic evidence from Greece). Winter (2003, p. 254) argues that sacrificial offerings aimed to evoke a continuous cycle of reciprocities between humans and divinities to stimulate the next round of positive responses. Various kinds of offerings hold intrinsic meanings which were determined by distinct social rules and norms (see Lange, 2014 for a lengthy treatment of the subject matter at Qatna, Mari and Ugarit; Recht, 2015 for visual imagery). In relation to the ancient Mesopotamian cultic offerings, Sallaberger (2012, p. 160) remarks the following important points;

> “Whereas at a conceptual level the sacrifice meant the feeding of the gods, on the level of practice the meal as a literally vital act was considered the appropriate moment to remember the cultural and cosmic order represented by the gods. The practice of offerings did not elaborate on the aspect of feeding the gods, but it regularly presented a symbolic pattern determined by variables such as time, place, occasion, or the agent of the sacrifice. The amount and quality of goods presented to a deity depended on occasion and calendar, thus monthly festivals required larger offerings than daily meals or at main festival of a deity his or her share was increased; the main god of the city was presented more sheep, bread and beer than his spouse or his son or minor deities, but a woman might offer more to a female deity than to the male main god”.

The political nature of sacrificial offerings can be recognized in the fact that the attendants of commensal events must fulfill certain duties according to their social status (Sallaberger, 2012). For instance, the Luwian inscriptions of the Palistin king Taita in the Storm-God temple of Aleppo show precise instructions, how much, in what order and by whom the sacrificial food should be offered to the divinity. Specifically, the king Taita is supposed to sacrifice both cattle and sheep while the lower-ranked lords and princes have to offer only sheep. Commoners, on the other hand, have to provide bread and other supplements (Hawkins, 2011). At Emar, the commoners for instance had to bring flour which was then used to supply the enhanced demand for commensal consumption (Sallaberger, 2012). Thus, parallel to feasts, food offerings have a socio-political dimension to reinforce and segregate social distinctions among both divine and human attendants of the commensal events.

To date, archaeological recognition of commensality and feasting are restricted to textual references mostly excluding the material culture record. There are only few archaeobotanical studies on this subject in the Near East during the Bronze and Iron Ages (see Palmer & Van der Veen, 2002, p. 197 for a review). Investigations of other potentially cultic contexts are only emerging (e.g. Fairbairn et al., 2018). In this chapter, I examined if commensal politics were reflected in the material culture, i.e. what was the role of foodstuffs in a cultic context. I therefore analyzed the plant macro-remains from the archaeological deposits recovered inside and around Building XVI at Tayinat.

8.2 DESCRIPTION OF BUILDING XVI

Building XVI is positioned within a larger religious complex referred to as the “Sacred Precinct” alongside the temple Building II and the *bit-hilani* palace Building I. Architectural layout and material culture strongly indicate Building XVI was a second temple to accompany Building II (Harrison, 2012; see Petrovich, 2016 for the most recent investigation of the monument). Both Building XVI and Building II are exemplars for the indigenous religious architecture in the Levant which is widely known as the temple *in antis* tradition (Harrison, 2012). It is suggested that these temples were renovated to become part of the Assyrian religious complex in the town during the late 8th or early 7th century BCE to be transformed into “proto-typical Neo-Assyrian *Langraum* temples (Harrison, 2016, p. 258).

Building XVI and its contents were severely conflagrated so that the material culture was preserved with little disturbance as a thick layer of burnt brick intermixed with ash. Interestingly, field supervisor, J. Osborne (2009 unpublished field report) observed that

> "… [a]nother significant note regarding preservation is that there is not a single fleck of burnt brick was found to the north, west, or south of the building. All of the collapse from the destruction fell within the building itself, or slumped to the east. Even plaster facing of the western N/S wall is perfectly preserved without evidence of burning. This can only mean that the fire was set from the inside, and probably near the inner face of the eastern N/S wall, explaining that wall's highly baked bricks".

8.2.1 Portico and south of the temple

The southern part of Building XVI is characterized by several features such as a square-shaped platform with finely-dressed stone blocks in front of the monument, a wide limestone staircase and a singular column base on the portico. The column base at the southern face of the monument base is identical in size, shape and decoration to those found in the portico of the *bit-hilani* palace (Building I) by the Syrian-Hittite expedition. To the left, a small basalt column is located in front of the southern end of the western N/S wall. There is also a vessel found in situ to the east of the porch. The porch is separated from the central room of the monument by two architectural brick piers (Harrison, 2012, p. 15).

8.2.2 Central room

The central room was heavily conflagrated. There is a thick deposit of destruction debris on the floor between the two piers. Three heavily burned wooden beams have been recovered at this location. One seems to have been set directly in the floor. No artifact or pottery finds were recovered from this part of the monument. Fragments of gold and silver foil and ivory inlays were found near the east wall. It was suggested that this room may have been equipped with furniture or fixtures (Harrison, 2012, p. 16). In 2011, the deposit has been probed to find an earlier floor surface which may have been associated with the Iron II levels of the temple, but unfortunately no such find had been encountered.

8.2.3 Inner sanctum

The inner sanctum is very rich in material culture (and cuneiform manuscripts as discussed in 7.4.2) in comparison to the central room. The inner sanctum is separated from the central room by a set of mudbrick piers and a wood-lined threshold. A podium or rectangular platform is located in the center of the room. The inner sanctum contains a vast array of material culture artifacts recovered either *in situ* or with little disturbance from their original locations. Numerous vessels, oil lamps and cuneiform tablets were found *in situ* or with little disturbance (Harrison, 2012, p. 16). For example, a large collection of cultic objects (i.e. gold, bronze and iron implements, libation vessels, decorated ritual objects) were recovered *in situ* including a *pyxis* or a cylindrical stone box with an elaborately carved scene of feasting depicted on it. Harrison and Osborne (2012, p. 134) state that these ceramic finds have some parallels to 7th century pottery assemblages in the Assyrian heartland.

One of the most noteworthy finds in the newly excavated temple, Building XVI, is a copy of the Esarhaddon's Succession Treaty (EST). The EST is an important finding as only a few other copies had been found in the Near East during the Neo-Assyrian period. This document is a loyalty oath (*adê*) to the designated successor of Esarhaddon, Assurbanipal. It is argued that material culture and cuneiform tablets identified in the inner sanctum of the temple would have been used in the *akitu*[40] festival in its original configuration to pledge allegiance to the

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[40] The *akitu* was the New Year Festival in the sense that it was gained during Neo-Babylonian period in the 1st millennium BCE (Bidmead, 2004). However, the festival itself had a greater antiquity in the Mesopotamia (M. Cohen, 1993). The *akitu* included in fact a group of festivities centered on legitimating of kingly power through some rites. Bidmead notes that to mark the transition from the old to the new has been determined by detailed ceremonies like "procession of the king and the deities, intricate sacrifices, prayers, rite of purification and cleansing of the temple, and celebrations to commemorate the upcoming year" as well as the ritual humiliation of the king as practiced during the Neo-Babylonian period (2004, p. 40). The Assyrians seem to have practiced

Neo-Assyrian king by provincial governors and the lower-ranked officers (Harrison & Osborne, 2012; see Lauinger, 2012 for a detailed evaluation of epigraphic evidence). Another group of tablets found with little disturbance in the inner sanctum are the *iqqur īpuš* texts. These are an hemerological series which describe the favorable months within the year for various mundane activities, ranging from planting an orchard to the construction and demolition of a house. Another tablet is a bilingual Sumerian-Akkadian lexical text (Harrison, 2014a, p. 89; see Lauinger, 2011 in general). It is observed that some of the tablets with piercings on the horizontal side were in fact destined to be displayed on the wall of the inner sanctum (Lauinger, 2011).

8.2.4 Features to the west of the monument

To the west of the monument some more archaeological features were unearthed. A *pithos* had been recovered installed on top of the cobble-stone surface and a rectangular stone installation found to the south of this *pithos*. It should be noted that the rectangular stone installation sits on top of the occupational debris, G4.37 L.7, not on the cobble stone surface (L.9). Thus, this stone installation was not associated with the earlier, but rather the later use phase of the temple (Osborne 2009 unpublished field report). Moreover, the pottery finds from occupational debris L.7 of G4.37 are reported to be similar with the Floor 2 ceramics of the *bit-hilani* Building I, which were unearthed by the Syrian-Hittite team (Osborne 2009 unpublished field report). Also, excavators found out that the outer parts of the western N/S wall of the temple were partly plastered (Harrison & Osborne, 2012).

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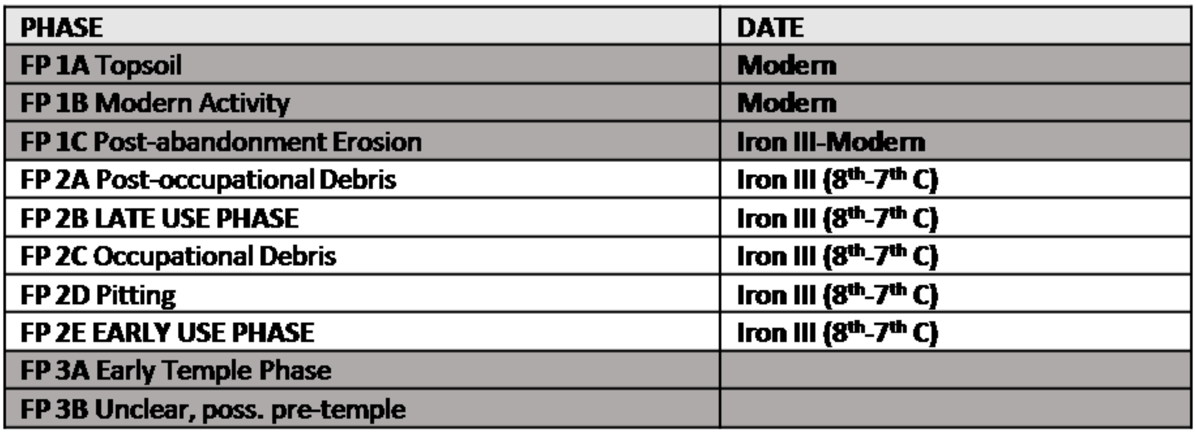
the festival during the Middle Assyrian period in their homeland at least as early as after the conquest of Babylon by Tukulti-Ninurta I around mid-14th century (M. Cohen, 1993, p. 418). From the time of Esarhaddon onwards, the loyalty-oath (*ade*) ceremony appears to have integrated to the festival calendar (see Fales, 2012, pp. 133-4 for history of loyalty oaths in general).

8.2.5 Modifications

Archaeologists have discerned several structural modifications and additions by the Neo-Assyrians in and around Building XVI. Stratigraphic evaluation from a 2011 probe at the west wall of the monument enabled the team to delineate two separate phases of construction. In the earlier phase, “wood-crib” construction technique was identified. This construction method, as well as the characteristic features of basalt column bases, is similar to the *bit-hilani* Building I. This evidence demonstrates that there should have been a close architectural relationship between the adjacent *bit-hilani* palace and the two temples during Iron II. In the later construction phase, a foundation trench was filled with “mudbricks containing nari, or crushed limestone” (Harrison & Osborne, 2012; Harrison, 2012, p. 16). Another modification was that the beautifully carved column base in the portico, an exact similar one was found in the porch of the *bit-hilani* palace, was covered by a layer of mudbrick surface. Therefore, the column base is out of sight. Two more architectural piers seem to have been placed inside the monument to separate the inner sanctum from the central room (Harrison & Osborne, 2012).

8.2.6 Chronology and periodization of deposits

No radiocarbon dates are yet available, but the material culture evidence and architectural parallels place Building XVI to the late 8th – early 7th centuries BCE. The periodization of the archaeological deposits, according to the archaeological observations and ceramic chronology, indicate three distinct episodes (Table 12); 1) post-abandonment phase including the topsoil and modern activity (FP 1), early and late use phase, and (FP 2); pre-temple phase (FP 3). These three phases were further divided into subphases. Specifically, FP1 was subdivided into the subphases FP1C post-abandonment erosion (mixed deposits), FP1B modern activity, and FP1A topsoil.



PHASE	DATE
FP 1A Topsoil	Modern
FP 1B Modern Activity	Modern
FP 1C Post-abandonment Erosion	Iron III-Modern
FP 2A Post-occupational Debris	Iron III (8th-7th C)
FP 2B LATE USE PHASE	Iron III (8th-7th C)
FP 2C Occupational Debris	Iron III (8th-7th C)
FP 2D Pitting	Iron III (8th-7th C)
FP 2E EARLY USE PHASE	Iron III (8th-7th C)
FP 3A Early Temple Phase	
FP 3B Unclear, poss. pre-temple	

Table 12 The periodization of deposits recovered from Building XVI.

FP2 contains all archaeobotanical samples investigated in the present study. This phase has been divided into five sub-phases; FP2E-2A. The so-called “Early Use Phase” (FP2E) contains the earliest archaeological deposits. FP2E shows strong similarities in construction techniques with the neighboring Iron II monuments. Therefore, the Neo-Hittite connection to the late 9th or early 8th century BCE is tentatively discerned. However, the exact dating of the early use phase remains unclear. Following this, a series of pitting activities have been delineated by the archaeologists in FP2D. Furthermore, the occupational debris covering FP2E and FP2D was assigned to FP2C and identified in several excavation trenches. FP2B represents the “Late Use Phase” of the temple including the deposits found *in-situ* inside the monument.

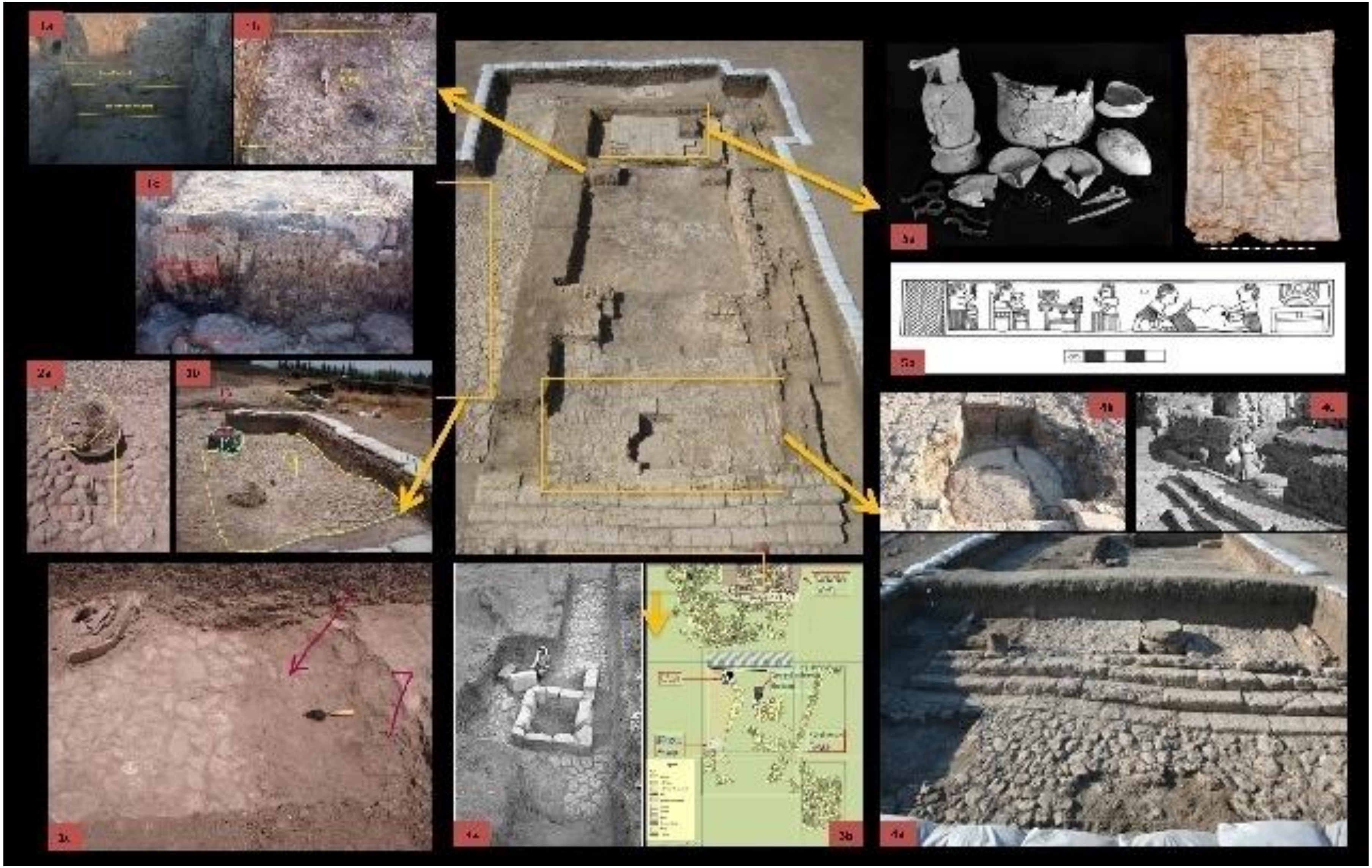


Figure 59 **Archaeological features and artifacts from inside and around Building XVI; 1a) 2011 probe from inside the temple, 1b) surface of central room from 2011 probe, 1c) cobble-stone surface and plastered west wall; 2a) Pithos to the west of the temple, 2b) Pithos and stone installation looking south, 2c) Pithos and earth layer atop the cobble-stone surface; 3a) Limestone installation in front of the temple uncovered by Chicago team, 3b) "Gate Complex" , 4a) Porch, stairs, column base and an altar, 4b) Column base after removal, 4c) Chicago team and the column base of the *bit-hilani* palace; 5a) Artifacts and Esarhaddon's Succession Treaty from the inner sanctum, 5b) Feasting scene on the pyxis found in the inner sanctum (Sources: OCHRE database, *sites.utoronto.ca/tap*, *hittitemonuments.com*).**

According to Harrison and Osborne (2012), the “Late Use Phase” certainly corresponds to the Neo-Assyrian provincial phase of the site dating to the late 8th or more probably early 7th century BCE. The Esarhaddon Succession Treaty provides a *terminus post quem* of 672 BCE for the destruction of the Building XVI during the Neo-Assyrian occupation of the site (Harrison, 2012; Harrison & Osborne, 2012). FP2A contains the post-occupational debris found on top of these layers identified both inside and outside of the monument. The earliest phase, FP3, is represented only with a few features. Namely the column and stairs are thought to be already in use during this earliest temple phase. A search for remains of FP3 inside the monument was so far unsuccessful (e.g. above mentioned 2011 probe).

8.3 MATERIALS AND METHODS

All sediments from squares G4.28, 29, 48, 49, 37 and 38 were scanned for their botanical contents. Scanning the entire samples (n=196) showed that FP3 and FP1 does not yield reliable samples for archaeobotanical analysis. FP3 included only sporadic archaeological features and none of them contain botanical remains. Furthermore, all samples from FP1 were also excluded because of their high degree of contamination by modern seeds, stem fragments and roots. Specifically, the reports of plough-marks cut across the topsoil on certain squares indicate that the archaeological deposits of Phase 1 were mixed to a certain degree with modern material. Furthermore, FP1 samples which contain lightly carbonized plant remains were omitted from the analysis. These carbonized remains may be the product of recent wildfires on the site since none of these objects were ever present in the plant assemblage of Tayinat studied so far, but observed as on-site vegetation. Supposedly, these remains were integrated via post-depositional disturbance either by modern agricultural activities or by the trenches of the Syrian-Hittite expedition. Furthermore, the samples excavated in 2011 northward on top of the mudbrick pavement between the Platform XV and Building XVI, were not yet stratigraphically attested to any phase and/or subphases. These samples are almost devoid of any plant remains and are contaminated with modern plant material. Thus, these were also excluded from the analysis.

The scanning produced 45 samples to be included in this study which all originate from Phase 2 (FP2A-FP2E). These samples were excavated in 2008, 2009 and 2011 from Field 2. Floatation of soil sediments was performed in 2008, 2009 and 2014. Additionally, 6 hand-picked samples and 25 previously published soil samples by Capper (2012) were added to the dataset. In total, all 76 samples correspond to 597 litres of soil sediment. Of these 76 samples, 28 samples contain no archaeobotanical remains. Out of the remaining 48 samples, 672 archeobotanical objects were identified into 63 analytical categories.

Quantification methods were similar to the previous chapters (sub-section 4.1.3). Due to the cultic nature of this particular context, the plant distributions were further analyzed with a qualitative approach (context + plant occurrences). For this reason, sample-by-sample descriptions are given in *sub-section 8.3.4.*

8.4 RESULTS

The samples include the typical range of crops such as cereals, pulses and arboricultural crops. Specifically, cereals were represented by barley and free-threshing wheat. Emmer wheat was completely absent. On the other hand, two einkorn objects were encountered. Bitter vetch is largely present. Grass pea/red vetchling is represented with one count. Only two lentil objects were recovered. Most of the wheat and bitter vetch finds were concentrated in the central room (see below sub-section *8.4.2*). Arboricultural crops such as olive, grape and fig were frequent. However, almond and pistachio were absent in this area of investigation (see Table 13 for a general overview).

8.4.1 Overall characteristics of plant assemblage

The ubiquity scores of crop plants are rather low in all phases. The ubiquity score of wheat categories are lower than barley. Also the other crop plants have significantly low ubiquity scores in general. Grape has an approximately 10% score. Olive finds show the highest score among crops with 21%. The occupational debris (FP2C) to the west of the monument, on the other hand, shows 52% ubiquity for olives (not shown in the Table 13).

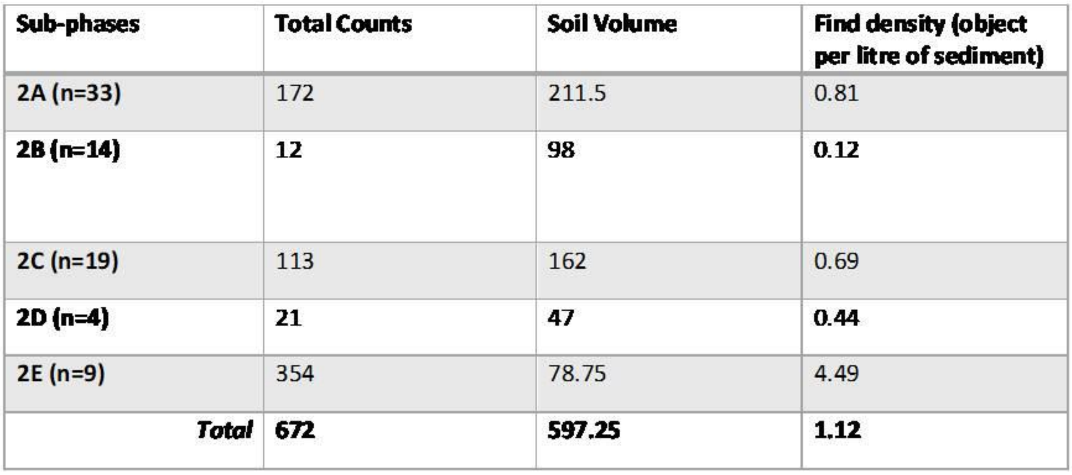
Field 2 Phase 2	**2a**	**2b**	**2c**	**2d**	**2e**	**Total counts**	**Proportions**	**Ubiquity**
Cereals								
Hordeum vulgare	1	1	5		12	**19**	**2.8**	**17.1**
Hordeum vulgare (rachis)					1	**1**	**0.1**	**1.3**
Triticum spp. (fr. thres/gl.)	9		3		8	**20**	**3.0**	**10.5**
Triticum aestivum/durum	29	1	3		10	**43**	**6.4**	**11.8**
Triticum aestivum/durum (chaff)					1	**1**	**0.1**	**1.3**
Triticum monococcum/boeticum					2	**2**	**0.3**	**2.6**
Pulses								
Vicia ervilia	14	1	2	2		**19**	**2.8**	**9.2**
Lathyrus sativus/cicera					1	**1**	**0.1**	**1.3**
Lens culinaris			1		1	**2**	**0.3**	**2.6**
Tree crops								
Olea europaea	3		12	6	2	**23**	**3.4**	**21.1**
Vitis vinifera (pip)	1		8		1	**10**	**1.5**	**9.2**
Vitis vinifera (berry)			1			**1**	**0.1**	**1.3**
Vitis vinifera (stalk)			2		1	**3**	**0.4**	**3.9**
Ficus carica	1	2			1	**4**	**0.6**	**5.3**
Flax								
Linum usitatissimum	3				3	**6**	**0.9**	**3.9**
Wild/weedy plants (> 5% ubiquity)								
Lolium sp.	2	2	35	5	155	**199**	**29.6**	**30.3**
Phalaris sp.	5	1	7	1	33	**47**	**7.0**	**21.1**
Phleum cf. phleoides			3		13	**16**	**2.4**	**5.3**
Poaceae, indet. (large)	79		4	3	3	**89**	**13.2**	**15.8**
Poaceae, indet. (medium)	8		4		10	**22**	**3.3**	**10.5**
Melilotus/Trifolium	4		8		32	**44**	**6.5**	**18.4**
Bupleurum sp.			1		7	**8**	**1.2**	**5.3**
Scirpus maritimus		4	3	1	2	**10**	**1.5**	**11.8**
Rumex sp.	2		1		4	**7**	**1.0**	**9.2**
Rubiaceae, indet. (small seeded)			5		3	**8**	**1.2**	**7.9**

Table 13 The absolute counts, ubiquity scores and percentages of the selected plant taxa according to the sub-phases of FP2 in Field 2.

Free-threshing wheat remains have higher proportions than two-rowed barley. While most of the barley finds were recovered from the mixed deposits in the pithos and the occupational debris in G4.37. None of the barley finds were encountered from inside the monument. Bitter vetch has higher proportions than other leguminous crop plants. Olive pits show comparatively higher percentages than the other fruit finds like grape and figs. Concentrated finds of free-threshing wheat, bitter vetch and olive pits contribute to the high proportions of these crops.

Lolium (ryegrass), *Phalaris* (canarygrass) and *Melilotus/Trifolium* (several clovers) appear with higher ubiquity scores than any other wild taxa. Further wild plants identified with over 5% ubiquities are *Scirpus maritimus*, *Rumex*, unidentified large grass grains, *Phleum* cf. *phleoides*, *Bupleurum* and several unidentified Rubiaceae objects. On the other hand, there are 36 other identified taxa which have ubiquity scores under 5% (not shown in the table above; see the Appendix C.1 for the raw macrobotanical data). The majority of these species were recovered from the *pithos* but not in other deposits. Most of the plant taxa recovered were these three weedy plants. 43% of the assemblage belongs to three categories; ryegrass, canarygrass and clovers. Furthermore, unidentified large and medium-seeded grasses were very common and accounted for 13% of the whole assemblage. 87 of these unidentified grass objects had been recovered from the central room of the monument.

The studied samples have a relatively low density of plant finds with a mean of 1,12 objects per sediment across all studied phases. The later phases (FP2A-2D) have a density between 0.43 and 0.86 per liter. However, the overall density of finds is 4.49 per liter for the FP2E. The samples collected from inside the pithos have an average density of ca. 7 objects per liter. The density of plant finds becomes the highest at the bottom of the *pithos* with a



Sub-phases	Total Counts	Soil Volume	Find density (object per litre of sediment)
2A (n=33)	172	211.5	0.81
2B (n=14)	**12**	**98**	**0.12**
2C (n=19)	113	162	0.69
2D (n=4)	**21**	**47**	**0.44**
2E (n=9)	354	78.75	4.49
Total	**672**	**597.25**	**1.12**

Table 14 **Absolute counts, sediment volume processed and find density scores according to sub-phases of Building XVI.**

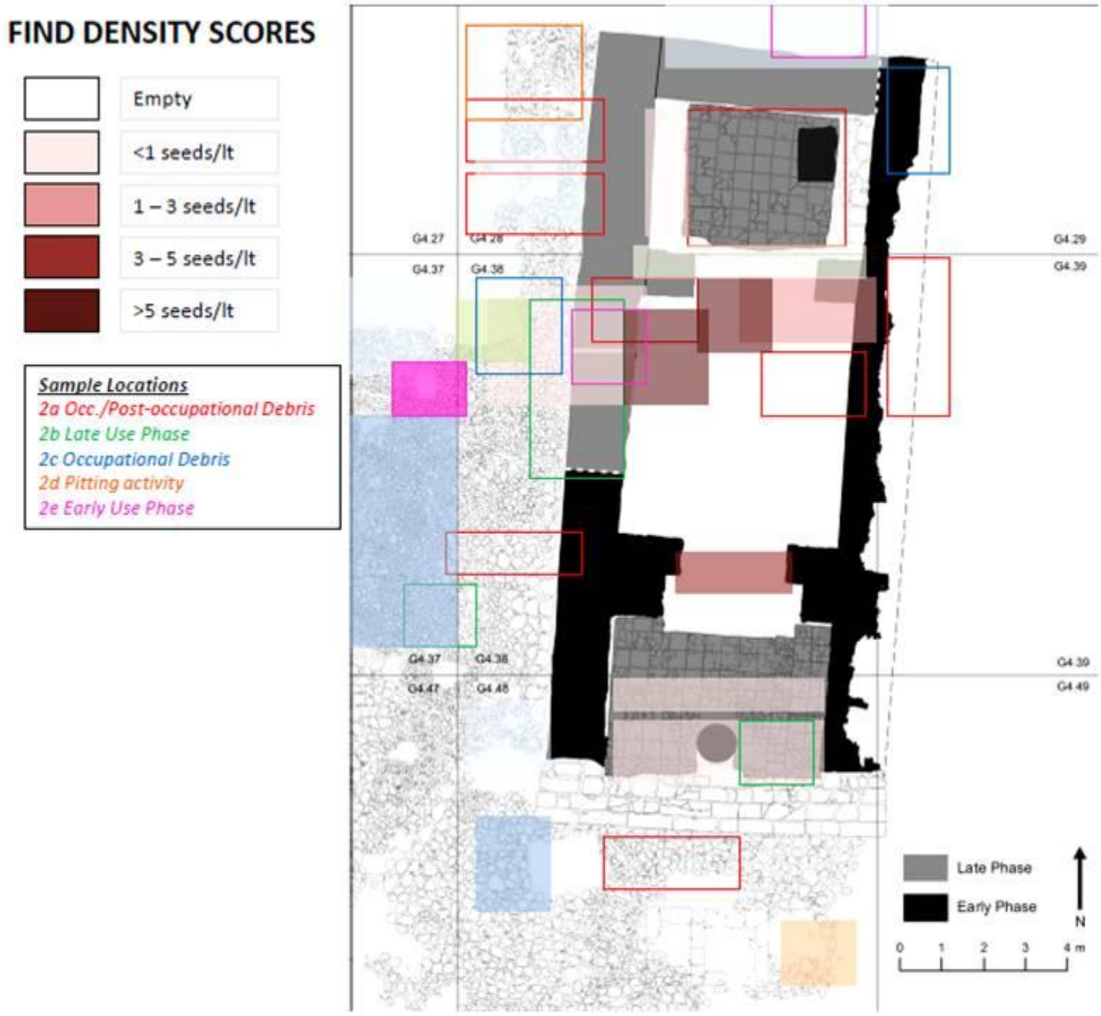


Figure 60 **The locations of archaeobotanical samples analyzed and their densities in and around Building XVI.**

decreasing trend towards the upper deposits. The plant density varies across sampled units within temporal phases. For example, in the FP2C, the occupational fill debris (L.7) surrounding the *pithos* featurein this particular trench (G4.37) has comparably higher density scores than neighboring deposits (Table 13).

8.4.2 Spatial patterning of archaeobotanical remains

The earliest phase, FP2E, examined in the present study covers the samples from the *pithos* (G4.37.9). This *pithos* is embedded in the cobble-stone surface. Six samples taken from this feature are full of seeds and fruits (Pail 45). The six samples were recovered in total from ca. 53 litres of soil sediments. Three flax/linseed objects were recovered from the deposits inside the *pithos*. Both barley and free-threshing wheat are present with well-preserved specimens as well as a rich diversity of wild and weedy plants. Three wild taxa (ryegrass, canarygrass and aggregate clovers) are abundant in these deposits.

One sample tentatively assigned to FP2E has no plant remains. This sample was recovered at G4.28 L.9 assigned to a brick tile to the north of the temple outside. Two samples (Pail 109 and 111) recovered from the deposits abutting the wall segment in G4.38 L.21 show that the deposit from P. 111 include remains of crops plants such as barley, free-threshing wheat, einkorn wheat, olive, as well as ryegrass and clovers. The other sample Pail 109 only contains modern seeds.

Phase 2D is assigned to pitting activities by the excavators. There are four samples from two pit features examined from this sub-phase. The sediment in G4.28 L.14 contains three samples (Pail 34, 35, 11). The former two pails are devoid of plant remains while the third one includes four objects. Each of these objects represents wild plant taxa (ryegrass, *Scorpiurus*, *Tymelaea* and *Euphoria*). The fourth pit sample (G4.48 L. 20) is richer in plant evidence and well-preserved. This sample is located beside the stone installation to the south of the temple. The sample is collected from the top of this pit feature. The sample contains olive pits (n=6), bitter vetch grains, wild plants such as ryegrass, canary grass and *Scirpus maritimus*.

The FP2C contains the deposits of occupational debris on top of the previous two sub-phases. There are 19 samples collected from this sub-phase. Four samples were collected by hand-picking by the excavators. The samples were recovered from the top of the cobble-stone surface in G4.37. One sample from L.6 contains only three objects (ryegrass, and two unidentified pulse and cereal grains). The six samples recovered from L. 7 represents comparatively rich finds. These samples contain primarily ten olive pits scattered around the cobble stone surface. The remainder taxa includes cereals and pulse grains. Wild plants are confined into ryegrass, canary grass and clovers categories in large. Other taxa appearing in low counts are *Scirpus maritimus*, *Vaccaria* cf. *pyramidata* and small-seeded Rubiaceae. A grape pip attached to an unknown hardy structure was found during this examination (Fig. 61).

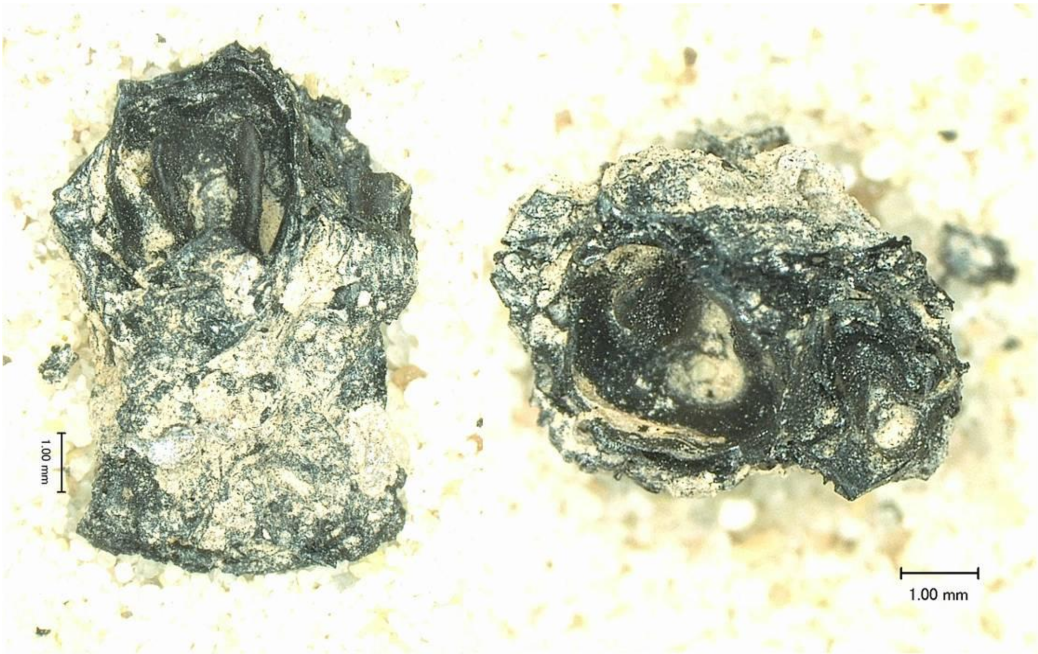


Figure 61 An unindetified object with a grape pip embedded into it (Photo courtesy: D. Karakaya).

The deposits covering the outside of the temple in G4.28 in the FP2C contain less plant remains and the evidence is fragmentary. Two hand-picked samples were collected by the excavators which are singular barley and free-threshing wheat objects. Two out of six other samples on top of the cobble-stone surface in G4.28 are empty. The other four samples contain grape, olive and barley objects as well as the typical weeds (ryegrass, canary grass and clovers). All are of low quantity. Another sample recovered in G4.29 north of the temple is also empty.

The sub-phase 2B coincides to the late use phase of the temple. Plant evidence is largely absent from this sub-phase. From 12 samples analyzed, 8 are empty. The remaining 4 samples bear only 12 objects. A stone installation (L. 10 in G4.37), an Assyrian addition, to the west of the monument was sampled for archaeobotanical purposes. Two samples from this stone installation yielded no archaeobotanical finds, except a singular *Scirpus maritimus* object.

The final subphase 2A yielded a good amount of plant remains inside the monument classified as post-occupational debris by excavators. This sub-phase covers the samples deposited after the destruction of the temple. Six samples were recovered from a mudbrick surface on the porch in G4.48 (L.11 and L.12) and show little evidence of plant remains with only nine counts. Two samples didn't yield any plant remains. Bitter vetch is the only crop plant (n=2) in this group of samples in the portico. There are also unidentified large cereals and pulses and some wild plants (*Rumex* sp. and *Sherardia arvensis*).

Within the same subphase, the samples recovered from the central room include concentrated plant remains. Another sample from the same square shows evidence of bitter vetch in L.13 in square G4.38 in between the first architectural piers. The destruction debris on surface L. 8 contains free-threshing wheat grains (n=15) as well as many unidentified large wheat specimens. Only one *Phalaris* object had been found as wild plant on this surface.

Concurrently, a single soil sediment from the 2011 probe also includes free-threshing wheat objects (n=13) together with many unidentified, severely deformed Poaceae grains (n=66) which may belong most probably to the same *Triticum* taxa. A sample recovered from the second architectural piers, separating the central room and inner sanctum, contains six unidentified large-seeded grass objects.

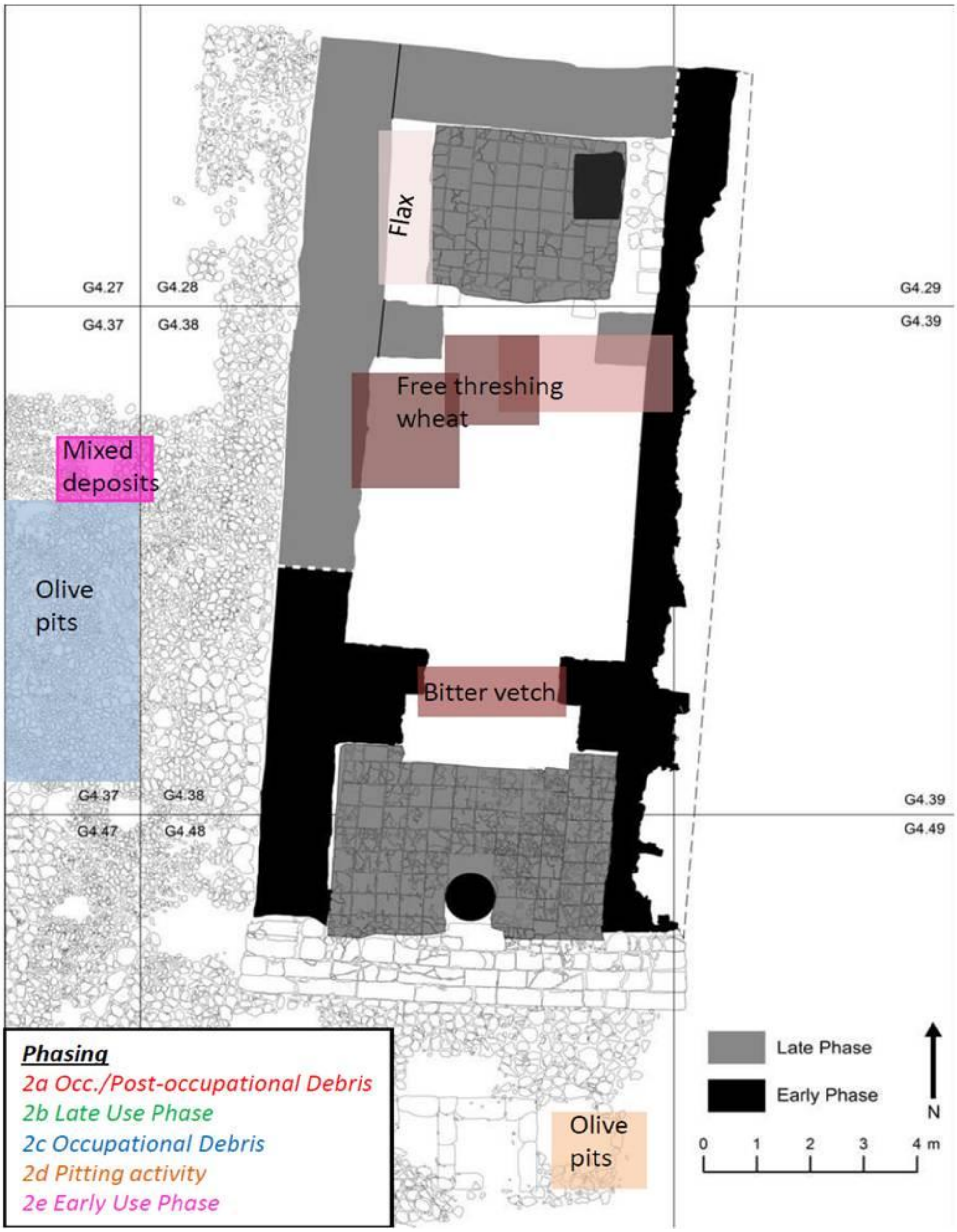


Figure 62 Simplified version of find density scores showing the most important finds from the area under investigation

The samples coming from the inner sanctum are decidedly devoid of plant remains in G4.28. Only one sample from L.26 includes plant evidence, i.e. 9 objects were recovered between the platform and the west wall. Specifically, this sample contains one barley object, three flax/linseed objects and wild plants such as two canarygrass objects, two ryegrass objects and one unidentified cyperious specimen.

8.5 DISCUSSION

The context and the associated archaeological remains under investigation fulfill most of the criteria to reconstruct feasting activities. Hayden (2001) suggests that there are four critical aspects which makes archaeological identification of commensal events possible; 1) a collective event which includes or segregates some members of the society, 2) a time- and place-specific event with a distinct celebratory occasion, 3) large amount of food and beverages consumed, 4) the consumption of exotic, rare products. These aspects can be classified according to the available archaeological evidence from Building XVI as follows;

1) "*a collective event*": several broken ceramics which were locally-produced (Karacic and Osborne 2016) from the occupational debris (G4.37 L.7) and a concentration of plant and animal finds testify this aspect. The ritual breakage of feasting equipment can be a factor of deposition of these vessels (e.g. Hayden, 2001, p. 53; Balossi-Restelli, 2012, p. 81). Textual records from Hattusha demonstrate the same aspect of ritual breakage of cultic vessel to execute the rites of passage to the netherworld for the deceased king (van den Hout, 1994). Zuckerman offers a political explanation for the public destruction of prestige items symbolizing the control over the production and consumption of these items by elites (2007: 200). This kind of broken ceramics was also identified at Tel Bazi in the temple area where the amount of broken ceramics increases from the entrance towards the altar (Otto, 2012,

p.186). Zuckermann (2007) and Halstead (2012) also observe that, most of the feasting equipment, identified of the Late Bronze Age Tel Hazor in the Southern Levant and in Mycenaean Greece respectively, was undecorated, simple wares rather than luxurious vessels.

2) "*a time- and place-specific event*": in its late use phase of Building XVI, it is certain that the monument housed the EST. Most possibly *akitu* ceremonies were performed in the second month of the calendar as the dating on the EST demonstrates.

3) "*large amount of food and beverages consumed*": although there is no easy way to determine the amount of foodstuffs and beverages consumed by an archaeobotanical analysis, the ceramic assemblage found around the monument includes predominantly drinking cups. Karacic and Osborne (2016) propose the liquid consumption during the banquets as the reason/function of these vessels. The authors argue that the locally-produced types of the ceramic wares found in this context, White Painted and Bichrome Ware, would have been related to the growing demand for these exotic-type vessels to be used in ceremonies and banqueting events (2016, p. 14).

4) "*exotic and rare products*": from an archaeobotanical perspective, the rarities, can be several different kinds of nuts, spices or other economic plants which were not easily accessible to every segment of the population[41]. Exotic plants are those not found in the region. However, despite of the greater expectation of finding rare and exotic products from such cultic contexts, it is likely that several botanical contents used in cultic activities were possibly in close reach of the inhabitants. For example, as Sallaberger (2012, p. 164, footnote 35) reports from the text *Emar* 452, the amount provisions gathered for offerings from different institutions are listed. According to this list, the palace has to provide "sesame oil scented with cedar, ghee, spices, one vessel (of wine), a string of figs, ten pomegranates, and

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[41] For an ancient Mayan context for such sacrificial use of rarities, see Cagnato 2017. See Curet and Pestle (2010) for a comprehensive account on the same issue.

an unknown amount of raisins”. The sesame oil mixed with cedar (barks or resin?) is an important indication of long-distance trade to acquire such valuables in Northern Mesopotamia. Bidmead reports that cedar resin was used for cleansing the temple of Nabu in the Neo-Babylonian period by smearing all the gates. The mention of “a string of figs” is equally interesting. During the 1997 excavations of Kilise Tepe in the west of Cilician Plain (Mersin Province of modern Turkey), the archaeologists report an *in-situ* hoard of dried figs with a hole on them in Level IIc (Bending & Colledge, 2007, p. 592). Although the context has not any cultic importance, this material find possibly represents what is described in the Emar tablet above. The same treatment, threading the fruits with a string, also appears at the Royal Cemetery of Ur but for apple (Nesbitt, 2003, p. 30).

So far, no archaeobotanical finds from this temple context can be classified as “exotic”, but some rare finds occurred such as a grape pip attached to a hardy object (this study), a significant amount of fish in *pithos* and some wild animal bones (e.g. bear and camel) unearthed in the occupational debris to the west of the monument (David Lipovitch, pers. comm.). Other zooarchaeological finds from the occupational debris include a worked bone, possibly Astragalus (ankle bones of ruminants) which has been known to be common for the divination in the Near East (Lev-Tov and McGeough 2007: 95). Preliminary charcoal analysis also shows that the cedar (*Cedrus libani*) wood is consistently absent elsewhere at the site, but found in the *pithos* and as a column on the portico (Brita Lorentzen, pers. comm.).

8.5.1 Formation processes and preservation of plant remains

The archaeobotanical evaluation demonstrates certain interesting results for the spatial distribution of plant remains during this examination. The plant evidence suggests that the depositional processes of archaeological plant remains were diverse. Besides, the plant evidence and the contextual analysis suggest that the formation processes and depositional contexts between inside and outside of Building XVI differ from each other.

At least two depositional processes can be discerned from archaeological and archaeobotanical finds[42]. Inside of Building XVI, the deposition is primarily because of disturbance by fire (if the modern ploughing activity is omitted) and appears to have resulted after a single destruction event. This destruction event only affected the monument but not the archaeological features outside of it. The monument is not devoid of organic remains despite earlier observations with smaller sample numbers (cf. Capper, 2012) but crop concentrations (wheat and bitter vetch) found in the central room and linseed finds in the inner sanctum (Capper, 2012). It appears that all plants have spilled onto the floor from their original location westwards during the initial destruction of the temple. It is also noteworthy to mention that some plant finds from burnt mudbrick can be another depositional factor for the formation of plant remains in this setting. The addition of straw and domestic waste during the mudbrick production is previously identified at Egyptian sites (Marinova,2012b). The wild plants found in the monument is low in comparison to crop finds, however, their presence in the inner sanctum may be related to this fact. Thus, it can be assumed that the plant remains recovered from inside Building XVI are of the final use phase of the temple thereby certainly coinciding to the Neo-Assyrian occupation phase.

The deposits which were recovered from around the monument, on the other hand, seem to be accumulated over a longer time period before they were buried by later Assyrian activity. No

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[42] The sub-phases FP2B and FP2A should best be examined together. In regard to the plant occurrences, the spatial distribution demonstrates patternings in sub-phase 2A but it is hard to reconcile this with the current phasing of the temple. That means regarding the destruction debris on top of the surface (assigned to 2A) produced concentrated plant finds in the severely burned deposits of the central room with plant concentrations. These deposits should be assigned to the 2B during the last use phase rather than 2A as post occupational debris. Possibly the uncertainty is mainly categorical to define the destruction debris as post-occupational (2A) and archaeological features in late use phase as occupational (2B).

concentrated plant finds documented in this area. However, these deposits are especially richer in taxa diversity than the finds from inside of the monument. These deposits can be tentatively considered an earlier use phase of Neo-Hittite Age than the deposits inside the monument.

The question as to how the plant objects were preserved is also critical to develop an understanding for the taphonomic processes in this context. Carbonization is the only way of preservation so far encountered in this context. As mentioned above, the destruction inside the monument happened through a single conflagration event. The degree of morphological deformation of the wheat grains due to over-carbonization can hypothetically confirm this severe conflagration inside the monument. This is also coincident to the observations of the excavators for the “crispy mudbrick surface” in the central room. This over-carbonization resulted in an unproductive identification of many Poaceae (grass family) grains from the floor surface in the central room. It is highly likely that these plant remains also belong to the free-threshing wheat category.

The likeliest entry ways of these plant objects around Building XVI remain to be a more complicated issue due to the cultic nature of the context. The accumulation of archaeological remains to the west and south of Building XVI should most closely be linked to the significance of open airspaces around the temples (as well as city gates and terraces) for cultic activities in the Northern Levantine sites (Mazzoni, 2015; Gilibert, 2015). The importance of the rear outer sides of the temples for ritual practices was previously studied at Emar and Tell Afis. These perimetral locations had always provided rich cultic paraphernalia, a variety of installations and pits (see Mazzoni, 2015 for an overview).

Intentional burning of foodstuffs may be a factor of deposition of plant remains around the monument. This sort of intentional deposition of cultic material has been studied in varying contexts and periods in the Bronze and Iron Age Near East as parts of commemoration of the event, sealing the monument, foundation or purification rituals (e.g. Ökse, 2015). Another parallel from the Southern Levant, the four-horned altar of Philistines at Tell es-Safi show no burning signs on top of it; however, it may be possible to have been used for libation or incense offerings burned in a receptacle (Maeir et al., 2013, p. 21). Some textual evidence appears to be mentioned in Hittite texts (Fairbairn et al., 2018) alongside biblical references for burning animal and cereal offerings (Stager & Wolff, 1981, p. 243). Burning meat offerings is well-documented in Hittite royal funerary rituals (van den Hout, 1994, p. 68) as well as Middle Assyrian *akitu* ceremonies for Marduk (M. Cohen, 1993, pp. 418-9). On the other hand, our knowledge for burning organic offerings in Classical Age from burial and domestic contexts is far more abundant (Megaloudi, 2005b).

Notwithstanding the fact that it is hard to define the sources of multiple carbonization events merely by looking to the composition of samples, the plant assemblage inside the *pithos*, for example, resembles food preparation debris usually recovered elsewhere at the site. This particular aspect, the abundant occurrences of wild/weedy plant remains in cultic context, has been previously discussed at Büklükale (Fairbairn et al., 2018) in Central Anatolia and in a classical Mayan *chultun* (Cagnato, 2017) from an archaeobotanical perspective. At Büklükale, in a certain "shaft-like" architectural unit (archaeologically documented as R62), the carbonization of the wild/weedy plant remains has been attested to the food preparation debris discarded intentionally in the studied cultic context. Fairbairn and his colleagues suggest that "… the food remains were the refuse of social gatherings after which the residue from cooking fires etc. were discarded into R62 alongside the cups and other serving paraphernalia as a commemoration of the event" (2018, p. 341). Cagnato (2017) proposes that ethnobotanical assessment of those wild/weedy plants shall bring a better understanding for their possible inclusion into the assemblage as probable vegetable greens in the archaeological deposits with cultic background.

On the other hand, these contaminants –as we today call it- might have also been perceived as contaminating the ritual process; an idea coined as "ceremonial trash" by Walker (1995; see section *8.4.1.2.2* "pit features" for more thorough discussion of the concept). It is already well-known that in the Old Hittite period around 1.700 BCE, when Anitta conquered Hattusha after a rebellion, recorded this event with such words; "In the night I took (the city) by storm. On her place [the town - DK] I sowed weeds[43] instead" (Dörfler et al., 2011). In spite of the fact that there are several centuries between our subject of investigation and Anitta's conquest, the principal behavioral pattern shall be similar with burning the food preparation debris (mainly weeds) because the crop contaminants would have been perceived as sources of impurity for ritual process.

There are also no indications that the food was prepared around or near Building XVI in regard to the absence of archaeological features like ovens and hearths. The absence of food preparation installations has also been observed by Sallaberger (2012, p. 165) in Emarite texts and by Otto (2012, pp. 185-6) in the archaeological record of Tel Bazi. Otto also mentions that there may have been communal ovens to provide large amounts of sacrificial bread to be consumed by the community. Huge ovens measuring 3.4 meters in diameter were discovered elsewhere on this site (2012, pp. 185-6).In some Levantine sites, pottery kilns (e.g. Tel Hazor Orthostats Temple of Area H, Zuckerman 2007, p. 193) and olive pressing installations (e.g. Stager & Wolff, 1981) have also been identified as integrated units of the temples. There is no evidence for this type of installations around Building XVI. It is known that the temple

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[43] The translation as "weeds" is only the best guess. The plant species mentioned in this text is unknown and there are several suggestions for this plant (e.g. ryegrass by Dörfler et al., 2011). However, the symbolic meaning seems to be clear enough to presuppose that this particular plant's role was desertion of the town by making it agriculturally unproductive/infertile.

complexes in Southern Mesopotamia encompass kitchens and other installations for food preparation to ensure the purity of sacrificial meals (Otto, 2012). For instance, for whatever reason the cook of the Nabu temple was the first person to open the door of the temple to start the *akitu* festivities during the Neo-Babylonian period (Bidmead, 2004).

8.5.2 Contextual analysis of plant remains in and around Building XVI

Establishing the fact that at least some biological remains have been burned intentionally for sacrificial purposes requires to investigate these deposits more thoroughly to delineate the observational differences (both archaeological and archaeobotanical) among the features with similar age and function. Osborne (2009 unpublished field report) notes an important point in this manner:

> "… if the temple was constructed during the Neo-Hittite occupation phase but then continued in use during the Assyrian period, as was proposed above in the Field Report, then the artifactual remains excavated from the temple are potentially later than material excavated from Phases D and C, despite the walls and floors of Phase E being stratigraphically earlier".

Keeping this information in mind, the contexts had been reduced into two categories by possible age relationship; 1) *Pithos,* occupational debris and pit features (subphases 2E, 2D, 2C) have possibly greater connection with the early use phase of the temple before the Assyrian annexation, 2) the interior surfaces of the monument with the late use phase of certainly corresponding to the Neo-Assyrian period. In case of function, this division remains more obscure since the functional characteristics of diverse features can change over and within the course of their use phases or could be obscured to us because of several physical modifications by the Assyrians and post-depositional processes. For this reason, functional interpretations of these archaeological features must be conceived tentative for the present study.

8.5.1.1 Pithos and occupational debris to the west

A significant find is a grape pip partially burned together with a hardy matrix. Partially burned grape fruit remains have also been reported at Büklükale in the context mentioned above (Fairbairn et al., 2018). There is also an interesting spatial patterning for olive objects which requires further attention. In this sense, olive pits are explicitly concentrated in the occupational debris located on top of the exterior cobble-stone surface to the west of the monument and none inside the temple. The outstanding ubiquity (ca. 50%) may be caused due to preservation conditions since the hard-shelled olive pits survived the post-depositional disturbances better. The sampling method with hand-picking may have caused this biased pattern towards over-representation of olive finds. However, when considering together, all of these plant objects may have a significant role in the ritual activity in this particular context rather than being represented as chance factor.

The *pithos* and in general the storage vessels are common features for the central performances of Spring and Autumn Festivals as extant Hittite texts from Hattushah demonstrate. Filling the vessel with grains (during the Autumn Festival) and opening of it (during the Spring Festival) represents one of the basic rites performed by the Hittite king and the royal entourage practiced for two main Storm-Gods (Archi, 2015a, p. 18; e.g. Hazenbos, 2003, p. 65, KBo XIII 246). Archi suggests that “avec cette cérémonie, durant laquelle on transformait en pain la céréale de l’année précédente, le nouveau produit, a peine germe, était lie a l’ancien unissant ainsi le cycle agricole s’une année a l’autre, et favorissant ainsi le croissance de la nouvelle récolte’’ (2015a: 18). The harvest of the year, therefore, was transformed into the sacrificial bread to be consumed in commensal settings (Hazenbos, 2003, p. 168). This *pithos* ceremony also appears to have been practiced for the Storm-God of Halab in Hattusha which had been possibly introduced to the Hittite pantheon after the conquest of northern Syria by Šuppiluliuma I (Archi, 2015a, p. 18).

Such *pithoi* are also documented as part of the visual imagery for libations in the Hittite imperial art (Hoffner, 1995, p. 111). There is much visual imagery of libations coming from the Hittite and Neo-Hittite ritual scenes (e.g. Bonatz, 2000, p. 204). The members of the ruling dynasty are usually depicted to be libating in front of the deities (Gilibert, 2015, p. 144). Bonatz observes a certain historical change of the iconography of libations during the late 10th and 9th centuries in the Neo-Hittite geography; "… The worship of the ancestors, which has been recognized as a substantial memorial act in the Hittite Empire, but which was never depicted there in a narrative scene, appears here for the first time as a complex cult illustration, still reflecting the theme of libation in the presence of gods who are now replaced by the ancestors" (2000, p. 205)[44].

8.5.1.2 Pit features

Some pit features with grey ashy deposits were unearthed to the west and south of the monument. The pits around cultic contexts are not only common in archaeological sites in the Near East (e.g. Tell es-Safi, Hitchcock et al., 2015) but also in other parts of the world (Gumerman, 1997, p. 125). However, it should be kept in mind that it is rather difficult to identify the function and age of these pit features at Tayinat.

There are many textual and some archaeological evidence that connect the pits in general with the purification rituals of Hurrian and Anatolian origins (Collins, 2002, p. 235; van den Hout, 1994, p. 68). Archaeological evidence from the MBA Salat Tepe in Eastern Anatolia is diverse and well-preserved in this manner. Ökse (2015, p. 125) defines small shallow pits on the terraces of a building, suggesting that they were used to place vessels. Another series of shallow pits had been uncovered at Salat Tepe dug into the fill of a heavily burned building

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[44] Bonatz also notes that the depiction of libation is a part of chronologically earlier visual idiom which came to an end when the depiction of funerary past became fashioned. "This process of replacement began in the late 10th and was complete by the 9th century; when a large number of stelae depicting funerary past, and sitting statues embodying the idea of repast … were erected nearly all over the Luwian and Aramean states …" (2000, p. 206).

(Ökse, 2015, p. 126). Possible ritual connection had been delivered with these shallow pits regarding their bone and material culture contents. In relation to this, it seems that the pits were closed with a thick layer of mud (Ökse 2015). Hitchcock et al. (2015) describe similar shallow pits at Tell es-Safi (late Iron I deposits). The Tell es-Safi pit is of a sandy-ashy matrix that cuts the shard surface and contains the remains of an immature goat placed completely within. Another shallow pit from the same site shows similar characteristics, but this time contains the skeletal elements of another immature goat. Archaozoological analysis shows that none of meat-rich upper limb was deposited in this pit but, only the skull, jaw and limb bones found present (Hitchcock et al., 2015, p. 16).

At Tayinat, to the south of the temple, another pit deposit abutting the stone installation to the south of the temple provides more interesting results. This pit feature contains high amounts of cattle bones (David Lipovitch pers. comm.) and several olive pits which may reflect elite or cultic use related to the temple. Very similar, this type of unusually rich animal bone deposits has also been discovered from the vicinity of a similar stone installation in the paved courtyard of the "Royal Sanctuary" (Area A) of Tel Hazor[45] (Zuckerman, 2007; Lev-Tov & McGeough, 2007). Its location and the composition of bone assemblage indicate that the paved courtyard of Tell Hazor was used for communal food consumption. Lev-Tov and McGeough (2007) defines that the bone midden at this location was massive and yielded some 17.000 objects. A similar context has also been defined at Tel Bazi, in N. Mesopotamia. In this case, two small pits in the floor had been unearthed next to the altar-like protrusions in two houses (H. 28, 29) (Otto, 2012, p. 184).

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[45] Tel Hazor was the central town of a petty kingdom during the LBA in the southern Levant.

8.5.1.3 Portico

In an earlier research on the archaeobotanical finds of Tayinat, Capper (2012, p. 121) describes that two samples in-between architectural piers, from the vicinity where a large fragment of cedar column were recovered, show evidence of bitter vetch concentration (n=13). Despite the fact that the depositional conditions need more care to make the following interpretation, the most likely location of these bitter vetch finds would be the *in-situ* vessel on the porch which was totally smashed when unearthed. The sediments collected from this smashed vessel are completely devoid of plant finds but some bitter vetch remains appear in the deposits just over the portico and between architectural piers. It is highly probable that the grains scattered over the floor of the portico during the initial destruction, which is assumed to be more severe at the eastern wall rather than the western one, as archaeologists reported (Osborne, 2009, unpublished field report). Therefore, most possibly, the plant remains spilled westwards from this vessel during the destruction.

The Hittite word for bitter vetch is designated through Sumeogram (GÚ.ŠEŠ) which literally mean "bitter" and "any type of legume" (Hoffner, 1974, p. 101). Keeping in mind that it is not possible to identify which particular plant this "bitter" designates in documentary sources This could be another leguminous plant with toxicity from *Lathyrus* or *Vicia* since seeds of many species of these two genera have toxic qualities and thereby bitterness. However, Hoffner (1974) reports an interesting passage from Hattusha (KBo XIII 101 i 8-12) which reads as follows;

> "They cut up a goat, and the ra[w] meat, […], the head, the feet, the breast (and) the shoulder [they ….] over the pit. But the intestines (and) the heart they roast in fire. [..] I pour out *walhi*- drink. I take one small KA.DU.A jug of bitter vetch [and ..] and put it before the deity."

More information exists on the medicinal use of bitter vetch in literary sources in the Hittite period, (Hoffner, 1974, p. 101-2) as well as Roman period (Miller & Enneking, 2014, p. 262), rather than its ritual use.

Nonetheless, toxicity and medicinal use of these two large-vetches shall be significant for their representations in cultic contexts in the Near East. Some particular contexts in the Near East show similarities with our results at the Building XVI. Another toxic plant, the grass pea/red vetchling (*Lathyrus sativus/cicera*) finds from Building 29305 at Tel Burna during the Late Bronze Age indicates that these seeds were stored in front of this building deliberately. Orendi and her colleagues report that the majority of charred seeds of grass pea/red vetchling had been recovered from a layer of smashed vessels found *in situ* (2017, p. 172). Similar find context had been reported at Tel Batash, in which 60 seeds of grasspea/red vetchling were found in the entrance room of an elite residence (Mahler-Slasky & Kislev, 2010). Grass pea/red vetchling finds had also been discovered in the destruction debris from the Kilise Tepe (Mersin Province of modern Turkey), from an interesting building, which the excavators named as “Stele Building”. The monument contains one central room (Room 3) with an altar with several other smaller rooms/extensions surrounding this central one in a rectangular fashion. The plant evidence shows that the central “stele room” yielded concentrated barley finds which was put near the stele and grass pea had been found in the destruction debris again in concentration (Bending & Colledge, 2007). The exact provenance of grass pea finds –unfortunately- remained unreported. Nevertheless, in line with Orendi et al. (2017, p. 181), the presence of these two plants could be related to a certain practice to place toxic grains to symbolically-charged locations -more specifically at thresholds. Putting a toxic plant to the threshold, would have been related to, for instance, purification of the monument, driving away evil or cleansing impurities from the monument.

8.5.1.4 Central room

Although the majority of sediments recovered from subphases 2A and 2B were analyzed and reported in Capper (2012), her results show some close similarities with the present study. The free-threshing wheat concentration recovered from the surface of the central room with the 2011 probe (this study) coincides well to the data reported from other parts of the surface by Capper (2012). This author reports some free-threshing wheat remains and several unidentified large-seeded grass finds from in-between second architectural piers which separated the central room and inner sanctum.

Were these grains food offerings which should be understood as an ancient tradition inherited from the Syro-Anatolian symbolic realm or specific for execution of *adê* ceremonies in the temple? It is hard to answer this question due to the lack of comparative contexts in archaeobotany. Emarite texts show that the grain products were not offered as unprocessed grains but transformed to bread and/or beer (Sallaberger, 2012, p. 160). It is important to ask why the grains were found unprocessed in this particular location. It should be added that there were no single crop contaminants found in these wheat deposits both in the present study and Capper's. This means the wheat assemblage was carefully cleaned from contaminants like weeds and stem fragments before have been placed within the central room.

This information can be significant to reconstruct the ritual behavior. A correspondence from a certain priest to the Crown prince of Esarhaddon, Assurbanipal, warns about the heavy schedule of the god Nabu during the *akitu* period. According to this correspondence, Nabu has to leave the temple to visit the threshing floor of the palace and later to the game park for making a sacrifice on the same day (Fales, 2012). This threshing activity of Nabu can be related to what is called "ceremonial threshing" which was identified through some artistic mediums (e.g. seals) and archaeological finds of ploughboard from well-preserved burial deposits in the Royal Cemetery of Ur during the Early Dynastic III period (Littauer & Crouwel, 1990). It is tempting to assume that the wheat grains in Building XVI would have meant to be displayed, to symbolize the ceremonial threshing activities of the respected deity during *akitu,* rather than food offerings destined to divine consumption.

In this connection, it does not seem that the wheat remains were intentionally deposited in their find location but somewhat scattered westward around the room during the initial destruction of the monument. Therefore these finds could have a closer relationship with the material culture finds recovered next to the east wall. Excavators describe that the object sitting in the central room shall be furniture or some kind of wooden installation inlayed with luxurious embellishments on top of it (Harrison & Osborne, 2012).

A Neo-Hittite connection for the ritual importance of wheat remains is also significant. The IVRIZ 1 rock-relief and KEŞLIK YAYLA stele in Central Anatolia depicts the figure of Storm-God Tarhunzas holding sheaves of cereals in the left hand and a bunch of grapes in the right one. In IVRIZ I, the left hand of the god stays higher than the right, like gesturing forward the sheaves of cereals, while pulling the vine stem to the fore in a motion of delivering or bestowing “abundance” to the royal persona standing in front of him. Moreover, KEŞLIK YAYLA stele shows the same scene (but lacks the royal persona) that the stems of cereals and the trunk of vine in the Storm-God’s hands are both depicted long enough to reach to the base of the stele as if they are still connected to the earth[46]. Similarly, Giusfredi (2010, p. 246) describes a Luwian inscription from the town of Bor in Central Anatolia which records the pledge of Warpalawas, who was the king of the Tuwana, another Syro-Anatolian kingdom. The texts describe the divine beneficiaries of the Storm-God Tarhunzas in providing a wealth of wine/vine and possibly grain (the latter is lost on the inscription). The

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[46] The same visual motif also appears in IVRIZ 1 but the composition is somewhat different. In this stele, the stems of cereals are also depicted elongated but somewhat end up where the royal persona stands under the earth (or platform?) and at the feet of the Storm-God.

same reference to wine/vine and grain also appears in Tell Tayinat Inscription 2 (Hawkins, 2000) but this time bestowed by the god Ea rather than Tarhunzas. That being the case, the wheat grains could have played an important role not only for the Assyrian ritual mindset but also for the Neo-Hittites already from the early use phase of the temple although symbolic ramifications would have been different.

8.5.1.5 Inner sanctum

Furthermore, another aspect of ritual behavior has to be mentioned in this context: the presentation of the offerings. Sallaberger (2012) regards this aspect as the central act of ritual activity; yet this is perhaps the archaeologically least-understood aspect of ancient rituals. This involves careful arrangements of cultic edifices, involving vessels for beverages and the meat offerings before the deity, as recorded in Emarite rituals (Sallaberger, 2012). The finds from the inner sanctum of Building XVI are therefore instructive for the arrangements and contents of cultic paraphernalia on the podium. Otto suggests that the cultic context was especially needed to be well-illuminated (2012, p. 182). Several oil lamps have been found in the inner sanctum of Building XVI and testify to this fact. A cauldron and a pitcher could have served for libations. Ceremonial washing of king's or deities' hands with water in *akitu* ceremonies (Bidmead, 2004; M. Cohen, 1993, p. 431) would be another interpretation for the appearances of such cultic edifice. This theme, washing hands on the altar, also appears in the Hittite invocation rites (Singer, 2002, p. 26).

Specifically important is the selection of items to be put in this location. *Pyxis*, for instance, depicts a feasting scene of two seated figures active with banqueting while another two figures to the left of the scene are slaughtering a bull. Harrison and Osborne mention that "the imagery of the scene is decidedly Syro-Hittite in style, with close affinities to the wall reliefs at Karatepe […], and stand in stark contrast to the Assyrian Glazed Ware vessel found on the adjacent step. Interestingly, *pyxides* are frequently portrayed as part of the tableware on Syro-Hittite funerary stelae … including the recently recovered Zincirli KTMW stele …" (2012, p. 135; see Recht, 2015 for the antiquity of this visual element). On the other hand, there is no information what these objects usually contained. It is proposed that they may have contained cosmetics (Mazzoni, 2001), incense or oil (Struble & Herrmann, 2009). Kislev and Hopf report such a pyxis from Tell Qasile in the Southern Levant containing about 300 six-rowed hulled barley grains (1985, p. 140). At Urartian Ayanis Castle, several different objects were found in the temple (e.g. quiver), these were filled with broomcorn millet (Çilingiroğlu, 2004).

Finally, although the inner sanctum has provided no plant concentrations in our study, Capper (2012) identified 3 linseed objects from the accumulated debris between the podium and the west wall. From an archaeobotanical perspective, it is interesting that the remains of an oil/fibercrop, flax, have been recovered in this context. It is highly likely that severe conflagration might have consumed the remaining finds due to rich oil contents of the flax seeds. At Tell Qasile the presence of flax deposits has been reported in the Philistine Temple 131 dated to the 11th century BCE (Kislev & Hopf, 1985). Although documentary sources do not specify what kind of oil plant was used in many cases, perfumed oil or "fine oil" was usually part of the religious ceremonies of the Hittites for purificatory rituals like anointment of the wall of the temple or statutes (Hoffner, 1995, p. 111; Recht, 2014, p. 13-15). Documentary evidence from many other parts of the Near East and Egypt also shows that oil mixed with aromatics was part of the rituals (Kislev et al., 2011). Weinfeld lists biblical references to oil which was part of the offering meals, possibly preferred by the poor more often since offering animals was more costly (1996, p. 125). Middle and Neo-Assyrian records especially show large amounts of a certain oil-plant and oil provisions as offerings to the temple of Assur in the town of Ashur (Postgate, 1985, pp. 149-150).

8.5.3 Pathways of agricultural colonization in the Assyrian periphery

All in all, there is also a strong link between commensal eating and oath-taking, sealing treaties and legal agreements in the Near East (e.g. Otto, 2011, p. 185). As ancient Near Eastern practice shows, the ingestion of food and beverages represents a metonymic relationship for oath-taking and food eating/sharing, (just like eating and drinking the flesh and blood of Jesus as an example), which was sealed in front of the deities. Therefore, embodiment of both products would create a non-discursive activity to evoke bodily memory (Hamilakis, 1999, p. 49). Furthermore, it is known that the legal agreements and treaties became only valid if one party of the agreement made a statement to the other in front of witnesses sealing with the words “Here eat bread!” (Wright & Chan, 2013, pp. 402-3). An earlier textual reference from the Ur III period shows that the generals of the Ur III king Amar-Suen had to swear a loyalty oath[47] (Steinkeller, 2008, p. 187; see Beal, 1995 for foodstuffs used in Hittite military rituals during oath-taking).

During the Hittite period, the KI.LAM Festival seems to have served a similar purpose of allegiance-seeking, although the oath-taking was not particularly referenced in the extant texts. This festival was practiced on the 25th, 26th and 27th day of the Autumm Festival in Hattusha and required the participation of “overseers of the royal storehouses” (AGRIGs) of several different towns in the imperial territories (Singer, 1983, p. 122 and p. 133). During these ceremonies, the administrators were presented to the king by the title of their respective towns in front of the temple of Halki, the Grain-goddess. AGRIGs delivered the victuals from their storehouses whilst the king inspected the produce provided by them. The festival continued with consuming breads, beverages and livestock (Archi, 2015a, pp. 12-3; see Singer, 1983 for synopsis of festival events and ration lists). Similarly, the MBA Mari texts

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[47] Although no references to feasts are mentioned explicitly, these Ur III texts record the bundles of reeds to have been used for the specific foods to be cooked during this specific event.

show that during the celebrations in honor of Ishtar, two types of flour were placed in front of her and then wetted; this was not part of a divine meal but used for oath-taking (Sasson, 2004, p. 212, Footnote 90). Moreover, the Esarhaddon's Succession Treaty (EST) found in Kalhu also marks this aspect of commensal eating by mentioning "setting a table" and "drinking from a cup" (Parpola & Watanabe 1988, p. 35) while these mentions are missing in the Tayinat EST specimen.

Another important point for the agricultural dimension of Tell Tayinat is the textual corpus in Building XVI and its connection with the agrarian economy. The textual corpus in this monument is significant for comprehending the divergent pathways of the creation of Assyrian subjectivities in reference to the recent contributions of Rosenzweig (2018).

In ideological terms, it is suggested that the Neo-Assyrians conceived the peripherial regions as "chaotic", a source of constant threat to be eliminated by reducing the diversity of local cultural traits, to incorporate into an imperial order and civilization (Liverani 1979). However, in opposition to such precise conceptualization of Liverani above, several other researchers conceived the relationship of the Neo-Assyrians and subjugated regions in the Levant differently (see Bagg, 2013; Faust, 2011; Herrmann, 2018 for various interpretations). Bagg (2013) suggests that the Assyrians had no "civilizing" agenda over its subjects in the periphery. On the other hand, Herrmann interprets this relationship through the notion of "cosmopolitan subordination" in which the emulation of imperial artistic styles did not necessarily exclude the local styles but "the imperial and local cultures are bridged through shared elite practices" (2018, p. 508). Rosenzweig suggests that

> "… [A]lthough incorporation into the empire afforded subjects access to produce circulating within the imperial economy; elites disproportionately accrued a greater share of these supplies. On the one hand, then, agricultural colonization homogenized elements of agricultural experience by instituting uniform production and consumption practices across groups in imperial society. On the other hand,

> though, inequitable distribution of these shares reified difference and demonstrated power (or lack of thereof) in the provinces" (2018, p. 39).

Specifically important is to ask how much the *adê* concerns the farming population, who cultivated their fields and returned some part of their products to the Assyrian authorities as tax obligations. This question is important in certain respects.

Firstly, the EST of Tell Tayinat primarily indicates that the *adê* embraces every subjects inhabiting under Assyrian jurisdiction as the text reads after naming the titles of high-ranked officers "… (and) with [all] the men [of his hands], great and small, as many as there are – [wi]th them and with the men who are born after the *adê* in the [f]uture, from the east […] to the west, …" (translation by Lauinger, 2012, p. 112). With this passage, the *adê* possibly aims to provide a receptive social and symbolic environment for all Assyrian subjects through reinforcing the participation of the general populace into the ideological cosmos of the empire.

Secondly, the same passage of the EST becomes more significant in combination with other members of the textual corpus of Building XVI, namely *iqqur īpuš,* for two interconnected reasons. The first reason would be related to the ideological legitimization of the Assyrian supremacy, not only by seeking loyalty with verbal confirmation from provincial governors and high-ranked executives (as reflected in the Tell Tayinat specimen of EST) but also aiming at regulating the timing of mundane activities to be followed in every sphere of social life (as reflected by *iqqur īpuš*). This argument, in fact, would be related to divergent processes for "the creation of imperial subjectivities" by agricultural colonization and creating receptive social and symbolic environments to manipulate agricultural resources (Rosenzweig, 2014, 2016, and 2018). In this case, the creation of Assyrian subjects was achieved by imposing a set of hemerological texts to regulate and to order the timing of mundane activities.

Furthermore, the question, as to whether or not, this set of rules are of purely of Assyrian prescriptions and originated from the Mesopotamian way of living, or adapted into the social life in the Syro-Anatolian cultural sphere, is particularly interesting[48]. There is not much in the Tell Tayinat *iqqur īpuš* to answer this question. The information about the timing of agricultural operations for field crops is lost in the Tell Tayinat *iqqur īpuš* texts due to the impact of charring. One exception is the information about the orchard management found in tablet T-1922. The designations of favorable months are also not preserved in this tablet (Lauinger, 2016). Also, many articles listed in this tablet mention the works related to the orchard management with no specific reference to which arboricultural products were in question. On the one hand, these mentions of orchards itself could be significant in regard to the standardization of tree crop cultivation to be taxed by provincial administrations as the documentary sources show that they were liable to taxation (Postgate, 1974a, p. 207).

However, one article in T-1922 refers to orchards of date palms (line 4 as appeared in Lauinger, 2016, p. 245). This particular mention of date orchards in these texts is interesting because this article might be more closely related to the Assyrian or more specifically southern Mesopotamian character of these texts. Tell Tayinat and most of the Levant and upper Mesopotamia are simply climatically unsuitable for date cultivation (Zohary et al., 2013). As expected, date kernels are non-existent in the Tell Tayinat plant assemblage. This is not particularly surprising because the northerly limit of the natural distribution of date palm (*Phoenix dactylifera* L.) is around latitude 35 degrees N coinciding to the town of Tikrit in modern Iraq (Powell, 2003; Zohary et al., 2013; E. Weiss, 2015; Zohary & Spiegel-Roy, 1975). Its natural distribution of wild populations covers the North Africa, Arabia and southern Asia in the arid and semi-arid environments of the Near East. Therefore, Tell

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[48] It is important to mention that the EST specimen of Tayinat seems to have already adapted to the Levantine region with naming some Levantine deities which had not been mentioned in other EST texts found in Kalhu (Fales, 2012, Harrison, 2014a).

Tayinat and all of northern Syria are out of its natural distribution zone (although localized and isolated types are present in Crete (Zohary & Spiegel-Roy, 1975, p. 323) while the date cultivation in the Mediterranean basin do not produce good quality fruits because this tree favors high temperatures and low humidity (Abbo et al., 2015, p. 340). In this manner, this particular mention of the management and cultivation of date orchards remains irrelevant for the inhabitants living in the environmental and climatic settings of northern Syria. Thus, this could be another indication of the mass-production of these texts in the Assyrian homeland and its distribution over the provinces as some authors previously suggested (e.g. Fales, 2012; Lauinger, 2015).

However, despite the fact that the climatic conditions are unsuitable for date cultivation, the inhabitants of the Levant seem to have been acquainted with the date tree and its processed product in the form of oil (although no evidence of date wine has so far reported in the archaeological literature of Levant). Total lipids analysis evidenced that date-oil were imported to north Syria (and possibly the Southern Levant, although there are suitable environments in this region for date cultivation) to be used in special bath-shaped basins for wool dying (Mazow et al., 2016, 2018). The date palm also appears in the visual imagery in one of Karatepe stelea at the west wall of the North Gate during the Neo-Hittite period. This visual evidence shows that the date palm was part of iconographic repertoire in Cilicia during this period. This particular stele shows a suckling mother and her child in the front scene while date trees are placed in the background (Winter, 1979). Winter (2007) and Miller et al. (2015) relate the figurative appearance of date palm in artistic mediums in the Southern Mesopotamia with fertility and abundance.

8.6 CONCLUDING REMARKS

This study only provides a first glimpse of the ritual consumption of foodstuffs in a well-preserved archaeological context of Building XVI. Despite the lack of comparative cultic contexts in archaeobotanical literature, potentially significant results of this study would be helpful to further develop a more detailed picture of the ritual behavior and commensal politics in the Northern Levant.

The deposition of plant remains in Building XVI demonstrates two distinct phases. The early use phase of the temple is represented through the remains to the west of the monument showing the long-term deposition of the plants. The rear sides of temple complexes were part of the ritual ceremonies as previously observed by archaeologists. The *pithos*, pits and occupational debris, in this manner, include several rarities (a bread-like object, a fleshy grape fruit, several olive pits) as well as an accumulation of wild and weedy plants were recovered at this location. Instead the plant recoveries inside the temple demonstrated evidence of a short-term deposition by a single destructive event. This provides a unique snapshot of the plant occurrences in such cultic context. The first mudbrick piers which separate the portico and the central room yielded the concentrated remains of bitter vetch. It is assumed that placing toxic plants around thresholds was an ancient practice. Parallel findings from the Levant show that this could have been a wide-spread practice in this region. The second mudbrick piers and the northwest of the central room show evidence of concentrated wheat remains; however, many of these grains were severely carbonized thus making their identifications difficult. Moreover, the inner sanctum had some flax finds reported in a previous study. This finding is significant because of the rarity of flax remains in the settlement. The reason why the flax finds appear here is difficult to assess. In regard to flammability of flax seeds due to its high oil content, it is highly likely that many other flax remains originally deposited in the inner sanctum could have been lost in the fire.

CHAPTER 9. SUMMARY

Through integrating new archaeobotanical and stable carbon isotope results from Tell Tayinat, a more complete picture of the local and regional patternings of crop husbandry in the Amuq Valley has been attained. Crop data demonstrate that a wide range of crop plants has been used by the Tayinat inhabitants throughout the Bronze and Iron Ages. Cereals such as barley, free-threshing wheat and emmer were the most prominent crop taxa while bitter vetch, and lentil have been used more often than other pulses such as garden pea, faba bean or grass pea. Barley dominates the crop assemblage during the Early Bronze Age IVB. This trend is also recognizable in several other settlements in the Northern Levant. The predominance of barley use has been supplemented with other crop taxa which appear ubiquitously in the Early Bronze Age sequence of Tell Tayinat. During the same period, bitter vetch is the dominant crop legume while lentil proportionally appears less often than this toxic plant. Concerning wild plants in the Early Bronze Age, the assemblage includes several medium-seeded grasses and a group of wild leguminous plants rather ubiquitously. In conjunction to the frequent appearance of wild leguminous plants, the nitrogen isotope values demonstrate higher degree of nitrogen availability for crop plants. The carbon isotope measurements also show no stress conditions for both free-threshing wheat and barley. This indicates that the crop growing conditions at Tell Tayinat were favourable during the end of Early Bronze Age occupation of Tell Tayinat.

The abandonment of Tell Tayinat and the beginning of Tell Atchana occupation represents an intriguing case to test the hypotheses for the impact of climate or environmental change in settlement patterns. The present study offers no marked decrease in water availability and soil nutrient contents for the crop plants although more research is needed to reach concrete conclusions of the impact of 4.200 BP event over agricultural production in the Amuq Valley.

Nonetheless, some climate models regard riparian habitats of the Amuq Valley as a favourable location for the migrating populations after the catastrophic impact of the 4.200 BP event in the Northern Mesopotamia (e.g. H. Weiss). However, it is still not easy to disentangle the sequence of events with such clarity in the Amuq to assume such connection.

The Middle Bronze Age shows the establishment of Amorite kingdoms all over the Near East while the principal settlement in the Amuq Valley, Tell Atchana, was also part of this development according to the textual records. At least to a certain extent, the excavations and textual evidence demonstrate the connectedness of Tell Atchana (e.g. Minoan wall paintings) to the international prestige networks. However, much less is known about agricultural production due to the lack of comprehensive archaeobotanical studies during the Middle and Late Bronze Ages in the Amuq Valley. Our knowledge on the palatial economy is basically supplemented with the textual evidence recovered from Tell Atchana. The Alalakh tablets demonstrate that palatial crop production was concentrated on a small range of taxa; more prominently, barley, emmer and *kissanu* (possibly bitter vetch). These crop taxa are all comparatively require less water input demonstrating a tendency to cultivate crops with less investment during the field operations.

Why would the farmers cultivate the crops that we today regard as fodder plants or at best inferior for human use although the rainfall amount in the Amuq was favourable for more water-demanding crops? First of all, it should be noted that the sizeable rainfall in the Amuq, its geographical proximity to the major moisture source, the Mediterranean Sea, its complex hydrogeography and transitional nature between Eastern Mediterranean to Mesopotamian lowlands complicate the likelihood of establishing a straightforward correlation between simple local precipitation figures and water uptake conditions of crop plants in this region. The main argument proposed in this dissertation is that the palatial economies of Bronze Age have depended on only a few plant taxa to facilitate resource mobilization across social segments and subregions. The palatial economies in the Bronze Ages imposed a particular set of economic relationships between the palace authorities and the dependent farmers. This system of agro-production affected the crop production patterning as shown in the regional archaeobotanical data in the Near East. The predominance of these three plants over large stretches of the Near East would be related to the conversion and equivalency factors in Bronze Age economic system. That indicates that barley, emmer wheat and possibly bitter vetch would possibly be the best investment for Bronze Age farmers providing a reliable yield structure with less investment and less affected from year-to-year fluctuations in weather conditions. That would give certain advantages over other crop plants like free-threshing wheat and lentil which need comparatively more water for cultivation. Converting the agricultural surplus into other food products or commodities in the form of “social storage”or “symbolic capital” would be maintained as a risk-management strategy to overcome the bad years with low crop yields. Therefore, these crop plants’ role can be prominently related to the principle of resource conversion in the Bronze Age economy rather than long-debated climatic and environmental factors.

The post-collapse periods are conceptually interesting timeframes to understand human-plant relationship in the ancient Near East. In this dissertation, it is argued that the breakage of palatial economic system of the Bronze Ages at the beginning of Iron Age I is reflected in the agro-production data; 1) labor optimization by cultivating less labor-intensive crops either during post-harvest operations (free-threshing wheat, lentil) or at field stage (bitter vetch, barley); and 2) continued cultivation of labor-intensive and water-demanding arboricultural crops in the Levant.

The Levantine sites largely follow a particular patterning in crop production. Our study shows that crop taxa appear mostly in pairs in the Levantine settlements. Barley and lentil predominantly appear together while free-threshing wheat and bitter vetch dominates other sites as principal crops. This patterning has to be confirmed by further research; however, it may represent a significant aspect of agro-production indicating that ancient farmers were seeking a balance between nutrient, labor and water status in their cultivation strategy. In this manner, a second important achievement in this study is the demonstration of the continued cultivation of arboricultural products over much of the Levant. Concerning the catastrophic narrative of decline in food sustainability during the Late Bronze-Iron Age transition by several adherents of climatic decline hypothesis, the continued cultivation of grape, olive and fig demonstrates that the Iron Age farmers were still cultivating these water and labor-intensive products. During the Iron Age I, a renewed interest in water-demanding crops is also visible for cultivation of free-threshing wheat, flax, einkorn and several crop legumes that require more water than barley, bitter vetch and emmer. In conjunction, stable carbon isotope data of Tell Tayinat and many other sites show only moderate stress conditions of water availability during the Iron Age I, Tayinat wild plant assemblage distinctly signals the appearance of wetland taxa with increasing trends for the complete Iron Age I sequence of Tell Tayinat. These wild plants have nowadays greater occurrences in habitats such as marshes, swamps and abandoned river courses. Nonetheless, from this dissertation, it becomes clear that the nitrogen pool of Iron Age arable fields were depleted to a certain extent in comparison to the Early Bronze Age values. Due to the high diversity of nitrogen sources in plant-soil system, it is difficult to precisely pinpoint a single reason for such decrease. It is already indicated in the literature that the nitrogen intake of crop plants were certainly decreasing when comparing the stable nitrogen isotope values of early Holocene to the later periods. Continued use of arable fields for cultivation can generate a wide-spread decrease in nutrient availability of soils. On the other hand, another factor would be related to the presence of wild leguminous plants in the arable fields. In an archaeobotanical assemblage, it is difficult to reconstruct the actual vegetation from the studied samples; however, Tell Tayinat assemblage demonstrates an interesting pattern in comparison to both periods under consideration. Iron Age I phases show reduced presence of wild leguminous plants that coincide also to the decreased stable nitrogen isotope values. This pattern may indicate diminishing soil fertility during the occupation of the settlement from early Bronze to Iron Age.

At a conceptual level, it has been argued in the literature that the factors relating to the intensification of production of staple crops and cash-crops are likely to be different from each other. The development of storable and transportable commodities with high value and low bulk (cash-crops) was an important element of the growth of trade and reciprocal exchange networks. Cash crops compared to staple crops are important indicators for political stability since the products manufactured out of the perennial trees require long-term investment and constant care. More prominently, the archaeological (Mediterranean maritime trade, tribute payments to the Assyrians) and archaeobotanical (circulation of spices and condiments) evidence fit well to each other. Summer crops, especially broomcorn millet and sesame, become more apparent in the 1st millennium BCE in our archaeobotanical assemblages indicating the need to intensify the agricultural production during the summer period to supplement the large-scale projects like massive irrigation systems or forced resettlement policies or the Neo-Assyrian demands to provision the Assyrian heartland. Also a similar process possibly marked the intensification in the Urartian highlands. The emerging international trade networks in the Mediterranean Sea was most probably another factor for the intensification of crop production to supplement the demand of particular social actors stand to gain a competitive advantage among their peers by creating more complex products with special social and symbolic meanings.

The association of these commodities with added-value to rituals and festivities is a particularly promising topic of archaeobotnaical research while there are still only few studies in the archaeobotanical literature. The archaeobotanical analysis from the Building XVI demonstrates an effort to contextualize the plant remains in an exclusive cultic monument. With this dissertation, it has been shown that cleansing impurities would be a particularly important factor for the deposition of plant remains in the Sacred Precinct of Tell Tayinat. The bitter vetch concentration could have been positioned between portico and first architectural piers for such a purpose. The physical thresholds were most probably loci with symbolic significance in the ancient Near East. This toxic crop plant is known to have the medicinal and ritual use as shown in Hittite and classical texts. For this reason, it is tempting to assume that its association with cultic contexts as a symbolic medium represents a certain role in rite of passages. Similarly, the *pithos* to the west of Building XVI contain wild and weedy plants which can be classified as food preparation debris as usually categorized in the archaeobotanical literature. However, the appearance of these wild taxa in a single concentration would also be related to their conception as impurities that should be eliminated by intentional burning and careful deposition in designated pits or containers ("ceremonial trash"). More interestingly, the appearance of pure free-threshing wheat concentration in the central room of Building XVI could be interpreted as either food offerings to respected deity of the temple ("feeding deities") or a symbolic role to mark the ritual process undertaken outside the temple ("ceremonial threshing"). Unfortunately, there are few surviving textual and visual records for a clear description of ceremonial threshing in the ancient Neat East. Nevertheless, targeted archaeobotanical research in such cultic contexts can definitely provide promising new data to comprehend ancient symbolic behavior in future.

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APPENDIX A.1 ABSOLUTE COUNTS OF BOTANICAL REMAINS ACCORDING TO TAXA CLASSIFICATION (CHAPTER 5 and 7)

SEASON	2010	2010	2010	2009	2009	2009	2010	2010	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2009	2009	2009	2009
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
LOCUS	285	285	285	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	258	268	270	270	279
PAIL	600	602	602	559	566	569	578	581	572	572	588	612	529	591	593	593	587	590	582	576	576	584	607	483	503	537	516
SA NUMBER	6653	6654	6668	6117	6120	6115	6639	6672	6123	6124	6645	6664	6640	6634	6649	6650	6638	6635	6669	6670	6671	6667	6659	5814	5879	5974	5946
PERIOD	EBIVB																										
FIELD 1 PHASES	9			8b																				8a			
PLANT TAXA//ARCHBOT. SAMPLE NO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
Hordeum vulgare	2	9	11		1	6	2	1	9		3	3	4	1	1	1	6	2				1	3	3		4	2
Hordeum vulgare (rachis)	2	47	86		1	9	6	1	34	1	1	2	4		6	12	4	2	3				31	10	5	11	1
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)			1						2														1				
Hordeum spp. (frags., NISP)		1							2						1			1							1		2
Triticum spp. (fr. thres/gl.)	2	8	8		1	3			5		3		1	1		5	2	2					4		2	7	1
Triticum aestivum/durum		7	2			3		1	5						1	5							2	5		3	
free-threshing wheat (spi. base common)		8	5			5			11						3	5	1					2	2				
free-threshing wheat (spi. base robust type)	1							1	1																		
Triticum dicoccum	3	3	2			1	2					3	5		3		8	1	1						1	1	
Triticum dicoccum (spikelet bases)	2	36	37			7	6	3	26	1	4	5	14	3	7	9	2	5		1			13	3	11	6	2
Triticum dicoccum (glume bases)	3	39	71		1	16	8	4	33		3	8	26	6	12	25	9	12		2			33	4	11	7	5
Triticum monococcum																											
Triticum monococcum/boeticum			1											1													
Lolium sp.	16	36	7	1	3	39	25	23	35	2	23	46	36	16	12	21	27	9		4			95	39	22	24	16
Phalaris sp.	12	11	3		3	22	7	4	22		8	17	18	6	10	25	9	4	1				14	15	28	14	4
Festuca-type	1												1	2		1		1					1				1
Avena type							1								1												
Bromus spp.	1		1					2			1		1				1	1				1	1	2	3	2	1
Stipa type																							1		2	1	
Phleum cf. phleoides	2				1	1			2		1												2			3	
Aeluropus cf. littoralis												1					1										
Alopecurus geniculatus type											2																
Poa cf. trivialis																											
Cynodon dactylon							2		1				1	1										1	1		
Agrostis canina type													2					1									
Echinaria capitata																											
TT-unidentified Poaceae 2																											
TT-unidentified Poaceae 4		2																1									1
Poaceae, indet. (large)	3	12	12			4			6				1		2			2							4	11	2

PLANT TAXA//ARCHBOT. SAMPLE NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Poaceae, indet. (medium)	10	14	9			14			24				7	4		9	1	7					5		7	6	6
Poaceae, indet. (small)			1			3			1				2										1		2		1
Poaceae, embryo (indet.)	1	7	23			1		2	8	1	1		5	7	1	3		1				2	6		2	1	3
Poaceae, chaff (indet.)						1																1			1	3	
Poaceae, floret (indet.)																											
Vicia/Lathyrus	3					2	1			1			7		1	6	8							2		3	1
Vicia ervilia						13	5		2		1	2		3	2	2	3							1		2	2
Vicia faba		1							1							1	1										
Lathyrus sativus/cicera			1								1	1			1	1	1				1		1	2	1	5	
Lens culinaris	5	2				1			1		1	3	7			2	1					1	1				
Pisum sativum																							1				
Coronilla sp.	2	5				2	1		5	1	1	4	1	3	1	2	5	1					2	1	3	4	1
Scorpiurus sp.	1	1				7			3		1	1	1		1	1						1				1	
Prosopis cf. farcta	3		1			6	1		13		3	1	1	1	1	1	1						1	1		2	
Securigera cf. securigeda		3	1			5	1		5			2					2	1						2	1	2	
Securigera type																							2				
Medicago sp.	1								2		1		2														
Medicago sp. (pod frags.)																											
Melilotus/Trifolium	12	9	1			29	27	28	106	1	23	34	29	12	14	18	29	9		1		1	9	40	29	24	9
Trifolium cf. alexandrium	2					1	1					1	1											2		1	
Trigonella foenum-graecum																											
Trigonella sp.							1									1							1				
Astragalus sp.																1											
Fabaceae, indet (medium)	1						1		5																		1
Fabaceae, indet (large)		5			3	12	4		9	2	1	4	1	2	3	4	9					2	2	1	3	6	1
Olea europaea	1		1			1	1	1	1		2	1		3		1	1	1	1					1	1	2	
Vitis vinifera (pip)	1	1				3	2	1	3		1	6	2	1		2							3	3	2		1
Vitis vinifera (mineralised pip)															1								1				
Vitis vinifera (smaller pip)																											
Vitis vinifera (skeletonized endosperm?)																											
Vitis vinifera (stalk)		3				3	1		1		1	2	2	2		2							15	2	1		1
Vitis type (rudimentary)	2					2							1	1									7	1			
Ficus carica	1	1						1				2			2												
Ficus carica (mineralised)																1											
Linum sp.										2							1							1			
Linum usitatissimum																											
Amygdalus sp.																											
Pistacia cf. lentiscus																									1		
Geranium sp.																											
Bupleurum sp.						1			3							2									1		
Bupleurum subovatum (with testa)	1					1									2		1										
Torilis leptophylla						1		1					1														
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)														2		2							2		2		

PLANT TAXA//ARCHBOT. SAMPLE NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Apiaceae, indet. small-seeded	2	3	2		1	5	1		13	1	2				2	5	2								7	5	
Centaurea type		1							2							2	1						1		1	1	
Anthemis cotula	5	4	3		1	8	6		16		1	3		3	6	6	3							6	8	2	3
Cichorium sp.					1	3									1												
Artemisia sp.																											
Picris hieracoides									1																		
Picris echioides type																											
Onopordum sp.																											
Asteraceae, indet			1			2			3				1		2	2							2				
Heliotropium sp.						1																					
Lithospermum arvense (carbonized)		3	1						1				1													2	
Lithospermum arvense (uncarbonized)			2																						1		
Lithospermum tenuifolium																											
Echium sp.																											
Boraginaceae, indet.						1																					
cf. Ochthodium aegyptiacum																											
Lepidium sp.																											
Brassica sp.																											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.																											
Valerianella dentata														1		1							1			1	
Valerianella coronata																1											
Vaccaria cf. pyramidata		1										1															
Silene sp.	1					2			2			1	2	1		1	1	2							1		1
Caryophyllaceae, indet.	1								1														1			1	
Scirpus maritimus						1								1	2								4	1	1		
Rumex sp.	2	2				1	2					2	3	2		2	1	1					1		5	1	2
Rumex type																							1				
Polygonum/Carex																	1										
Eleocharis sp.									1						2												
Fimbristylis cf. annua																											
Cyperus cf. michelianus									1																		
Cyperaceae, indet.							1																		1		
Galium aparine (3 mm)														1													
Galium aparine/spurium		1					2		2			4		1			1						2	1	1	1	1
Galium spurium type												2	2										1		2		
Galium cf. parisiense		1				1							1			6								4		5	
Asperula arvensis/orientalis	2	1					1						6				1							1	3	7	1
Asperula cf. orientalis		1												1													
Asperula sp.																		1									
Sherardia arvensis	1																								1	2	
Rubiaceae, indet. (frags)							5		2			2					1	1					3	4	3	2	
Rubiaceae, indet. (large/medium seeded)		1							2														1				
Rubiaceae, indet. (small seeded)		1						1																			

PLANT TAXA//ARCHBOT. SAMPLE NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Rubiaceae, indet. (mericarps)																											
Rubiaceae, indet. (fruit)								1																			
Salix sp.													1														
Thymelaea sp.	1	4	1				1	10	5		1		1		3			2					5	2	4		
Chenopodium murale																										1	
Chenopodium album																											
Chenopodiceae (indet.)																											
Ornithagalum/Muscari																								1			
Bellevalia sp.																1											
Asparagaceae (Liliaceae), indet.																											
Malva sp.													1														
Plantago cf. lagopus																				1							
Teucrium/Ajuga																											
Euphorbia falcata/maculata									1		1															1	
Hypericum sp.	1								1									1									
Alisma sp.																											
Verbena sp.																				2							
Anagallis sp.									1																1		
Papaver spp.	2															10							1				
Verbascum/Scrophularia		1							1								1										
Fumaria sp.			1																								
Cephalaria type																											
Ranunculus cf. Arvensis									1														1				
Nigella sp.			1																								
Adonis cf. annua																								1			
Capparis cf. spinosa																											
Lamiaceae, indet.																											
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)	1																						2				
TT-unidentified object 2 (Anagallis?)																											
TT-unidentified object 3 (Saxifragaceae?)							4		5		5		23												1		5
TT-unidentified object 4 (Ziziphora?)					1	1																					
TT-unidentified object 5 (Rosaceae/Dryas type?)						1			1				1										4				
TT-unidentified object 6 (Spergularia?)									4						2												
TT-unidentified object 7 (Cuscuta?)						2																					
TT-unidentified object 8 (Matricaria?)											2							6									
Flowering bud (indet.)		1					2		1			2	2	2		1							3		1		1
Chara (oogonia)																	1										
Insect remains			1												1										1		
Mouse droppings		1						4	2			2	2										1		1		
TOTALS	116	298	298	1	18	254	131	90	457	13	99	168	231	91	110	209	148	78	6	11	1	12	298	163	192	188	79

(continued)

SEASON	2009	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012	2007	2007	2009	2009	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	55	56	56	56	56	56	56	56	65	65	65	65	55	55	55	55	56	56	56	56	56	56	56	56	56	56	56
LOCUS	280	316	316	329	329	332	332	332	193	193	179	181	201	148	276	276	277	280	287	287	287	287	295	296	296	297	298
PAIL	518	764	735	771	778	785	789	795	511	513	491	497	345	277	508	508	617	718	648	672	640	637	730	660	662	675	674
SA NUMBER	5957	8800	7464	8787	8788	8821	8797	8794	8780	9093	8776	8779	3542	3054	5940	5894	7470	7431	7476	7482	7477	7456	7448	7481	7466	7479	7475
PERIOD	EBIVB																										
FIELD 1 PHASES	8a												7														
PLANT TAXA//ARCHBOT. SAMPLE NO	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
Hordeum vulgare	9		3	2	1				3		3	2	1		2	2	1	3	1	4	1		11	1	1	2	4
Hordeum vulgare (rachis)	5		2	1	3			1		1	1			1	3	3			3	1	2	1	14	1			
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)																										1	
Hordeum spp. (frags., NISP)											2	1							1	3			1				
Triticum spp. (fr. thres/gl.)	6		2	1	3		1				3	2	2			5	1		2				6			3	3
Triticum aestivum/durum	1		2	6	2				4	4					4	5					3					1	1
free-threshing wheat (spi. base common)			2		1				1									1					3			1	1
free-threshing wheat (spi. base robust type)																1											
Triticum dicoccum	1		2		1					4	1			2		1				1		1	1				1
Triticum dicoccum (spikelet bases)	4		5	5	2	1			1	2					4	1		1	1	3	4	1	3		2	6	3
Triticum dicoccum (glume bases)	16		1	4	5		4		2	1		1		1	4	8			3	3	3	1	5	2	8	6	7
Triticum monococcum					1																						
Triticum monococcum/boeticum															1												
Lolium sp.	47	8	12	28	18	4	1	6	11	10	45	17	7	8	15	16		8	16	8	19	6	90	11	13	11	35
Phalaris sp.	11	1	11	7	5		5	2	3	6	8	5		2	5		5	3	9	9	5	6	22	2	16	9	6
Festuca-type	7																										
Avena type																											
Bromus spp.				3		1					2							1	2	1	1				2	1	
Stipa type			1					1								2				1	1			1			
Phleum cf. phleoides																		1	2	1							
Aeluropus cf. littoralis													1	3					4	2				1			
Alopecurus geniculatus type						1																					
Poa cf. trivialis																											
Cynodon dactylon						1				1													1				1
Agrostis canina type																			1								
Echinaria capitata																											
TT-unidentified Poaceae 2																											
TT-unidentified Poaceae 4																											1
Poaceae, indet. (large)	1	1	3	2			4	1	4	5	1	2		1				4					5		4		3
Poaceae, indet. (medium)	4	2	7	6	2		1	1	4	6	3	1	3					2	3			2	41	1	6		
Poaceae, indet. (small)																							4				
Poaceae, embryo (indet.)			1		1					1						4			2				3				1
Poaceae, chaff (indet.)																							7				
Poaceae, floret (indet.)																			1								

PLANT TAXA//ARCHBOT. SAMPLE NO	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Vicia/Lathyrus	6		2	2						6		2	8	1	3	2		1		6	1	1			3	4	
Vicia ervilia		1	2										7			1		1			1	3					
Vicia faba																											
Lathyrus sativus/cicera	1			1					1				1	1		3		1								3	1
Lens culinaris												1				1		1	5	1			1	3	1	5	1
Pisum sativum								1						1													1
Coronilla sp.	4		1		1				1	1	2	1			1	1		1		1			2	1		3	1
Scorpiurus sp.	1					1				3		1			1	1						1			1	4	1
Prosopis cf. farcta		1	1	1					1		2	1		1	3	1		1		2						1	
Securigera cf. securigeda	3		2	2						2	2		1				1					1	2		1		1
Securigera type				1			1																1				
Medicago sp.	2									1				2				1									
Medicago sp. (pod frags.)	1																										
Melilotus/Trifolium	28	2	12	9	16	1	4	3	10	15	1	1	8	7	41	61	1	5	54	3	5	4	6	5	3	14	18
Trifolium cf. alexandrium																			2								
Trigonella foenum-graecum																											
Trigonella sp.											3												1				
Astragalus sp.																											
Fabaceae, indet (medium)													2									2					1
Fabaceae, indet (large)	1	1	1	1	2		1		1	5	2	2	4	4	1			1	1				4	3		2	5
Olea europaea	1		1		1		plenty		1			1			2	2		1	1	1	2		1		1	1	1
Vitis vinifera (pip)	3			2	2		1		2	3	4	4	2		3				1	1	1	1			1	2	1
Vitis vinifera (mineralised pip)																											
Vitis vinifera (smaller pip)					1																						
Vitis vinifera (skeletonized endosperm?)																											
Vitis vinifera (stalk)	5			4	1						1	3			1	4				1			1		2		
Vitis type (rudimentary)	2				1							1				1						1					
Ficus carica				1				1			1	1			4						1						
Ficus carica (mineralised)										1											1						
Linum sp.																											
Linum usitatissimum																											
Amygdalus sp.																											
Pistacia cf. lentiscus																											
Geranium sp.																											
Bupleurum sp.				1			1									1							2				
Bupleurum subovatum (with testa)	3									1	3												4				1
Torilis leptophylla																											
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)										1																	
Apiaceae, indet. small-seeded			4						1				1		1			1				1	1			1	3
Centaurea type	1									1	1															1	
Anthemis cotula	2		3							2				1	24	40			26				1			1	4
Cichorium sp.																											
Artemisia sp.																											

PLANT TAXA//ARCHBOT. SAMPLE NO	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Picris hieracoides	1												1														
Picris echioides type																											
Onopordum sp.										1																	
Asteraceae, indet			1							1											1						1
Heliotropium sp.																											
Lithospermum arvense (carbonized)								1		1											1					1	
Lithospermum arvense (uncarbonized)			1															5				1	1				
Lithospermum tenuifolium																											
Echium sp.																											
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum																											
Lepidium sp.																											
Brassica sp.																											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.														1									1				
Valerianella dentata	1							1								1		1	1	1		1					
Valerianella coronata																							1				
Vaccaria cf. pyramidata			1	1	1										1												
Silene sp.	2		1	1	1										3	3		1							2		1
Caryophyllaceae, indet.	1		1									1	1										2				
Scirpus maritimus													1		1				2	1			3	1	1		
Rumex sp.			1	1	1		1					1	1	1	2	1	3	2			3	1	7	3		6	2
Rumex type																											
Polygonum/Carex	2																										
Eleocharis sp.																							1				
Fimbristylis cf. annua																											
Cyperus cf. michelianus																											
Cyperaceae, indet.	3																										
Galium aparine (3 mm)			1																								
Galium aparine/spurium	1		1	2					2		1				1	1											1
Galium spurium type								1							1												
Galium cf. parisiense																			1								
Asperula arvensis/orientalis	4		4		1				1		2				4	2			2			1	1		1		
Asperula cf. orientalis																											
Asperula sp.																			1		1					1	
Sherardia arvensis										1						1											
Rubiaceae, indet. (frags)	2		3	1			1	1							3	4			1		1		1		1	2	
Rubiaceae, indet. (large/medium seeded)								1	1																		
Rubiaceae, indet. (small seeded)			1																			1				1	
Rubiaceae, indet. (mericarps)																											
Rubiaceae, indet. (fruit)																			1								
Salix sp.																											
Thymelaea sp.	3		1	2	4				4	3	2	1		1	5	5		1	2		1		1				
Chenopodium murale									1																		

PLANT TAXA//ARCHBOT. SAMPLE NO	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Chenopodium album																											
Chenopodiceae (indet.)																											
Ornithagalum/Muscari				2																							
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.																											
Malva sp.											1						2									1	
Plantago cf. lagopus																											
Teucrium/Ajuga																											
Euphorbia falcata/maculata																											
Hypericum sp.																											
Alisma sp.																							1				
Verbena sp.																											
Anagallis sp.											1			1													
Papaver spp.																											
Verbascum/Scrophularia													2	1													
Fumaria sp.																											
Cephalaria type																											
Ranunculus cf. Arvensis	1																	1	1				1				
Nigella sp.																											
Adonis cf. annua				1									1							1	1						
Capparis cf. spinosa																											
Lamiaceae, indet.																											
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)																											1
TT-unidentified object 2 (Anagallis?)												1			1												
TT-unidentified object 3 (Saxifragaceae?)										24									12								
TT-unidentified object 4 (Ziziphora?)																4											
TT-unidentified object 5 (Rosaceae/Dryas type?)	3																		2				4	1		1	
TT-unidentified object 6 (Spergularia?)																			1								
TT-unidentified object 7 (Cuscuta?)																											
TT-unidentified object 8 (Matricaria?)																					1						
Flowering bud (indet.)																			3				3				
Chara (oogonia)																											
Insect remains										1																	
Mouse droppings			1		1		1				1					1		1			2						
TOTALS	200	17	101	101	79	10	27	22	60	115	99	54	55	41	145	190	14	51	171	56	63	38	272	37	70	96	113

(continues)

SEASON	2011	2011	2011	2011	2011	2011	2011	2011	2012	2012	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2011	2015
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	56	56	56	56	56	56	56	56	56	56	56	56	65	65	65	65	65	65	65	65	65	65	65	65	65	65	66
LOCUS	293	293	301	301	301	301	302	308	308	308	308	313	125	129	134	134	134	134	135	137	140	141	145	154	151	151	159
PAIL	671	651	685	686	687	688	693	728	758	756	703	724	348	361	364	377	363	392	376	378	385	386	400	414	408	408	375
SA NUMBER	7478	7484	7445	7447	7449	7425	7442	7433	8795	8796	7422	7428	7409	7449	7421	7388	7410	7386	7416	7393	7395	7397	7391	7420	7392	7413	9623
PERIOD	EBA IVB																										
FIELD 1 PHASES	7																										
PLANT TAXA//ARCHBOT. SAMPLE NO	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**
Hordeum vulgare	2	1	5	1	2	3	1	6	11	5		5	3		2			3	2	2	4	7	1	2	1	2	
Hordeum vulgare (rachis)	1		2			1	2	8	29	4	2						1	1		3	2			1			
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)		1													1												
Hordeum spp. (frags., NISP)	1																1		1			1	1				
Triticum spp. (fr. thres/gl.)	3	3	4	1	3	3			9	11	3	1		1		1	1	2		5	11	15	7	4	2	4	4
Triticum aestivum/durum	1	2	5					2	2	1	1	4	3	1		1		5	2	2	1	8	3	1			
free-threshing wheat (spi. base common)				2				14	33	6		1									1			1			
free-threshing wheat (spi. base robust type)																											
Triticum dicoccum							1	1	1									2	1	2	8	7	3	2			
Triticum dicoccum (spikelet bases)	2	1	1		1		1	26	25	28	5	2	2			1	3	6	4	4	1	4	6	5		4	
Triticum dicoccum (glume bases)	4	4	11	2		1	2	113	94	63	25	5	6	1	2	2		5		6	6	2	4	13	1	4	
Triticum monococcum																											
Triticum monococcum/boeticum							1																				
Lolium sp.	17	12	17	7	15	17	12	22	22	6	28	23	11	9	18	14	34	115	22	16	126	99	59	26	7	9	7
Phalaris sp.	3	4	9	3	5	3	6	5	5	3	5	10	5		9	7		30	5	7	43	11	19	10	3	1	1
Festuca-type									1												7		1		1		
Avena type																									1		
Bromus spp.	1								1												2	1	1				
Stipa type			1											1				1			1					1	1
Phleum cf. phleoides						1												5			1			1			
Aeluropus cf. littoralis																		10									
Alopecurus geniculatus type																											
Poa cf. trivialis																											
Cynodon dactylon										1			1														
Agrostis canina type																											
Echinaria capitata																											
TT-unidentified Poaceae 2																											
TT-unidentified Poaceae 4																											
Poaceae, indet. (large)	4			3					2	7	4	3	3	3	2	4	4	7	4		3		7	3	2	1	
Poaceae, indet. (medium)	2	2	7	2		6		21	9	9	7	9	2	2	5	2	10	15	7	6	24		14	1	1	3	
Poaceae, indet. (small)									1		1				3	1	2	2									
Poaceae, embryo (indet.)								4	6	5								1		2		2					
Poaceae, chaff (indet.)													1					1									
Poaceae, floret (indet.)																											

PLANT TAXA//ARCHBOT. SAMPLE NO	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Vicia/Lathyrus	4		3	1			2	8			2	5	2			1	2	4		2	3	6	2	2	3		
Vicia ervilia	2	2	2	1				3		1		1		1						2	1	1		2		2	1
Vicia faba																											
Lathyrus sativus/cicera			2	1	1	1		3	1		2								2								
Lens culinaris			2	1	2			9	2	2		2	2	1		5		1			5	4	2	1	1	1	1
Pisum sativum		1																									
Coronilla sp.		1	1		1	2	1	2	2			2	1	2	5	2	3	18	1	6	10	2	6	2	1	1	
Scorpiurus sp.				1	1	2	1							2				1		3		1	1	3			
Prosopis cf. farcta	1				3		1	1	1		1	1	1	1	2	1		4	1	2	9	4	3	1			2
Securigera cf. securigeda			1		1			1					1		1	2	1	5	2	3	9	4	3			2	1
Securigera type																		3	1						1		
Medicago sp.												1															
Medicago sp. (pod frags.)																											
Melilotus/Trifolium	12	8	6	3	7	1	12	8	3	2	9	10	8	1	10	6	13	34	5	23	59	6	27	16	4	3	1
Trifolium cf. alexandrium																											
Trigonella foenum-graecum																											
Trigonella sp.			1					1										1		2	3		1	1			2
Astragalus sp.																											
Fabaceae, indet (medium)			1								1	1				1	1		1	2						1	
Fabaceae, indet (large)						3		8	3	8	3		2		2	1	3		1		4	4	1	4		2	2
Olea europaea		1	1	1	3	1	1				1	2	1			1	1	1	1	1	5	6	2	1		1	2
Vitis vinifera (pip)	1		1	1		1	4	2	1	1	1	1							1	1	6	8	1	2			2
Vitis vinifera (mineralised pip)																											
Vitis vinifera (smaller pip)			1																			2					
Vitis vinifera (skeletonized endosperm?)																											
Vitis vinifera (stalk)		1	1				2			1		3	1			1			1	2			3				1
Vitis type (rudimentary)	1					1	1						2			1		2									
Ficus carica			1	1				8			2	1						1	1								
Ficus carica (mineralised)																											
Linum sp.															1												
Linum usitatissimum																											
Amygdalus sp.																											
Pistacia cf. lentiscus																											
Geranium sp.																											
Bupleurum sp.						1																2		3			
Bupleurum subovatum (with testa)					1							3									2						
Torilis leptophylla																			1								
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)																											
Apiaceae, indet. small-seeded	1									1		2	3		4			6	1	2	6		2	3			
Centaurea type				9														2					1				
Anthemis cotula	1	1	1		1			4		3					3	1	1	8	1	3	1		2	1	1		
Cichorium sp.																						1					
Artemisia sp.																											

PLANT TAXA//ARCHBOT. SAMPLE NO	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Picris hieracoides																		1									
Picris echioides type																											
Onopordum sp.														2													
Asteraceae, indet						1														2			3	2	1		
Heliotropium sp.																			1								
Lithospermum arvense (carbonized)		1								3	1										1						
Lithospermum arvense (uncarbonized)																										1	
Lithospermum tenuifolium																											
Echium sp.																											
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum																					1						
Lepidium sp.																											
Brassica sp.																											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.														1		1											
Valerianella dentata																	1							1			
Valerianella coronata																											
Vaccaria cf. pyramidata																		1				1					
Silene sp.						1		1								2		3		1	2	1	2		1		
Caryophyllaceae, indet.									1									1									
Scirpus maritimus		1						15	1	4	7													1			
Rumex sp.	1	1			1	1	2	9	3	5	7	1				1		1		1	5	1	1				
Rumex type																											
Polygonum/Carex																											
Eleocharis sp.								2		1																	
Fimbristylis cf. annua								1							1												
Cyperus cf. michelianus																											
Cyperaceae, indet.																									1		
Galium aparine (3 mm)																										1	
Galium aparine/spurium		1		1	3	1						1				1					1			2			
Galium spurium type	1					2																				1	
Galium cf. parisiense																				1							
Asperula arvensis/orientalis	2	1	1	1	3	3	1		1						2	2	1	3			9			7			
Asperula cf. orientalis																											
Asperula sp.				1																							
Sherardia arvensis			1				1		1				1					1			2						
Rubiaceae, indet. (frags)		1		1	1		1		1	1		3				1		3		2	1		1	2			
Rubiaceae, indet. (large/medium seeded)	1																										
Rubiaceae, indet. (small seeded)																											
Rubiaceae, indet. (mericarps)																							1				
Rubiaceae, indet. (fruit)																											
Salix sp.																											
Thymelaea sp.							1	3		2	2	1			1	3	3	5	2	3	6	9	3	1	1	1	
Chenopodium murale				1						1																	

PLANT TAXA//ARCHBOT. SAMPLE NO	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Chenopodium album			1																								
Chenopodiceae (indet.)									1																		
Ornithagalum/Muscari								1															1				
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.									3																		
Malva sp.			2								1														1		1
Plantago cf. lagopus																		1									
Teucrium/Ajuga																											
Euphorbia falcata/maculata								1																			
Hypericum sp.																											
Alisma sp.																											
Verbena sp.																											
Anagallis sp.																	1			2						1	
Papaver spp.																						2					
Verbascum/Scrophularia																		1									
Fumaria sp.																											
Cephalaria type																											
Ranunculus cf. Arvensis												1															
Nigella sp.																											
Adonis cf. annua											1																
Capparis cf. spinosa																											
Lamiaceae, indet.																								1			
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)																									1	1	
TT-unidentified object 2 (Anagallis?)	1																					2					
TT-unidentified object 3 (Saxifragaceae?)										5								3									
TT-unidentified object 4 (Ziziphora?)																				1			1				
TT-unidentified object 5 (Rosaceae/Dryas type?)															1			2			3		1				
TT-unidentified object 6 (Spergularia?)								8										1		1							
TT-unidentified object 7 (Cuscuta?)																											
TT-unidentified object 8 (Matricaria?)																											
Flowering bud (indet.)		1									1							1	1					1			
Chara (oogonia)																											
Insect remains					2																1						
Mouse droppings						1			2			1											1				
TOTALS	70	52	92	46	57	58	57	321	278	190	123	106	62	29	75	67	87	330	73	123	396	224	198	130	36	48	29

(continued)

SEASON	2011	2011	2011	2012	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2011	2011	2015	2010	2010	2009	2010	2010	2010	2009
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	65	65	65	65	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	66	56	56	56	56	56	56	56
LOCUS	160	164	169	189	240	240	251	263	268	268	268	247	248	245	249	258	258	258	258	140	180	180	207	208	210	212	213
PAIL	429	446	454	502	513	515	558	589	598	600	644	550	552	535	553	566	562	699	704	344	346	343	413	416	440	426	433
SA NUMBER	7385	7384	7367	8769	6642	6647	6663	6675	6677	6682	7455	6657	6660	6652	6661	6673	6665	7463	7436	9463	4583	4640	5801	5811	5867	5825	5844
PERIOD	EBIVB				Iron IA																						
FIELD 1 PHASES	7				6c															6b							
PLANT TAXA//ARCHBOT. SAMPLE NO	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**
Hordeum vulgare	14	2	1	3	3	2	3	3	2	1	2	4	1		1	39	13	3	1	2	1	1	4		1	1	
Hordeum vulgare (rachis)		1	1		2	1	2		2	1	3			2		66	3	1	1	1			1		2	1	
Hordeum spontaneum																				1							
Hordeum spp. (wild, >4mm)					6	1						1				10	2						1		1	1	
Hordeum spp. (frags., NISP)	1	1													2	2							1		2		
Triticum spp. (fr. thres/gl.)	7	3	2		18		1	4	11	6		4	2		1	27	7	2	1				4	5			1
Triticum aestivum/durum		1	4	5	3	1	4		17	9	1	4				69	20		3	6			9		3		
free-threshing wheat (spi. base common)		2			1	1		2	7	6		1		1		44	5	1									
free-threshing wheat (spi. base robust type)																2											
Triticum dicoccum	4		2			2			4	2		1				23	10			1					1		
Triticum dicoccum (spikelet bases)				3				1			7	1			2	17		2									
Triticum dicoccum (glume bases)	1			2		3	3	1	1		5		1		6	13	1			1			3		2	1	
Triticum monococcum																											
Triticum monococcum/boeticum																											
Lolium sp.	20	19	32	37	26	7	9	7	13	13	13	7	5	3	21	26	15	3	4		2	2	15	2	3	5	
Phalaris sp.	6	6	6	4	9	13	7	7	29	17	7	2	4	2	8	104	12	6	4	8		1	6	14	6	15	3
Festuca-type																					1						
Avena type																											
Bromus spp.				1												1		2									
Stipa type											1																
Phleum cf. phleoides					47	2			1	1		3				21	3							1	2		
Aeluropus cf. littoralis				1			1									1								1			
Alopecurus geniculatus type					4	1								2		1	1		2				1	1			
Poa cf. trivialis																6	2										
Cynodon dactylon					1											1	1						3	2			
Agrostis canina type				1	2																						
Echinaria capitata																											
TT-unidentified Poaceae 2					32								1		1										4		
TT-unidentified Poaceae 4																											
Poaceae, indet. (large)	7	2	3		15	4	2	1	8	7	1	5	1	5	2	11		3	6	2	2		6	2		4	
Poaceae, indet. (medium)		6	12		2		16	2	2	1	3		1	2	4	8			2	2		2	1	3		2	
Poaceae, indet. (small)			1		7	1		2	1									1						1		1	
Poaceae, embryo (indet.)	2		1	1	6	1			8	2					2	10	1		1								
Poaceae, chaff (indet.)											1					11								4		2	
Poaceae, floret (indet.)				1																							

PLANT TAXA//ARCHBOT. SAMPLE NO	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
Vicia/Lathyrus	8	5	2	3	1		3	3	3	2	5	2	2	2	2	4	5			1			3		2	2	
Vicia ervilia		1	1			1					3				1	10							1	1			
Vicia faba																1											
Lathyrus sativus/cicera		1		2						1						3							1				
Lens culinaris			1	3	6				3		1		1		2	15	5	1	1				2	1	1		
Pisum sativum																			1								
Coronilla sp.	1	2	2	2			1	1			1				1	1	2										
Scorpiurus sp.		1	1	1		1					1	1							1	1				1			
Prosopis cf. farcta	2	1	4	1				1							1												
Securigera cf. securigeda	2		2												1										1		
Securigera type				2																							
Medicago sp.					1																						
Medicago sp. (pod frags.)																											
Melilotus/Trifolium	9	12	16	11	26	12	5	9	3	7		4	7		13	11	6	2	8	8		4	13	12	11	1	4
Trifolium cf. alexandrium																								1			
Trigonella foenum-graecum																5											
Trigonella sp.																1											
Astragalus sp.																											
Fabaceae, indet (medium)		4									1		1			5		1								1	
Fabaceae, indet (large)	29	2	2						1						1	3	5										1
Olea europaea			1		1	1		1	1	1	1		1	1	1	1	1	1						1	1		
Vitis vinifera (pip)		3	3	1		2	2	1	15	4		2			1	21	3			1			9	1		1	1
Vitis vinifera (mineralised pip)								2	2	1																	
Vitis vinifera (smaller pip)																2							1				
Vitis vinifera (skeletonized endosperm?)																	1										
Vitis vinifera (stalk)		1			2		2		1							10	1		1	1			1				
Vitis type (rudimentary)			2				1		1											1		1					
Ficus carica											1					29	15						1			1	
Ficus carica (mineralised)								12	1	5																	6
Linum sp.							1					1				5	2										
Linum usitatissimum																											
Amygdalus sp.																											
Pistacia cf. lentiscus																1											
Geranium sp.																1											
Bupleurum sp.			1					1			1				2	13			2								
Bupleurum subovatum (with testa)																14	2										
Torilis leptophylla																14	1			1			1	1			
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)																2											
Apiaceae, indet. small-seeded	2			1					4		1				2	5	4	1						1			
Centaurea type					26	1	1	2	1	1		3			1	55	25		2				2		2		
Anthemis cotula	1	2	4		20		1	2				4	2	2	6	25		2		1			1	3	6	2	
Cichorium sp.									1	14		1															
Artemisia sp.																											

PLANT TAXA//ARCHBOT. SAMPLE NO	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
Picris hieracoides			1													1											
Picris echioides type																											
Onopordum sp.																											
Asteraceae, indet						2											1										
Heliotropium sp.				1											1												
Lithospermum arvense (carbonized)																1											
Lithospermum arvense (uncarbonized)																											
Lithospermum tenuifolium			1			1																					
Echium sp.									1																		
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum																1	1										
Lepidium sp.																3											
Brassica sp.																											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.						1																					
Valerianella dentata																											
Valerianella coronata																1			1	1							
Vaccaria cf. pyramidata		2														19											
Silene sp.	5	2	1	3															1					1			
Caryophyllaceae, indet.																											
Scirpus maritimus	1			1		4						1		1		2		1	1	3			1	1	1		
Rumex sp.			1	4	15	4	8	1	6	3		4	3		3	41	16						7	9	1	1	
Rumex type							1									6								1			
Polygonum/Carex					1																				1		
Eleocharis sp.	1					1			1							1											
Fimbristylis cf. annua						2											1									10	
Cyperus cf. michelianus																											
Cyperaceae, indet.																8						1			4	1	
Galium aparine (3 mm)	2															2											
Galium aparine/spurium	2	1		1	1						1				1		1									1	
Galium spurium type																											
Galium cf. parisiense					2				1	1						5	1	2					1		4		
Asperula arvensis/orientalis	1	2											3			9		1	1								1
Asperula cf. orientalis																4											
Asperula sp.																											
Sherardia arvensis			1													4											
Rubiaceae, indet. (frags)	1	2		1		1			2						2	13										1	
Rubiaceae, indet. (large/medium seeded)													2				1										
Rubiaceae, indet. (small seeded)					1					1				3		4									2		
Rubiaceae, indet. (mericarps)													1			1	1										
Rubiaceae, indet. (fruit)					2								1			1											
Salix sp.																2											
Thymelaea sp.	13		2	2	3		1				1					4		1					3	1			
Chenopodium murale					27											16	1						1				

PLANT TAXA//ARCHBOT. SAMPLE NO	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
Chenopodium album																1	4						2				
Chenopodiceae (indet.)									1							1		1					5				
Ornithagalum/Muscari			1													3											
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.																											
Malva sp.						22			2			5	4		1	6	5		1				1	1	9		
Plantago cf. lagopus																1											
Teucrium/Ajuga																1	1										
Euphorbia falcata/maculata								1									1										
Hypericum sp.	1																1										
Alisma sp.					2		1													1							
Verbena sp.							1																				
Anagallis sp.					3								1			1											
Papaver spp.																	1										
Verbascum/Scrophularia				1									2				1							2			
Fumaria sp.																											
Cephalaria type																					1						
Ranunculus cf. Arvensis														1													
Nigella sp.																1											
Adonis cf. annua																											1
Capparis cf. spinosa								1								6	5										
Lamiaceae, indet.																											
Solanaceae																1											
TT-unidentified object 1 (Vitaceae?)																											
TT-unidentified object 2 (Anagallis?)			1																								
TT-unidentified object 3 (Saxifragaceae?)					1	4			8			8			8		9		1				22	1	2		
TT-unidentified object 4 (Ziziphora?)																2		1	1								
TT-unidentified object 5 (Rosaceae/Dryas type?)																											
TT-unidentified object 6 (Spergularia?)	1						1																			2	
TT-unidentified object 7 (Cuscuta?)					2											21							1		8		
TT-unidentified object 8 (Matricaria?)																											
Flowering bud (indet.)			1	2		1										2											
Chara (oogonia)																											
Insect remains																1											
Mouse droppings														1	2	10											
TOTALS	144	87	117	102	327	101	78	68	165	107	62	69	47	28	103	977	226	39	48	44	7	12	135	76	83	57	18

(continued)

SEASON	2009	2010	2010	2009	2010	2009	2010	2010	2010	2010	2015	2006	2006	2010	2010	2006	2006	2006	2006	2006	2010	2010	2006	2006	2006	2006	2006
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	56	56	56	56	56	56	56	56	56	56	66	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
LOCUS	216	221	223	227	227	232	232	237	237	237	156	122	128	163	171	135	135	135	137	98	98	98	112	112	112	112	112
PAIL	454	471	468	497	481	494	494	522	518	599	364	205	262	287	314	265	268	268	260	167	167	170	186	195	245	243	248
SA NUMBER	5949	5977	5970	6111	5872	6100	6101	6636	6646	6683	9612	1341	1706	4562	4601	1715	1711	1708	1438	1434	1322	1324	1979	1316	1987	2079	2077
PERIOD	Iron IA															Iron IB											
FIELD 1 PHASES	6b															5b				5a							
PLANT TAXA//ARCHBOT. SAMPLE NO	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**135**
Hordeum vulgare	1	3	1	5	5		2	3	7	4	3			1	3		44	5		2	21		2	1		1	
Hordeum vulgare (rachis)				1	2			1	17	2	1									1	6	1					
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)										2							2			1					1		
Hordeum spp. (frags., NISP)					1																1				2		
Triticum spp. (fr. thres/gl.)	1	5	3		5	2	1	4	3	8			1	1			5			13	22	5	1	3	2	3	1
Triticum aestivum/durum	3	1		15	7	1			5	7	3				1		8	2	1	12	27		2	3	3		
free-threshing wheat (spi. base common)		1		1		1			3							1	4								1		
free-threshing wheat (spi. base robust type)					1																1						
Triticum dicoccum		1	1					4	3	3						1	33	1			4	2	1	1			
Triticum dicoccum (spikelet bases)							2	2	2	2							4								1		
Triticum dicoccum (glume bases)								2		2								2									
Triticum monococcum																	2										
Triticum monococcum/boeticum																	5	2									
Lolium sp.	13	6	7	29	28		3		5	5	23	4	6		4	7	19	4	1	4	6	2	2	7	5	3	13
Phalaris sp.	2	1	5	9	7	1	1	49	348	33		2			1		50	7	1	1	4		3	5	2	1	1
Festuca-type				1	6																						
Avena type																				1	1						
Bromus spp.																	5								4	1	
Stipa type																											
Phleum cf. phleoides			2					2	1	1	1	1												1			
Aeluropus cf. littoralis				2	9											1										2	
Alopecurus geniculatus type									1																		
Poa cf. trivialis																											
Cynodon dactylon									3								1										
Agrostis canina type		1																	1								
Echinaria capitata																											
TT-unidentified Poaceae 2										2																	
TT-unidentified Poaceae 4																								1			
Poaceae, indet. (large)	2	3	3	6	4	1	4	1	4	4		4	3		2	1	7	6		2	10		2	3	5	1	
Poaceae, indet. (medium)		2	3	9	7	1		1	2	1		4					4	1	1	3	3		4		1	1	
Poaceae, indet. (small)					3	2				3			1								1						
Poaceae, embryo (indet.)		2		1	7			1	2								4			2	3		1				
Poaceae, chaff (indet.)					1												5										
Poaceae, floret (indet.)																											

PLANT TAXA//ARCHBOT. SAMPLE NO	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
Vicia/Lathyrus		5		1	2		2	1	2	1	2	1								2							
Vicia ervilia		2													1		1				2	1	2		1		1
Vicia faba																											
Lathyrus sativus/cicera		1																				1					1
Lens culinaris		2					1		1		1							1					1		1		1
Pisum sativum																				1	7						
Coronilla sp.			1		1			1	1		2																
Scorpiurus sp.	1																										
Prosopis cf. farcta																				1							
Securigera cf. securigeda																											
Securigera type																			1								
Medicago sp.																											
Medicago sp. (pod frags.)																											
Melilotus/Trifolium	5	7	8	5			3	8	21	10	7	6	2		1		33	9	1	1			11	8	15	7	
Trifolium cf. alexandrium									3														1				
Trigonella foenum-graecum																											
Trigonella sp.																											
Astragalus sp.																											
Fabaceae, indet (medium)													1				1										
Fabaceae, indet (large)	2			2	5					3					1				2		7	6			4		
Olea europaea		1	1			3	1																				
Vitis vinifera (pip)	3	1	1	1	2		2	1			1				1					2			2	1		1	
Vitis vinifera (mineralised pip)																								1			
Vitis vinifera (smaller pip)																											
Vitis vinifera (skeletonized endosperm?)																											
Vitis vinifera (stalk)																											
Vitis type (rudimentary)					1																2						
Ficus carica	1										16	1														1	
Ficus carica (mineralised)																								1			
Linum sp.																											
Linum usitatissimum																											
Amygdalus sp.																											
Pistacia cf. lentiscus																											
Geranium sp.																											
Bupleurum sp.											1													1			
Bupleurum subovatum (with testa)						1																					
Torilis leptophylla																											
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)																					3						
Apiaceae, indet. small-seeded						2	3	4	3	4	1							1			2				3		
Centaurea type		2							1	1	2																
Anthemis cotula	1	8		4	6		4	9	24	17		1					3	2		1	10		4	1	2		
Cichorium sp.			2	1																							
Artemisia sp.																									1	1	

PLANT TAXA//ARCHBOT. SAMPLE NO	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
Picris hieracoides									17	8							3										1
Picris echioides type																	1										
Onopordum sp.																											
Asteraceae, indet							2			2																1	
Heliotropium sp.												1															
Lithospermum arvense (carbonized)			2																								
Lithospermum arvense (uncarbonized)																											
Lithospermum tenuifolium																											
Echium sp.									2	4																	
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum								1	1	1										1							
Lepidium sp.																											
Brassica sp.																											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.																											
Valerianella dentata									1		1																
Valerianella coronata	1																										
Vaccaria cf. pyramidata																											
Silene sp.	1		1																								
Caryophyllaceae, indet.																											
Scirpus maritimus	1					2	1	4	9	3							5	1	1						1		1
Rumex sp.			1	4	3				1	3		1					4				2		1	1		1	
Rumex type																		1									
Polygonum/Carex																											
Eleocharis sp.					1														1								
Fimbristylis cf. annua																	1										
Cyperus cf. michelianus																											
Cyperaceae, indet.							1	2																			
Galium aparine (3 mm)																											
Galium aparine/spurium																											
Galium spurium type			1																								
Galium cf. parisiense								1	4	4											1						
Asperula arvensis/orientalis																	1										
Asperula cf. orientalis																											
Asperula sp.									1	1																	
Sherardia arvensis																											
Rubiaceae, indet. (frags)			1																								
Rubiaceae, indet. (large/medium seeded)																											
Rubiaceae, indet. (small seeded)								1	3	2																	
Rubiaceae, indet. (mericarps)									8	4																	
Rubiaceae, indet. (fruit)									1																		
Salix sp.																											
Thymelaea sp.			1						1	1										1			1				
Chenopodium murale		4															2										

PLANT TAXA//ARCHBOT. SAMPLE NO	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
Chenopodium album																											
Chenopodiceae (indet.)																											
Ornithagalum/Muscari							1			1	1																
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.																											
Malva sp.		1					1	2		1																1	
Plantago cf. lagopus																											
Teucrium/Ajuga																											
Euphorbia falcata/maculata																											1
Hypericum sp.																											
Alisma sp.																								1			
Verbena sp.																											
Anagallis sp.								1																			
Papaver spp.																											
Verbascum/Scrophularia							8						1				2							1	2		
Fumaria sp.																											
Cephalaria type								1																			
Ranunculus cf. Arvensis																											
Nigella sp.																											
Adonis cf. annua																											
Capparis cf. spinosa																											
Lamiaceae, indet.																											
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)																											
TT-unidentified object 2 (Anagallis?)									3									1					1				
TT-unidentified object 3 (Saxifragaceae?)	4		2				2		8	4						2	1						2		2		
TT-unidentified object 4 (Ziziphora?)																											
TT-unidentified object 5 (Rosaceae/Dryas type?)																											
TT-unidentified object 6 (Spergularia?)																				1							
TT-unidentified object 7 (Cuscuta?)																											
TT-unidentified object 8 (Matricaria?)																											
Flowering bud (indet.)									1																		
Chara (oogonia)				2								1															
Insect remains											1						2										
Mouse droppings									3												1						
TOTALS	42	60	47	99	114	17	45	107	526	154	67	27	15	2	15	13	262	46	11	53	147	18	44	41	59	26	21

(continued)

SEASON	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2005	2005	2005	2005	2005	2005	2005	2005	2005	2010	2006	2015	2010	2010	2010	2010	2010
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	56	56	56	56	56	56	56	56	56	56	55	55	55	55	55	55	35	35	35	45	45	66	58	58	58	58	58
LOCUS	112	112	112	112	112	119	121	121	130	130	71	36	36	36	68	68	18	13	13	17	17	161	21	26	27	27	27
PAIL	245	245	245	246	246	235	218	214	252	236	121	78	78	78	112	112	61	35	35	41	44	387	95	90	91	94	94
SA NUMBER	1414	1415	1983	1430	2076	1387	1379	1412	1693	1388	574	545	546	547	569	570	608	572	573	1369	1370	9587	8719	8718	8722	8724	8725
PERIOD	Iron IB																Iron IC					Iron II					
FIELD 1 PHASES	5a										4	3					(FIELD 2)					2	(FIELD 7)				
PLANT TAXA//ARCHBOT. SAMPLE NO	**136**	**137**	**138**	**139**	**140**	**141**	**142**	**143**	**144**	**145**	**146**	**147**	**148**	**149**	**150**	**151**	**152**	**153**	**154**	**155**	**156**	**157**	**158**	**159**	**160**	**161**	**162**
Hordeum vulgare						1			1			6	13	9	2	1		1	1	1			3	1	1	1	
Hordeum vulgare (rachis)													1	1													
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)														1			1										
Hordeum spp. (frags., NISP)				1									3					1				1					
Triticum spp. (fr. thres/gl.)	1	3	3	3	3		1				6	22	16	6	2			1				2	2				
Triticum aestivum/durum	1			3			1			3	1	26	19	15		2	4	4	2	1	1	1					
free-threshing wheat (spi. base common)										1			4	3													
free-threshing wheat (spi. base robust type)	1																										
Triticum dicoccum		2									8		2	4		1		1		1		3					
Triticum dicoccum (spikelet bases)	1							1																			
Triticum dicoccum (glume bases)	1									1																	
Triticum monococcum																											
Triticum monococcum/boeticum																											
Lolium sp.	6	7	5	9	3		2	3	5	2	4	83	94	141			4	27	31	8	37	31		5	9	1	3
Phalaris sp.	5	2	1		1			1	2		15	7	16	6	7	14	1	1	1	1	2	7			2	1	
Festuca-type																											
Avena type																											
Bromus spp.	1											1															
Stipa type													1														
Phleum cf. phleoides											3					3											
Aeluropus cf. littoralis	1			1			4			2						1			1	2							
Alopecurus geniculatus type																											
Poa cf. trivialis																											
Cynodon dactylon																1											
Agrostis canina type																											
Echinaria capitata											1																
TT-unidentified Poaceae 2																											
TT-unidentified Poaceae 4			1													1											
Poaceae, indet. (large)	1			2					1			2	8	13	2	4		3		1							
Poaceae, indet. (medium)				2								41	13	20				1		1	4	7					1
Poaceae, indet. (small)				1									4			1											
Poaceae, embryo (indet.)													6	6	1						1						
Poaceae, chaff (indet.)													1			1											
Poaceae, floret (indet.)																											

PLANT TAXA//ARCHBOT. SAMPLE NO	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
Vicia/Lathyrus		1	2	2								2		9				1				2		1			
Vicia ervilia														1		1						1					
Vicia faba																											
Lathyrus sativus/cicera											1			2	1												
Lens culinaris			1										1			4											
Pisum sativum																											
Coronilla sp.													2								1	3					
Scorpiurus sp.		1				1						1															
Prosopis cf. farcta																						2					
Securigera cf. securigeda																											
Securigera type																						1					
Medicago sp.													4	3				2									
Medicago sp. (pod frags.)																											
Melilotus/Trifolium	6		6	2	2	3	6	2	1	4	2	2	29	13	1	8	4		2	2	1	10				1	1
Trifolium cf. alexandrium																4											
Trigonella foenum-graecum																											
Trigonella sp.																											
Astragalus sp.												1	2	1													
Fabaceae, indet (medium)																					2					1	
Fabaceae, indet (large)								1	2			4		2		4	2				1		2				
Olea europaea				1								1										1	1		1		
Vitis vinifera (pip)			2							2		1	2	1			1				1	2			1		1
Vitis vinifera (mineralised pip)																											
Vitis vinifera (smaller pip)																											
Vitis vinifera (skeletonized endosperm?)																									4		
Vitis vinifera (stalk)	1									1			2	1	1												
Vitis type (rudimentary)										2			1	1					1								
Ficus carica										2			6	13	3												
Ficus carica (mineralised)				1																							
Linum sp.																											
Linum usitatissimum				1																							
Amygdalus sp.																											1
Pistacia cf. lentiscus																											
Geranium sp.																											
Bupleurum sp.													1												1		
Bupleurum subovatum (with testa)																											
Torilis leptophylla																											
Coriandrum sativum													3	1													
Apiaceae, indet. fruit (underdeveloped)																											
Apiaceae, indet. small-seeded				3																							
Centaurea type								1						1													
Anthemis cotula		1										4	20	12							2						
Cichorium sp.														9				1	1								
Artemisia sp.																											

PLANT TAXA//ARCHBOT. SAMPLE NO	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
Picris hieracoides																											
Picris echioides type																											
Onopordum sp.													6														
Asteraceae, indet											1					1											
Heliotropium sp.																											
Lithospermum arvense (carbonized)				1									3	2													
Lithospermum arvense (uncarbonized)																											
Lithospermum tenuifolium																											
Echium sp.																											
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum												2	2	2													
Lepidium sp.															1												
Brassica sp.																3											
TT-unidentified Brassicaceae 1																											
Brassicaceae, indet.																											
Valerianella dentata													1	1													
Valerianella coronata																											
Vaccaria cf. pyramidata																											
Silene sp.				1						1			1					1				1					
Caryophyllaceae, indet.																											
Scirpus maritimus	2		3			1	1		2				2	1	3	4											
Rumex sp.						2	4					8	26	33	3	3		3				1			1		1
Rumex type												1															
Polygonum/Carex				1									1														
Eleocharis sp.	2												2				1										
Fimbristylis cf. annua															1	1											
Cyperus cf. michelianus																											
Cyperaceae, indet.																											
Galium aparine (3 mm)														1													
Galium aparine/spurium																1											
Galium spurium type																											
Galium cf. parisiense																											
Asperula arvensis/orientalis																											
Asperula cf. orientalis																											
Asperula sp.	1																										
Sherardia arvensis																						1					
Rubiaceae, indet. (frags)	1													1													
Rubiaceae, indet. (large/medium seeded)																											
Rubiaceae, indet. (small seeded)										1																	
Rubiaceae, indet. (mericarps)																											
Rubiaceae, indet. (fruit)																											
Salix sp.																											
Thymelaea sp.				1	1									1													
Chenopodium murale																1									1		

PLANT TAXA//ARCHBOT. SAMPLE NO	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
Chenopodium album																									1		
Chenopodiceae (indet.)													4	4													
Ornithagalum/Muscari													1			1								1			
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.																											
Malva sp.											1																
Plantago cf. lagopus																											
Teucrium/Ajuga																											
Euphorbia falcata/maculata																											
Hypericum sp.														1													
Alisma sp.																											
Verbena sp.																											
Anagallis sp.																1											
Papaver spp.																1											
Verbascum/Scrophularia	1																										
Fumaria sp.						2																1					
Cephalaria type																											
Ranunculus cf. Arvensis																											
Nigella sp.																											
Adonis cf. annua																											
Capparis cf. spinosa																											
Lamiaceae, indet.																											
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)																											
TT-unidentified object 2 (Anagallis?)																											
TT-unidentified object 3 (Saxifragaceae?)						3		5	4	1					1												
TT-unidentified object 4 (Ziziphora?)																											
TT-unidentified object 5 (Rosaceae/Dryas type?)						1																					
TT-unidentified object 6 (Spergularia?)																		1									
TT-unidentified object 7 (Cuscuta?)										1									2								
TT-unidentified object 8 (Matricaria?)																											
Flowering bud (indet.)																											
Chara (oogonia)																											
Insect remains																											
Mouse droppings																											
TOTALS	33	17	24	36	10	14	19	14	18	24	43	215	323	342	29	68	18	49	42	18	53	78	8	8	22	5	8

(continued)

SEASON	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2015	2010	2010	2015	2015	2012	2011	2008	2010	2009	2009	2009
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	F5	F5	F5	F5	F5
SQUARE	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	68	68	69	48	98	98	98	98	98
LOCUS	28	34	37	38	41	42	46	47	47	50	53	53	53	55	58	61	153	0	0	7	5	38	8	15	16	23	25
PAIL	99	130	105	121	127	128	140	153	153	170	158	158	162	177	176	180	158	0	28	33	10	129	33	80	83	81	85
SA NUMBER	8741	8753	8792	8745	8755	8756	9577	9571	9611	9468	9472	9479	9475	9620	9572	9477	9467	8738	9578	9579	8714	7362	4651	5987	6000	5989	6007
PERIOD	Iron II																		Iron III								
FIELD 1 PHASES	(FIELD 7)																		(FIELD 5)								
PLANT TAXA//ARCHBOT. SAMPLE NO	**163**	**164**	**165**	**166**	**167**	**168**	**169**	**170**	**171**	**172**	**173**	**174**	**175**	**176**	**177**	**178**	**179**	**180**	**181**	**182**	**183**	**184**	**185**	**186**	**187**	**188**	**189**
Hordeum vulgare		1		1	1		1		1	1		1	1		2	1			1			1	1	1	2	2	
Hordeum vulgare (rachis)									1																		
Hordeum spontaneum																											
Hordeum spp. (wild, >4mm)																											
Hordeum spp. (frags., NISP)												1			1												
Triticum spp. (fr. thres/gl.)											1	1	1			3							1	5			2
Triticum aestivum/durum	10			2	6			1		4		3		1		37			21		11				1	8	
free-threshing wheat (spi. base common)														1													
free-threshing wheat (spi. base robust type)																											
Triticum dicoccum							1											1									
Triticum dicoccum (spikelet bases)															1	1											
Triticum dicoccum (glume bases)																							1				
Triticum monococcum																											
Triticum monococcum/boeticum																1											
Lolium sp.		1	4		2	5	11	2	3	3	1	13	6			231	3	4	3		2	6	2	3	14	7	1
Phalaris sp.		1				1	4	2	3	1	1	3	3	1	1	4	1			1	1	2		1		5	1
Festuca-type																											
Avena type																											
Bromus spp.																											
Stipa type																											
Phleum cf. phleoides																											
Aeluropus cf. littoralis																											
Alopecurus geniculatus type																											
Poa cf. trivialis																											
Cynodon dactylon																											
Agrostis canina type																											
Echinaria capitata																											
TT-unidentified Poaceae 2																											
TT-unidentified Poaceae 4																											
Poaceae, indet. (large)						1								1													
Poaceae, indet. (medium)				1	2	2		2	3	5				2		9											
Poaceae, indet. (small)																											
Poaceae, embryo (indet.)												2				2											
Poaceae, chaff (indet.)																											
Poaceae, floret (indet.)																											

PLANT TAXA//ARCHBOT. SAMPLE NO	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
Vicia/Lathyrus						1	2			1	1				1	1		1									1
Vicia ervilia							1							1		1											
Vicia faba																											
Lathyrus sativus/cicera																1											
Lens culinaris						1	1										1				1			2			
Pisum sativum																											
Coronilla sp.												2										1					
Scorpiurus sp.													1									2					
Prosopis cf. farcta										1						1											
Securigera cf. securigeda																											
Securigera type									1																		
Medicago sp.												4				1											
Medicago sp. (pod frags.)																											
Melilotus/Trifolium		1				4	5	2		6	2	4	2		1	12		2				3			5	4	
Trifolium cf. alexandrium																											
Trigonella foenum-graecum																											
Trigonella sp.							1																				
Astragalus sp.																											
Fabaceae, indet (medium)																						1					
Fabaceae, indet (large)												2												1		2	
Olea europaea			1		1												1				1					1	
Vitis vinifera (pip)			1			1										1						1	1	1			
Vitis vinifera (mineralised pip)						1																					
Vitis vinifera (smaller pip)						1																					
Vitis vinifera (skeletonized endosperm?)																1											
Vitis vinifera (stalk)						1				1					1	1										2	
Vitis type (rudimentary)							1																				
Ficus carica					2						1	1														2	
Ficus carica (mineralised)																											
Linum sp.																											
Linum usitatissimum												1				8											
Amygdalus sp.																								1		1	1
Pistacia cf. lentiscus																										1	
Geranium sp.																											
Bupleurum sp.																										3	
Bupleurum subovatum (with testa)												1															
Torilis leptophylla																											
Coriandrum sativum																											
Apiaceae, indet. fruit (underdeveloped)																											
Apiaceae, indet. small-seeded												1				4											
Centaurea type													1			2											
Anthemis cotula																											
Cichorium sp.																											
Artemisia sp.																											

PLANT TAXA//ARCHBOT. SAMPLE NO	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
Picris hieracoides						1																					
Picris echioides type																											
Onopordum sp.																											
Asteraceae, indet																											
Heliotropium sp.																											
Lithospermum arvense (carbonized)																											
Lithospermum arvense (uncarbonized)																											
Lithospermum tenuifolium																											
Echium sp.																											
Boraginaceae, indet.																											
cf. Ochthodium aegyptiacum																2											
Lepidium sp.																											
Brassica sp.																											
TT-unidentified Brassicaceae 1																3											
Brassicaceae, indet.																5										1	
Valerianella dentata																											
Valerianella coronata																											
Vaccaria cf. pyramidata																3											
Silene sp.																											
Caryophyllaceae, indet.																											
Scirpus maritimus																	1			1	1				1		
Rumex sp.						1				1	1	1	5			5								1	1	2	
Rumex type																											
Polygonum/Carex																											
Eleocharis sp.												1															
Fimbristylis cf. annua																											
Cyperus cf. michelianus																											
Cyperaceae, indet.																											
Galium aparine (3 mm)																											
Galium aparine/spurium																											
Galium spurium type																											
Galium cf. parisiense																											
Asperula arvensis/orientalis																								1			
Asperula cf. orientalis																											
Asperula sp.																											
Sherardia arvensis																										1	
Rubiaceae, indet. (frags)																											
Rubiaceae, indet. (large/medium seeded)																											
Rubiaceae, indet. (small seeded)																									2		
Rubiaceae, indet. (mericarps)																											
Rubiaceae, indet. (fruit)																											
Salix sp.																											
Thymelaea sp.																						1					
Chenopodium murale																											

PLANT TAXA//ARCHBOT. SAMPLE NO	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
Chenopodium album																											
Chenopodiceae (indet.)																											
Ornithagalum/Muscari																2											
Bellevalia sp.																											
Asparagaceae (Liliaceae), indet.																											
Malva sp.												1	1			4				1				1			
Plantago cf. lagopus																											
Teucrium/Ajuga																							1				
Euphorbia falcata/maculata																											
Hypericum sp.																											
Alisma sp.																											
Verbena sp.																											
Anagallis sp.																											
Papaver spp.																											
Verbascum/Scrophularia												3															
Fumaria sp.																											
Cephalaria type																											
Ranunculus cf. Arvensis																3											
Nigella sp.																											
Adonis cf. annua																											
Capparis cf. spinosa																											
Lamiaceae, indet.																											
Solanaceae																											
TT-unidentified object 1 (Vitaceae?)																										1	
TT-unidentified object 2 (Anagallis?)																											
TT-unidentified object 3 (Saxifragaceae?)																											
TT-unidentified object 4 (Ziziphora?)																											
TT-unidentified object 5 (Rosaceae/Dryas type?)																											
TT-unidentified object 6 (Spergularia?)																											
TT-unidentified object 7 (Cuscuta?)																											
TT-unidentified object 8 (Matricaria?)																											
Flowering bud (indet.)																											
Chara (oogonia)																										2	
Insect remains																											
Mouse droppings																1											
TOTALS	10	4	6	4	14	21	28	9	12	24	8	46	21	7	8	351	7	8	25	3	17	18	7	18	26	45	6

(continued)

SEASON	2009	2008	2009	2009	2009	2009	2009	2010	2009	2009	2009	2009	2009	2009	2009	2011	2011	2011	2011	2011	2011	2009	2009	2009	2009	
FIELD	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	F5	E5	E5	E5	E5	E5	E5	G5	G5	G5	G5	
SQUARE	98	99	99	99	99	99	99	99	99	99	99	100	100	100	100	65	65	65	65	78	88	8	8	8	8	
LOCUS	26	18	18	18	18	26	35	36	37	39	52	11	12	12	12	11	11	11	13	10	13	8	8	12	12	
PAIL	87	57	78	87	90	184	108	117	118	122	181	29	32	31	33	37	50	51	65	35	28	51	45	54	54	
SA NUMBER	6009	4707	5802	5816	5826	6102	5857	5885	5886	5942	6012	5944	5950	5951	5952	9094	7542	7543	7519	7507	7500	6103	5979	6106	6107	
PERIOD	Iron III																									
FIELD 1 PHASES	(FIELD 5)																									
PLANT TAXA//ARCHBOT. SAMPLE NO	**190**	**191**	**192**	**193**	**194**	**195**	**196**	**197**	**198**	**199**	**200**	**201**	**202**	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**212**	**213**	**214**	**TOTALS**
Hordeum vulgare				2				1					5		31	1	4	3			1			1	1	**536**
Hordeum vulgare (rachis)																										**505**
Hordeum spontaneum																										**1**
Hordeum spp. (wild, >4mm)																										**38**
Hordeum spp. (frags., NISP)			1							1									2		1					**47**
Triticum spp. (fr. thres/gl.)	2				1	2				3	1			3	1	1		1	3		1					**492**
Triticum aestivum/durum				2		1		1	1	2	2	1	2	4	3	3	6	4	5		3	1		3	1	**606**
free-threshing wheat (spi. base common)						1			1							1									2	**207**
free-threshing wheat (spi. base robust type)																										**9**
Triticum dicoccum																										**207**
Triticum dicoccum (spikelet bases)									1																	**435**
Triticum dicoccum (glume bases)								1					1											1		**855**
Triticum monococcum																										**3**
Triticum monococcum/boeticum																										**12**
Lolium sp.	3		26	6	3	1	7	23	1	5	12	3	5	16	3	39	45	20	80	10	23	3	4	3	1	**3521**
Phalaris sp.	1		4				2	5	1		3	1	3		1	1	2	2	1		4	2	1			**1636**
Festuca-type								3											2							**38**
Avena type																										**5**
Bromus spp.																										**54**
Stipa type			1							1																**21**
Phleum cf. phleoides								1									1							2		**124**
Aeluropus cf. littoralis																										**53**
Alopecurus geniculatus type															1											**18**
Poa cf. trivialis																	1									**9**
Cynodon dactylon																										**26**
Agrostis canina type																										**9**
Echinaria capitata																										**1**
TT-unidentified Poaceae 2																										**40**
TT-unidentified Poaceae 4																										**8**
Poaceae, indet. (large)							1		1	2				3	8					2						**399**
Poaceae, indet. (medium)				2			5		3		4		4	1	4		3			3		3				**651**
Poaceae, indet. (small)									1																	**57**
Poaceae, embryo (indet.)				1					2						2			1					1			**191**
Poaceae, chaff (indet.)																										**41**
Poaceae, floret (indet.)																										**2**

PLANT TAXA//ARCHBOT. SAMPLE NO	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	TOTALS
Vicia/Lathyrus	1		2	1		1				1			2		1	2					1	3		3		**261**
Vicia ervilia											2		1	2										1		**118**
Vicia faba																										**5**
Lathyrus sativus/cicera					1													1			3	1				**64**
Lens culinaris					1											1				4	1			1	1	**162**
Pisum sativum																										**14**
Coronilla sp.			1						1					1			1									**172**
Scorpiurus sp.	1					1		1									1		1							**71**
Prosopis cf. farcta																					1					**109**
Securigera cf. securigeda			1											1			1									**89**
Securigera type																			1							**16**
Medicago sp.																		1						1		**30**
Medicago sp. (pod frags.)			1																							**2**
Melilotus/Trifolium	1		10	3		1	2	2	2		1	1	1			2	6	3	2		2			2	1	**1713**
Trifolium cf. alexandrium																										**20**
Trigonella foenum-graecum																										**5**
Trigonella sp.																										**21**
Astragalus sp.																										**5**
Fabaceae, indet (medium)										1																**42**
Fabaceae, indet (large)								1											1		2					**270**
Olea europaea				1		1	1				1	1									2			1	1	**112**
Vitis vinifera (pip)			1			1	2	2	1	1			2		2	1	2	1		1			1		1	**230**
Vitis vinifera (mineralised pip)																										**9**
Vitis vinifera (smaller pip)																										**8**
Vitis vinifera (skeletonized endosperm?)																										**6**
Vitis vinifera (stalk)														1												**109**
Vitis type (rudimentary)								1												1	2					**47**
Ficus carica				1			1	3	1							1			1							**135**
Ficus carica (mineralised)			1																							**30**
Linum sp.																										**14**
Linum usitatissimum																										**10**
Amygdalus sp.										1													1		1	**7**
Pistacia cf. lentiscus																										**3**
Geranium sp.																										**1**
Bupleurum sp.			2							1																**48**
Bupleurum subovatum (with testa)			2																							**43**
Torilis leptophylla																										**22**
Coriandrum sativum													1													**5**
Apiaceae, indet. fruit (underdeveloped)																										**14**
Apiaceae, indet. small-seeded						2																				**150**
Centaurea type																				1						**159**
Anthemis cotula											4															**445**
Cichorium sp.																										**36**
Artemisia sp.																										**2**

PLANT TAXA//ARCHBOT. SAMPLE NO	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	TOTALS
Picris hieracoides																										**36**
Picris echioides type																										**1**
Onopordum sp.																										**9**
Asteraceae, indet																										**36**
Heliotropium sp.																										**5**
Lithospermum arvense (carbonized)																										**27**
Lithospermum arvense (uncarbonized)																										**12**
Lithospermum tenuifolium																										**2**
Echium sp.																										**7**
Boraginaceae, indet.																										**1**
cf. Ochthodium aegyptiacum																				1						**16**
Lepidium sp.																										**4**
Brassica sp.																										**3**
TT-unidentified Brassicaceae 1																										**3**
Brassicaceae, indet.																										**11**
Valerianella dentata								1																		**18**
Valerianella coronata																										**6**
Vaccaria cf. pyramidata																										**32**
Silene sp.																										**64**
Caryophyllaceae, indet.																										**12**
Scirpus maritimus						1										1										**121**
Rumex sp.			1	1					1	2			1							1	6					**370**
Rumex type																										**11**
Polygonum/Carex																										**7**
Eleocharis sp.																										**19**
Fimbristylis cf. annua																										**18**
Cyperus cf. michelianus																										**1**
Cyperaceae, indet.																							1			**24**
Galium aparine (3 mm)										1																**9**
Galium aparine/spurium																										**48**
Galium spurium type																										**14**
Galium cf. parisiense																										**47**
Asperula arvensis/orientalis								1																		**104**
Asperula cf. orientalis																										**6**
Asperula sp.																										**8**
Sherardia arvensis											1															**21**
Rubiaceae, indet. (frags)																1										**90**
Rubiaceae, indet. (large/medium seeded)																										**10**
Rubiaceae, indet. (small seeded)																										**25**
Rubiaceae, indet. (mericarps)																										**16**
Rubiaceae, indet. (fruit)																										**7**
Salix sp.																										**3**
Thymelaea sp.									1		1															**165**
Chenopodium murale																										**57**

PLANT TAXA//ARCHBOT. SAMPLE NO	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	TOTALS
Chenopodium album																										**9**
Chenopodiceae (indet.)																										**17**
Ornithagalum/Muscari																										**17**
Bellevalia sp.													1													**2**
Asparagaceae (Liliaceae), indet.															1											**4**
Malva sp.											1										2	1				**86**
Plantago cf. lagopus																										**3**
Teucrium/Ajuga																										**3**
Euphorbia falcata/maculata																										**7**
Hypericum sp.																										**6**
Alisma sp.																										**6**
Verbena sp.																										**3**
Anagallis sp.																										**15**
Papaver spp.																										**17**
Verbascum/Scrophularia																		1								**32**
Fumaria sp.																										**4**
Cephalaria type						1																				**3**
Ranunculus cf. Arvensis										1																**12**
Nigella sp.																										**2**
Adonis cf. annua				1																						**8**
Capparis cf. spinosa																										**12**
Lamiaceae, indet.																										**1**
Solanaceae																										**1**
TT-unidentified object 1 (Vitaceae?)																										**7**
TT-unidentified object 2 (Anagallis?)																										**11**
TT-unidentified object 3 (Saxifragaceae?)																										**192**
TT-unidentified object 4 (Ziziphora?)																										**12**
TT-unidentified object 5 (Rosaceae/Dryas type?)							1																			**27**
TT-unidentified object 6 (Spergularia?)																										**23**
TT-unidentified object 7 (Cuscuta?)																										**37**
TT-unidentified object 8 (Matricaria?)																										**9**
Flowering bud (indet.)																										**34**
Chara (oogonia)	1					2			14															4		**27**
Insect remains																										**11**
Mouse droppings																										**44**
TOTALS	10		54	21	6	16	22	47	33	23	33	7	29	32	58	55	73	38	99	24	55	14	9	23	10	**17901**

(end)

APPENDIX A.2 TELL TAYINAT and TELL ATCHANA MACROBOTANICAL DATA AS COUNTS (CHAPTER 6)

ABSOLUTE COUNTS	PERIOD	EBA	EBA	EBA	LBA	LBA	IRON	IRON	IRON	TOTAL COUNTS
	n	21	12	30	54	59	39	22	6	
	Site	T	T	T	A	A	T	T	T	
	Level/Phases	TAY_P9-8a	TAY_8b	TAY_7	ALA_L5-4	ALA_L3-2	TAY_P6	TAY_P5	TAY_P4-3	
plant name	codes									
Adonis sp.	ADONIS		2	4		3	1			10
Aeluropus cf. littoralis	AELUROP	2		22			14	11	1	50
Agrostis sp.	AGROSTI	3		2			3	1		9
Aliaria sp.	ALIARIA				1					1
Alisma sp.	ALISMA			1		1	4	1		7
Alopecurus sp.	ALOPECU					13	16			29
Anagallis sp.	ANAGASP	1	2	5	1		6		1	16
Anthemis (Anthemis cotula)	ANTHEM	65	26	137	9		151	24	36	448
Artemisia sp.	ARTEMSP					3		2		5
Asperula sp.	ASPERULA	14	24	55						93
Asteraceae, indet	ASTREIN	13	2	11		5	7	1	2	41
Astragalus sp.	ASTRSPE	1			1				4	6
Avena sp.	AVENSPE	2		1	9			2		14
Beta sp.	BETASPE					1				1
Boraginaceae indeterminate	BORAIND	1				1				2
Brassica sp.	BRASSSP								3	3
Brassicaceae indet.	BRASSIN			4	7		1			12
Bromus sp.	BROMSPE	10	14	15	28	11	3	11	1	93
Buglossoides arvensis/tenuifolium	BUGLARV	8	6	17	18	5	4	1	5	64
Bupleurum sp.	BUPLESP	11	10	21		12	37	1	1	93
Capparis cf. spinosa	CAPPSPI						12			12
Carex sp.	CARESPE				2	4				6
Centaurea sp. L.	CENTSPE	7	5	13		2	129	1	1	158
Cephalaria type	CEPHALA						2			2
cf. Cuscuta (small-seeded)	CUSCUTA						32	1		33
cf. Ziziphora	ZIZIPHO						4			4
Chara sp.	CHARSPE	1			1		3			5
Chenopodiceae (indet.)	CHENOIN			1			8		8	17
Chenopodium album	CHENOAL			1			7			8
Chenopodium murale	CHENOMU		2	2			49	2	1	56
Cichorium sp.	CICHOSP	5		1			19		9	34
Coriandrum sativum	CORIASAT								4	4
Coronilla sp.	COROSPE	36	20	90	1521		13		2	1682
Cynodon dactylon	CYNODAC	5	4	4			11	1	1	26
Cyperaceae indet.	CYPEIND	1	4	1	15	13	17			51
Echinaria capitata	ECHINCA								1	1
Echium L. sp.	ECHISPE				15		7			22
Eleocharis sp.	ELEOCSP	3		5	1		4	3	2	18
Euphorbia falcata/maculata	EUPHFAL	2	1	1			2	1		7
Festuca-type	FESTUSP	7	8	10			8			33
Fimbristylis sp.	FIMBSPE			2			13	1	2	18
Fragaria vesca	FRAGARI				6					6
Fumaria sp.	FUMASPE	1				1		2		4
Galium aparine	GALAPAR				48	2				50
Galium aparine/spurium	GALAPSP	19	15	26	38	16	8		2	124

Galium cf. parisiense	GALPARI	9	9	2			26	1		47
Galium/Asperula sp.	ASPEGAL				36	11	21	2		70
Geranium sp.	GERANIS						1			1
Heliotropium L. sp.	HELOSPE	1		2	17	45	2			67
Hippocrepis sp.	HIPPSPE				35					35
Hordeum sp. (wild)	HORDSPW	9	6	15	4	2	34	8	4	82
Hypericum sp.	HYPERSP	3		1			1		1	6
Lepidium sp.	LEPIDSP						3		1	4
Linum sp.	LINUSPE				13	1				14
Lolium spp.	LOLISPE	476	315	1141	901	324	336	115	322	3930
Malva sp.	MALVSPE	1	1	8	2	4	62	1	1	80
Malvaceae indet.	MALVIND				5	2				7
Medicago sp.	MEDISPE	6	4	4	241	8	1		7	271
Melilotus/Medicago	MELIMED					5				5
Melilotus/Trifolium	MELITRI	392	204	580	575	152	257	117	55	2332
Nigella arvensis/damasceana	NIGELDA	1					1			2
Ochthodium cf. aegyptiacum	OCHTHAE			1			5	1	6	13
Onopordum sp.	ONOPOSP		1	2					6	9
Ornithagalum/Muscari	ORNIMUS		3	3			6		2	14
Papaver spp.	PAPASPP	13		2			1		1	17
Phalaris sp.	PHALSPE	196	127	333	245	132	744	87	65	1929
Phleum sp.	PHLESPE	9	3	12	204	1	89	1	6	325
Phleum/Alopecurus	PHLEALO				9					9
Picris echioides type	PICRIEC							1		1
Picris hieracoides	PICRIHI	1	1	3			26	4		35
Pinus sp.	PINUSPE				1					1
Pistacia cf. lentiscus	PISTALE						1			1
Plantago sp.	PLANSPE	1		1	30	2	1			35
Poa sp.	POATRIV						8			8
Polygonaceae indet.	POLYIND						2	1	1	4
Polygonum aviculare type	POLYATY				6	2				8
Polygonum sp.	POLYSPE				24	14				38
Polygonum/Rumex sp.	POLYRUM					5				5
Prosopis cf. farcta	PROSOFA	34	10	57	18	1	2	1		123
Ranunculus arvensis	RANUNCA				13					13
Ranunculus sp.	RANUNSP	2	1	4	1		1			9
Rumex sp.	RUMESPE	19	13	78	684	11	144	16	74	1039
Salix sp.	SALIXSP	1					2			3
Salsola sp.	SALSSPE					2				2
Scirpus maritimus	SCIRPMA	8	2	41	2	1	37	18	10	119
Scorpiurus sp.	SCORSPE	18	8	28	13	4	7	2	1	81
Securigera securigeda	SECURSE	22	19	56	130	1	2	1		231
Sherardia arvensis L.	SHERARV	1	4	9	36	10	4			64
Silene sp.	SILESPE	13	7	35	2	31	4	2	1	95
Stipa type	STIPASP	1	5	11			1		1	19
Teucrium/Ajuga	TEUCAJU						2			2
Thymelaea sp.	THYMSPE	34	26	80	532	2	19	4	1	698
Torilis leptophylla	TORILEP	3		1			18			22
Trifolium cf. alexandrium	TRIFOAL	6	3	2			4	1	4	20
Trigonella sp.	TRIGOSP	3	3	13			1			20
Triticum monococcum/boeticum	TRITIMBO							7		7
Vaccaria cf. pyramidata	VACCAPY	2	3	5			19			29
Valerianella dentata/coronata	VALEDENC	4	3	8	6	15	6		2	44
Verbascum/Scrophularia	VERBSCR	3		5			14	6		28
Verbena sp.	VERBEHA	2					1			3
		1512	926	2995	5620	980	2550	487	669	10306

APPENDIX B.1 PRESENCE/ABSENCE DATA OF SELECTED CROPS IN THE NEAR EAST (CHAPTER 6)

Location	Sitenames	Dates	Sample amount	Hordeum vulgare	Free threshing wheat	Triticum dicoccum	Triticum monococcum	Triticum sp. (fr thr/gl wheat)	Cicer arietinum L.	Lathyrus cicera/sativus	Lens culinaris Medik.	Pisum sativum L.	Vicia ervilia (L.) Willd.	Vicia faba L.	Vicia/Lathyrus	Linum usitatissimum	Vitis vinifera L.	Ficus carica L.	Olea europaea L.	Punica granatum L.
Northern	Tel Rifaat	IRON	2	X																
Northern	Ain Dara	IRON	35	X	X						X						X	X		X
Northern	Tell Tayinat	IRON	72	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	
Northern	Hazrek of Luhuti	IRON	46	X	X	X	X	X		X	X	X	X				X		X	
Northern	Qarqar	IRON	23	X	X	X	X			X	X		X		X	X	X			
N. Mesopotamia	Tell Halaf	IRON	7	X	X	X	X	X	X		X		X		X		X	X		
N. Mesopotamia	Shioukh Fawqani	IRON	6	X	X	X							X			X	X	X		
N. Mesopotamia	Tell Schech Hamad	IRON	15	X						X		X					X			
Central	Tell Mishrifeh	IRON	6	X			X	X			X		X				X		X	
Central	Tell Nebi Mend	IRON	4	X	X	X		X		X	X		X		X		X			
Central	Kamid, Kumidi	IRON	3	X	X				X	X	X		X				X			
Central	Sidon	IRON	7	X	X	X			X		X			X			X	X	X	
Southern	Tell Kēsān	IRON	1	X	X	X							X							
Southern	Kinneret	IRON	?	X	X	X	X				X		X				X	X	X	
Southern	Tệl Hadar	IRON	2	X	X								X			X				
Southern	Jokneam	IRON	8					X											X	
Southern	Afula	IRON	1						X				X	X					X	
Southern	Megiddo	IRON	58	X		X		X			X		X	X			X	X	X	
Southern	Beth Shean	IRON	7	X	X											X			X	
Southern	Pella	IRON	14			X			X		X	X	X			X	X		X	X
Southern	Deir Alla	IRON	6	X	X	X			X		X	X	X			X	X			X
Southern	Tell el-Qasīle	IRON	9	X		X				X	X			X		X	X	X		
Southern	Tell el-Ifshar	IRON	9	X	X	X					X		X	X						
Southern	Tell Aphek	IRON	5	X	X	X					X		X	X		X	X	X		X
Southern	Shiloh	IRON	8	X	X						X		X	X		X	X	X	X	
Southern	Jaffa	IRON	113	X	X	X			X	X	X	X	X	X			X	X	X	X

Southern	Tall al-Umayri	IRON	1	X				X			X						X	X		
Southern	Heschbon	IRON	6	X	X						X						X			
Southern	Timnah, Têl Bāṭāš	IRON	4																X	
Southern	Tell es-Safi, Gath	IRON	6	X	X	X					X		X	X			X	X	X	
Southern	Lachish	IRON	23					X									X		X	
Southern	Dibon	IRON	158	X	X												X	X		
Southern	Tell el-Ḫuwēlfe	IRON	92	X							X	X					X		X	
Southern	Qubur al-Walaydah	IRON	84	X	X	X	X				X						X		X	
Southern	Tell el-Fārʿa (Süd)	IRON	58	X	X	X					X		X				X	X	X	
Southern	Ḫirbet el-Mšāš	IRON	62	X				X									X			

Location	Sitenames	Dates	Sample amount	Hordeum vulgare	Free threshing wheat	Triticum dicoccum	Triticum monococcum	Triticum sp. (fr thr/gl wheat)	Cicer arietinum L.	Lathyrus cicera/sativus	Lens culinaris Medik.	Pisum sativum L.	Vicia ervilia (L.) Willd.	Vicia faba L.	Vicia/Lathyrus	Linum usitatissimum	Vitis vinifera L.	Ficus carica L.	Olea europaea L.	Punica granatum L.
Northern	Kinet Höyük	LBA	37	X	X	X		X	X		X		X	X	X		X	X	X	x
Northern	Alalakh, Alalaḫ, Tell Atchana	LBA	82	X	X	X		X	X	X	X		X	X	X	X	X	X	X	
Northern	Hazrek of Luhuti	LBA	13	X	X	X	X	X		X	X		X	X			X		X	
N. Mesopotamia	Shiouk Fawgani	LBA	18	X	X	X				X			X					X		
N. Mesopotamia	Tell Hadidi	LBA	46	X	X							X					X	X	X	
N. Mesopotamia	Tell Munbaqa, Ekalte, Mumbaqat	LBA	22	X	X	X					X				X				X	
N. Mesopotamia	Umm el-Marra	LBA	12	X	X			X		X	X						X	X		
N. Mesopotamia	Meskene Qadime	LBA	15	X													X	X	X	
Central	Tell Mishrifeh	LBA	38	X	X	X		X					X		X		X	X	X	
Central	Tell Nebi Mend	LBA	1	X		X				X							X			
Central	Kamid, Kumidi	LBA	2	X	X				X	X	X		X				X			
Central	Sidon	LBA	6	X		X			X		X	X					X		X	
Southern	Megiddo	LBA	17					X											X	
Southern	Beth Shean	LBA	5	X	X	X										X	X		X	
Southern	Pella	LBA	5	X		X			X		X		X	X			X			
Southern	Tell Abu al-Kharaz, Tell Abu el-Kharaz	LBA	1	X		X	X							X			X			
Southern	Tell el-Ifshar	LBA	6		X								X				X			
Southern	Tell Aphek	LBA	8	X	X	X					X		X	X		X	X	X	X	

Southern	Tall al-Umayri	LBA	4	X	X	X			X	X	X	X	X				X	X		
Southern	Timnah	LBA	24	X	X	X				X	X		X	X			X	X	X	
Southern	Ashdod	LBA	20	X									X	X			X			
Southern	Tel Miqne, Ḫirbet el-Muqannaʿ, Tệl Miqnệ	LBA	1							X										
Southern	Tel Burna	LBA	40	X						X	X		X				X	X	X	
Southern	Lachish	LBA	348	X				X									X		X	
Southern	Deir el-Balah	LBA	4	X	X															
Southern	Qubur al-Walaydah	LBA	11	X	X	X	X				X						X			

APPENDIX B.2 PRESENCE/ABSENCE DATA OF SELECTED CROPS IN THE NEAR EAST (CHAPTER 7)

Time Interval			1200-900 BCE														900-500 BCE														500-0 BCE													
Crop taxa			Hordeum vulgare/distichum	Triticum sp. (free-threshing tetraploid/hexaploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea
Total number of occurrences in each period			15	16	8	11	5	4	15	5	6	7	1	14	5	10	44	39	21	31	13	8	22	15	8	11	1	34	16	23	18	15	8	9	7	6	9	5	2	3	2	9	6	8
Total number of samples in each period			21	21	21	21	21	21	21	21	21	21	21	21	21	21	53	53	53	53	53	53	53	53	53	53	53	53	53	53	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Ubiquity Scores (%)			**71**	**76.2**	**38**	**52**	**24**	**19**	**71**	**24**	**29**	**33**	**5**	**67**	**24**	**48**	**83**	**73.6**	**40**	**58**	**25**	**15**	**42**	**28**	**15**	**21**	**2**	**64**	**30**	**43**	**86**	**71.43**	**38**	**43**	**33**	**29**	**43**	**24**	**10**	**14**	**10**	**43**	**29**	**38**
W Iran	Tepe Yahya	4800 BC / 300 BC															x														x		x	x						x				
W Iran	Konar Sandal	3200 BC / 500 BC															x								x																			
W Iran	Bastam	840 BC / 1500 AD															x	x		x	x	x			x			x																
W Iran	Nush-i Jan	750 BC / 50 AD															x	x		x			x					x			x		x											
W Iran	Qal'eh Ismail Aqa	800 BC / 1750 AD																x	x	x																								
W Iran	Susa, Ville Royale	1100 BC / 224 AD															x	x													x	x												
W Iran	Tahirbaj Tepe	1000 BC / 500 BC															x																											
W Iran	Tappeh Gijlar	5200 BC / 539 BC																x										x																
W Iran	Tepe Sialk	6400 BC / 535 BC															x	x	x				x					x																
S Mesopotamia	Larsa	238 BC / 224 AD																													x	x												
N Mesopotamia	Tell Hadidi	3400 BC / 1516 AD																													x	x		x		x	x					x	x	
N Mesopotamia	Tell Shiukh Fawqani	4800 BC / 1750 AD	x	x	x				x			x		x			x	x	x	x	x	x	x					x		x	x	x												
N Mesopotamia	Tell Halaf	1000 BC / 500 BC															x	x		x	x			x				x	x															
N Mesopotamia	Mahmudiya	400 BC/200 AD																													x			x								x		
N Mesopotamia	Nimrud	1200-600 BC	x											x			x	x	x	x	x					x		x	x	x	x	x												
N Mesopotamia	Tell Schech Hamad	1392 BC / 700 BC	x					x			x			x			x	x		x			x	x	x			x	x															
N Mesopotamia	Kenan Tepe	1200-900 BC	x			x			x					x																														
N Mesopotamia	Ziyaret Tepe	900-600 BC															x	x	x	x	x	x	x	x	x	x		x	x															
S Levant	Abi'or cave	60 BC / 400 AD																													x		x					x			x			x
S Levant	Ashkelon	900-600 BC															x	x	x	x	x		x					x	x	x														
S Levant	'Afula	3200 BC / 500 BC																			x		x	x						x														
S Levant	Beth Shean	3200 BC / 1200 AD	x	x								x					x	x	x	x										x														

		Time Interval	1200-900 BCE														900-500 BCE														500-0 BCE													
		Crop taxa	Hordeum vulgare/distichum	Triticum sp. (free-threshing tetraploid/hexaploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea
S Levant	Bethsaida	980 BC / 840 BC																																										
S Levant	Horbat Rosh Zayit	1000 BC / 500 BC															x	x	x					x				x																
S Levant	Khirbet er-Rasm	918 BC / 535 BC															x			x								x		x														
S Levant	Kuntillet 'Ajrud	918 BC / 535 BC															x													x														
S Levant	Megiddo	3200 BC / 500 BC		x		x			x	x					x	x	x													x														
S Levant	Nahal Yattir	60 BC / 400 AD																													x	x	x				x							
S Levant	Shiloh	1600 BC / 500 BC															x	x		x			x	x		x		x	x	x														
S Levant	Tel Kedesh	980 BC / 840 BC															x						x					x	x	x														
S Levant	Tel Kinrot	3200 BC / 840 BC	x	x	x	x			x					x	x	x														x														
S Levant	Tel Malhat	918 BC / 535 BC																					x					x		x														
S Levant	Tell Aphek	3200 BC / 840 BC	x	x	x	x			x			x	x	x	x	x	x	x	x	x			x	x		x		x	x	x														
S Levant	Tell el Ifshar	3200 BC / 1100 AD															x	x	x	x			x	x																				
S Levant	Tell el-Hesi	400 BC / 1516 AD																													x		x	x	x	x	x	x		x		x		x
S Levant	Tell el-Mazar II	1000 BC / 500 BC															x	x		x						x	x	x				x						x		x				
S Levant	Tell Hadar	1150 BC / 980 BC		x					x			x																																
S Levant	Tell Halif	5200 BC / 1516 AD															x			x		x						x		x														
S Levant	Tell Keisan	1000 BC / 500 BC															x	x	x				x																					
S Levant	Tell Qasile	1000 BC / 500 BC																	x	x				x		x		x																
S Levant	Tell Yoqneam	1800 BC / 840 BC														x														x														
S Levant	Timnah (Tel Batash) III	1700 BC / 400 BC														x	x	x		x								x		x														x
S Levant	Deir'Alla	1500 BC / 500 BC															x	x	x	x	x	x	x	x	x	x		x	x	x														
S Levant	Dhiban	1000 BC / 500 BC															x	x										x	x															
S Levant	Pella	1600 BC / 900 BC		x			x	x	x			x		x		x																												
S Levant	Tell Abu al-Kharaz	3200 BC / 500 BC															x																											

		Time Interval	1200-900 BCE														900-500 BCE														500-0 BCE													
		Crop taxa	Hordeum vulgare/distichum	Triticum sp. (free-threshing tetraploid/hexaploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea	Hordeum vulgare/distichum	Triticum sp. (free-threshing hexaploid/tetraploid)	Triticum dicoccum	Lens culinaris	Cicer arietinum	Pisum sativum	Vicia ervilia	Vicia faba	Lathyrus sativus	Linum usitatissimum	Pistacia atlantica/palaestina	Vitis vinifera	Ficus carica	Olea europaea
S Levant	Tell Hesban	1000 BC / 1750 AD															x	x		x								x			x	x		x			x		x			x		x
S Levant	Udhruh	1000 BC / 400 AD																													x	x	x								x	x	x	x
S Levant	Lachish	3200 BC / 500 BC																x	x		x			x		x		x	x	x														
S Levant	Petra	500 BC/500 AD																													x	x		x	x	x	x	x				x	x	x
N Levant	Kamid el-Loz	1800 BC / 900 BC	x	x		x	x		x		x			x																														
N Levant	Sidon	2400 BC / 535 BC		x	x	x	x			x				x		x		x	x		x			x				x	x	x														
N Levant	Kinet Höyük	1800 BC / 1500 AD															x	x	x				x	x		x		x	x		x	x												
N Levant	'Ain Dara	1000 BC / 500 BC															x	x		x								x	x															
N Levant	Tell Afis	4800 BC / 500 BC	x	x	x	x		x	x	x	x			x		x	x	x	x	x			x		x			x		x														
N Levant	Tell Mishrifeh	3200 BC / 500 BC															x	x		x			x					x		x														
N Levant	(Kadesh)	3200 BC / 500 BC	x	x					x		x			x			x	x	x	x					x			x																
N Levant	Tell Qarqur	2350 BC / 1100 AD	x	x	x	x			x		x																																	
N Levant	Zincirli	900-600 BC															x	x		x	x	x	x	x	x			x	x	x														
N Levant	Tell Tayinat	1200-600 BC	x	x	x	x		x	x	x		x		x	x	x	x	x	x	x		x	x			x		x	x	x														
C Anatolia	Çadir Höyük	5200 BC / 1100 AD															x	x		x	x	x		x							x	x	x	x		x	x							
C Anatolia	Kusakli	1800 BC / 500 BC	x	x	x	x			x		x						x	x		x																								
C Anatolia	Kaman-Kalehöyük	3200 BC / 1923 AD	x	x			x		x					x			x	x		x			x			x		x																
C Anatolia	Kerkenes	900-600 BC															x	x	x																									
E Anatolia	Asvan Kale (Asvan)	2800 BC / 1900 AD																													x	x		x	x	x	x					x		
E Anatolia	Patnos	1500 BC / 1200 BC															x	x	x	x			x																					
E Anatolia	Yoncatepe (Van)	1000 BC / 400 AD															x	x		x	x		x					x																
E Anatolia	Ayanis	900-700 BC															x	x																										
W Anatolia	Serce Limani	400 BC / 1500 AD																																								x	x	x
W Anatolia	Miletos	700 BC / 400 BC																														x		x			x		x				x	x
W Anatolia	Troia	3200 BC / 323 BC	x	x		x	x		x	x		x		x	x	x															x	x	x			x	x	x				x	x	

APPENDIX B.3 PRESENCE/ABSENCE DATA OF SELECTED CROPS IN THE NEAR EAST (CHAPTER 7)

	Time Interval	1200-900 BCE																		900-500 BCE																		500-0 BCE																		
	Plant taxa	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Amni majus	Trigonella foenum graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Amni majus	Trigonella foeunm-graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Amni majus	Trigonella foenum-graecum	Coriandrum sativum	Prunus	Prunus armenica	Prunus persica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix dactylifera	Ceratonia siliqua	Juglans regia
W Iran	Tepe Yahya																			X																		X																		
W Iran	Konar Sandal																																		X																					
W Iran	Bastam																						X							X		X																								
W Iran	Nush-i Jan																																																							
W Iran	Qal'eh Ismail Aqa																																																							
W Iran	Susa, Ville Royale																															X			X					X											X			X		
W Iran	Tahirbaj Tepe																			X																																				
W Iran	Tappeh Gijlar																																																							
W Iran	Tepe Sialk																																																							
S Mesopotamia	Larsa																																											X		X								X		
N Mesopotamia	Tell Hadidi																																																							
N Mesopotamia	Tell Shiukh Fawqani																															X	X																		X	X				
N Mesopotamia	Tell Halaf																											X																												
N Mesopotamia	Mahmudiya																																																					X		
N Mesopotamia	Nimrud																														X			X	X																					
N Mesopotamia	Tell Schech Hamad	X																		X	X		X						X					X																						
N Mesopotamia	Kenan Tepe																																																							
N Mesopotamia	Ziyaret Tepe																																																							
S Levant	Abi'or cave																																																			X	X	X	X
S Levant	Ashkelon																															X		X		X																				
S Levant	'Afula																																																							
S Levant	Beth Shean																																																							

	Time Interval	1200-900 BCE																		900-500 BCE																		500-0 BCE																		
	Plant taxa	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foenum graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foenum-graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foenum-graecum	Coriandrum sativum	Prunus	Prunus armenica	Prunus persica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix dactylifera	Ceratonia siliqua	Juglans regia
S Levant	Bethsaida																																																							
S Levant	Horbat Rosh Zayit																																																							
S Levant	Khirbet er-Rasm																																																							
S Levant	Kuntillet 'Ajrud																														x		x	x																					
S Levant	Megiddo												x																																										
S Levant	Nahal Yattir																																																							
S Levant	Shiloh																																																							
S Levant	Tel Kedesh																																																							
S Levant	Tel Kinrot																																																							
S Levant	Tel Malhat																																	x																					
S Levant	Tell Aphek						x	x	x							x																																							
S Levant	Tell el Ifshar																																																							
S Levant	Tell el-Hesi																																																							
S Levant	Tell el-Mazar II																																																							
S Levant	Tell Hadar																																																							
S Levant	Tell Halif																																x																						
S Levant	Tell Keisan																																																							
S Levant	Tell Qasile																											x																												
S Levant	Tell Yoqneam																																																							
S Levant	Timnah (Tel Batash) III																									x																														
S Levant	Deir'Alla																						x	x		x	x				x		x																						
S Levant	Dhiban																																																							
S Levant	Pella												x		x	x																																								
S Levant	Tell Abu al-Kharaz																																																							
S Levant	Tell Hesban																																																							
S Levant	Udhruh																																																							
S Levant	Lachish																									x							x																							
S Levant	Petra																																														x	x					x		x

	Time Interval	1200-900 BCE																		900-500 BCE																		500-0 BCE																		
	Plant taxa	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foenum graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foeunm-graecum	Coriandrum sativum	Prunus sp.	Prunus armenica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix cf. dactylifera	Ceratonia siliqua	Juglans regia	Panicum miliaceum	Setaria italica	Oryza sp.	Sesamum indicum	Sesamum orientale	Cuminum cyminum	Ammi majus	Trigonella foenum-graecum	Coriandrum sativum	Prunus	Prunus armenica	Prunus persica	Corylus avellana	Amygdalus cf. communis	Pyrus/Malus	Punica granatum	Phoenix dactylifera	Ceratonia siliqua	Juglans regia
N Levant	Kamid el-Loz																																																							
N Levant	Sidon																																																							
N Levant	Kinet Höyük																			x														x																						
N Levant	'Ain Dara																																	x																						
N Levant	Tell Afis																																																							
N Levant	Tell Mishrifeh																																																							
N Levant	Tell Nebi Mend (Kadesh)																																																							
N Levant	Tell Qarqur																																																							
N Levant	Zincirli																															x	x																							
N Levant	Tell Tayinat								x	x																		x				x																								
C Anatolia	Çadir Höyük																																																							
C Anatolia	Kusakli		x																																																					
C Anatolia	Kaman-Kalehöyük																																																							
C Anatolia	Kerkenes																																																							
E Anatolia	Asvan Kale (Asvan)																																					x	x								x									
E Anatolia	Patnos																																																							
E Anatolia	Yoncatepe (Van)																																																							
E Anatolia	Ayanis																			x	x							x																												
W Anatolia	Serce Limani																																													x	x						x			
W Anatolia	Miletos																																					x												x	x		x			
W Anatolia	Troia	x													x																																									

APPENDIX C.1 ABSOLUTE COUNTS OF BOTANICAL REMAINS ACCORDING TO TAXA CLASSIFICATION(CHAPTER 8)

SEASON	2009	2009	2011	2009	2009	2009	2009	2009	2009	2009	2009	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2011	2011	2009	2008	2008	2009	2008	2008
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	28	28	28	28	28	28	28	28	28	28	28	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	39	48	48	48	48	48
LOCUS	2	2	2	4	4	4	4	4	4	4	26	2	2	2	2	3	4	4	4	4	7	7	7	13	22	8	4	11	11	11	11	11
PAIL	5	27	7	8	55	8	38	39	40	56	78	82	87	12	18	13	14	15	15	27	16	16	17	91	101	100	6	67	109	109	35	42
SAMPLE NUMBER	**5797**	**5310**	**7373**	**5803**	**6687**	**5804**	**5966**	**5972**	**5981**	**6001**	**6113**	**4774**	**4776**	**4322**	**4314**	**4306**	**4328**	**4341**	**4346**	**4349**	**4330**	**4340**	**4356**	**4869**	**7358**	**7353**	**5967**	**4713**	**5876**	**5877**	**4327**	**4357**
FIELD 2 PHASES	*2a*																															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Hordeum vulgare											1																					
Hordeum vulgare (rachis)																																
Hordeum spontaneum																																
Hordeum spp. (wild, >4mm)																																
Hordeum spp. (frags., NISP)																																
Triticum spp. (fr. thres/gl.)																		1			8											
Triticum aestivum/durum																					15		1			13						
Free-threshing wheat (spi. base)																																
Triticum monococcum/boeticum																																
Lolium spp.											1				1																	
Phalaris spp.											2			1			1				1											
Phleum cf. phleoides																																
Aeluropus cf. littoralis																																
Poa cf. trivialis																																
Poaceae, indet. (large)																	1	2			3				6	66				1		
Poaceae, indet. (medium)																		1	1		6											
Poaceae, indet. (small)																														2		
Vicia ervilia																								12						1		1
Lathyrus sativus/cicera																																
Lens culinaris																																
Coronilla sp.																																
Scorpiurus sp.																																
Securigera cf. securigeda																																
Medicago sp.																		1					1									
Melilotus/Trifolium														2				1						1								
Fabaceae, indet (medium)																															1	
Fabaceae, indet (large)																													1			
Olea europaea		1										1	1																			
Vitis vinifera (pip)														1																		
Vitis vinifera (berry)																																
Vitis vinifera (stalk)																																
Ficus carica								1																								

Linum usitatissimum											3																					
Bupleurum sp.																																
Bupleurum subovatum (seed with testa)																																
Torilis leptophylla																																
Asteraceae, indet														1																		
Brassicaceae, indet.																																
Vaccaria cf. pyramida																																
Scirpus maritimus																																
Rumex sp.											1																				1	
Cyperaceae, indet.																							1									
Galium spurium type																																
Sherardia arvensis																															1	
Rubiaceae, indet. (frags)																																
Rubiaceae, indet. (large/medium seeded)																																
Rubiaceae, indet. (small seeded)																																
Thymelaea sp.														1																		
Chenopodium murale																																
Malva sp.																																
Euphorbia sp.																																
Anagallis sp.																									1							
Papaver spp.																																
Verbascum/Scrophularia																																
Cephalaria type																																
Ranunculus sp.																																
Ranunculus cf. arvense																																
Adonis cf. annua																																
TT-unidentified object 2 (Anagallis?)																																
TT-unidentified object 5 (Rosaceae/Dryas type?)																																
TT-unidentified object 6 (Spergularia?)																																

(continuesbelow)

SEASON	2009	2009	N/A	2009	2009	2009	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009	2009	2009	2009	2011	2009	2009	2009	2009
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G5	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	28	28	28	28	37	37	38	38	38	38	38	48	28	28	28	28	28	28	28	28	29	37	37	37
LOCUS	22	22	22	30	15	15	5	9	9	9	9	12	6	6	6	6	8	8	8	8	2	6	7	7
PAIL	68	71	76	79	53	53	42	38	61	23	44	78	11	23	23	23	22	24	36	100	2	17	37	37
SAMPLE NUMBER	**6014**	**6109**	**N/A**	**6121**	**5992**	**5991**	**4653**	**4648**	**4682**	**4623**	**4626**	**5796**	**5812**	**5305**	**5306**	**5861**	**5863**	**5862**	**5961**	**7380**	**5891**	**5808**	**5865**	**5864**
FIELD 2 PHASES	*2b*												*2c*											
	33	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
Hordeum vulgare							1							1					1					
Hordeum vulgare (rachis)																								
Hordeum spontaneum																								
Hordeum spp. (wild, >4mm)																								
Hordeum spp. (frags., NISP)																								
Triticum spp. (fr. thres/gl.)																								
Triticum aestivum/durum							1								1									
Free-threshing wheat (spi. base)																								
Triticum monococcum/boeticum																								
Lolium spp.							2						4			1		2	4			1		2
Phalaris spp.							1									1							1	
Phleum cf. phleoides																								
Aeluropus cf. littoralis																								
Poa cf. trivialis																								
Poaceae, indet. (large)													2			1						1		
Poaceae, indet. (medium)																			2					
Poaceae, indet. (small)																								
Vicia ervilia	1																	1					1	
Lathyrus sativus/cicera																								
Lens culinaris																								
Coronilla sp.																								
Scorpiurus sp.																								
Securigera cf. securigeda																								
Medicago sp.																								
Melilotus/Trifolium													1					1	2				1	
Fabaceae, indet (medium)																						1		
Fabaceae, indet (large)																								
Olea europaea													1						1				2	1
Vitis vinifera (pip)													1			1							1	
Vitis vinifera (berry)																								
Vitis vinifera (stalk)																							1	
Ficus carica							1			1														
Linum usitatissimum																								
Bupleurum sp.																							1	
Bupleurum subovatum (seed with testa)																								
Torilis leptophylla																								
Asteraceae, indet																								
Brassicaceae, indet.																								
Vaccaria cf. pyramida																								
Scirpus maritimus	2		1							1														1
Rumex sp.																1								

FIELD 2 PHASES	*2b*												*2c*											
	33	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
Cyperaceae, indet.																								
Galium spurium type																								
Sherardia arvensis																								
Rubiaceae, indet. (frags)																								
Rubiaceae, indet. (large/medium seeded)																								
Rubiaceae, indet. (small seeded)													1						1					
Thymelaea sp.																								
Chenopodium murale																								
Malva sp.																								
Euphorbia sp.																								
Anagallis sp.																								
Papaver spp.																								
Verbascum/Scrophularia																								
Cephalaria type																								
Ranunculus sp.																								
Ranunculus cf. arvense																								
Adonis cf. annua																								
TT-unidentified object 2 (Anagallis?)																								
TT-unidentified object 5 (Rosaceae/Dryas type?)																								
TT-unidentified object 6 (Spergularia?)																								

(continues below)

SEASON	2009	2009	2009	2009	2008	2008	2009	2009	2009	2011	2009	2009	2009	2009	2009	2009	2009	2009	2011	2011
FIELD	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4	G4
SQUARE	37	37	37	37	38	48	48	28	28	28	48	28	37	37	37	37	37	37	38	38
LOCUS	7	7	7	7	11	5	22	14	14	14	20	9	9	9	9	9	9	9	21	21
PAIL	19	43	42	21	93	17	112	35	34	111	116	54	45	45	45	45	45	47	111	109
SAMPLE NUMBER	**5805**	**5945**	**5312**	**5813**	**4779**	**4627**	**5983**	**5954**	**5953**	**7382**	**6098**	**6002**	**5828**	**5829**	**5830**	**5831**	**5832**	**5833**	**7351**	**7349**
FIELD 2 PHASES	*2c*							*2d*				*2e*								
	57	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**
Hordeum vulgare	1			1		1							1	1		2	6	1	1	
Hordeum vulgare (rachis)															1					
Hordeum spontaneum																	1			
Hordeum spp. (wild, >4mm)	1			1																
Hordeum spp. (frags., NISP)																1				
Triticum spp. (fr. thres/gl.)	2			1											2	1	3	2		
Triticum aestivum/durum	2															4	4		2	
Free-threshing wheat (spi. base)													1							
Triticum monococcum/boeticum																	1		1	
Lolium spp.	5	1		13		1	1			1	4		5	4	7	15	92	31	1	
Phalaris spp.		2		3							1		2	3	2	2	17	7		
Phleum cf. phleoides				3												2	10	1		
Aeluropus cf. littoralis																1				
Poa cf. trivialis																1	2	2		
Poaceae, indet. (large)											3			1		2				
Poaceae, indet. (medium)	2													5	3				2	
Poaceae, indet. (small)																3		2		
Vicia ervilia											2									
Lathyrus sativus/cicera															1					
Lens culinaris				1													1			
Coronilla sp.																		1		
Scorpiurus sp.										1							1			
Securigera cf. securigeda																	1			
Medicago sp.																				
Melilotus/Trifolium		1		1		1										2	11	17	2	
Fabaceae, indet (medium)																				
Fabaceae, indet (large)																				
Olea europaea	1	1	1	1	2	1					6							1	1	
Vitis vinifera (pip)	2			3									1							
Vitis vinifera (berry)				1																
Vitis vinifera (stalk)				1									1							
Ficus carica																1				
Linum usitatissimum																	1	2		
Bupleurum sp.															1		5	1		
Bupleurum subovatum (seed with testa)															1					
Torilis leptophylla																	1			
Asteraceae, indet																1				
Brassicaceae, indet.														1	1					
Vaccaria cf. pyramida				1																
Scirpus maritimus						1	1				1		1		1					
Rumex sp.													1	1			1	1		

FIELD 2 PHASES	*2c*							*2d*				*2e*								
	57	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**
Cyperaceae, indet.																		2		
Galium spurium type																	1			
Sherardia arvensis																				
Rubiaceae, indet. (frags)																	4	3		
Rubiaceae, indet. (large/medium seeded)															1	1				
Rubiaceae, indet. (small seeded)				3											1		1	1		
Thymelaea sp.				1						1										
Chenopodium murale																		1		
Malva sp.																	2			
Euphorbia sp.										1										
Anagallis sp.																				
Papaver spp.																	1			
Verbascum/Scrophularia																	2			
Cephalaria type																	2			
Ranunculus sp.																	1			
Ranunculus cf. arvense																	2			
Adonis cf. annua																		1		
TT-unidentified object 2 (Anagallis?)																		1		
TT-unidentified object 5 (Rosaceae/Dryas type?)																	1			
TT-unidentified object 6 (Spergularia?)																	1			

(end)

APPENDIX C.2 LOCUS DESCRIPTIONS (CHAPTER 8)

Season	Field	Square	Locus	Pail	SA number	Analyzed by	Phasing	Locus description
2009	G4	28	2	5	**5797**	DK	*2a*	top of L. 2
2009	G4	28	2	27	**5310**	DK	*2a*	found in sweep somewhere above a surface
2011	G4	28	2	7	**7373**	DK	*2a*	Soil between w baulk and mudbrick wall
2009	G4	28	4	8	**5803**	DK	*2a*	soil from around the bronzes
2009	G4	28	4	55	**6687**	DK	*2a*	soil from inside oil lamp (TT09.G4.28.55.1)
2009	G4	28	4	8	**5804**	DK	*2a*	soil from locus next to E face of mudbrick wall
2009	G4	28	4	38	**5966**	MC	*2a*	Soil from tabun in interior of room. Light orangey brown, silty.
2009	G4	28	4	39	**5972**	MC	*2a*	Soil just above altar. Medium brown, clayey.
2009	G4	28	4	40	**5981**	MC	*2a*	Soil from abovoe the paved surface. Brown with mudbricky chunks, silty.
2009	G4	28	4	56	**6001**	MC	*2a*	Around pails 55 + 57 (oil lamp and larger vessel). Brown with some nari, silty.
2009	G4	28	26	78	**6113**	MC	*2a*	Sandy orange brown (burnt), lots of insoluble, sandy soil. Soil just above beaten earth surface.
2008	G4	38	2	82	**4774**	DK	*2a*	Possible occupational debris
2008	G4	38	2	87	**4776**	DK	*2a*	Possible occupational debris
2008	G4	38	2	12	**4322**	MC	*2a*	Med brown w/ ash flecks, plaster bits, silty. From above surface L5
2008	G4	38	2	18	**4314**	MC	*2a*	Material right above plaster surface.
2008	G4	38	3	13	**4306**	MC	*2a*	Med brown, nari. Material right above plaster surface.
2008	G4	38	4	14	**4328**	MC	*2a*	Dk brown, mudbricky and silty. Mudbricky burnt fill.
2008	G4	38	4	15	**4341**	MC	*2a*	Dk orangey brown, silty. From next to plaster-faced mudbrick wall.
2008	G4	38	4	15	**4346**	MC	*2a*	Med orangey brown, silty sand. From poss. Installation.
2008	G4	38	4	27	**4349**	MC	*2a*	Dark brown, silty. Mudbricky fill, poss. Inside burnt room.
2008	G4	38	7	16	**4330**	MC	*2a*	Dark ashy brown, silty. Ashy soil above plaster surface L8.
2008	G4	38	7	16	**4340**	MC	*2a*	Dark ashy brown, silty. Ashy soil above plaster surface L8.
2008	G4	38	7	17	**4356**	MC	*2a*	Burnt area - center of north baulk
2008	G4	38	13	91	**4869**	MC	*2a*	Med ashy brown, silty. From soil btw architectural piers - just above floor.
2011	G4	38	22	101	**7358**	DK	*2a*	Ash filled destruction layer
2011	G4	38	8	100	**7353**	DK	*2a*	surface of middle part ofthe temple
2009	G4	39	4	6	**5967**	DK	*2a*	Interior space west of locus 3
2008	G4	48	11	67	**4713**	DK	*2a*	layer of soil on the stone surface (L.8)
2008	G4	48	11	109	**5876**	DK	*2a*	from around pot bust
2009	G4	48	11	109	**5877**	DK	*2a*	from above mudbrick paving in baulk between squares 38 and 48
2008	G4	48	11	35	4602	MC	*2a*	Med brown, silty. Above mudbrick surface.
2008	G4	48	11	42	4632	MC	*2a*	Light brown, silty. From the soil on the mudbrick surface L12.
2009	G4	28	22	68	6014	MC	*2b*	Soil in front of platform around burned beams. Dark brown ashy, tons of insoluble, couldn't really tell the soil around it (barely any dissolved).

2009	G4	28	22	71	6109	MC	*2b*	Ashy greyish brown with plaster pcs. Small amt ashy soil; tons of burnt mudbrick. Soil surrounding iron stain S of platform/altar
2009	G4	28	22	76	**No info**	MC	*2b*	Brown with some nari and crumbs of burnt mudbrick. Loads of insoluble with sandy soil. Fill locus between surface and wall.
2009	G4	28	30	79	**6121**	MC	*2b*	soil from mudbrick surface
2009	G4	37	15	53	**5992**	DK	*2b*	2nd bag of L. 10 installation
2009	G4	37	15	53	**5991**	DK	*2b*	1st bag of L. 10 installation
2008	G4	38	5	42	**4653**	DK	*2b*	Soil from plaster surface L5
2008	G4	38	9	38	**4648**	DK	*2b*	fill soil east of locus 5, possible trench
2008	G4	38	9	61	**4682**	DK	*2b*	from top of the stone pavement
2008	G4	38	9	23	4623	MC	*2b*	L.9 - fill
2008	G5	38	9	44	4626	MC	*2b*	Fill locus east of surface 5, east of possible trench adjacnt to surface 5.
2008	G4	48	12	78	**5796**	DK	*2b*	patch of soil just north of column base
2009	G4	28	6	11	**5812**	DK	*2c*	soil aboe possible plaster surface
2009	G4	28	6	23	**5305**	DK	*2c*	found just above exterior surface (L. 7)
2009	G4	28	6	23	**5306**	DK	*2c*	Soil below plaster surface
2009	G4	28	6	23	**5861**	DK	*2c*	soil above exterior surface L. 7
2009	G4	28	8	22	**5863**	DK	*2c*	soil near possible north end of possible E-W wall
2009	G4	28	8	24	**5862**	DK	*2c*	soil just above mudbrick pavement
2009	G4	28	8	36	**5961**	DK	*2c*	*fill above paved mudbrick surface*
2011	G4	28	8	100	**7380**	DK	*2c*	*Soil N of east-west wall*
2009	G4	29	2	2	**5891**	DK	*2c*	north of possible mudbrick wall, c. 4 m north of baulk. Potentially outside of temple context
2009	G4	37	6	17	**5808**	DK	2c	above cobble surface in north of square
2009	G4	37	7	37	**5865**	DK	2c	clean up of last sum or so above cobble surface
2009	G4	37	7	37	**5864**	DK	2c	locus above cobbles have been finding olive pits
2009	G4	37	7	19	**5805**	DK	2c	in front of rock/cobble surface
2009	G4	37	7	43	**5945**	DK	2c	above cobble surface in baulk removal
2009	G4	37	7	42	**5312**	DK	2c	excavated locus from baulk removal
2009	G4	37	7	21	**5813**	DK	2c	debris above stone surface and near ceramic installation
2008	G4	38	11	93	**4779**	DK	*2c*	from beneath the shell layer and above stone cobble surface
2008	G4	48	5	17	**4627**	DK	*2c*	sample from 1x1x1 m probe in loc 5
2009	G4	48	22	112	**5983**	DK	*2c*	Stone surface
2009	G4	28	14	35	**5954**	DK	*2d*	soil just above level of cobble stone surface but surface doesn't continue north
2009	G4	28	14	34	**5953**	DK	*2d*	Fill deposit
2011	G4	28	14	111	**7382**	DK	*2d*	Fill locus north of cobblestone pavement
2009	G4	48	20	116	**6098**	DK	*2d*	top layer from pit
2009	G4	28	9	54	**6002**	DK	*2e*	next to brick tile (w)
2009	G4	37	9	45	**5828**	DK	2e	fill of ceramic vessel on top of the cobble surface
2009	G4	37	9	45	**5829**	DK	2e	fill of ceramic vessel on top of the cobble surface
2009	G4	37	9	45	**5830**	DK	2e	fill of ceramic vessel on top of the cobble surface
2009	G4	37	9	45	**5831**	DK	2e	fill of ceramic vessel on top of the cobble surface

2009	G4	37	9	45	**5832**	DK	2e	fill of ceramic vessel on top of the cobble surface
2009	G4	37	9	47	**5833**	DK	2e	fill of ceramic vessel on top of the cobble surface
2011	G4	38	21	111	**7351**	DK	*2e*	Wall
2011	G4	38	21	109	**7349**	DK	*2e*	Wall

APPENDIX D. STABLE ISOTOPES (CHAPTER 5)

Barley stable isotope measurements

Sample no.	C-content	δ 13C	D13C	N-content	δ 15 N	C:N	AIRCO2-LOESS	AIRCO2-LOESS TIMEFRAME	FIELD PHASES
	(%C)	(‰ VPDB)		(%N)	(‰ ATM)				
SA 6668 B-a	**75.0**	**-23.07**	17.13	**2.48**	**5.82**	30.24	-6.33	2317 BCE	FP8
SA 6668 B-b	**61.5**	**-22.71**	16.76	**6.26**	**5.58**	9.83	-6.33	2317 BCE	FP8
SA 6668 B-c	**66.7**	**-23.21**	17.28	**3.15**	**4.76**	21.18	-6.33	2317 BCE	FP8
SA 6668 B-d	**62.9**	**-23.29**	17.37	**6.90**	**8.15**	9.11	-6.33	2317 BCE	FP8
SA 6123 B-a	**63.6**	**-23.71**	17.81	**4.00**	**4.71**	15.90	-6.33	2317 BCE	FP8
SA 6123 B-b	**62.0**	**-23.98**	18.08	**5.38**	**7.77**	11.51	-6.33	2317 BCE	FP8
SA 6123 B-c	**60.1**	**-24.01**	18.12	**4.67**	**2.33**	12.87	-6.33	2317 BCE	FP8
SA 8769 B-a	**68.5**	**-23.49**	17.57	**3.08**	**2.83**	22.23	-6.33	2317 BCE	FP7
SA 8769 B-b	**67.3**	**-24.08**	18.18	**2.57**	**4.38**	26.19	-6.33	2317 BCE	FP7
SA 6673 B-a	**72.6**	**-24.03**	17.97	**3.67**	**4.54**	19.76	-6.50	1243 BCE	FP6
SA 6673 B-b	**65.6**	**-21.89**	15.73	**5.71**	**6.72**	11.49	-6.50	1243 BCE	FP6
SA 6673 B-c	**66.5**	**-22.91**	16.80	**3.49**	**2.63**	19.09	-6.50	1243 BCE	FP6
SA 6673 B-d	**63.8**	**-23.36**	17.27	**4.83**	**3.22**	13.21	-6.50	1243 BCE	FP6
SA 6673 B-e	**67.2**	**-24.33**	18.27	**3.18**	**2.58**	21.10	-6.50	1243 BCE	FP6
SA 6673 B-f	**66.6**	**-22.28**	16.14	**4.21**	**2.86**	15.82	-6.50	1243 BCE	FP6
SA 5872 B-a	**67.1**	**-23.39**	17.29	**2.91**	**6.72**	23.06	-6.50	1243 BCE	FP6
SA 6683 B-a	**64.5**	**-22.94**	16.83	**3.13**	**4.38**	20.61	-6.50	1243 BCE	FP6
SA 6683 B-b	**62.5**	**-22.69**	16.57	**3.47**	**4.77**	18.01	-6.50	1243 BCE	FP6
SA 6683 B-c	**70.5**	**-22.12**	15.97	**2.83**	**1.97**	24.94	-6.50	1243 BCE	FP6
SA 1711 B-a	**62.5**	**-23.35**	17.23	**3.72**	**1.83**	16.82	-6.52	1064 BCE	FP5
SA 1711 B-b	**61.4**	**-23.14**	17.02	**2.78**	**3.62**	22.10	-6.52	1064 BCE	FP5
SA 1711 B-c	**66.6**	**-21.72**	15.54	**3.75**	**2.73**	17.77	-6.52	1064 BCE	FP5
SA 1711 B-d	**61.1**	**-22.97**	16.84	**3.76**	**2.49**	16.24	-6.52	1064 BCE	FP5
SA 1711 B-e	**61.8**	**-22.58**	16.43	**3.43**	**1.45**	18.01	-6.52	1064 BCE	FP5
SA 1711 B-f	**63.9**	**-23.33**	17.21	**3.21**	**1.19**	19.93	-6.52	1064 BCE	FP5
SA 545 B-a	**67.4**	**-22.52**	16.37	**3.51**	**5.98**	19.19	-6.52	1064 BCE	FP3
SA 545 B-b	**62.7**	**-24.37**	18.30	**3.25**	**5.57**	19.33	-6.52	1064 BCE	FP3
SA 545 B-c	**66.5**	**-23.94**	17.85	**2.62**	**2.70**	25.39	-6.52	1064 BCE	FP3
SA 546 B-a	**64.1**	**-24.35**	18.27	**2.88**	**3.20**	22.26	-6.52	1064 BCE	FP3
SA 546 B-b	**66.2**	**-22.51**	16.36	**3.63**	**4.01**	18.21	-6.52	1064 BCE	FP3

Free-threshing wheat stable isotope measurements

Sample no.	C-content	*δ* 13C	D13C	N-content	*δ* 15 N	C:N	AIRCO2-LOESS	AIRCO2-LOESS TIMEFRAME	FIELD PHASES
	(%C)	(‰ VPDB)		(%N)	(‰ ATM)				
SA 6668 W-a	**61.9**	**-22.33**	16.36	**4.10**	**4.63**	15.07	-6.33	2317 BCE	FP8
SA 6668 W-b	**64.1**	**-23.17**	17.24	**4.53**	**4.23**	14.15	-6.33	2317 BCE	FP8
SA 6650 W-a	**65.1**	**-23.12**	17.19	**3.68**	**4.86**	17.70	-6.33	2317 BCE	FP8
SA 6650 W-b	**74.4**	**-22.86**	16.91	**3.78**	**6.10**	19.66	-6.33	2317 BCE	FP8
SA 6650 W-c	**64.7**	**-24.67**	18.80	**4.50**	**8.34**	14.37	-6.33	2317 BCE	FP8
SA 8769 W-a	**64.0**	**-23.06**	17.12	**3.65**	**4.05**	17.53	-6.33	2317 BCE	FP7
SA 8769 W-b	**66.1**	**-24.09**	18.19	**3.63**	**4.10**	18.21	-6.33	2317 BCE	FP7
SA 8769 W-c	**64.3**	**-22.34**	16.37	**3.76**	**7.12**	17.12	-6.33	2317 BCE	FP7
SA 8769 W-d	**64.8**	**-23.31**	17.39	**2.90**	**5.63**	22.31	-6.33	2317 BCE	FP7
SA 6673 W-a	**63.1**	**-23.61**	17.52	**5.65**	**6.89**	11.17	-6.50	1243 BCE	FP6
SA 6673 W-b	**62.7**	**-21.77**	15.61	**5.24**	**2.78**	11.97	-6.50	1243 BCE	FP6
SA 6673 W-c	**59.2**	**-21.75**	15.60	**5.26**	**3.76**	11.24	-6.50	1243 BCE	FP6
SA 6673 W-d	**63.4**	**-22.68**	16.56	**5.14**	**2.52**	12.34	-6.50	1243 BCE	FP6
SA 6673 W-e	**68.0**	**-22.03**	15.88	**4.29**	**3.00**	15.83	-6.50	1243 BCE	FP6
SA 6673 W-f	**68.2**	**-21.77**	15.61	**3.69**	**3.26**	18.48	-6.50	1243 BCE	FP6
SA 6683 W-a	**65.1**	**-22.55**	16.42	**3.36**	**7.91**	19.40	-6.50	1243 BCE	FP6
SA 6683 W-b	**63.6**	**-22.39**	16.25	**3.70**	**3.77**	17.17	-6.50	1243 BCE	FP6
SA 6683 W-c	**57.2**	**-21.56**	15.40	**4.23**	**4.23**	13.53	-6.50	1243 BCE	FP6
SA 6683 W-d	**62.0**	**-21.22**	15.04	**3.85**	**2.37**	16.10	-6.50	1243 BCE	FP6
SA 6683 W-e	**64.2**	**-23.23**	17.13	**3.29**	**2.05**	19.53	-6.50	1243 BCE	FP6
SA 6683 W-f	**65.4**	**-21.27**	15.09	**3.52**	**2.73**	18.59	-6.50	1243 BCE	FP6
SA 1711 W-a	**64.5**	**-22.64**	16.49	**4.65**	**3.95**	13.85	-6.52	1064 BCE	FP5
SA 1711 W-b	**63.5**	**-20.52**	14.30	**4.92**	**2.82**	12.90	-6.52	1064 BCE	FP5
SA 1711 W-c	**65.0**	**-22.43**	16.28	**4.63**	**4.91**	14.04	-6.52	1064 BCE	FP5
SA 1711 W-d	**62.5**	**-21.92**	15.75	**4.71**	**2.90**	13.28	-6.52	1064 BCE	FP5
SA 1711 W-e	**62.5**	**-22.06**	15.89	**3.76**	**1.36**	16.61	-6.52	1064 BCE	FP5
SA 1711 W-f	**65.9**	**-22.06**	15.89	**3.67**	**2.38**	17.96	-6.52	1064 BCE	FP5
SA 545 W-a	**66.2**	**-23.35**	17.24	**3.36**	**2.76**	19.67	-6.52	1064 BCE	FP3
SA 545 W-b	**65.6**	**-23.65**	17.54	**3.75**	**1.37**	17.50	-6.52	1064 BCE	FP3
SA 545 W-c	**57.7**	**-24.25**	18.18	**3.34**	**1.35**	17.27	-6.52	1064 BCE	FP3
SA 545 W-d	**66.2**	**-24.54**	18.47	**3.24**	**1.37**	20.45	-6.52	1064 BCE	FP3
SA 546 W-a	**68.7**	**-23.86**	17.76	**4.19**	**3.37**	16.39	-6.52	1064 BCE	FP3
SA 546 W-b	**63.0**	**-23.04**	16.91	**3.56**	**2.72**	17.69	-6.52	1064 BCE	FP3
SA 546 W-c	**67.1**	**-23.11**	16.99	**3.44**	**2.67**	19.49	-6.52	1064 BCE	FP3
SA 546 W-d	**64.1**	**-24.37**	18.29	**5.12**	**3.25**	12.51	-6.52	1064 BCE	FP3